TM 11-2216

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TELETYPEWRITERS

TT-7/FG

AND

TT-8/FG

DEPARTMENT OF THE ARMY • OCTOBER 1951

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Figure 1. Teletypewriter TT–7/FG (or TT–8/FG) ready for operation.

This manual supersedes TM 11-2216, 27 November 1944.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of personnel to whom this equipment is issued. They include information covering the installation, operation, maintenance, theory, and repair of Teletypewriters TT-7/FG and TT-8/FG.

b. This manual is prepared in five chapters and four appendices. The first appendix provides a list of pertinent references. The second appendix contains parts identification illustrations and identification tables of parts. The third appendix describes interoperation of British and American teletypewriters, and the fourth appendix is a glossary.

2. Forms and Records

The standard forms indicated below will be used for reporting unsatisfactory conditions of Army equipment and in performing preventive maintenance.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5.

b. DA AGO Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Material Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AFR 65-26.

d. DA AGO Form 419, Preventive Maintenance Checklist for Signal Corps Equipment, will be prepared in accordance with instructions on the back of the form.

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Description

a. GENERAL. Teletypewriters TT-7/FG and TT-8/FG (fig. 1) are fixed station communication equipments intended for use where large amounts of traffic are anticipated. They include a Teletype model 15 teletypewriter, a model 15 perforator transmitter, a model 14 transmitter distributor, a REC-30 rectifier, and a model 19 table. They are known commonly as model 19 sets. They exchange typewritten page messages between two or more points. One set of either type completely equips a station for sending to and receiving from one or more stations connected by a telegraph channel. These sets are arranged for direct transmission by the perforator transmitter keyboard or transmission from tape by the transmitter distributor. Both methods may be used together if simultaneous transmission over two separate loops is desired. Either the perforator transmitter or the transmitter distributor may be connected in series with the local teletypewriter relay and the line in order to actuate the local and the distant receiving components, thereby furnishing a home copy of both transmitted and received messages at each station.

b. TAPE. In addition to typing page copy, these teletypewriter sets can produce perforated tape by means of the perforator transmitter for use in the transmitter distributor. If required as auxil-

iary equipment, a typing or nontyping reperforator can be connected to these teletypewriter sets to produce perforated tape and record the messages carried by a signal line. The perforator transmitter inserted in the base of the printer is a combination keyboard transmitter and tape perforator with an electrically operated character counter and end-of-line warning lamp. A manually operated three-position operating lever is mounted at the right end of the perforator transmitter unit. Selection of any one of four methods of operation may be made by placing this operating lever and a line switching key in one of the following positions:

(1) *Operating lever in upper or KEYBOARD position.* Direct keyboard transmission to the signal line.

(2) *Operating lever in middle or KBD (keyboard) & TAPE POSITION.* Simultaneous direct keyboard transmission to the line and perforation of tape.

(3) *Operating lever in lower or TAPE position.* Perforation of tape only while the teletypewriter is either receiving messages from a distant station or monitoring a message that is being transmitted to a distant station by the transmitter distributor from perforated tape.

(4) *Operating lever in middle or KBD & TAPE position and transmitter line switching key of table in test position.* It is also possible to perforate tape and print a home record without transmitting directly to a line when the set is connected for local (test) operation. This method is helpful in preparing perforated tape for use in connection with printed forms or as a check on the final results of perforated tape messages to be transmitted at some later period.

c. Uses.—Teletypewriter TT-7/FG is used for general communication purposes and may be started or stopped through use of a mechanical motor stop mechanism either by its own or a distant station keyboard. Teletypewriter TT-8/FG is adapted particularly to the collection and dissemination of weather information. It does not have a mechanical motor stop mechanism.

Note. Except when otherwise stated, information given in the text may be considered applicable to both teletypewriters. Refer to paragraph 7 for differences between the two sets. Refer to TM 11-2222 for information covering the transmitter distributor and to TM 11-2223 for information covering reperforators sometimes used in conjunction with Teletypewriters TT-7/FG and TT-8/FG.

d. Recording Methods. Either one or both of the transmitted and received messages at each station may be recorded on a continuous roll of paper 8½ inches wide. When double-loop, simultaneous two-way transmission is used, a perforated tape record of the transmitted message may be retained as the home copy, and the received message may be recorded on the roll of paper. If a reperforator is available as auxiliary equipment, it can be used to monitor the receive loop and furnish a record of received messages on perforated tape while the transmitted messages are recorded on the roll of paper by the typing unit.

e. American and British Speed. The teletypewriter and transmitter distributor motors of these sets normally are adjusted for a standard American speed of 368.1 opm (operations per minute) which permits sending and receiving approximately 61 wpm (words per minute). By varying the speed through adjustment of the motor governor, it is possible to increase this speed to 404 opm or 66 wpm when interoperation with equipment operating at a higher speed (such as British teleprinters) is desired. Refer to paragraphs 19 and 211 and to appendix III for adjustments of motor speed.

f. Table. The table provided with each teletypewriter is designed to support and cushion all components of the set. This table is wired so that all interconnections of the operating components and connections to the power and signal lines are made at the table. A three-position transmitting line switching key on the table is used to switch the operating components from one line to another or to connect them in a test circuit (dummy loop) built into the table. Two variable resistors are included in the table to facilitate the supply of positive or negative battery to one or two separate loops if required.

g. Rectifier. The rectifier is designed to provide suitable dc (direct current) (up to .9 ampere at 120 volts) for operation of the signal circuits, and adjusted a-c (alternating-current) motor voltage for a maximum of three series-governed motors. This can be accomplished over a range of rectifier inputs from 95 to 250 volts at from 25 to 60 cycles, single-phase ac. The signal line (d-c loop) current applied to the equipment

through the transmitter contacts is approximately .060 ampere at 115 volts; through the relay line winding it is approximately .060 ampere for neutral operation or .030 ampere for polar operation, all at approximately 115 volts.

h. Dimensions of Assembled Teletypewriter Set. An assembled Teletypewriter TT–7/FG or TT–8/FG occupies a space approximately 23½ inches long (front to rear), 36 inches wide, 41 11/16 inches high and weighs about 425 pounds.

4. Component Parts and Packing Data

The principal components of Teletypewriters TT–7/FG and TT–8/FG are the same except that the TT–7/FG has a standard communication keyboard and typing unit with corresponding type pallets and a mechanical motor stop mechanism; the TT–8/FG has a weather communication keyboard and typing unit with corresponding type pallets, but no mechanical motor stop mechanism. The principal components and units with their Signal Corps stock numbers are listed in paragraph 12. These two teletypewriters have a black wrinkle finish and appear the same outwardly. Refer to chapter 5 for detailed packing instructions.

5. Characteristics and Code Designations

a. General. Model 15 teletypewriters used with Teletypewriters TT–7/FG and TT–8/FG

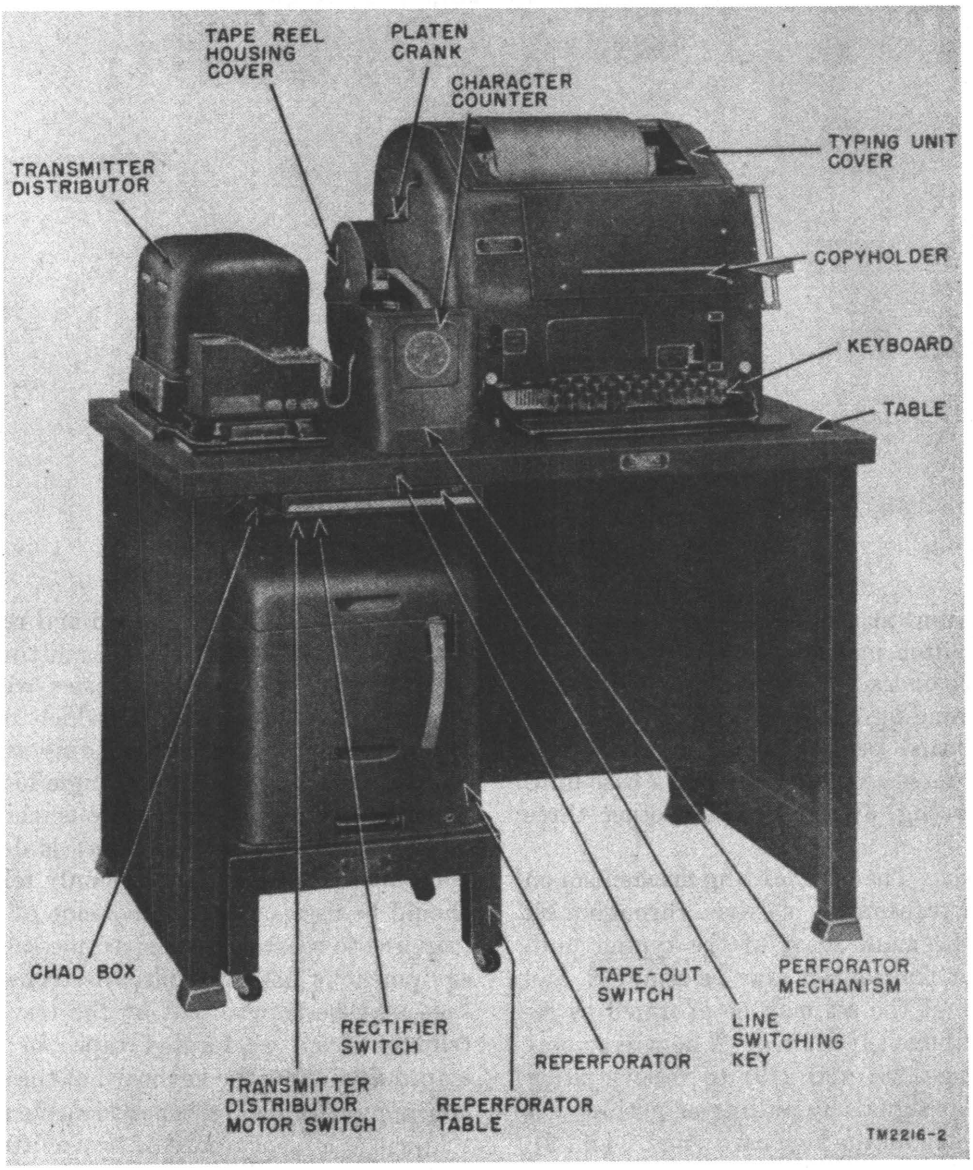


Figure 2. Complete teletypewriter set with reperforator.

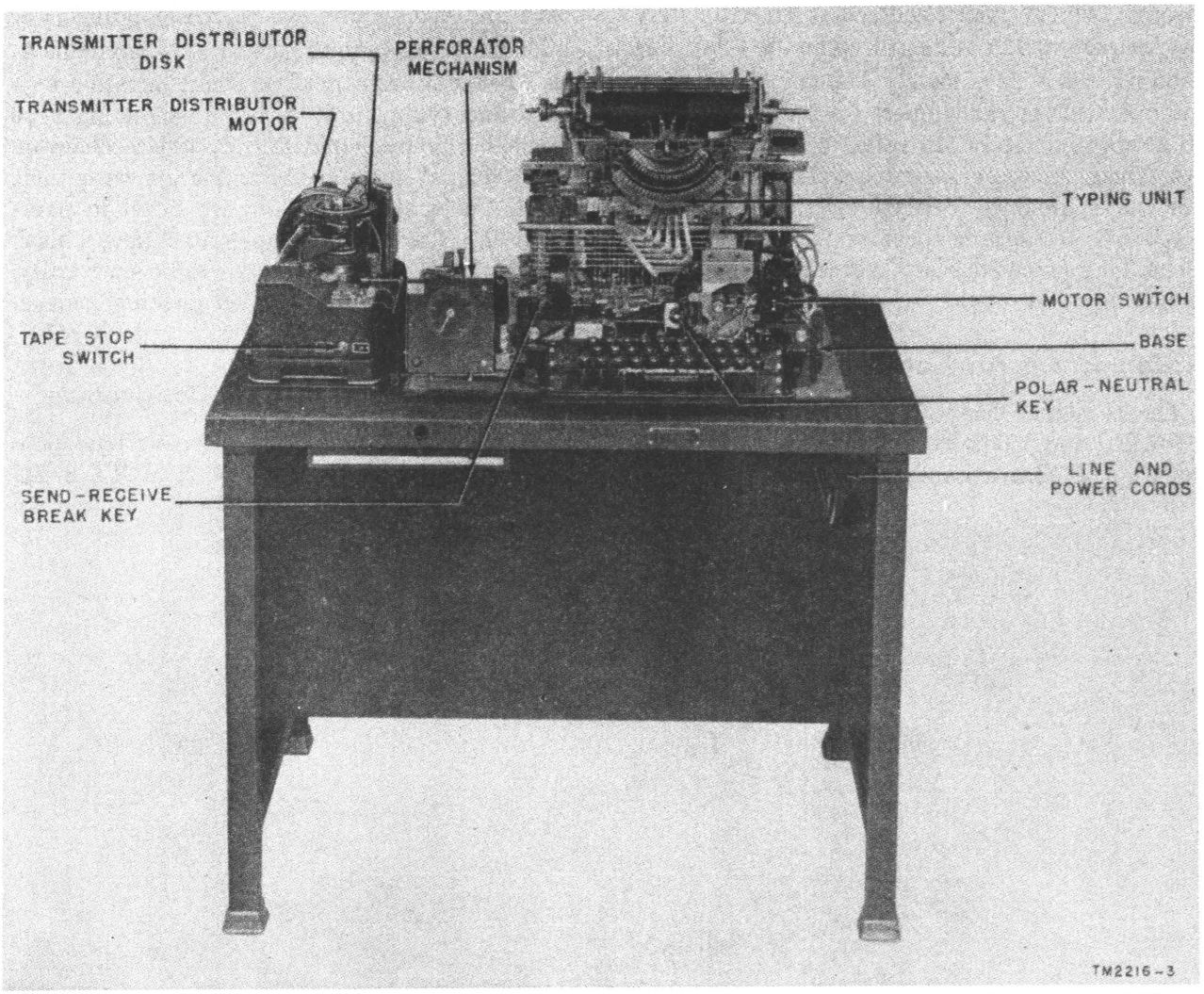


Figure 3. Complete set with covers removed.

are motor-driven machines designed to interchange typewritten messages by electrical means (wire, carrier, or radio) between two or more points. The sending-receiving teletypewriter includes a keyboard perforator and transmitting unit, a typing unit, a motor unit, and a base unit. The base unit (fig. 5) supports the other three units.

b. Receiving. The transmitting mechanism on the perforator transmitter is driven through a set of gears by the main shaft of the typing unit. The perforator transmitter may be removed, and the remainder of the set may be operated as receive-only equipment if desired. The wiring may be adapted (figs. 268 and 279) to receive either neutral or polar signals by pulling or pushing the polar-neutral key on the keyboard (figs. 3 and 9).

c. Transmitting. To retain at least one page-printed copy of all transmitted and received messages at each station, the transmitting unit normally should be wired in series with the line winding of the polar relay which operates the typing unit. This permits sending and receiving with one teletypewriter on a single loop (one way at a time) basis. If simultaneous sending and receiving (double-loop operation) is desired, a reperforator or a second receive-only teletypewriter should be used on the receive side of the double-loop line to record the received messages. If this equipment is not available, the transmitted message may be transmitted by the transmitter distributor from perforated tape, or it may be transmitted from the keyboard at the same time it is being perforated on tape; then the tape may be retained as a home record of transmitted messages, while the typing unit (page-printing component)

is connected directly to the receive loop. When these last two methods are used, it is not possible to read a transmitted message as it is being sent. For transmitting polar signals, a terminal repeater or similar equipment must be used.

d. CONTROL. All teletypewriters, except weather report printers, connected in the same circuit may be started through the use of the mechanical motor control by momentarily opening the signal line (depressing the SEND—REC—BREAK key) and may be stopped by transmitting the upper case H (FIGS H) signal combination from the keyboard of any teletypewriter in the circuit.

e. OPERATING FEATURES. The TT–7/FG and TT–8/FG sets have friction paper feed, 110-volt, 50- to 60-cycle a-c series-governed motors, a remote control motor stop mechanism (on the TT–7/FG only) operated by the upper case H key, a transmitter distributor to transmit from tape, a perforator transmitter to perforate tape and transmit from the keyboard, and general purpose REC–30 rectifiers (for local and/or line current) with built-in transformers for 95- to 125- and 190- to 250-volt, 25- to 60-cycle input. The transformer of the REC–30 rectifier includes variable tap windings for adjusting motor terminal voltage. Signaling is accomplished through the use of a five-unit code of marking and spacing (current and no current) signal impulses which are produced by mechanical action of a transmitting unit and are reconverted to mechanical action by the selector mechanism of a typing unit.

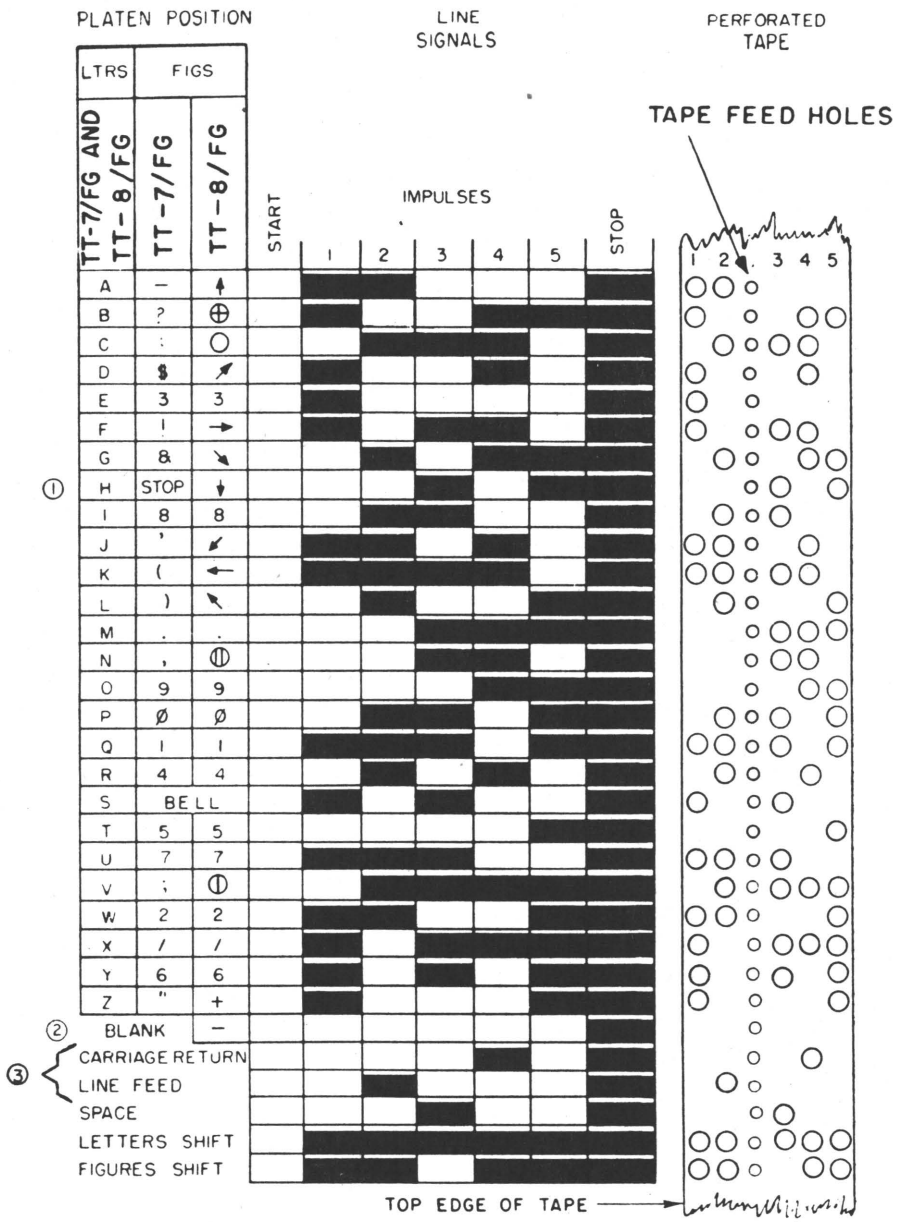
f. UTILIZATION. To establish communication between stations, some equipment is necessary to maintain and control a d-c line or loop to the teletypewriters. Such equipment may include (in series) the resistance installed in the teletypewriter or table or external equipment, such as line units, d-c repeaters, telegraph switchboards, telegraph carrier terminals, and speech-plus-duplex terminals, preferably capable of furnishing dc through a variable resistance and maintaining correct bias (ratio of marking current to spacing current). When bias is not correct, a signal is said to be distorted or to have marking or spacing bias. For a very short loop when there are no appreciable variations in line conditions, it is possible to interconnect these teletypewriters directly over a pair of wires or one wire and ground if the correct d-c voltage is furnished in series through a resistance.

g. SYNCHRONIZATION (TIMING). Maintenance of correct timing between transmitting and receiving units is achieved by means of the five-unit start-stop code. Five impulses (seven with start and stop included) are fed into the line circuit of the teletypewriter for every operation to be performed by the receiving unit. Each of these five impulses or intervals is 22 milliseconds long at 368.1 opm. The first impulse of every five-impulses sequence is *preceded* by a start (spacing) impulse which is also 22 milliseconds long. The last impulse of the five-impulse sequence is *followed* by a stop (marking) impulse which is 31 milliseconds long. Thus the transmitting and receiving equipments on a signal circuit both will come to a stop at some point between the completion of one code sequence and the beginning of the next. With the next spacing impulse, these equipments will start their sequences together, for all practical purposes, and if the motor speeds are correct, will complete their sequences without losing relative synchronism. Bias and distortion that may exist in a signal and corrective action or compensation are discussed briefly in paragraphs 21, 99, and 287, and in TM 11–486 and TM 11–680. Figure 4 shows the code used and the duration of signal impulses referred to above.

6. Detailed Description of Teletypewriters TT–7/FG and TT–8/FG

(figs. 1 through 3)

a. BASE. The base (fig. 5) consists of a metal casting set on top of the table. It provides mounting facilities for the polar line relay (fig. 11), the motor unit (fig. 12), the typing unit (fig. 13), and the perforator transmitter (fig. 9). Four bakelite terminal boards (fig. 5) are provided by which power is connected to the motor unit and signal lines are brought to the relay line winding and transmitter contacts. Two power cords (a-c and d-c) and two line cords (sending and receiving) are attached to the right side of the terminal boards. The sending cord terminates in a black shell plug, and the receiving cord terminates in a red shell plug. The a-c power cord is fitted with a two-prong plug and the d-c cord with a four-prong plug. The base unit is set and centered on a felt pad which is held in place on top of the equipment table by metal channels on both sides and at the rear of the table top. The line relay mounting brackets and the resistor assembly with wiring



NOTES:

① FIGS. H FOR MOTOR STOP ON TT-7/FG ONLY.

② THE BLANK COMBINATION OPERATES FROM LTRS POSITION ONLY, ON TT-8/FG.

③ THESE FUNCTIONS PERFORMED FROM LTRS POSITION ONLY, ON TT-8/FG.

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Figure 4. Five-unit, start-stop teletypewriter code.

and the motor control relay are mounted on the base toward the rear. The SEND—REC—BREAK key is a double lever type key which is mounted on the front of the base, to the left (fig. 5), and extends through an opening in the cover. The ON-OFF switch on the front of the base, to the right, starts and stops the motor manually. It is reached through an opening in the cover. The terminal boards for connecting a-c and d-c power and the signal line are mounted on the right side, as viewed from the front. The terminal board for the line relay connections is mounted on the left side toward the back. The relay and typing unit line shorting jacks and slip connections for the motor, the keyboard, and the typing unit are mounted on the base. Radio-frequency induction filters are mounted near the relay and power terminal boards.

b. Perforator Transmitter. This unit (fig. 9) is an assembly consisting of the keyboard, transmitter contacts, and the perforator mechanism with its associated character counter and warning lamp.

(1) *Keyboard.* The keyboard contains the keys that must be operated to transmit letters, figures, symbols, or nonprinting functions. Figures 7 and 8 show the arrangement of the key levers. The uses of the function keys are discussed in paragraph 23.

(2) *Transmitter.* The transmitter is an assembly of cams and spring contacts that

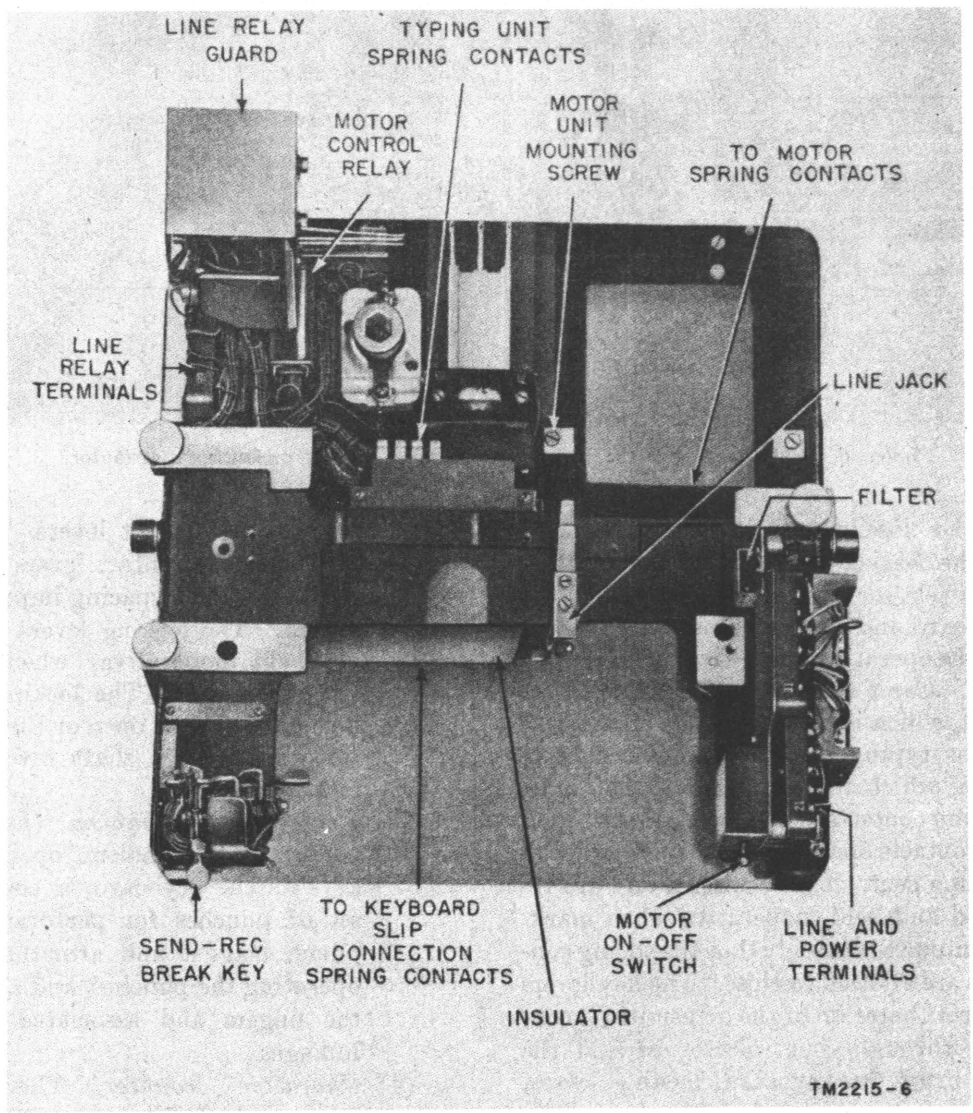


Figure 5. Teletypewriter base less motor unit.

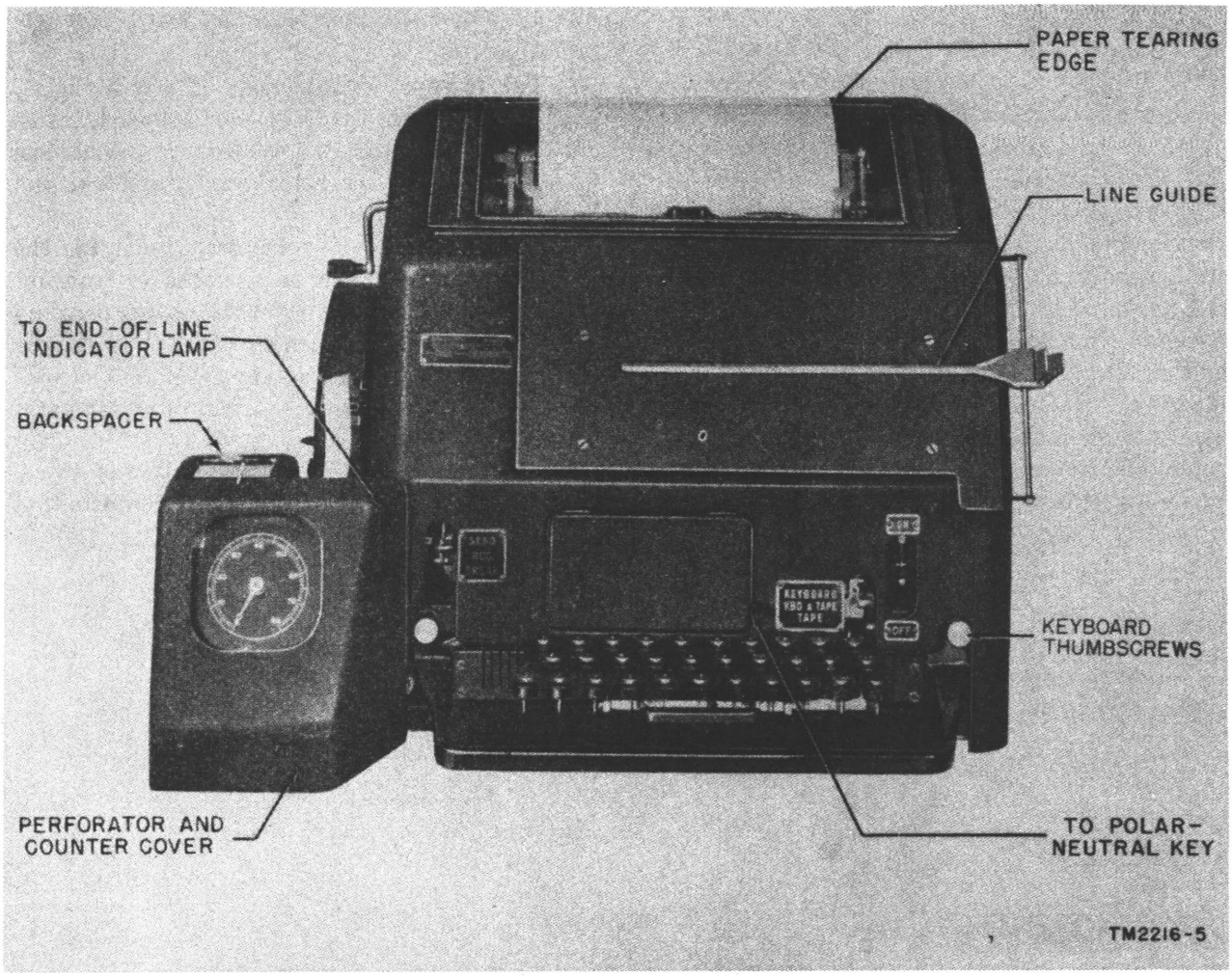


Figure 6. Teletypewriter set less table, rectifier, and transmitter distributor.

open or close in accordance with the code for the character or function transmitted. Code selector bars at the bottom of the keyboard and associated mechanism govern the operation of the transmitting contacts. Cams rotating on the transmitter shaft, which is rotated by the main shaft of the typing unit, operate the contact levers which in turn operate the transmitting contacts. The contact levers hold the contacts open when a spacing impulse is being sent. The locking levers are released and held inoperative when marking impulses are sent; thus the spring contacts are allowed to close. The key levers control operation of the transmitting contacts through code selector bars at the bottom of the keyboard, locking levers, clutch, and associated mechanism. The rotating cams of the transmitter shaft operate the contact levers. Locking levers hold the contact levers in the open position when a spacing impulse is transmitted. The locking levers are released (or held inoperative) when a marking impulse is sent. The locking levers are held either in the open or the closed position during each shaft revolution by a lock loop bar.

(3) *Perforator mechanism* (fig. 9). The perforator mechanism, operated by the keys on the keyboard, is composed of a set of punches for perforating tape, a punch magnet and armature lever for operating the punches, and a set of selector fingers and associated mechanical linkages.

(4) *Character counter.* The character counter (fig. 9) is associated with the perforator mechanism and operates only

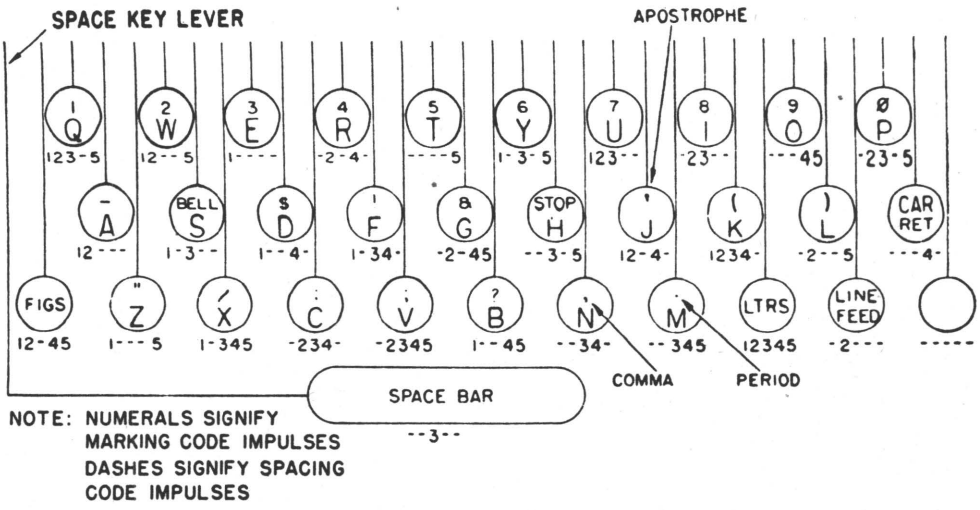


Figure 7. Standard communications keyboard and associated five-unit code for each character.

when the operating control lever is set in the TAPE position. The purpose of the character counter is to indicate to the operator when the maximum permissible number of characters is perforated in tape for a single line of typing. A warning lamp lights six spaces before the limit is reached, as a warning to the operator to avoid typing over the margin. Operation of the LTRS, FIGS, or LINE FEED key does not register on the character counter dial. The indicator of the character counter dial returns to zero when the CAR RET key is pressed.

c. TRANSMITTER DISTRIBUTOR. The transmitter distributor (fig. 2) is mounted on the table in a mounting especially provided for it. Power and line circuits for operation of the transmitter distributor are connected by means of spring slip contacts in the mounting. The transmitter distributor is described in TM 11–2222.

d. REPERFORATOR (fig. 2). A reperforator is not a component of Teletypewriters TT–7/FG and TT–8/FG, but, if one is required, provision is made in the wiring of the table for connecting such a unit. Wiring provisions for a reperforator are shown in figure 274. Reperforators that may

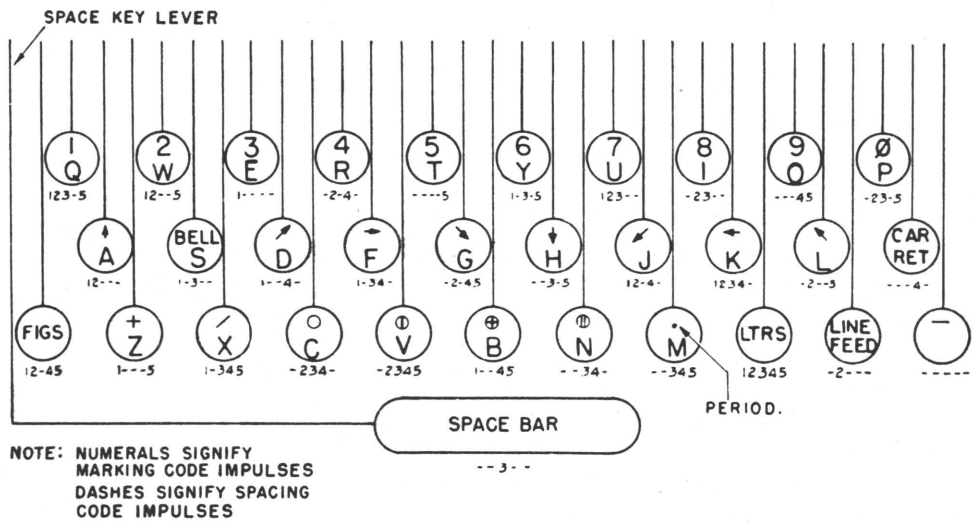


Figure 8. Weather communications keyboard and associated five-unit code for each character.

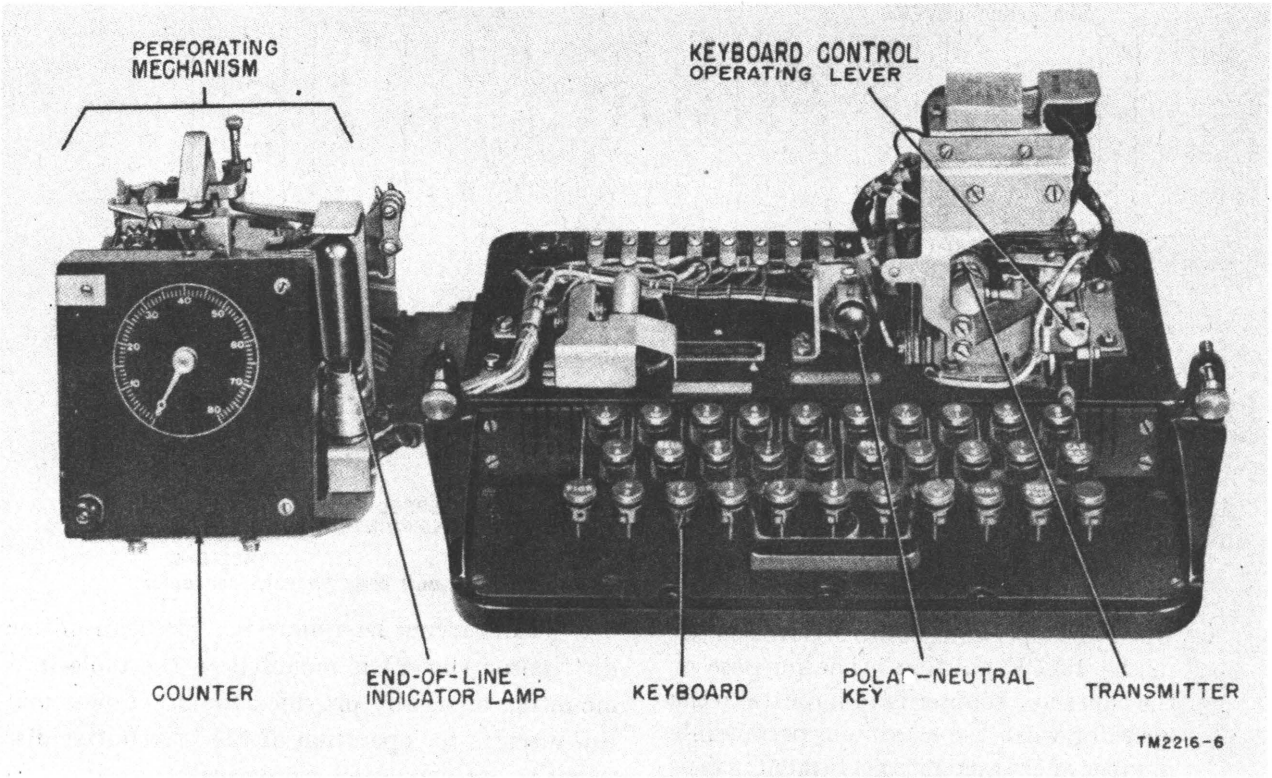


Figure 9. Perforator transmitter.

be used with these teletypewriters are described in TM 11–2223.

e. Relay (fig. 11). The line relay with which these teletypwriters are equipped is a WEC (Western Electric) type 255A relay. A circuit diagram of this device is shown in figures 268 and 276. The circuit arrangement can be changed to receive either neutral or polar type signals by operating the polar-neutral key (fig. 9).

(1) *Neutral.* To receive neutral signals, the relay bias winding is connected into a d-c circuit by pulling the polar-neutral key *out.*

(2) *Polar.* To receive polar type signals, the circuit is opened through the relay bias winding by pushing the polar-neutral key in. Refer to types of operation (par. 9).

f. Motor Unit. Motor Unit PU–109/GG (fig. 12) consists of a series-governed motor mounted upon a base plate. The base plate of the motor unit contains holes for the mounting screws by which it is mounted on the base of the teletypewriter. The base plate also has a screw for vertical adjustment to aline the motor pinion with the main shaft gear of the typing unit. Horizontal alinement is obtained by means of elongated screw holes in the base of the motor casting. Mounted near the flywheel governor assembly of the motor unit is a lamp, lamp bracket, and lamp switch. The lamp is used to light the target while the motor speed is checked with a speed indicator (tuning fork) (fig. 18). The target consists of a series of alternate black and white segments painted on a rim that revolves with the motor governor flywheel. Circuit connections are established through spring contacts on the base unit; these contacts exert pressure against the terminals of the motor unit when they are in position on the base unit. The motor unit is mounted at the right rear of the teletypewriter base and includes a filter for suppressing radio-frequency induction. When regulated 50- or 60-cycle current is available, the correct one-speed synchronous motor and gears may be used in place of the governed motor. Unless otherwise specified, the standard motor for Teletypewriters TT–7/FG and TT–8/FG is the MU–27, a 110 to 120 volt, 50- to 60-cycle a-c series-governed motor. To remove the motor unit from the base unit, remove the three screws that hold the motor base

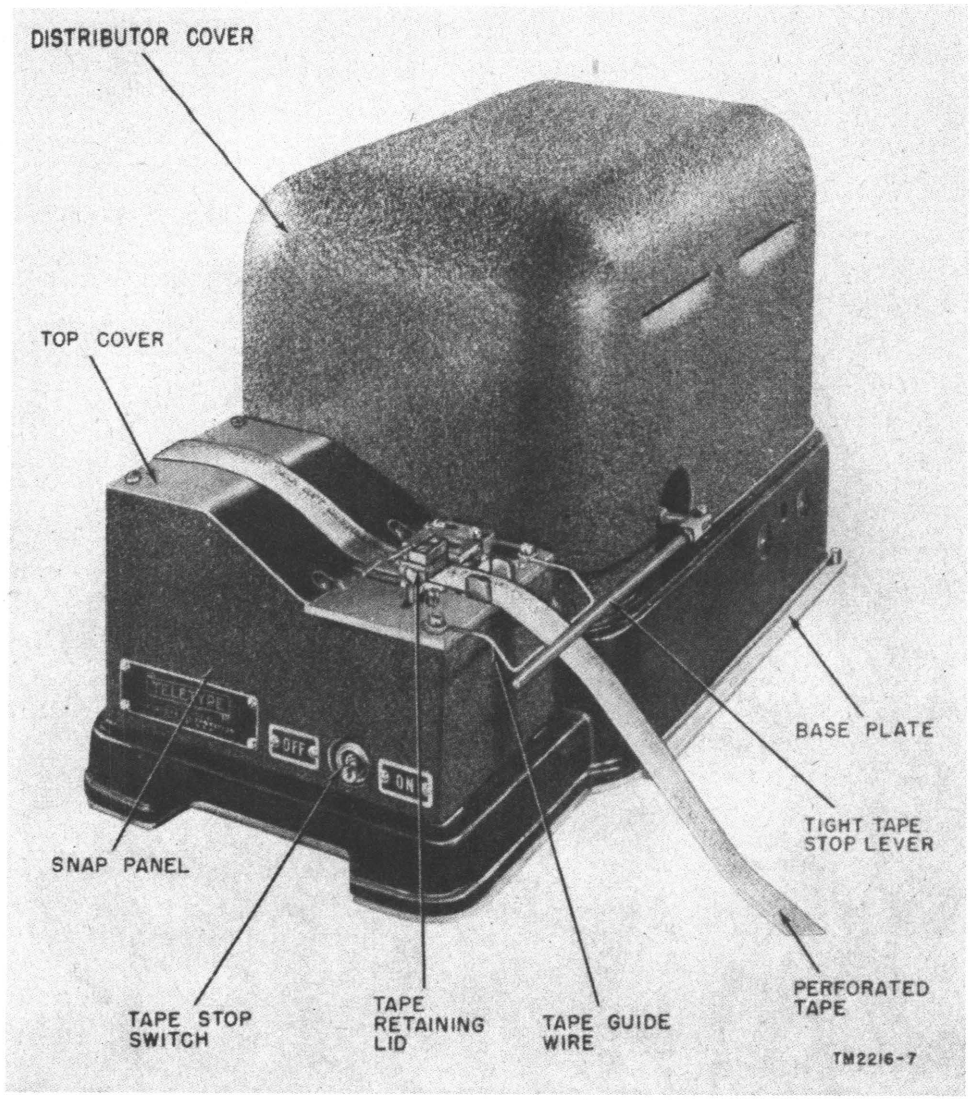


Figure 10. Transmitter distributor.

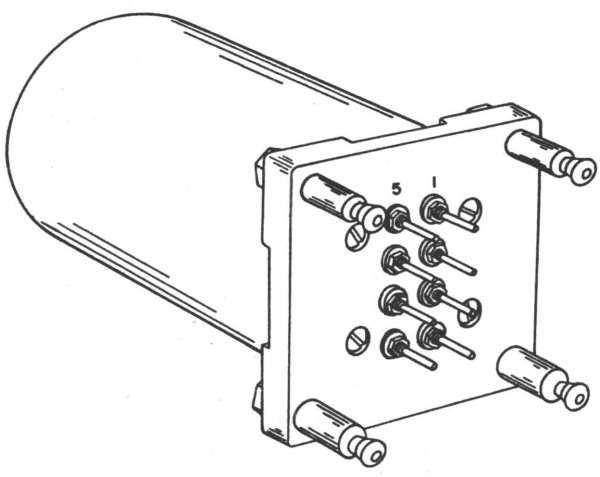


Figure 11. Polar line relay RY-30 (WEC 255A type).

plate to the base unit and lift the motor unit upwards.

g. TYPING UNIT. The typing unit is shown in figures 13 (front), 14 (back), 15 (bottom), 16 (left side), and 17 (right side). This unit consists essentially of selecting, printing, and functional mechanisms. The typing unit is mounted on the teletypewriter base and is held in place by three large thumbscrews.

h. COVER AND COPYHOLDER. A removable metal cover incloses the motor unit, typing unit, perforator transmitter, tape reel, and base. The cover is constructed to allow easy access to the switches, paper, and units of the teletypewriter which must be reached during normal operation. Felt padding which lines the inside of the cover

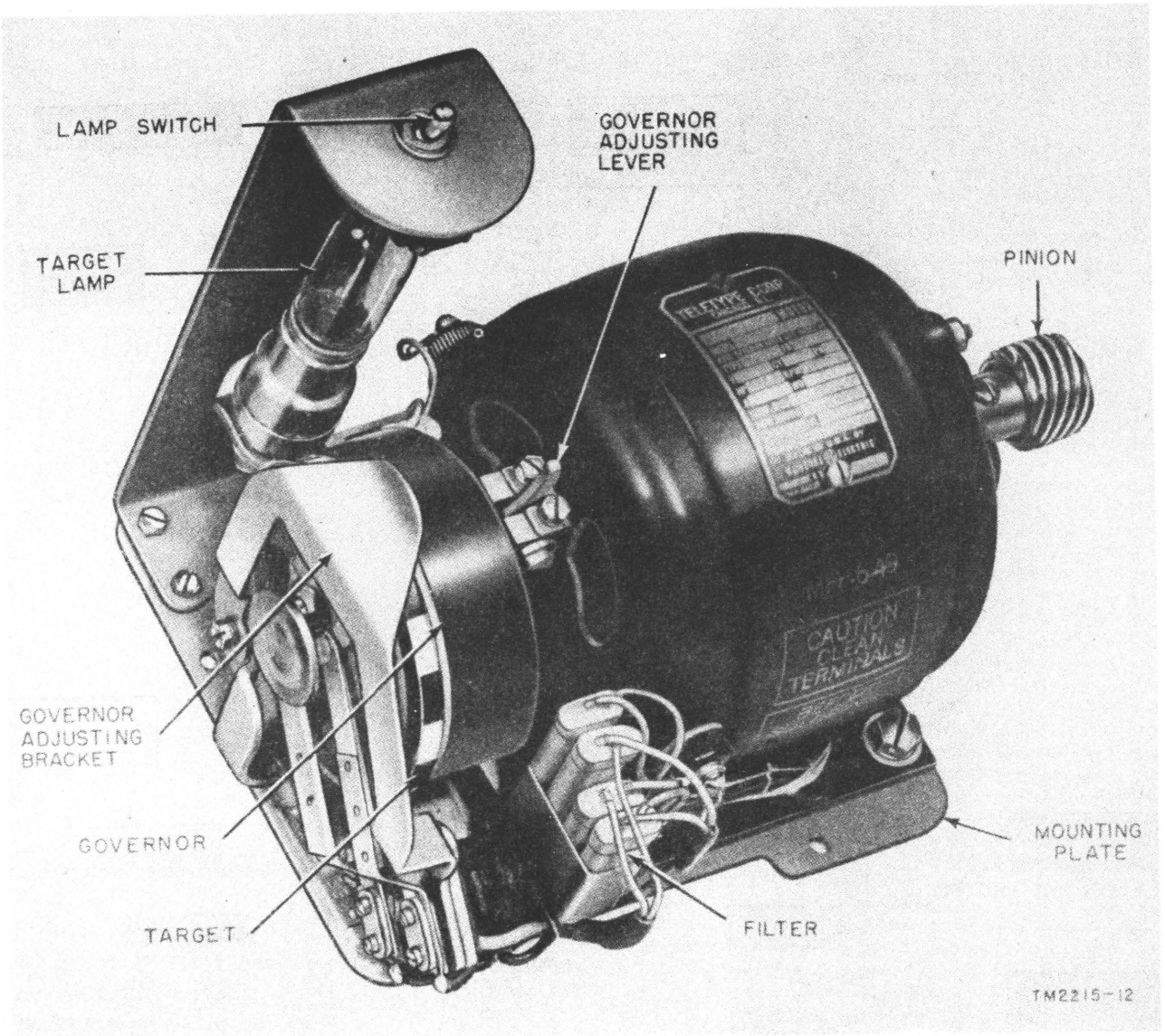


Figure 12. Motor Unit PU–109/GG.

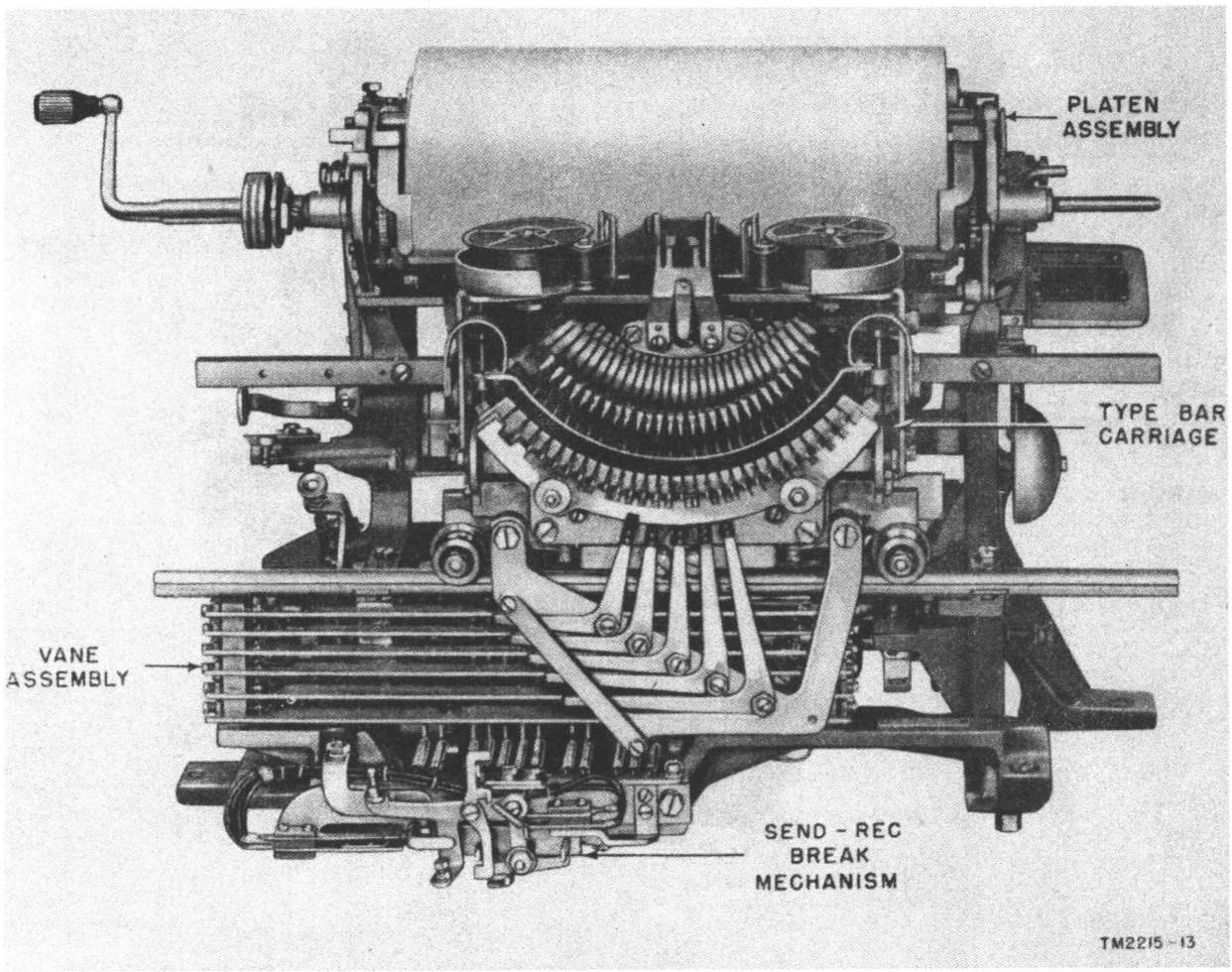


Figure 13. Front of typing unit.

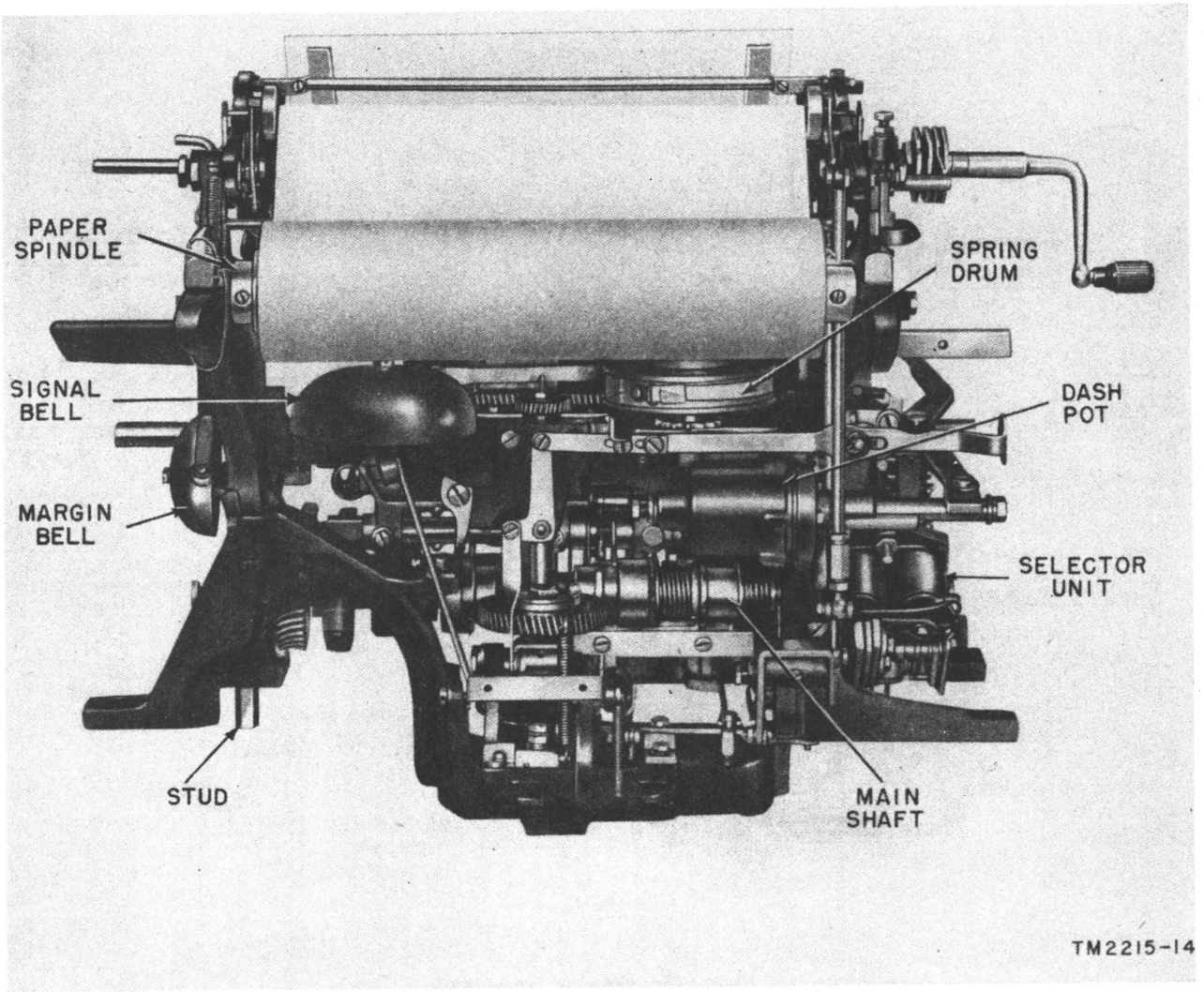


Figure 14. Back of typing unit.

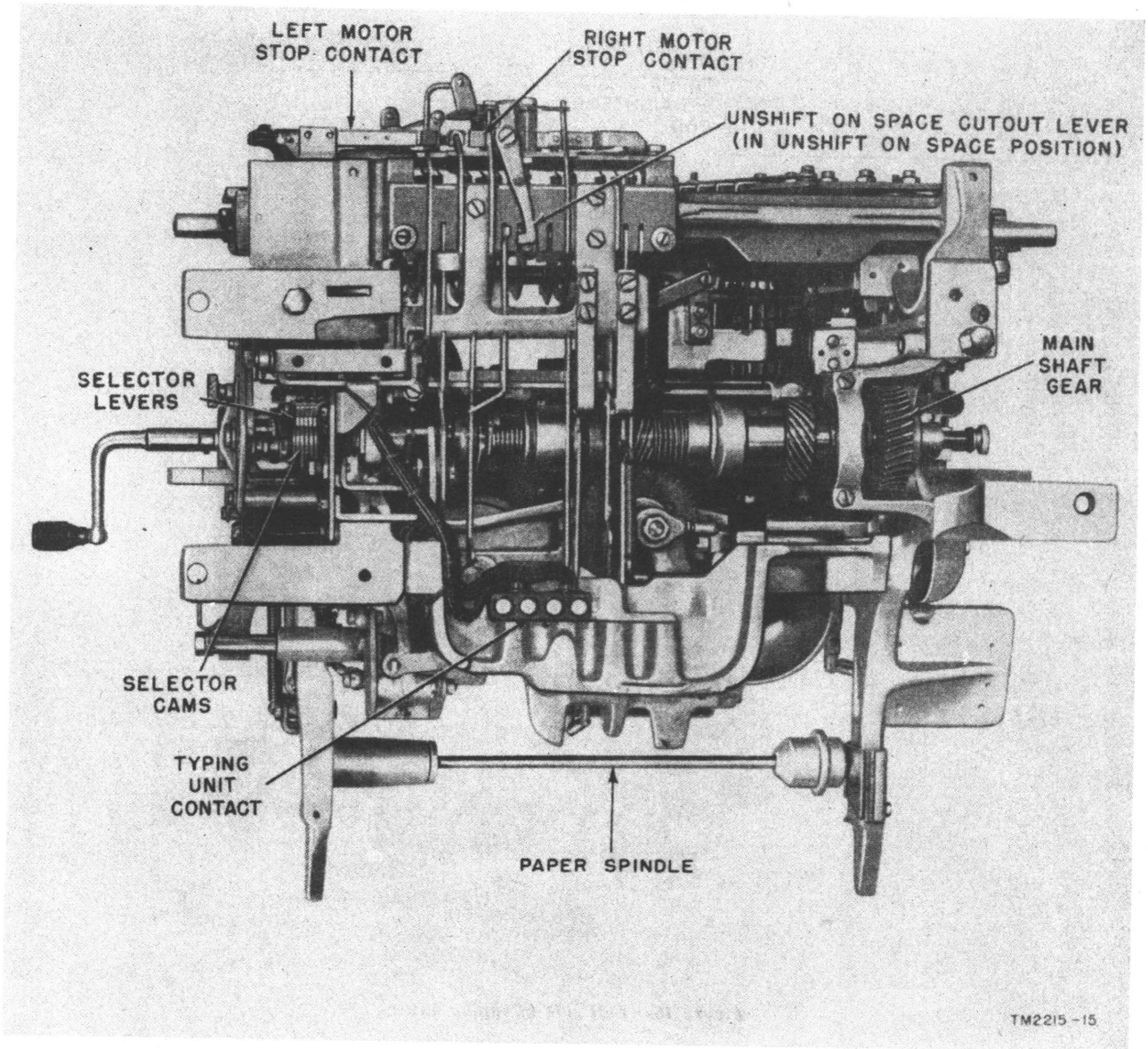


Figure 15. Bottom of typing unit.

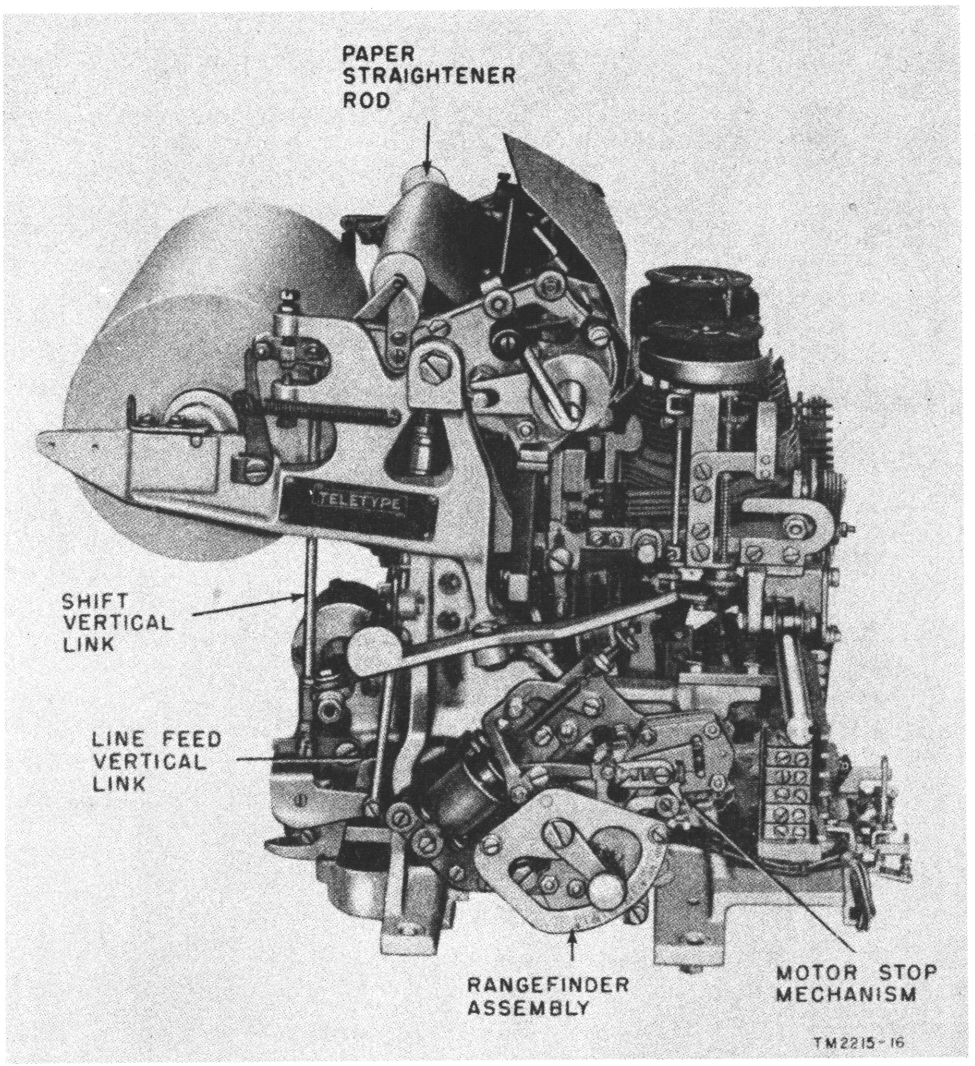


Figure 16. Left side of typing unit.

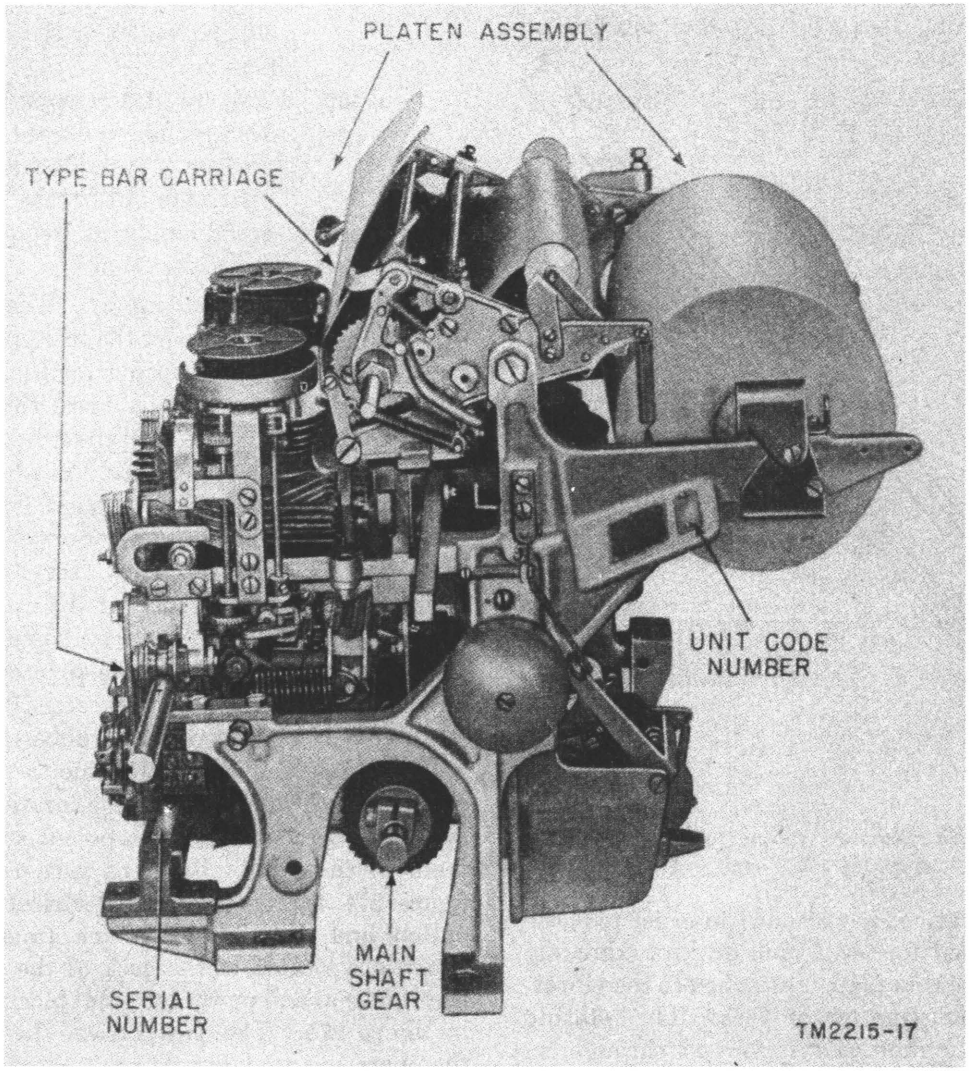
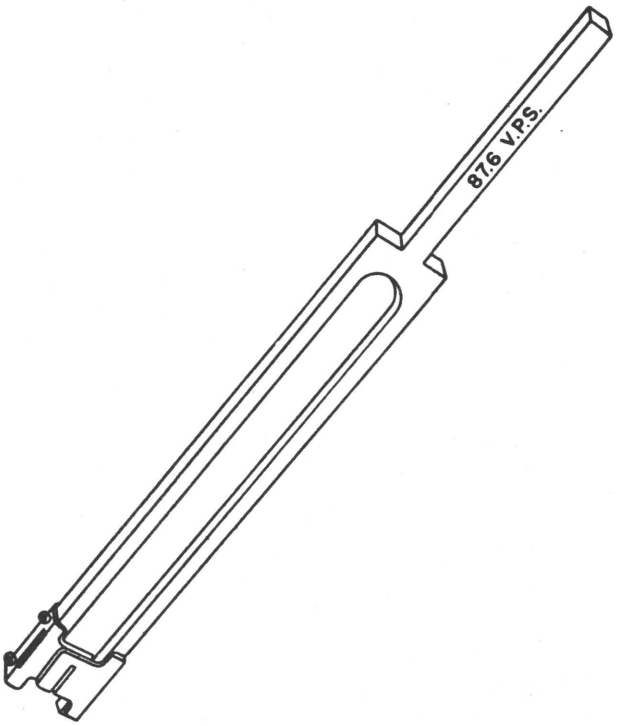


Figure 17. Right side of typing unit.

reduces sound and protects the operating parts of the teletypewriter. A copyholder is attached to the front of the cover (fig. 2). There are openings in the cover for the platen crank, for checking orientation range, manual carriage return, polar-neutral and SEND—REC—BREAK keys, paper outlet, and the motor ON-OFF switch.

i. Speed Indicator. The standard speed indicator is a tuning fork (fig. 18) that vibrates at



TM2216-74

Figure 18. Speed indicator (tuning fork) for standard speed of 368.1 opm.

87.6 vps (vibrations per second) in order to check the motor speed for 368.1 opm or approximately 61 wpm. A slotted plate is attached to the vibrating end of each tine of the fork. The rotating target of the motor unit is viewed through an aperture formed by the slots in these plates when the motor speed is checked and adjusted. A special tuning fork that vibrates at 96.1 vps is required for 404 opm or 66 wpm operation (British speed).

j. Rectifier Power Unit (fig. 28). The series-governed motors operate on ac at 110 to 120 volts. The local and signal line circuits utilize a d-c supply at 110 to 120 volts. These requirements can be supplied by the REC–30 rectifier unit that is part of each teletypewriter set. The model REC–30 rectifier power unit (par. 139) is designed to provide filtered dc suitable for the operation of teletypewriter signal circuits and to provide the proper a-c voltage for the operation of series-governed motors, when the rectifier is connected to a-c sources of various voltages and frequencies. The input requirements and the output ratings are as follows:

Input: 95, 105, 115, 125, 190, 210, 230, or 250 volts, 25, 40, 50, or 60 cycles, single-phase a-c.

Output: .9 ampere at 120 volts ac (no-load voltage not to exceed 130 volts); also, ac at suitable voltage for the operation of three series-governed motors at frequencies of 25, 40, 50, or 60 cycles.

k. Equipment Table (fig. 2). The table is designed specially to support the teletypewriter and rectifier, to provide mounting for the transmitter distributor, and to accommodate the associated cords and cables. The teletypewriter unit is set squarely on a pad which is held in place by channels on top of the table. A shelf built into the back of the table provides mounting space for the rectifier. An electrical service assembly mounted on the rear inside of the table provides terminals for line and battery connections, and plugs and receptacles for the printer, local test circuit, rectifier, and a reperforator if one is used. The table is equipped with rubber feet which, with the felt pad on top, promotes quietness of operation. Figure 2 shows the location of power and line switches and the tape out switch at the front of the table. Refer to paragraph 18 and figure 274 for the various electrical plugs and outlets and the a-c—d-c switch (marked S605) which are located at the back of the table. The line terminal and power terminal blocks are shown in figure 275. The jack blocks through which the operating components are connected to a signal line are shown in figures 28 and 275. Figures 274 and 275 are the schematic and the actual wiring diagrams of the table.

7. Differences Between Teletypewriters TT–7/FG and TT–8/FG

a. At the left of the typing unit of Teletypewriter TT–7/FG is a mechanical motor stop mechanism which may be controlled by any transmitter or keyboard in the signal line. The right margin adjusting screw of the typing unit is ad-

justed to print the usual 72 characters per line. The typing unit suppresses printing and spacing for both the upper and lower case blank combinations. The line feed and carriage return functions are effective in either upper or lower case. The motor may be stopped and started by remote control (from local or distant stations).

b. Teletypewriter TT–8/FG has a set of type pallets equipped with weather report symbols and a standard keyboard with weather report key markings to correspond (fig. 8). The margin adjusting screw of the typing unit is adjusted to print 76 characters per line. The printer is arranged to print a dash and space on the upper case blank combination and suppress printing and spacing only on the lower case blank. The carriage return and line feed functions are effective in lower case (or LTRS) position only. The feature of remote motor control is not applicable to weather report printers because all upper case positions are assigned to necessary weather report symbols and figures. The special spacing, carriage return, and line feed functions of the weather report printer are accomplished through use of a set of parts containing three special function levers. Otherwise, the two types of printer sets are identical in component parts, functioning, and appearances.

c. In paragraph 12, note that all components of Teletypewriters TT–7/FG and TT–8/FG are interchangeable (without changing type of service) except the typing unit and perforator transmitter.

8. Teletypewriter Line Circuits

a. General. These teletypewriters are designed to operate over any wire or radio circuit suitable for automatic telegraph communication at established speed.

b. Basic Teletypewriter Circuits. The Simplest type of teletypewriter loop circuit consists of a single wire, with ground return, connecting two teletypewriter equipments. Generally, this type is used only over short distances. The equipment may be used with three general types of wire circuits as follows: full-metallic, ground return, and superimposed circuits. The usual types of the superimposed circuits are the simplex, phantom, simplexed phantom, and composited circuits.

9. Types of Operation

a. General.

(1) These teletypewriters send and receive a code signal known as the five-unit, start-stop code (fig. 4) which is comprised of a series combination of seven impulses for each character, function, or letter transmitted. Each of these seven impulses must be either a marking or a spacing impulse. The order and arrangement of the five code impulses between the start and the stop impulses depend on the character or function transmitted. The marking impulses are characteristically opposite or at least substantially different from the spacing impulses; for example, when neutral operation is used there will be current flow during a marking impulse (usually 60 ma) (milliamperes) and no current during a spacing impulse (zero current). For polar operation, the difference between marking and spacing will be only the direction of current flow (polarity). For type B polarential operation, this difference will be only in the quantity of current flowing, with the same polarity for both mark and space.

Note. Of the A and B types of polarential, type B is the only one considered here.

(2) To maintain synchronism (actually relative timing) between sending and receiving units, this code series of five impulses always is preceded by a spacing (start) impulse and followed by a marking (stop) impulse, which makes a total of seven impulses for each signal. The stop impulse is 31 milliseconds long. The other six impulses are of the same duration, 22 milliseconds each.

b. Neutral. Neutral operation means operation through the use of current impulses and no-current impulses for each character or operation. To send a current impulse, the contacts of the transmitter mechanism close. During the no-current impulses, these contacts are held open. Transmission of a current impulse results in a marking action at the selector magnets of the

receiving teletypewriter. A no-current impulse results in a spacing action at the selector magnets. These five impulses of the five-unit code are each of the same duration. In neutral operation (transmitting from a teletypewriter), the circuit is closed when marking and open when spacing. When a teletypewriter is receiving from a carrier terminal, repeater, or similar equipment, this same neutral effect sometimes is obtained by aiding batteries (d-c voltage) to give, usually, 60 ma of current for marking and opposing batteries to give zero current for spacing. If neutral operation is desired when a polar signal of positive battery for marking and negative for spacing is received at the teletypewriter equipment, this may be obtained in the following manner: A steady, unvarying source of negative voltage is connected to the teletypewriter in series with the selector magnets (or in series with the line winding if relay is used) and the line (also in series with the transmitter contacts if single-loop operation is used). This results in a steady marking current for the marking condition. If a negative spacing condition is supplied from a carrier or repeater terminal, this results in negative battery connection to equal negative battery or a zero current spacing condition. In this case, if the teletypewriter receiving unit is grounded rather than connected to battery, the operation will be on a polar instead of a neutral basis. Neutral operation commonly is used on Army teletypewriter circuits. The distance limitation of neutral circuits is imposed primarily by signal distortion resulting from varying weather conditions. Changes in weather and circuit conditions do not have the same effect on the current impulse as on the no-current impulse. This type of distortion cannot be compensated for readily in the adjustment of the teletypewriter mechanism. This form of signal distortion, however, can be overcome to a certain extent by interposing an adjustable receiving relay between the line and the teletypewriter. This relay may be the electrically biased type or the mechanically biased type that is found in line units.

c. POLAR. In polar operation, the spacing and marking conditions are both obtained by line current impulses of equal magnitude but opposite polarity. Current flows in the signal line for both marking and spacing action. Since, normally, teletypewriters send only neutral type signals, the transmitter distributor or some form of pole-changing equipment is connected in the circuit to change the neutral type signals generated by the transmitter contacts to the polar-type signals required. Such pole-changing equipment may be either a terminal or intermediate repeater. Reception of polar type signals also requires a pole-changing device at the receiving equipment. Teletypewriters TT–7/FG and TT–8/FG are equipped with a polar relay for this purpose.

d. POLARENTIAL. A polarential circuit provides an approximate equivalent of a half-duplex polar circuit and uses only one line conductor instead of two. In a polarential circuit, transmission in one direction is polar, and in the other direction, it is differential or equivalent to polar in its effect on the receiving relay armature action and contacts. The transmitting arrangements at the two terminals of a polarential circuit are different. One end, referred to as the polar sending end, applies equal voltages of opposite polarities for marking and spacing. The other end, referred to as the differential sending end, applies ground for marking and positive polarity for spacing. The two terms (polar and differential) are combined to form the term polarential. The polar relay of a teletypewriter operating on a polarential circuit responds to the differential signals as it would to polar type signals. This equivalent is attained by providing the receiving relay at the polar sending (polarential receiving) end with a local marking bias current which is midway between the marking line current and the spacing line current or equal to one-half the sum of the marking and spacing current.

(1) *Transmission limiting factors.* Generally, the limiting usable length of a telegraph circuit, whether wire or radio, has been exceeded when:

(*a*) The signals received are too weak to actuate the receiving equipment properly.

(*b*) The distortion of the impulses is too great.

(*c*) The strength of the signal received is too weak to overcome interference. Circuits can be extended by inserting repeaters before the limiting length of a circuit is reached. Repeaters that are used for this purpose in d-c telegraph circuits receive the signals by means of a relay and retransmit them automatically by use of a local scource

of energy, such as batteries or rectifiers. In carrier or radio telegraphy, a-c signals may be changed to d-c form before retransmission, or the repeating equipments may be vacuum-tube amplifiers that merely amplify them. Regenerative (d-c) repeaters may be used at an intermediate point in a teletypewriter d-c signal loop circuit. This type of equipment automatically retransmits the received signals in practically perfert form if they have not become so distorted as to cause errors in copy in a teletypewriter at the regenerative repeater point in a circuit.

(2) *D-c line sections.* The distance over which satisfactory teletypewriter communication can be maintained is limited by the characteristics of the various types of circuits and by operating conditions. Important limiting factors are line leakage, line resistance, ground resistance, waveshape distortion, and interference. The recommended limits for line sections vary.

(3) *Carrier line sections.* The maximum length for a carrier telegraph section normally is about the same as the maximum length of a telephone section that is furnishing satisfactory service. The maximum loss should not exceed approximately 25 db (decibels) between telegraph terminals. If extensions from the telephone terminals to the telegraph terminals are involved, these should not be noisy and should not have a loss in excess of approximately 8 db each. Several carrier telegraph sections may be included in a multisection network, provided the over-all coefficient is not exceeded (TM 11–486).

(4) *Operation on radio.* These teletypewriters may be used in a radio-teletypewriter system. A single-channel teletypewriter (multichannel with carrier) system may be erected to operate over distances from a few hundred to several thousand miles through the use of radio teletypewriter terminal equipment. For further details of this type of operation, refer to TM 11–486 and TM 11–487.

10. General Functioning of Equipment

a. GENERAL. Specific procedures for connecting the equipment for various methods of operation are given in paragraph 18. This paragraph describes the different capabilities of Teletypewriters TT–7/FG and TT–8/FG.

b. TRANSMITTING. Teletypewriters TT–7/FG and TT–8/FG can transmit into at least two separate circuits.

(1) Transmission in one circuit can be carried on by operation of the keyboard of the perforator transmitter, and the transmitter distributor can send from perforated tape into an additional circuit.

(2) Tape can be perforated while the perforator transmitter is sending to the line, or by the perforator transmitter keyboard without transmitting to the line.

(3) By making a perforated tape copy of messages received and then feeding the tape to the transmitter distributor, these teletypewriters can operate as relay stations. Automatic relaying may be accomplished through use of a reperforator. A prepreforator can be used with these teletypewriters to receive messages and perforate them in tape; however, it is not a component of Teletypewriter TT–7/FG or TT–8/FG.

(4) The perforator transmitter with its keyboard can be split from the typing unit so that both units can operate simultaneously and independently on two separate circuits. In this application, no home copy of the messages transmitted is produced. Typed copy can be produced by feeding the tape (perforated while transmitting to the line) into a transmitter distributor connected to a typing unit in a local circuit.

c. RECEIVING. The receiving component of this equipment is the line winding of a polar relay with contacts that control the selector circuit of the typing unit. Normally, this line winding is connected in series with the perforator transmitter. It also can work on an independent circuit; for example, in full-duplex type of service through use of a double loop. A reperforator can be connected to these teletypewriters to receive incoming messages or to monitor outgoing messages. A reperforator can be connected to either of two

separate lines by means of jacks at the back of the table.

d. LINE SWITCHING. The table has a line switching key with which each of the operating components or any combination of them (depending on the method of operation) can be connected to either of two signal circuits. This arrangement provides a variety of possible hook-ups, among which are the following:

(1) Half-duplex (single loop, one direction at a time) operation.
(2) Transmission only, on either of two lines.
(3) Reception only, from either of two lines.
(4) Simultaneous and independent transmission and reception with the perforator transmitter and/or typing unit connected to either of two lines.
(5) Single operation (perforator transmitter and line winding of receiving relay to operate the typing unit in series) on either of two lines.
(6) Independent transmission by the transmitter distributor from perforated tape on either of two lines.
(7) Transmission by either the transmitter distributor or perforator transmitter arranged in series with a typing unit, on either of two lines.
(8) Operation of a reperforator on either of two receive lines associated with the line switching key.
(9) Connection of a reperforator to either of two send lines associated with the line switching key.

e. POWER SOURCES. Refer to paragraphs 18 and 139 for electrical characteristics of the rectifier power unit. Any power source, either commercial or military, within the necessary electrical characteristics can be used.

f. OPERATING CONTROLS.

(1) *Table.* To the left of the operator's position, immediately under the top of the table are located the following controls:
  (*a*) *Line switching key.* See figure 2 and *d* above.
  (*b*) *Tape-out switch (fig. 2).* This key is used in conjunction with a reperforator when such a unit is connected to the table. After a complete message has been received by the reperforator, pressing this key short-circuits the signal line and permits the reperforator to feed out blank tape to prevent tearing it off before the end of the perforated message.
  (*c*) *Transmitter distributor motor switch.* This switch (fig. 2) controls a-c power to the motor unit of the transmitter distributor.
  (*d*) *Rectifier power unit control switch.* This switch (fig. 2) controls a-c power to the rectifier power unit.
  (*e*) *Ac—dc switch.* This four-pole, double-throw switch is mounted at the rear of the table. Place it in its upper position for a-c operation and in its lower position for d-c operation.
(2) *Rectifier power unit.* The rectifier power unit has an on-off switch (fig. 2) located on the table and another ON-OFF switch on the rectifier itself (par. 139).
(3) *Typing unit and base.* The following controls are labeled by appropriate escutcheons attached to the typing unit cover:
  (*a*) *Motor ON-OFF switch.* This switch is located above the right end of the keyboard.
  (*b*) *SEND—REC—BREAK key* (fig. 3). This key is located above the left end of the keyboard.
(4) *Perforator transmitter* (fig. 2). Each of the keys of the keyboard is an operating control. Operation of the perforator transmitter is governed by a three-position control lever marked KEYBOARD — KBD & TAPE — TAPE. This control is located to the left of the ON-OFF switch and to the right of a flap that covers the polar-neutral key. This key is unlabeled and arranges the set for polar or neutral operation.
(5) *Transmitter distributor.* A description of this unit, which has an ON-OFF switch located at the front (fig. 10), is contained in TM 11–2222.
(6) *Reperforator.* A description of the reperforator (fig. 2), which also has an ON-OFF switch, is contained in TM 11–2223.

g. OPERATOR'S ADJUSTMENTS.

(1) *Rangefinder.* The rangefinder is located on the left end of the typing unit and can be reached by lifting a metal flap in

the typing unit cover. Adjustment of the rangefinder is discussed in paragraph 20.

(2) *Key pressure adjustment.* This adjustment is on the perforator assembly and is used to adjust the pressure that the operator must exert to depress the keys of the keyboard (par. 427).

(3) *Backspace lever.* This lever (fig. 6) is on the perforator mechanism of the perforator transmitter. This lever is used to move the tape backward when necessary to correct errors that may have been perforated in the tape. When the backspace lever has moved the tape backward, operation of the LTRS key of the keyboard will perforate five holes in the tape to obliterate the error.

(4) *Replacing paper, ribbon, and tape.* Installing ribbon and paper in the typing unit, and inserting tape for the perforator transmitter are discussed in paragraph 14. TM 11–2223 describes how to load or replace tape in a reperforator.

(5) *Testing.* The TEST jacks of the table are connected to a local test circuit preadjusted for 60 ma. The send and receive cords may be plugged into these jacks to make a local test of teletypewriter equipment.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

11. Installation Planning Data.

a. PLANNING. Prior to installing teletypewriter stations, it is necessary to plan the over-all layout of the circuits with which they are to be connected. A circuit layout combines line sections (including wire lines and repeater equipment) and extensions (including the local circuits or loops). The over-all circuit layouts considered in this manual may be engineered by personnel at either higher or lower headquarters, depending on the extent of the area to be covered. The information that follows is intended only as a general guide for planning systems and installations. For detailed planning data, refer to TM 11–486.

b. PLANNING FACTORS. Some of the more important factors governing the erection of teletypewriter systems and installations that must be considered are:

(1) The area to be covered by the installation and the number of organizations that are to be served.
(2) The number and types of available circuits.
(3) Traffic considerations, such as the number of word groups daily for each circuit or channel between organizations, the estimated hour of peak traffic load, and the type of traffic handled.
(4) Number and lengths of circuits and channels required.
(5) Availability of equipment.
(6) Personnel requirements, including the number of installers, operators, and maintenance men, but excluding line construction and maintenance personnel.

c. LIMITING FACTORS. With equipment correctly arranged and adjusted for the particular type of connecting facility, satisfactory teletypewriter service at the rate of 61 wpm can be maintained for distances exceeding the limits for satisfactory telephone service on like facilities. These teletypewriters are designed for service with nearby terminal equipment and intermediate repeaters or switchboards as required. Paragraph 9*d* discusses transmission possibilities.

d. INSTALLATION OF TELETYPEWRITERS. Installation of the teletypewriters consists of the following steps:

(1) Selection of a suitable location.
(2) Unpacking and setting up the equipment.
(3) Connection to power source and ground.
(4) Completion of connections to signal lines and preparation for operation.

e. SELECTION OF SUITABLE LOCATION. Because these teletypewriters are fixed-plant equipments, the following information is intended only as a general guide. Specific data for installing circuits into which the equipments work are contained in TM 11–486. Details for station layout are given in TM 11–2207.

(1) *Determining site.* The suitability of exact location depends on the necessity for keeping the station hidden, the housing facilities or shelter available, and the type of terrain. Whenever possible, select a location where the equipment can be set upon a flat, level surface. If necessary, grade the ground and, if a building is not available, provide a wooden platform and a suitable shelter. Drainage around the shelter must be adequate to prevent flooding during wet weather. If ground-return circuits are used, be sure that the station is set up near a suitable ground. Usually a small stream will provide a suitable ground.
(2) *Shelter.* When the shelter has been arranged, take precautions for blackout operation.

(3) *Space.* Allow enough room around the equipment to permit free access to the back of the table (or at least 10 inches to swing the cover back) by installation and maintenance personnel, and for the operator to check the range at the left of the teletypewriter.

(4) *Lighting.* Provide adequate light for the operator. Arrange a drop cord for use by maintenance personnel.

(5) *Special considerations.* For techniques to be applied to protect the equipment under extreme weather conditions, refer to the following publications: TB SIG 13, TB SIG 66, TB SIG 69, TB SIG 72, and TB SIG 75.

12. Uncrating, Unpacking, and Checking

a. GENERAL. When unpacking these equipments, follow the steps outlined in the subparagraphs below. Be careful not to damage any of the components by handling the packages roughly. Always use a nail puller to remove nails. Never try to pry off the top or the sides of a shipping container. Cut the metal strapping that secures each package and be sure to bend back each cut end so that it will not harm equipment or personnel. Always clean and inspect each item before setting it aside for assembly. Note any damage that may have occurred during shipment. Check all items against the packing list. Remove all traces of packing material such as excelsior. Do not remove instruction tags until ready to install the item in its operating position. Refer to *b* below and chapter 5 for contents and size of each package. Save all packing materials; they may be required for repacking. One packing slip is tacked to the outside of the box and one is placed inside under the cover. Each packing slip is sealed in a moisture-vaporproof foil-lined envelope. Stenciled on the outside of each box are the teletypewriter code numbers of the inclosed set; the set number indicates the number of sets in a particular order or shipment. The box number is marked over the total number of boxes required for one set. For example, 1/7 indicates box No. 1 of a total of seven boxes required to make up a complete set such as a Teletypewriter TT–7/FG or a TT–8/FG.

Caution: Contents of metal containers and boxes are inflammable.

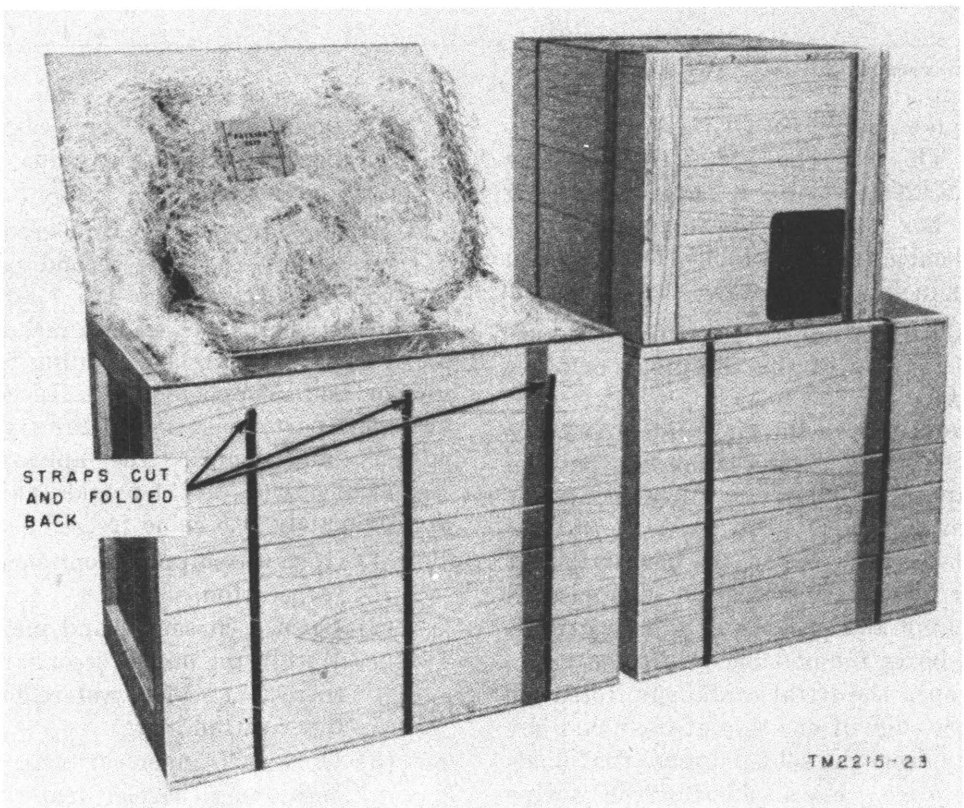


Figure 19. Typical oversea shipping container.

b. Contents of Boxes Comprising One Teletypewriter Set.

Quantity used per set	Signal Corps stock No.		Component parts	Spares*	Box No.
	TT-7/FG (4T4.15A-1)	TT-8/FG (4T4.13A-1)			
1	4TXRT202AA	4TXRT202AA	Table, model 19, sending and receiving	----------	2/7
1	3Z2601.39	3Z2601.39	Fuse, plug: 1.25 amp, 125 v; for transmitter distributor.	(1 spare)	2/7
1	4TREC30	4TREC30	Rectifier	----------	1/7
1	2JCFCG	2JCFCG	Tube, electron	(1 spare)	1/7
2	2J323A	2J323A	Tube, electron	(2 spares)	1/7
1	2Z5878	2Z5878	Lamp, neon, 105 to 125 v	(1 spare)	1/7
1	3Z1903–3	3Z1903–3	Fuse, fusetron: 3 amp, 250 v	(1 spare)	1/7
1	3Z1903–10	3Z1903–10	Fuse, fusetron: 10 amp, 250 v	(1 spare)	1/7
1	4TBB44	4TBB44	Base, model 15 printer	----------	5/7
1	3Z2601.31	3Z2601.31	Fuse, plug: 1.6 amp, 125 v	(5 spares)	5/7
1	4TMU27	4TMU27	Motor unit	----------	5/7
1	6Z6820–2	6Z6820–2	Lamp, target: 120 v, 15 w	(2 spares)	5/7
1	4TRY30	4TRY30	Relay (WECo type 255A)	----------	6/7
1	4TXD200AA	4TXD200AA	Transmitter distributor	----------	6/7
1	4T103628	4T103628	Fork, tuning (87.6 vps)	----------	6/7
1	4TBP22/210	4TBP93/221	Typing unit, with platen crank	----------	3/7
1	6M1175	6M1175	Ribbon, printing, black	(2 spares)	3/7
1	4T80374	4T80374	Set of gears (for motor and main shafts)	----------	6/7
1	4TPEX25JX	4TPEX25KQ	Perforator transmitter	----------	4/7
1	4T122–50	4T122–50	Lamp, incandescent, 110–130 v, 10 w	(1 spare)	4/7
1	4TPEXC200AA	4TPEXC200AA	Cover, typing unit and perforator transmitter.	----------	4/7
1	4T91752	4T91752	Copyholder (Teletype No. 115700AA)	----------	6/7
1	4T1	4T1	Paper	(15 rolls spare)	7/7

*The spares are contained in box 6/7; paper is contained in box 7/7.

c. First Package To Be Opened. Open box No. 2 first. This box (marked "2/7") contains the table XRT202AA with a 1.25-ampere plug fuse. This box weighs approximately 363 pounds (31.9 cubic feet). A table of weights and dimensions is included in chapter 5.

(1) Remove one side (either front or back) and the top of the shipping container (box).

(2) Carefully open the moisture-vaporproof metal barrier, and remove the cushion wrappings. Open the metal container from the top.

(3) Lift the table out of the box and set it near its operating location. Replace all blocking and packing details in cartons and boxes for possible future use.

(4) To open the metal containers, force the upper edge of one side of the metal box away from the soldered seam that holds it in place. Use a soldering iron to wipe off excess solder. Do not leave any exposed sharp or rough edges. Refer to paragraph 14 as a guide for assembly and installation.

d. Second Package To Be Opened. Box No. 6 (marked "6/7") is the second package to be opened. It contains two TM 11–2216, a transmitter distributor packed in a metal container, a set of gears, a line relay, a tuning fork speed indicator, and a copyholder. It also contains parts and spare parts consisting of fuses, vacuum tubes, ribbons, and lamps. The approximate gross weight of box 6/7 is 151 pounds, and it displaces approximately 10.3 cubic feet.

(1) Open the shipping container and remove each carton.

(2) Open each carton and metal container. Within the outer (secondary) container there is a sealed, watertight (primary) inner carton.

(3) Open each inner carton and remove all cushioning, barrier materials, and the desiccant (water-absorbing material).

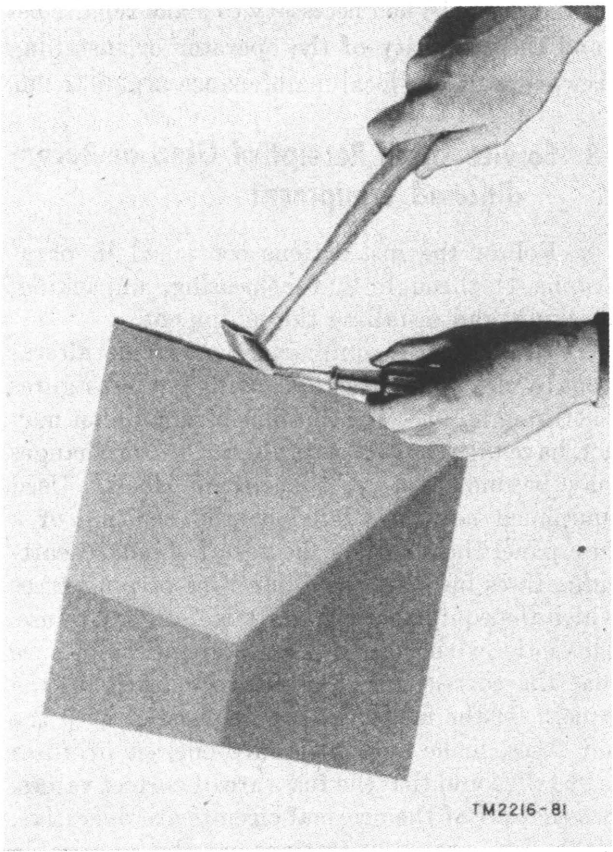


Figure 20. Opening metal container with screw driver.

(4) Carefully lift out each item of equipment and place it on the table or on a wooden box; protect it from dust.

(5) Set the transmitter distributor in its mounting on top of the table or set it aside and protect it against dust or damage until the other components are assembled.

e. THIRD PACKAGE TO BE OPENED. This package contains rectifier REC–30. The shipping box is marked "1/7", weighs approximately 193 pounds gross, and displaces 7.9 cubic feet.

(1) Open the outer container.

(2) Remove the cushioning and protective wrapping and blocking from around the rectifier power unit.

(3) Lift the unit out and remove the desiccant.

(4) Set the rectifier power unit near or on the shelf at the rear of the table.

f. FOURTH PACKAGE TO BE OPENED. This package is box No. 5 and is marked "5/7". It contains the base BB44 and the motor unit MU–27. The approximate gross weight of this package is 190 pounds, and it displaces approximately 15.7 cubic feet.

(1) Carefully remove the packing material and both metal containers.

(2) Center the base on its pad on top of the table and mount the motor unit on the base as directed in paragraph 14. Cover and protect it against dust or damage while assembling the remaining components.

g. FIFTH PACKAGE TO BE OPENED. This package contains the typing unit 4TBP22/210 for general communication or 4TBP93/221 for weather communication and is marked "3/7". Its gross weight is approximately 160 pounds, and it displaces approximately 10.9 cubic feet.

(1) After the metal straps and the nails that hold the front of the case to the top have been removed, take off the top and the front of the case.

(2) Remove the excelsior packing material.

(3) Take the metal box out of the container.

(4) Open the metal box by forcing the upper edge away from the seam as directed in *c* above.

(5) Pry the top cover out.

(6) Cut the edges of the sides of the metal container and bend them down.

(7) Carefully lift out the fiberboard carton that contains the typing unit.

(8) Open the carton and remove the desiccant and desiccant tray.

(9) Lift out the typing unit with its crate.

(10) Set the unit in an upright position.

(11) Remove the wedge locks from each side.

(12) Remove the two screws from each of the four vertical corner members of the crate.

(13) Remove the crate from around the typing unit.

(14) Remove the two wood screws that hold the wooden top frame to the wooden front frame. Remove the front and top frames.

(15) Remove the tie cord and paper packing from the type bar carriage.

(16) Detach the parts bag and remove the paper reel spindle, platen crank, and ribbon spools. Set these parts aside until the typing unit is set up.

(17) Remove the PK-21296 and PK-21297 brackets (fig. 21) that hold the type bar carriage in place for shipping. These brackets are located on each side of the typing unit over the carriage track supports.

(18) Remove the cord that holds the bell at the rear of the unit.

(19) Set the typing unit, still attached to its wooden base, aside until ready to install it upon the base unit on the table. Cover the typing unit to prevent dust and dirt from reaching the internal mechanism. When setting the typing unit upon the base, be careful not to jam the bakelite main shaft gear against the steel pinion on the motor shaft. Face the front of the typing unit. With the right hand, grasp the flat projection on the right-hand typing unit casting (fig. 22). With the left hand, grasp the extreme left lower front corner of the left-hand typing unit casting. Lift the typing unit carefully. Do not place undue strain upon the unit. This could cause the mechanism to be thrown out of alinement.

h. Sixth Package To Be Opened. This package contains the perforator transmitter (4TPEX-25JX for general communication or 4TPEX25KQ for weather communication) and the typing unit cover PEXC200AA. The gross weight of this package is approximately 212 pounds, and its displacement is 17.5 cubic feet.

(1) After the metal straps and the nails that hold the front of the case to the top have been removed, take off the top and front of the case.

(2) Remove the metal box containing the perforator transmitter and the carton containing the cover.

(3) Open the carton. Open the metal box by forcing the upper edge away from the seam as directed in *c* above.

(4) Remove the desiccant and packing materials.

(5) Lift out the perforator transmitter and cover it for protection against dust. Set it aside with the cover unit until ready for use.

i. Checking. Check the components against the list given in paragraph 12*b*. Check each item for damage. When necessary to make repairs beyond the authority of the operator or installing crew, consult the local maintenance organization.

13. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions contained in paragraphs 11 through 15 for locating, unpacking, checking, and installing the equipment.

b. Examine the equipment for circuit alterations by checking the actual wiring against figures 268 through 276. The equipment should, but may not, have tags that indicate alterations, or changes may be indicated on the circuit labels. Used equipment may be altered by the addition of a fuse panel that permits the use of standard cartridge fuses instead of the fusetrons or plug fuses which the equipment orginally is designed to use. Check the wiring of such a fuse panel to be sure that the correct fuse values are marked on the panel. If the new fuses are in parallel with the old fuses, make sure that only one set of fuses is installed and that the fuses are of correct values. See that all of the original circuits are operative. Mark any circuit alterations on the applicable diagrams in this technical manual.

c. Attempted alterations or changes in used equipment may include unusual or difficult-to-detect conditions caused by the following, but not recommended, practices:

(1) Line relay windings wired in series-aiding for operation on weak, substandard signals.

(2) Rectifier rewired for half-wave operation because of defective or burned-out parts.

(3) Selector armature and magnet gap, or magnet windings changed to compensate for defective signals.

(4) Bridged fuses or time-delay switches.

(5) Undersized resistors or capacitors.

(6) Loose or missing motor shaft governor screw which may cause a series motor to burn out or damage other equipment.

(7) Burned felt clutch washers on main shaft wick because of improper lubrication.

(8) Loose screws and/or metallic particles between pole pieces of line relay because of poor maintenance.

(9) Strap removed and left off at polar-neutral key for polar operation without perforator transmitter.

14. Assembly and Installation

a. TABLE. Before installing the operating components on the table, set the table in its working location. Information on completing the power and signal line connections at the table is covered in paragraphs 18 through 21. Assemble the equipment in the order given below.

b. TRANSMITTER DISTRIBUTOR. The transmitter distributor, described in TM 11–2222, is installed in a special mounting on top of the table. Slide the unit into its mounting so that the slip contacts of the transmitter distributor make contact with the slip contacts of the mounting.

c. RECTIFIER POWER UNIT. This unit is set upon the rear shelf of the table. Refer to paragraph 18 for adjustments that must be made to this unit before it can be installed.

d. SETTING BASE IN PLACE. On top of the table there is a felt pad which is held in place by steel channels. Set the base in place as follows:

(1) Lift the base carefully and lower the back edge onto the pad. Hold up the front edge until the cables and cords attached to the connection strips are fed through the cut-out in the steel plate and table top. Lower the base in place.

(2) Aline the base so that its edges are parallel to the edges of the table.

(3) Check the line relay to see that it is in place (fig. 63).

(4) Check the plug-type fuse to see that it is screwed properly into its receptacle (fig. 63).

e. MOTOR UNIT.

(1) Remove the three screws, which are located at the right rear corner of the base, from the motor unit mounting.

(2) Remove the screw and lockwasher in the end of the motor shaft.

(3) Obtain the steel pinion that is packaged in box No. 4/4 with the bakelite main shaft gear.

(4) Assemble the steel pinion on the motor shaft.

(5) Set the motor unit in place and slide it in against the spring contacts.

(6) Insert and tighten the two front mounting screws; then back them off about ¼ turn. Do not tighten the rear mounting screw until the typing unit has been set in place. Examine the target lamp for damage; then install it if no damage is observed.

f. TYPING UNIT. Remove the typing unit from its wooden shipping base. Underneath the typing unit are two hexagonal studs. These studs enter clearance holes in the base and are used only to protect the typing unit mechanism from injury when it is removed from the teletypewriter.

(1) Remove the oil-retaining plug from the right end of the main shaft.

(2) Remove the clamping screw and lockwasher that hold the gear hub to the shaft, and slide the gear hub off the shaft.

(3) Remove the right and left carriage fastening brackets; then replace and tighten the bolts.

(4) Remove the three screws and lockwashers from the hub and assemble the gear and hub by inserting the three screws and lockwashers through the counterbored holes in the gear.

(5) Slip the gear and hub onto the main shaft so that the hub is toward the outside of the typing unit. Slide the assembled

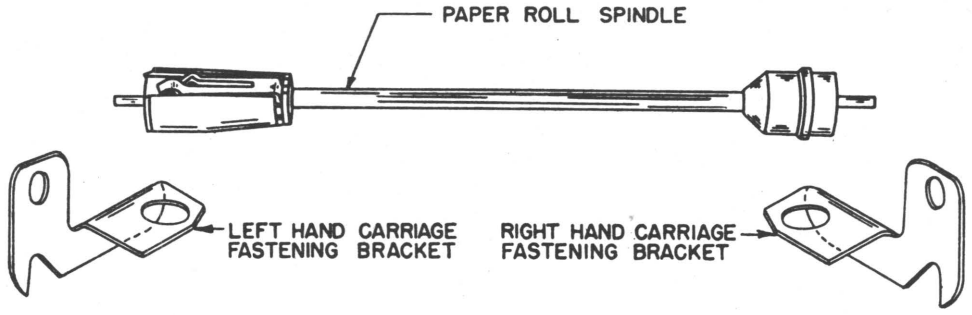


Figure 21. Paper spindle and carriage fastening brackets.

gear and hub along the shaft until the slot in the main shaft permits the hub clamping screw, with its lockwasher, to be fastened in place. Replace the oil plug in the end of the shaft.

(6) Remove the three large flat thumbscrews and the lockwashers beneath them from the base.

(7) The exact location of the typing unit upon the base is determined by two dowel pins on the two forward machined surfaces of the base unit. The right dowel pin fits into a hole; the left dowel pin enters a slot in the typing unit casting.

(8) Place the typing unit upon the base by setting the left side down first. Hold the right side so that the main shaft gear is just ready to mesh with the motor pinion.

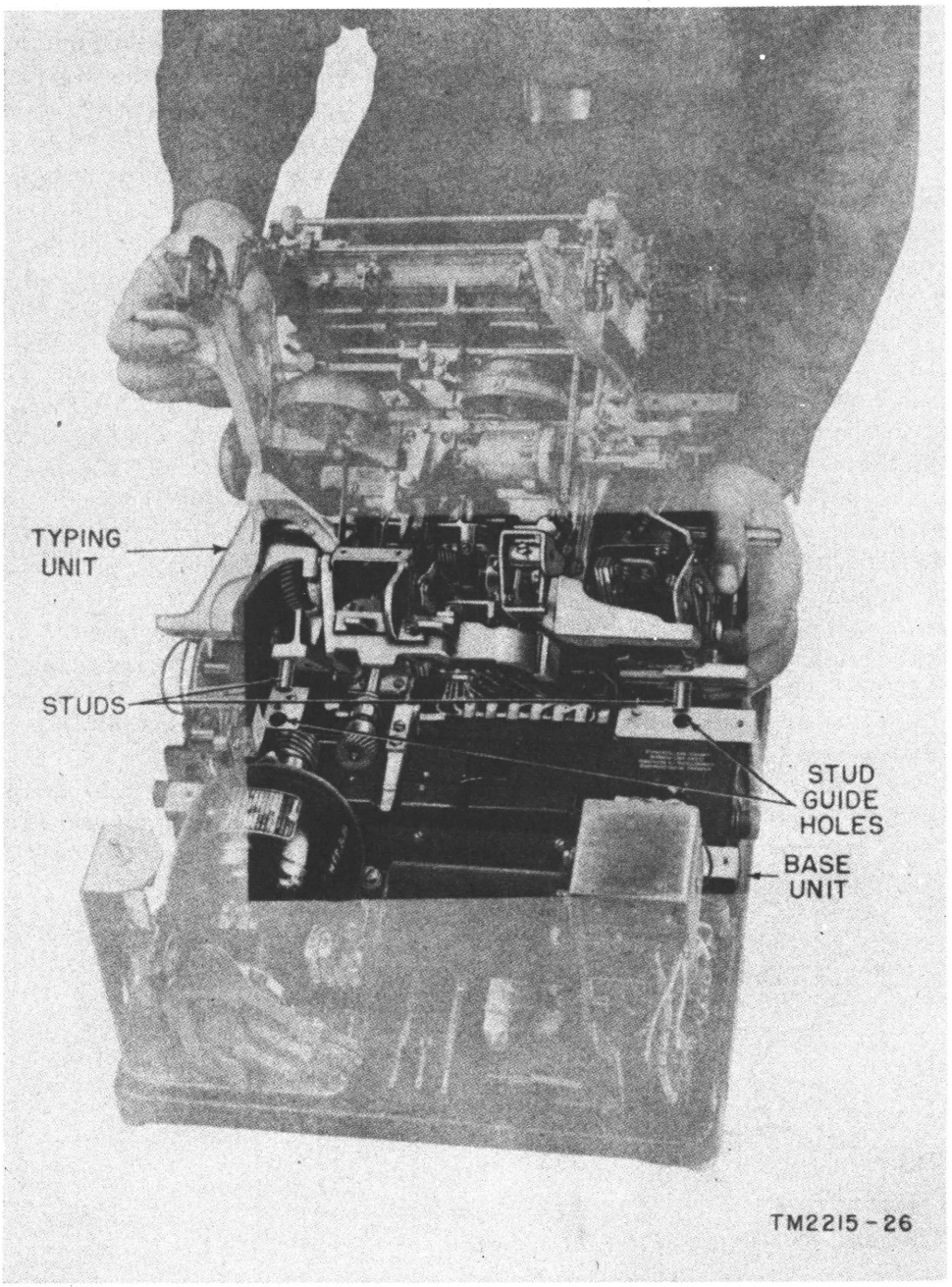


Figure 22. Lowering typing unit onto base.

(9) With the left hand, turn the motor flywheel and, at the same time, carefully lower the right end of the typing unit until the motor pinion meshes properly with the main gear.

(10) Check the alinement of the motor pinion and main shaft gear by looking through the opening at the front bottom of the typing unit. (This is the opening into which the keyboard will be installed.) A vertical line drawn through the center of the motor pinion should bisect the gear face of the main shaft gear (fig. 24). If it is necessary to improve lateral alinement between gear and pinion, loosen the four motor base bolts and move the motor unit very carefully on its base plate. If satisfactory alinement is not possible by this means, refer to chapter 4. If the alinement appears satisfactory, tighten the four motor base bolts and insert the three thumbscrews and their lockwashers that hold the typing unit to the base. Tighten the three motor unit base plate mounting screws. Then tighten the three thumbscrews to secure the typing unit to the base unit.

(11) Check the motor pinion and the main shaft gear adjustment by turning the flywheel of the motor by hand. The proper adjustment is achieved when the amount of backlash is just barely perceptible (par. 367). Mount the paper spindle on the typing unit until ready to install the paper.

g. PERFORATOR TRANSMITTER. This assembly includes the keyboard and perforator with the associated character counter (fig. 9). The entire assembly fits into the front of the typing unit. Handle the perforator transmitter carefully to avoid undue strain upon the mechanism. When mounting the perforator transmitter to the base

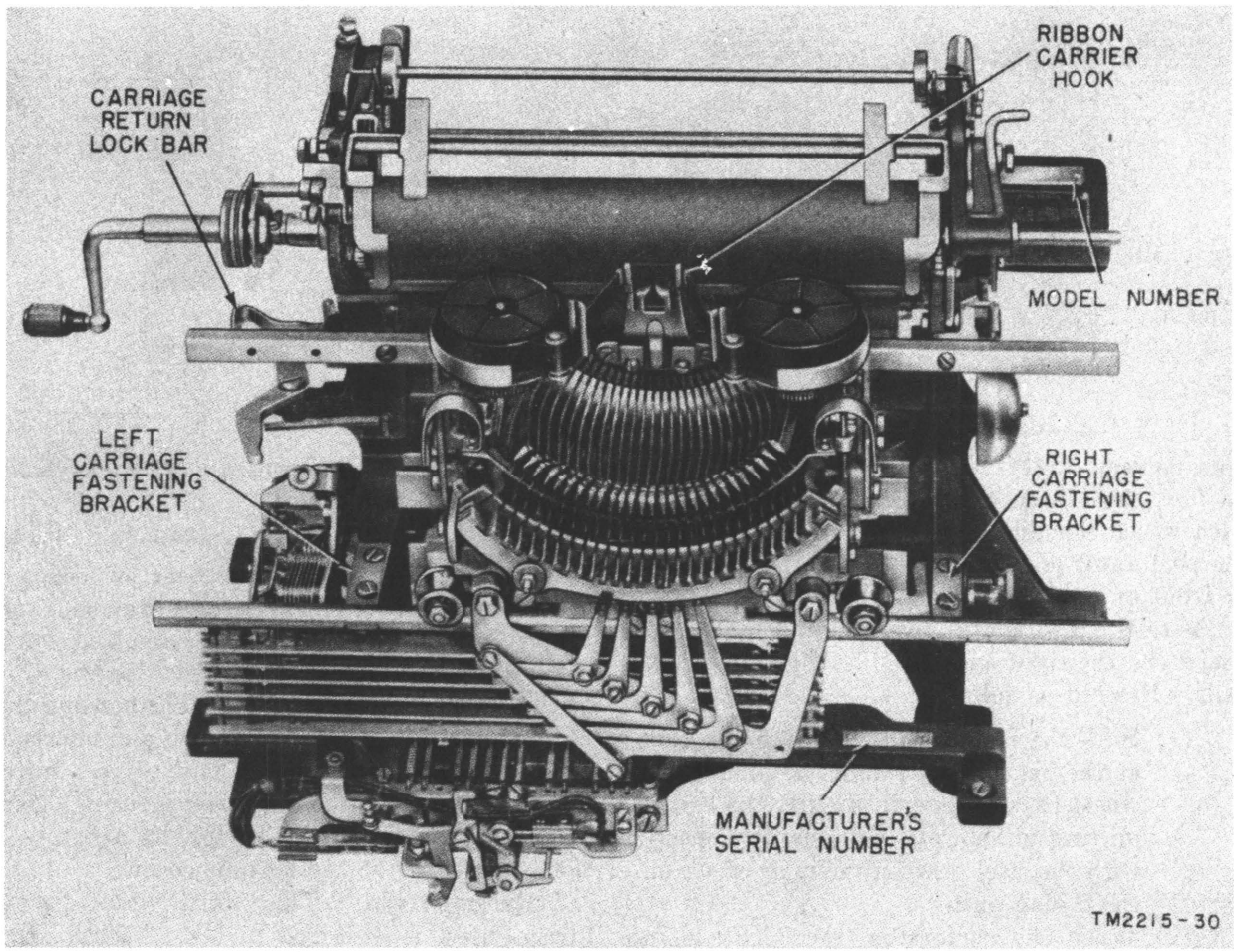


Figure 23. Front of typing unit.

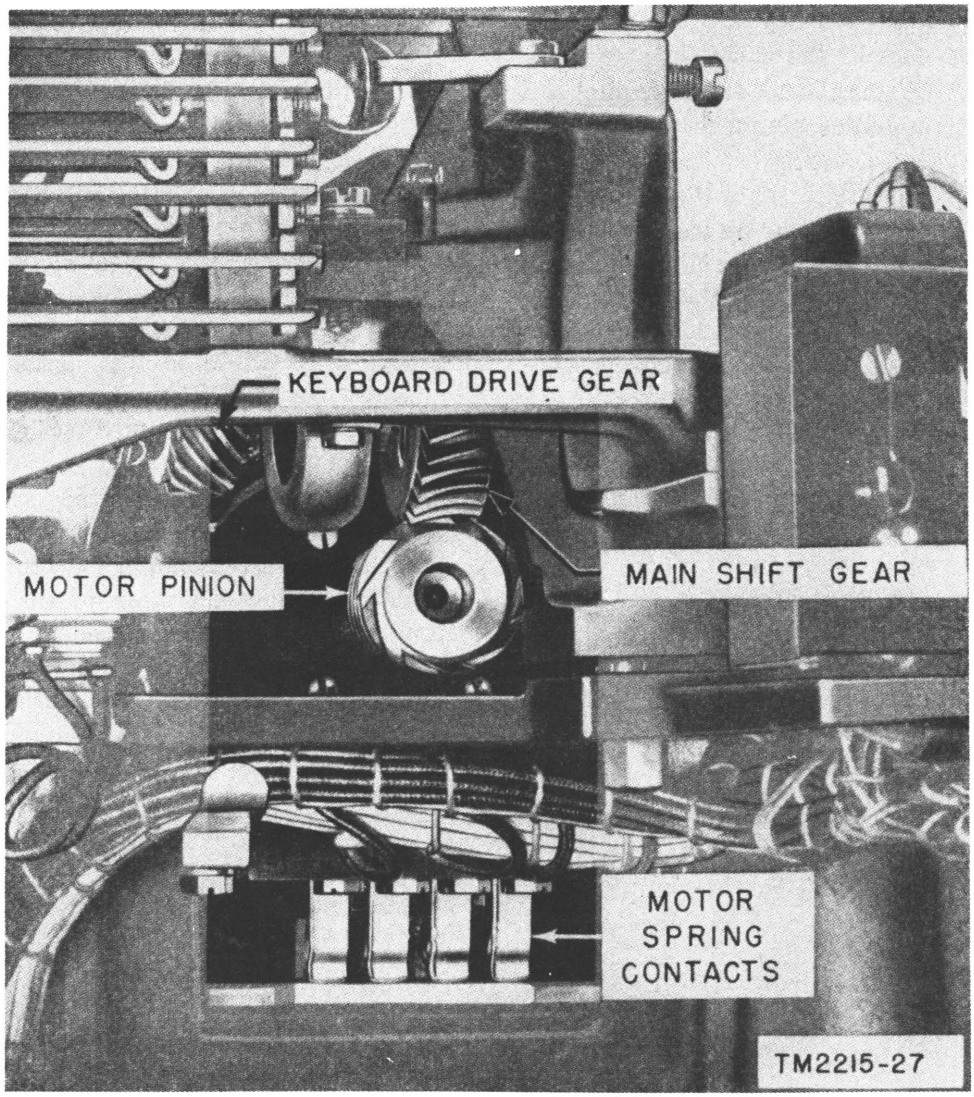


Figure 24. Motor and typing unit gears in mesh.

unit, be very careful not to jam the bakelite gear on the transmitter shaft against the steel gear with which it meshes on the main shaft. Slide the perforator transmitter unit into the opening in front of the base upon two angle irons which act as rails. Two plates, fastened under the keyboard (on the right and left sides), go under the rails. Proceed as follows:

(1) Slide the assembly into place slowly and, at the same time, rotate the motor flywheel back and forth so that the transmitting shaft gear will mesh properly with the steel gear on the main shaft on the typing unit.

(2) When the perforator transmitter is in place, tighten the two captive thumbscrews (fig. 9) which hold the keyboard to the base unit.

h. Typing Unit Cover and Copyholder (fig. 2). Attach the copyholder to the cover by means of the four flathead machine screws provided. Set the typing unit cover over the assembled equipment so that its sides are parallel with the edges of the table. *Do not use force.* The housing that protects the perforator mechanism and character counter is part of the typing unit cover. Install the tape reel and the tape reel housing cover. Insert the platen crank through its aperture in the left side of the typing unit cover.

i. Reperforator. This unit, which is not always used, is described in TM 11–2223. It is installed as shown in figure 2. The electrical con-

nections for the reperforator are indicated in figure 274.

j. RIBBON. Make sure that the ribbon (figs. 25 and 26) has a hook fastened to each end and that it has a reversing eyelet about 4 inches from the hook at each end. The ribbon spool may be of either metal or fiber, but it must have small holes in the flange, spaced around the center hole, to engage the ribbon spool driving pin on the ribbon spool shaft. Proceed as follows:

(1) Open the glass panel and the metal top that are hinged to the top of the typing unit cover. Remove the empty spool. Engage the hook at one end of the ribbon in the hub of the empty spool. Wind a few turns of ribbon onto the spool to make sure that the reversing eyelet has been wound upon the spool.

(2) Place the ribbon spools on the shafts so that the ribbon feeds from the back of each spool without twisting. Turn each spool slightly until the driving pin on the ribbon spool shaft is engaged by one of the holes in the flange.

(3) Thread the ribbon forward around both ribbon rollers, through the slots in the ribbon reverse arms, across the ribbon carrier, and under the carrier hooks (fig. 25).

(4) Be sure that the ribbon remains in the slots and that both reversing eyelets are between the ribbon spools and the ribbon reverse arms. Eliminate any slack in the ribbon.

k. PAPER (fig. 27). Open the glass plate of the typing unit cover and the metal lid hinged to its top. Push back the paper spindle retaining plates and remove the spindle. Insert the spindle in the roll of paper. The round flange on the spindle should be on the right-hand side of the roll.

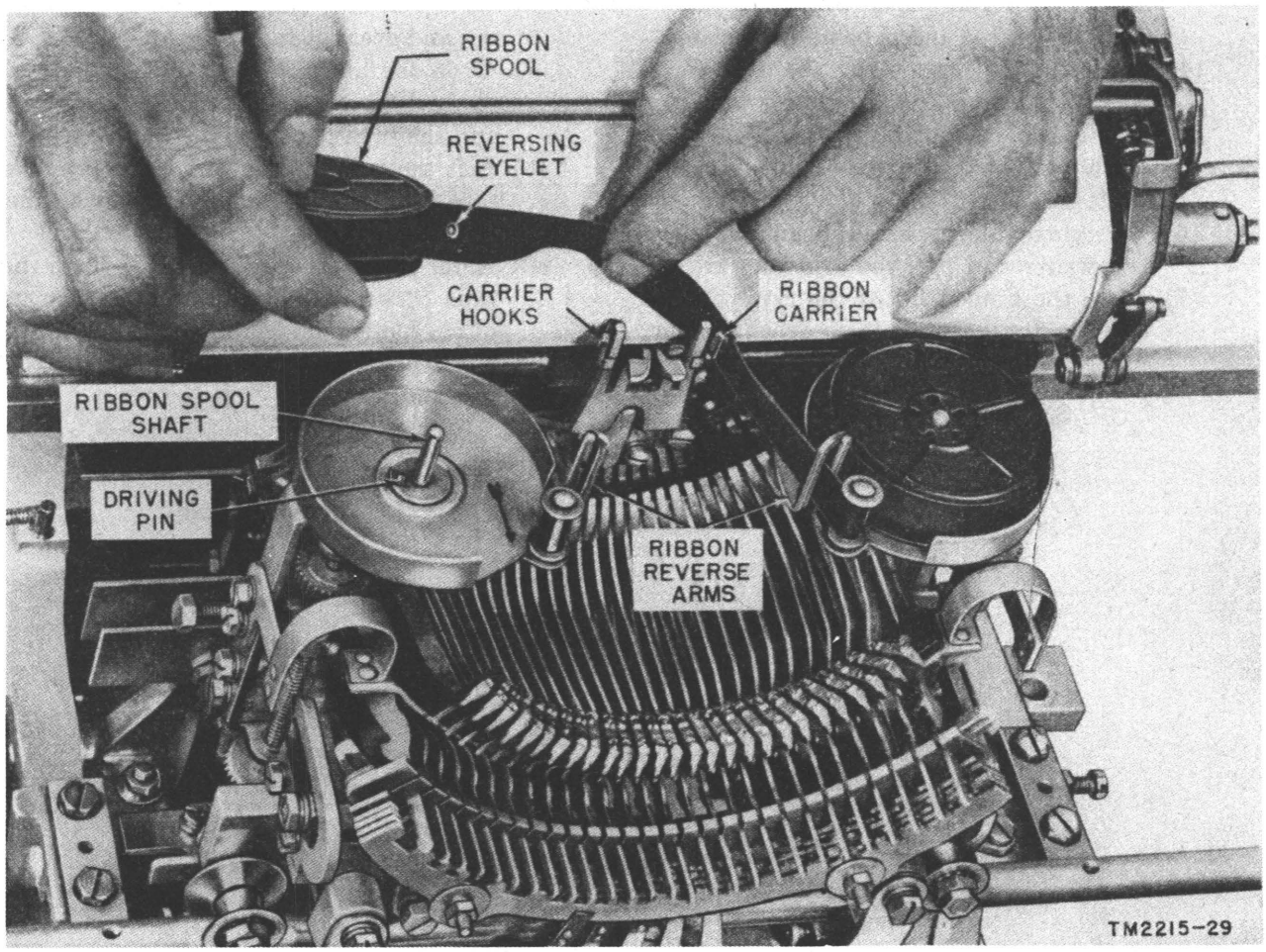


Figure 25. Installing ribbon in teletypewriter.

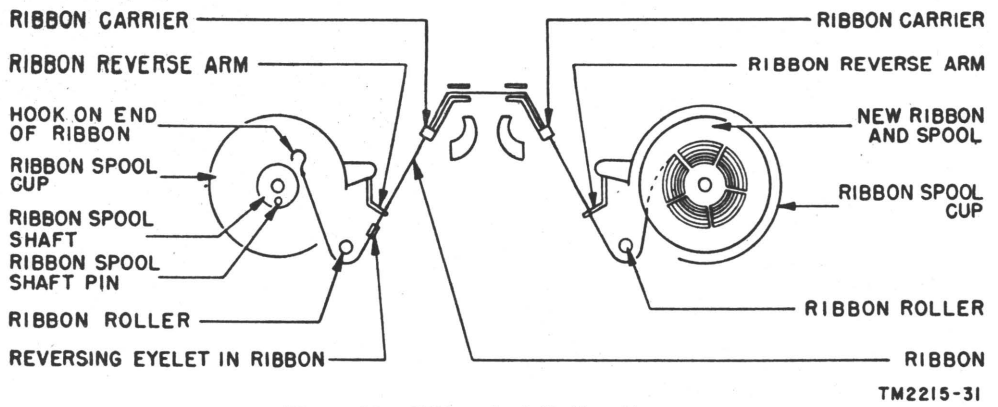


Figure 26. Ribbon installation diagram.

(1) With the paper feeding up from the front of the roll, place the spindle in the right-hand groove first and then in the left-hand groove.
(2) Push the retaining plates back to lock the spindle in place.
(3) Fold the end of the paper back to square it off; feed the paper over the paper straightener rod and in behind the platen.
(4) Bring the paper up under the paper fingers by turning the platen crank. Do not disturb the ribbon.
(5) Push back the pressure roller release shaft arm (fig. 27).
(6) Straighten the paper as in an ordinary typewriter and pull the arm forward.
(7) Close the hinged lid of the typing unit cover and roll the paper up over it, using the platen crank. Close the glass front cover.

l. TAPE:
(1) Remove the cover of the tape reel housing.
(2) Insert the tape roll so that it unwinds forward from the bottom.
(3) Bring the tape out of the tape reel housing and over the tape roller.
(4) Open the hinged top of the perforator. Thread the tape between the tape chute and the tape punching mechanism.
(5) Lift the tape tension lever and pass the tape between the tape tension lever and the feed roll.
(6) After power has been applied, grasp the tape between the thumb and forefinger of one hand and strike characters (on the

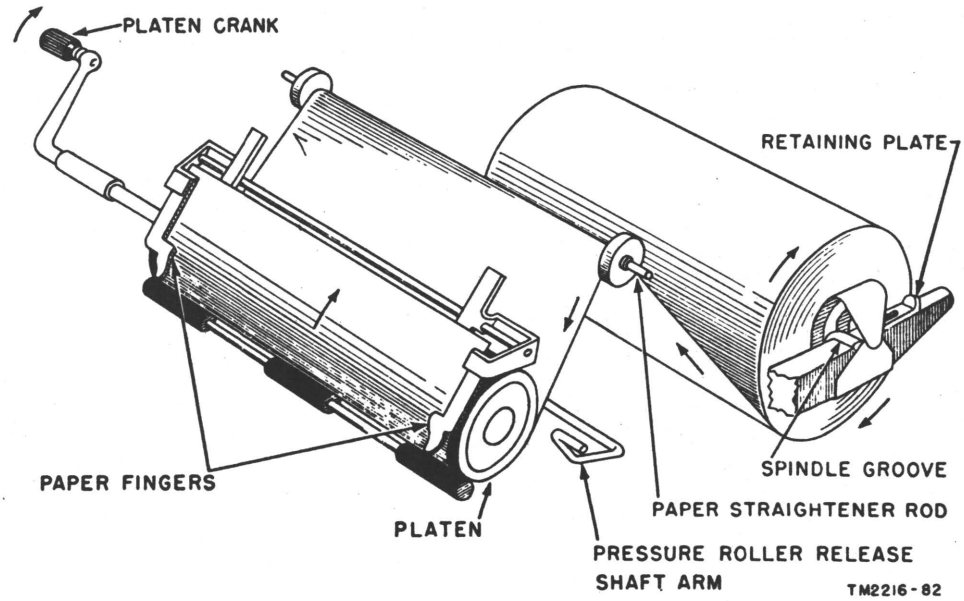


Figure 27. Paper installation diagram.

keyboard) until there have been enough perforations punched in the tape for the tape feed pins to engage in the tape feed holes.

(7) Insert the tape in the tape guide which is fastened to the top of the perforator mechanism housing.

15. Physical Checks and Adjustments

During and immediately after assembly, but before power or signal line connections are made, examine each component carefully. See that all dust, dirt, and packing debris have been cleaned away. Lubricate the equipment in accordance with instructions given in chapter 3, section II. If major repairs are required, refer to the local maintenance unit. Check the following items:

a. Mechanical Parts. Carefully examine all parts for damage. Look for dents in metal covers and worn spots or scratches on painted surfaces. See that the glass plate in front of the typing unit cover is not cracked, chipped, or broken, and that the tearing edge is straight. Check all switches and controls to make sure that they move easily and are in good operating condition.

b. Electrical Parts. Examine all electrical terminals, receptacles, and cords for wear, breaks, and other damage. Check all screws on the power and line terminal boards. See that all fusing devices are of the correct electrical values and see that they are installed properly. Examine all electrical contacts and see that they make good electrical connection. Check the ground screws on each component of the equipment.

c. Supplies. Be sure that paper, tape, and ribbon are installed correctly, and make sure they will operate satisfactorily in their carriers.

d. Protection. Make sure that the moisture-proofing and fungiproofing coatings are intact. If not, refer to paragraph 47.

Section II. CONTROLS AND INSTRUMENTS

16. Controls

a. Switches and Keys. The controls included as parts of a teletypewriter consist of the switches and keys shown in figure 2 and in the diagrams (figs. 268 through 276). The mechanical motor stop used for remote motor control of any teletypewriter in a signal circuit from any other teletypewriter in the same circuit is described in paragraph 126. The polar-neutral key and other controls are described in paragraphs 3 and 10. Refer to paragraph 121 for a description of the unshift-on-space cut-out lever.

b. References. Controls on components are described in paragraph 10*f* and in technical manuals covering the components. Refer to appendix I for applicable technical manuals on associated equipment.

17. Instruments

Electrical measuring instruments (except the character counter with dial, the end-of-line indicator lamp, and the speed indicator) are not included as parts of the teletypewriters. When it is necessary to measure signal loop current, this frequently may be accomplished at some point in the loop such as at a telegraph switchboard, terminal repeater, or carrier terminal where facilities are available for measuring and adjusting loop current and bias.

Section III. OPERATION UNDER USUAL CONDITIONS

18. Connections to Ground, Line, and Power

a. Grounding Arrangements. Stations at which these equipments are operated must have good grounding facilities. One or more grounds are required to provide protection against damage from lightning or other high-voltage sources, to reduce cross-fire interference, and to complete ground-return paths for d-c telegraph circuits. Each item of equipment must be connected to a low-resistance ground. The grounding point should be as conveniently close to the equipment as possible. The procedure for establishing ground facilities for protection is the same as that required to establish a ground-return connection (TM 11–676).

b. Establishing Grounding Facilities. A low-resistance ground must be established for

satisfactory operation of teletypewriter circuits which use ground return. This is particularly true where a single ground connection is used to serve more than one line. A high-resistance ground acts as a coupling between circuits and causes cross-fire effects between them. Whenever possible, connect the ground lead from the teletypewriter equipment to a water pipe or similar low-resistance ground. It is advantageous to do this even if it requires a considerable length of line. If such a connection is not possible, drive ground rods deep into damp earth and connect them to the equipment with field wire. The ground rods also may be installed at a considerable distance from the teletypewriter equipment, and the grounding point may be as great as 1,000 feet away if necessary. Drive ground rods so that the best possible contact is made with the earth. When driving a ground rod, be careful that that it does not whip. Whipping will loosen the soil and result in poor contact. To make the best possible connection, pack the earth against the rod all the way from the surface of the ground to the bottom of the rod. To establish a good ground connection:

(1) Select the lowest and dampest spot in the vicinity. Clay or loamy soil is best.
(2) Prepare a hole about 6 inches deep.
(3) Drive a ground rod, free of paint or grease, into the hole until the top of the rod is about 3 inches above the bottom of the hole. Avoid whipping the rod.
(4) Clamp the ground lead wire securely to the ground rod. Saturate the earth around the ground rod with water. Then fill in the hole, covering the top of the rod. Pour water over the spot as frequently as necessary to keep the earth moist at all times.
(5) If a satisfactory low-resistance ground cannot be obtained with one ground rod, use several additional rods at the same location and connect them in parallel. Do not space the rods less than 10 feet apart.
(6) If a multiple ground rod arrangement does not give the desired results, it will be necessary to give the soil around each ground rod special treatment. Such treatment is as follows: Dig a hole about 3 feet in diameter and 1 foot deep over the top of each ground rod. Make a brine solution (5 pounds of salt to 5 gallons of water) for each rod. Pour the solution into each hole and permit it to seep into the earth. After approximately ½ hour, or as soon as the brine solution has seeped into the soil, check the electrical connection again and then fill the hole over each ground rod. Pack the earth down as solidly as possible.

c. Testing for Good Ground Conditions. It is not practicable to test single ground connections to water pipes and similar facilities. If the efficiency of such a ground arrangement is in doubt, install a ground rod or other separate ground. Tests for determining conditions under which a satisfactory ground can be established are contained in TM 11–486 and in TM 11–676. A test of the earth's resistivity can be made as follows:

(1) Drive two ground rods 5 feet apart into the earth to a depth of 5 feet.
(2) Connect a suitable wire lead to the exposed top of each ground rod.
(3) Connect these leads to Test Set I–49 or equivalent test equipment.
(4) Take the reading (in ohms) on the meter, reverse the wire leads at the test set, and take the reading again.
(5) Compute the average of the two readings. The resistance between ground rods, in ohms, is about equal to the resistivity of the earth between the two points, measured in meter-ohms. Always try to establish grounds in earth of the lowest resistivity. Resistivities may be rated as follows:
   (*a*) Low—up to 100 meter-ohms (100 ohms as read on Test Set I–49).
   (*b*) Medium—approximately 300 meter-ohms (300 ohms as read on Test Set I–49).
   (*c*) High—1,000 meter-ohms and higher (1,000 ohms as read on Test Set I–49).

d. Power Connections. The total maximum power required to operate these teletypewriters is about 500 watts. The rectifier power unit is designed to operate from a-c sources of 95, 105, 115, 125, 190, 210, 230, or 250 volts at 25, 40, 50, or 60 cycles. This rectifier power unit also delivers the required adjusted a-c motor voltages suitable for simultaneous operation of three series-governed motors. In addition, it can deliver filtered d-c for

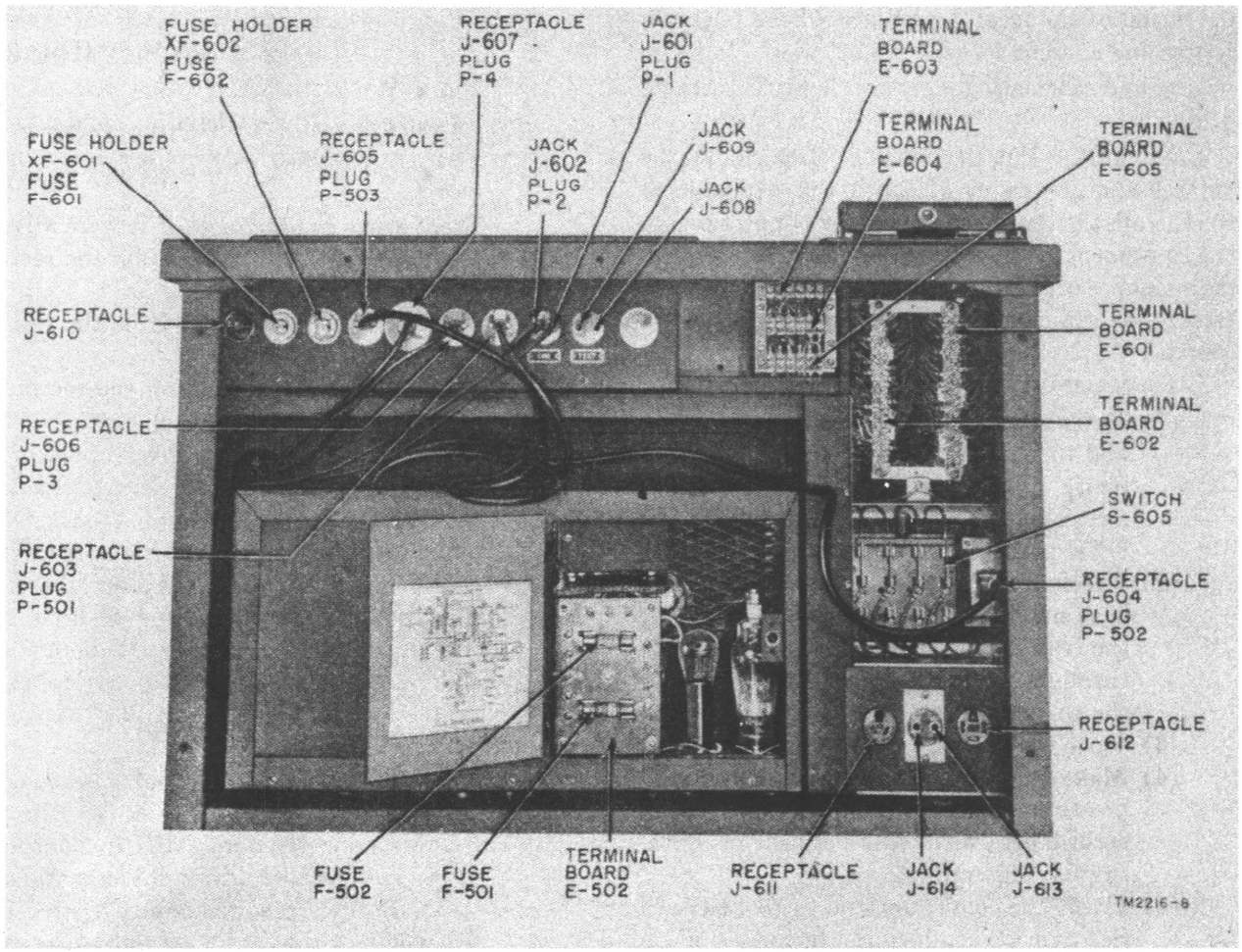


Figure 28. Connector plugs, receptacles and cords between components.

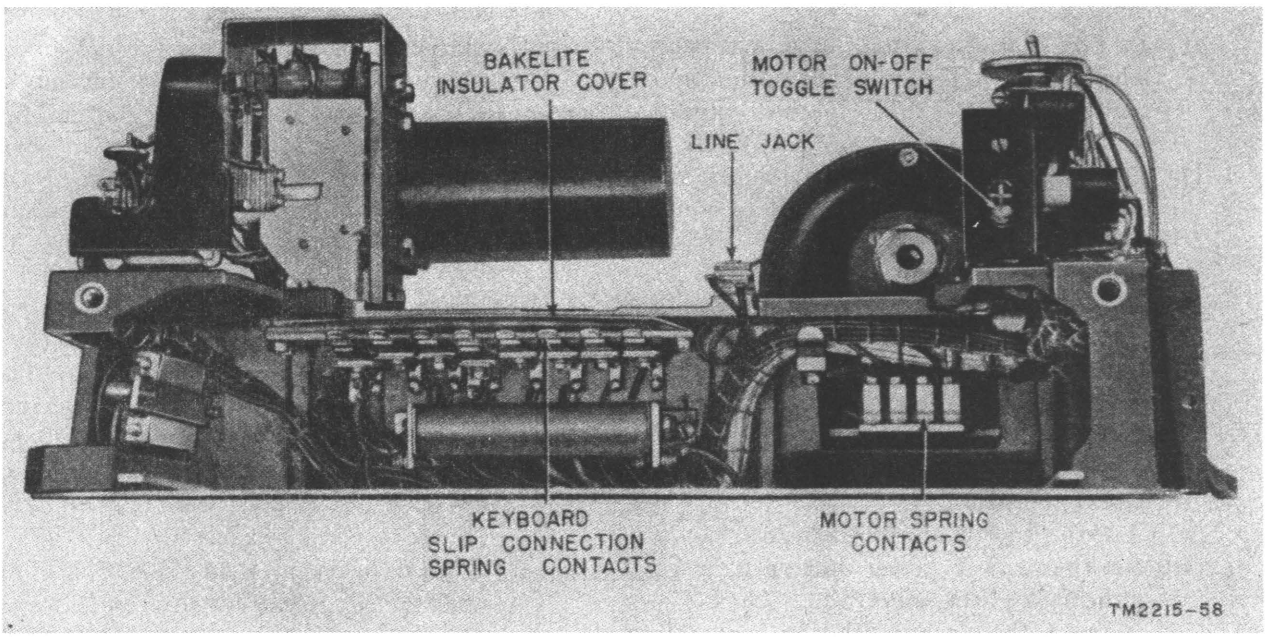


Figure 29. Keyboard and motor contacts on base.

operation of the local d-c circuits of the teletypewriter and current for two signal loops. Refer to wiring and schematic diagrams (figs. 268 through 276).

e. Checking Power Source. Determine the voltage and frequency of the power available at the installation before making any connections to the equipment. When necessary, request the local maintenance organization to conduct the necessary tests to determine the characteristics of the power source.

f. Installing Rectifier.

(1) Refer to paragraph 490 for adjustments, and to figures 268 through 276 for schematic diagrams. Check all power switches to make sure they are in the OFF positions.

(2) Check all fusing devices at the table, the base, and in the operating components of the equipment. Refer to figures 268 through 276 for test values applicable to the fuses used in these equipments.

(3) Open the door of the rectifier power unit.

(4) Make sure that the fuses in the rectifier power unit are installed. Check them in accordance with instructions in paragraphs 144 and 145.

(5) Check the connections on the cord panel. See that all conductors are connected securely at the terminal screws and that the three power cords are in good condition.

(6) Be sure that the vacuum tubes and neon lamp are in good operating condition, and that they are installed in their proper sockets.

(7) Connect the voltage lead (left-hand side) on the tap and fuse panel to the terminal which most nearly corresponds to the a-c input *voltage* supplied.

(8) Move the right-hand lead to the binding post for the *frequency* nearest that of the a-c input supply to the rectifier. This lead connects to the appropriate terminal on the right-hand edge of the tap and fuse panel where the marking MOTOR CYCLES appears.

(9) Close the door of the rectifier power unit.

(10) Set the rectifier power unit on its shelf in the back of the table.

(11) Connect the ground lead to the table ground screw.

(12) Plug the various power cords into their proper receptacles and outlets (figs. 28 and 275).

Caution: Never handle conductors with bare hands. Always use lineman's gloves.

Treat every conductor as if it were alive. Make sure the power switch on the rectifier power unit is at OFF.

(13) Connect the cords to and from the rectifier (figs. 272 and 274).

(14) Place the power switch on the rectifier to ON.

(15) At the front of the table (operator's position), operate the rectifier power unit control switch (fig. 2) forward to the ON position. This connects ac to the rectifier power unit. It is necessary for the a-c supply to be turned on for at least 20 seconds before d-c output will be available. This time delay is necessary for the protection of the grid-controlled rectifier tubes.

(16) Test the d-c output as follows: Connect a 60-watt, 115-volt lamp in series with a suitable ammeter across the d-c output of the rectifier and adjust the potentiometer with the screw-driver slot located in the center of the tap panel until the ammeter reads .5 ampere. This adjustment should be checked when the unit is installed and periodically thereafter.

(17) After power has been on for at least 20 seconds, start the teletypewriter motor unit by operating the motor switch (fig. 5) to ON. If there is excessive noise (probably caused by faulty meshing between motor pinion and main shaft gear), *immediately* operate the motor switch to OFF.

(18) Turn on the transmitter distributor motor by operating the switch on the table (fig. 2) forward to the ON position. The transmitter distributor motor should run. If there is evidence of abnormal operation, such as excessive noise, stop the transmitter distributor *immediately.* (Refer to TM 11-2222.)

(19) If the equipment seems to be operating satisfactorily, let it run approximately 1 minute, then turn the power off. If there is any doubt about the satisfactory oper-

ation of the equipment, or if it does not operate at all, turn off the power. Refer to chapters 3 and 4.

(20) Disconnect the power to the equipment and to all operating components by operating the switches indicated in figure 2 to the OFF positions. This is preparatory to the connection of the equipment to the signal circuits.

g. Connections to Signal Line and Other Equipments.

(1) After power and grounding arrangements are completed connect the teletypewriter components in the signal circuits in which they will operate.

(*a*) Plug the typing unit cord (terminated in a plug with a red shell) into the LINE jack marked RED in the jack block of the table, above the rectifier.

(*b*) Plug the perforator transmitter cord (terminated in a plug with a black shell) into the LINE jack marked BLK in the jack block of the table, above the rectifier.

(*c*) The transmitter distributor is connected to both signal lines of terminal board E603 and the power supply by spring slip contacts in its mounting (fig. 274).

(*d*) The table diagrams (figs. 274 and 275) show the electrical outlets and receptacles and the jack block by which a reperforator can be connected, if one is used.

(2) To communicate, each transmitting component must be connected in series with a receiving component of a teletypewriter or a d-c repeater, carrier terminal, or line unit in the same signal loop which in turn will retransmit to the receiving component of another teletypewriter. This is true for the receiving teletypewriter at a remote end of a signal line and also for the local transmitting and receiving components, if local or home copy of the transmitted message is desired. If one or more teletypewriters are arranged to send to several other teletypewriter stations in the same circuit, all receiving components in the same signal circuit must be in series with, or must be indirectly actuated by, a receiving component in series with the local transmitting contacts. To arrange the equipment for various methods of operation, make the necessary wiring changes at the line terminal boards E604 and E605 and line battery supply terminal boards E607 and E608.

h. Wiring Diagrams.

(1) The schematic and the actual wiring diagrams of the table (figs. 274 and 275) show where to make the equipment arrangement for operation as follows:

(*a*) Typing unit connected for independent operation on a separate (receive) loop.

(*b*) Perforator transmitter and transmitter distributor contacts, in series, operating into either of two loops (lines 1 or 2), selected by the line switching key (fig. 274). Refer to figure 30, if the typing unit is to be included in a series circuit.

(*c*) A reperforator operating on either of two receive lines by selection of the appropriate jack. These reperforator jacks may be connected to independent signal lines or wired in series with any other component or combination of components at one or more of terminal boards E603 through E605.

(2) The wiring changes at the line terminal boards that must be made for other common methods of operation are shown in, or may be constructed from, the schematic diagrams (figs. 30 and 274).

i. Signal Line and Battery Connections (figs. 274 and 275). The loop terminal boards in the electrical service assembly of the table facilitate connection of either a single-loop or double-loop signal line to the teletypewriter set. These connections may be made for full-metallic or ground-return loops. Also available are two slide-wire, 2,500-ohm resistors and two sets of battery terminals through which rectifier battery, may, if required, be supplied for one or two single loops or a double loop. Operate the teletypewriter motor switch to the OFF position and switch off or disconnect the rectifier. Figure 30 is an illustration of the loop terminal boards by which signal lines are connected to the operating components. Each of terminal boards E603, E604, and E605 is molded of bakelite, and contains two rows of terminal screws. The terminal screws of each vertical pair are connected to each other by a brass strap in the terminal board.

Thus, a conductor brought to an upper terminal also is connected to a lower one. The vertical pairs of terminal screws are separated by a partition molded into the terminal board to prevent short circuits between each pair. Where necessary to connect one pair of terminals to another, use short wire jumpers or straps. *Never use stranded wire.* Always observe the polarity shown in the schematic diagrams. See that all terminal screws are tight, but do not strip their threads by exerting too much force. Never handle signal line conductors with bare hands. Always use lineman's gloves. Remember that every signal line may be connected to a source of at least 120 volts. Make sure the equipment is grounded properly before attempting to connect signal line conductors.

(1) *Single-loop (half-duplex) operation.* For this type of operation, connect the local relay line winding in series with the transmitting contacts of the local perforator transmitter. Figure 30 shows one method of wiring connections at the line terminal boards for this type of operation. The perforator transmitter can transmit to, and the local typing unit can receive from, a remote station, but both units cannot be operated at the same time. Local copies of messages transmitted and received at a local station are produced. By switching from one to another (by means of the line switching key), either of two loops can be selected for single-loop (half-duplex) operation. If required, the transmitter distributor can be connected to a third, and completely independent, loop by removing and splicing the wires on lower terminals 5 and 6 and then connecting the separate independent loop to these two terminals. If the transmitter distributor is retained in the loop with the typing unit (in series with typing unit LINE jack (fig. 30)), messages transmitted from tape by the transmitter distributor will be typed on the local typing unit.

(2) *Transmission from tape to either of two lines associated with line switching key (single-loop operation).* If required, the transmitter distributor may be the only component connected to the line switching key to send to either of two loops (line 1 or 2) by operating the key to the right or to the left. One method of making connections for this arrangement, shown in figure 30, is to remove, splice, and tape the wires of lower terminals 5 and 6 of E603, remove the new transmitting and receiving loop pair of wires created by this splice from lower terminals 5 and 6 of E604, and connect them to any appropriate signal loop. The transmitter distributor now may be connected directly to the line switching key by strapping lower terminal 5 of E603 to terminal 5 of E604, and strapping terminal 6 of E603 to 6 of E604.

(3) *Reperforator connected to either of two additional loops associated with line switching key (single-loop operation).* In this arrangement, the perforator transmitter and typing unit are connected for half-duplex operation to a loop. The transmitter distributor may be connected to another independent loop, and the reperforator may be connected to terminals 5 and 6 of E604 in a manner similar to that in (2) above; it is then connected to either of two other loops by the line switching key from terminals 5 and 6 of E604.

(4) *Reperforator connected to either of two loops normally associated with line switching key (single-loop operation).* Figure 30 shows the perforator transmitter, typing unit, and transmitter distributor ready for half-duplex operation on either of two circuits associated with the line switching key. The reperforator may be connected in series with these three units. All messages transmitted or received over these two loop circuits then are perforated in tape by the reperforator. The transmitter distributor may be removed from the series circuit and reconnected to operate independently on a separate send loop.

(5) *Double-loop (full-duplex) operation* (figs. 268 through 276).

(*a*) The arrangements shown in figures 30, 274, and 275 (dotted lines only in figure 274) can be used for full-duplex operation. For this application, operate the

line switching key to the desired send loop that terminates at the receiving component of the remote teletypewriter. At the local station, either the transmitter distributor or the perforator transmitter can be used to transmit. The typing unit can receive while the perforator transmitter (or transmitter distributor) sends separately and independently of the typing unit, because two separate loops are used. In this kind of operation, no typed local copy of the messages being transmitted will be produced locally. The tape used by the transmitter distributor, or that produced by the perforator transmitter, may be retained in place of local (home) copy.

(*b*) The equipment may be connected for full-duplex operation with the perforator transmitter and reperforator connected in series with each other and then this combination connected to the line switching key at lower terminals 5 and 6 of E604. In such an arrangement, the perforator transmitter and reperforator both can produce perforated tape of the messages being sent. The typing unit and transmitter distributor may be connected to a separate loop, or to loops.

(6) *Single operation.* Single operation is the same as single-loop (half-duplex) operation, except that the remote equipment need not be arranged to reply ((1) through (4) above). Obtain full-duplex operation by using two single (half-duplex) loops, one for each direction of transmission.

(7) *Simultaneous and independent operation by transmitter distributor and perforator transmitter.* Each of these transmitting components must operate on a separate loop if they are to operate at the same time. In this kind of operation, independent operation of the typing unit and of the perforator transmitter may be required in full-duplex type of communication. Both perforator transmitter and transmitter distributor are connected for independent operation on different send lines, and the reperforator may be connected to either, or to the line switching key as discussed in (4) above.

j. Supplying Neutral Signal Loop Current. To supply the required 60 ma of dc to a signal loop, proceed as follows:

(1) On E603, E604, or E605 at terminals 1 or 3, remove the upper and lower wires of the loop extension to which battery is to be furnished (fig. 275).

(2) Connect the wire removed from the upper terminal of the line terminal board to the negative terminal marked minus (−) on connection strip E607.

(3) Connect the wire removed from the lower terminal to the positive (+) terminal on connection strip E607.

(4) Adjust the 2,500-ohm resistor marked R603 in figure 274 to provide line current of 60 ma.

Note. If line current must be supplied to an additional signal loop, follow the procedure given in (1) through (4) above; use connection strip E606. Adjust resistor R601 for the correct line current value. Refer to paragraph 21*c* for information on use of flat type resistors in the teletypewriter base. Current must always flow through the line winding of the polar relay in the direction indicated in diagrams. A current direction for the send contacts is given as a convenient standard but does not affect their operation. Ground may be substituted (ground return) for either wire of any loop pair between stations to furnish a loop with only one wire. The ground-return loop may have less resistance but is usually less stable than the full-metallic loop.

(5) *Connections to other equipment.* The teletypewriter sending and receiving circuits usually are connected to the associated equipment by placing the black shell plug in the send jack and the red shell plug in the receive jack of the table, line unit, telegraph switchboard, carrier telegraph terminal, or other equipment with which the teletypewriter is used.

k. Test Circuit (fig. 274). Operating the line switching key to its center (test) position connects the perforator transmitter, typing unit, transmitter distributor, or any series combination connected to terminals 5 and 6 of E604 in series with the local test loop consisting of the TEST jacks, the 2,500-ohm test resistor R602, and the d-c power source. Any equipment plugged into either or both TEST jacks also is included in series in the

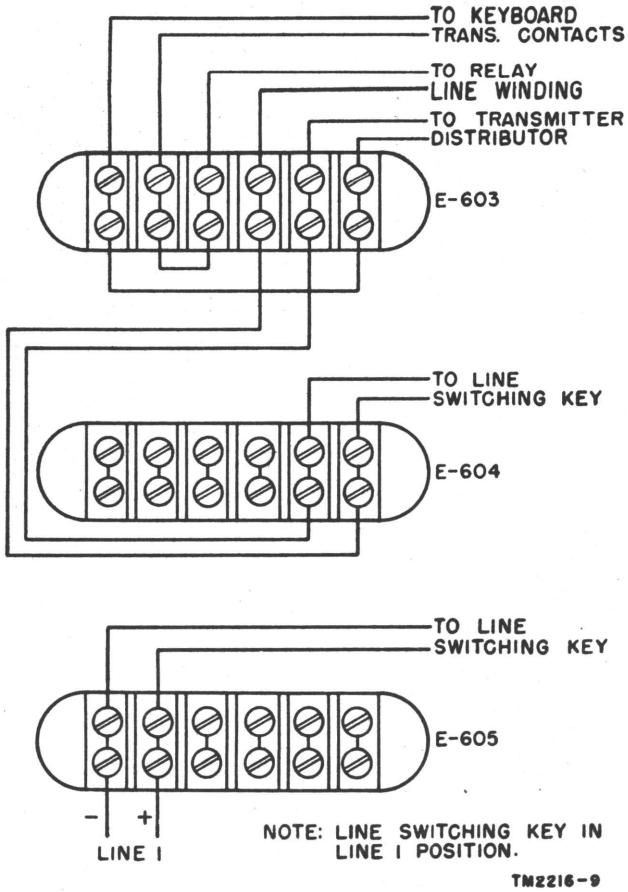


Figure 30. Typical series, single-loop arrangement.

test loop. When the equipment is connected in series and the local test loop resistor is adjusted to 60 ma, the test circuit simulates an actual signal loop. With the line switching key in position, perform the following operations:

(1) Use the perforator transmitter and transmit to determine whether both the typing unit and perforator transmitter are operating properly.

(2) Use the transmitter distributor and transmit from perforated tape to test the operation of the transmitter distributor and/or to indicate if the perforator transmitter or the typing unit is causing trouble.

(3) Produce typed copy of messages perforated in tape by using the transmitter distributor to send from tape to the typing unit.

19. Preoperational Adjustments

a. General. With the equipment connected to power and signal lines, and the ribbon and paper installed as directed in paragraph 14, check the speed of the motor units, the rangefinder adjustment, and the operation of each item of equipment. The information outlined below is furnished as a guide in making these adjustments. When the adjustments do not result in proper operation of the equipment, refer to chapter 4. Distortion in teletypewriter circuits is discussed in TM 11-486 and TM 11-680.

b. Checking and Adjusting Motor Speed (fig. 32). To adjust the teletypewriters to inter-

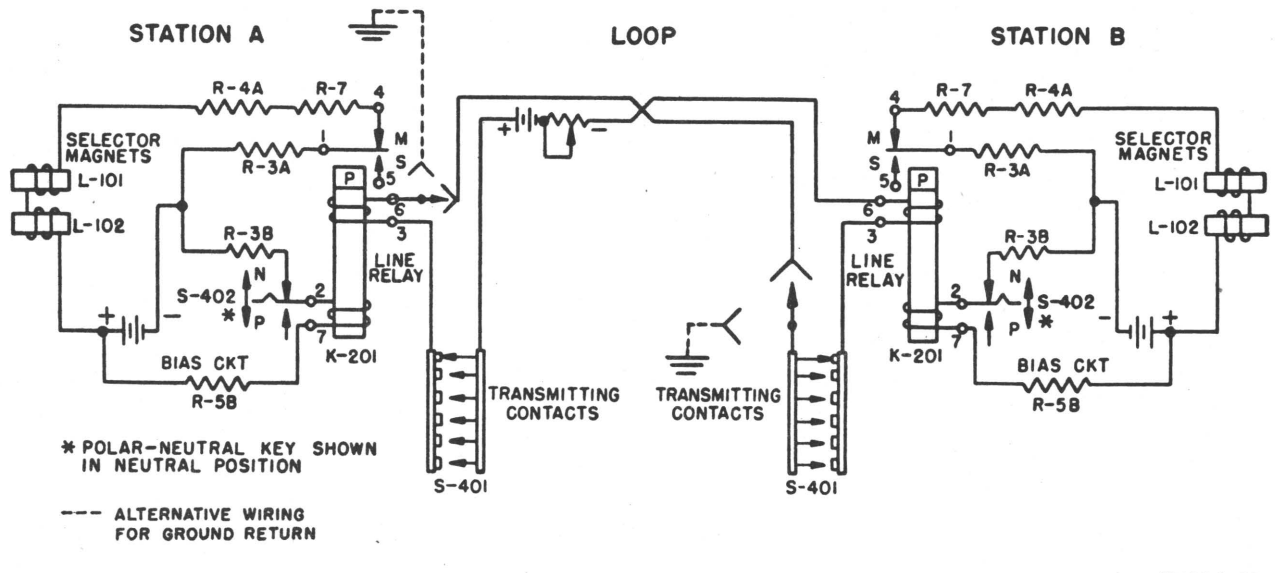


Figure 31. Simplified schematic of interconnected teletypewriters, ground- or metallic-return.

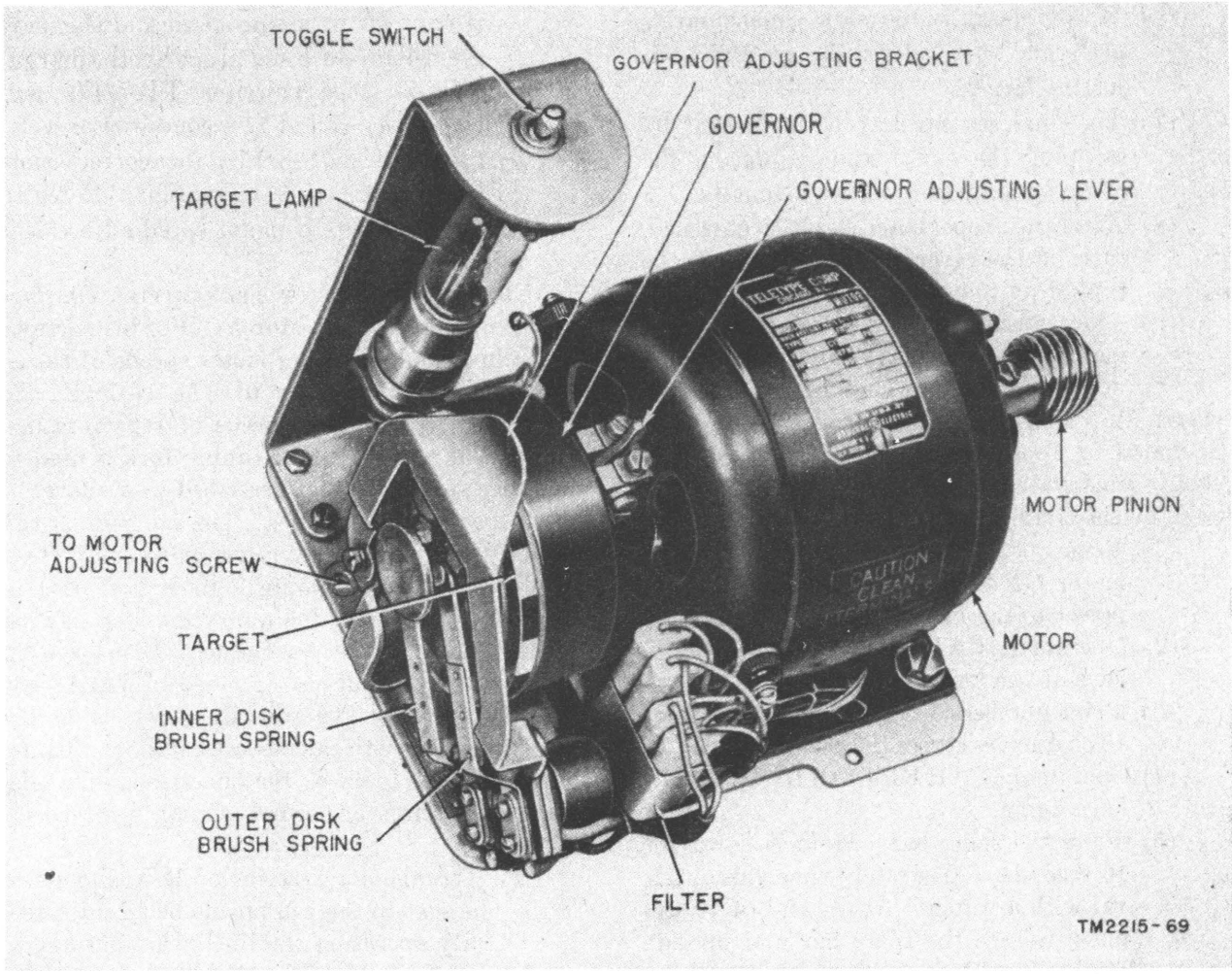


Figure 32. Motor governor adjusting parts.

operate with British equipment, refer to appendix III and TM 11–486. The series-governed motors used with Teletypewriters TT–7/FG and TT–8/FG must rotate the main shaft of the typing unit at the same speed as that of every other teletypewriter in the same circuit. The speed of the transmitter distributor motor must also be the same. Check the motor speeds with the speed indicator (tuning fork) as follows:

(1) Remove the typing unit cover.
(2) Turn on the target lamp (fig. 32).
(3) Turn on the typing unit motor. Let it run approximately 10 minutes before attempting speed adjustment. Always adjust the motor speed under normal load conditions. To provide this load, hold the space bar down while adjusting the motor speed. Operate the line switching key to TEST and use the transmitter distributor to provide the required load by sending from perforated tape or, if desired, plug the teletypewriter into the test jacks and check in the same artificial loop as that provided through the line switching key.
(4) Strike the tuning fork against the hand. Observe the target of the motor unit through the slots in the plate attached to the ends of each tine of the fork. The correct speed adjustment is obtained when the white segments appear stationary. When the white segments seem to move backward, the speed is too slow. If the segments move forward, the speed is too great. If the segments appear to jump back and forth or disappear suddenly, governor trouble is indicated.
(5) If the speed is too great, momentarily press and then release the governor adjusting *bracket.*

(6) If the speed is too slow, momentarily press and then release the governor adjusting *lever*.

(7) The final setting may be made best by stopping the motor and regulating the governor adjusting wheel manually.

(8) After the proper speed has been obtained, turn off the target lamp and restore the typing unit cover.

(9) The transmitter distributor motor speed may be checked in a similar manner.

c. Alternate Method of Checking Teletypewriter Motor Speed. If the proper tuning fork (included in Tool Equipments TE–50 and TE–50–A) is not available, check and adjust the motor speed by the timing method outlined below:

(1) Remove the typing unit cover; place the motor ON-OFF switch at ON to apply power to the motor.

(2) Operate the CAR RET and LINE FEED keys of the keyboard.

(3) Print numbers 1 through 0 in groups of 10 characters across the entire page.

(4) Operate the CAR RET and LINE FEED keys again.

(5) Press the space bar. Hold it down for 10 seconds. Accurately time this interval with a watch. At the end of 10 seconds, release the space bar and operate any numeral key.

(6) Count the number of spaces traveled by the type bar carriage during the 10-second interval. The correct number of spaces traveled for proper adjustment is 61. If the number of spaces traveled is more or less than 61, adjust the governor as follows:

(*a*) If the number of spaces is greater, decrease the motor speed.

(*b*) If the number of spaces is less, increase the speed.

(7) Restore the typing unit cover.

d. Rechecking Motor Speed. Make a quick recheck of the motor speed on a teletypewriter known to be adjusted properly, as follows:

(1) Allow the motor to warm up from 3 to 5 minutes.

(2) Press the CAR RET key to return the type bar carriage to its returned (extreme left) position.

(3) Check the time that elapses after the space bar is pressed until the margin bell rings. If the motor speed and the margin bell are adjusted properly, the margin bell on Teletypewriter TT–7/FG will ring at the end of 11 seconds. For Teletypewriter TT–8/FG, the correct time interval is nearly 12 seconds. Refer to *b* and *c* above if motor speed adjustment must be made.

e. Checking Speeds of Transmitter Distributor and Reperforator Motors. For instructions on checking and adjusting motor speeds of transmitter distributors, refer to TM 11–2222. To check and adjust motor speeds of reperforators, refer to TM 11–2223. The tuning fork is used in a manner similar to that described in *b* above.

f. Setting Rangefinder. The rangefinder can be used to adjust a teletypewriter to compensate for distortion in incoming signals and also to check the operation of a teletypewriter against signals known to be acceptable. Distortion in teletypewriter circuits is discussed in TM 11–486 and TM 11–680. The procedure for using the rangefinder for both purposes is similar. To use the rangefinder to check the operations of a teletypewriter using a normal signal, proceed as follows:

(1) Arrange for a series of R Y signals to be sent to the equipment being adjusted. (By operating the line switching key to the test position, the local perforator transmitter, or the transmitter distributor sending from perforated tape, can be used for this purpose.)

(2) Loosen the index arm thumbscrew of the rangefinder mechanism (fig. 155).

(3) Move the index arm toward the zero end of the scale until errors appear in the typed matter being received on the typing unit.

(4) Move the index arm back slowly until the errors disappear. At this point, note the low limit reading of the rangefinder scale.

(5) Move the arm back slowly, toward the high end of the scale, until errors are observed.

(6) Move the index arm back slowly, toward the low end of the scale, until the errors disappear. At this point note the high limit reading on the rangefinder scale.

(7) To find the scale reading for the point of best operation for this teletypewriter,

take the average of the readings noted in (4) and (6) above.

(8) Set the index arm to the computed scale reading and tighten the thumbscrew securely.

(9) If errors cannot be compensated for by adjustment of the rangefinder, refer to chapters 3 and 4.

20. Local Operating Tests

a. General. When giving the testing procedure below, it is assumed that all connections are completed, fuses are installed, a visual examination has been made to see that the equipment is lubricated (ch. 3) properly, and no damage to parts is evident. Instructions for line-up procedure are given in paragraph 21. Complete the tests in the order given below. If any difficulty is encountered, refer to chapters 3 and 4.

b. Operating Tests.

(1) Remove the typing unit cover.

(2) Place the rectifier a-c switch (fig. 2) to ON.

(3) After about ½ minute, operate the motor switch (fig. 2) to ON.

(4) Operate the line switching key (fig. 2) to test.

(5) Move the SEND—REC lever (fig. 6) to SEND. Operate the polar-neutral key to neutral (pulled-out position) and the keyboard control operating lever to KEYBOARD.

(6) Turn the platen crank (fig. 6). See that the paper feeds evenly and does not tear.

(7) Check the rangefinder as instructed in paragraphs 212 and 287.

(8) Check the line current of the test circuit for 60 ma (fig. 274 and 275).

(9) Type at least three consecutive copies of the test paragraph which is as follows: "THE (space) QUICK (space) BROWN (space) FOX (space) JUMPED (space) OVER (space) THE (space) LAZY (space) DOG (FIGS) ' (LTRS) S (space) BACK (space) (FIGS) 1234567890 (LTRS) (CAR RET) (LINE FEED)" (follow by all the remaining upper case characters).

(10) While the test paragraph is being typed, observe the ribbon feed mechanism to see that it oscillates and feeds each time a character is typed.

(11) Hold down the space bar to see that spaces are transmitted continuously while the space bar is held operated.

(12) Operate the carriage return lock bar (fig. 23) to see that the type bar carriage can be returned manually.

(13) Test the setting of the margin warning bell by typing CAR RET, LINE FEED, and FIGS followed by 1234567890; repeat until the margin bell rings. Count the number of characters per line to the point when the bells rings. On teletypewriters TT–7/FG, the correct character count per line is 66; on Teletypewriter TT–8/FG, the count is 70.

(14) On Teletypewriter TT–7/FG, test the mechanical motor stop feature by typing CAR RET, LINE FEED, FIGS, and STOP (upper case H).

Note. On Teletypewriter TT–8/FG, a symbol necessary to weather communication is transmitted from the FIGS H positions (or upper case H).

(15) Test the mechanical motor stop-start feature by first stopping the motor and then holding the SEND—REC—BREAK key (in its lower position) at BREAK for 2 to 3 seconds to restart the motor (TT–7/FG only).

(16) Be sure that the sending mechanism cannot send when the SEND—REC—BREAK key is at the middle or REC position.

(17) Test the signal bell by operating FIGS and BELL (upper case S) keys.

(18) With the SEND—REC—BREAK key at the upper SEND position, press the blank key twice in succession. On Teletypewriter TT–7/FG, this function should move the SEND—REC—BREAK key to REC position automatically. On Teletypewriter TT–8/FG, operation of the blank key from the FIGS position of the teletypewriter results in the transmission of a dash. This keyboard lockout on the second consecutive blank function operates on Teletypewriter TT–8/FG from the LTRS position only.

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(19) Set the SEND—REC—BREAK key at SEND. Transmit one blank combination alternately with some other letter or character of the keyboard. This should *not* result in moving the key from SEND to REC, as described in (18) above.

(20) Restore the typing unit cover and test the opening and closing of all doors and hatches. Try the cutting edge of the glass window by tearing off paper as is done when tearing off typed messages during actual operation.

c. TESTING PERFORATOR TRANSMITTER. When the operating control lever is set at KBD & TAPE or TAPE, the procedure for testing the operation of the perforator transmitter is the same as that outlined in subparagraph *b* above. The following additional functions, however, are performed:

(1) With the control lever set at KBD & TAPE, a duplicate of the messages transmitted should be perforated in tape by the perforator mechanism.

(2) With the control lever set at TAPE, perforated tape should be produced without transmitting to the line. The mechanical motor stop combination (FIGS, H, or STOP on TT–7/FG only) should not be perforated in tape unless special care is taken to see that it is the last combination to be perforated in the tape. The start (spacing) impulse of any succeeding combination, including H, sent by a transmitter distributor from the tape will start the motors again. This causes a momentary fluctuation in motor speed and results in loss of synchronism between transmitting and receiving equipments. Teletypewriter TT–8/FG, in common with other weather communication teletypewriters, does not have the mechanical motor stop feature, because an important weather symbol is transmitted from the upper case, or FIGS H position.

(3) Set the key pressure adjustment (par. 427) to the pressure desired.

(4) Test the operation of the backspacer by operating the backspace lever. To correct errors that have been perforated in the tape, move the tape backward one space and then operate the LTRS key. This will result in five holes being perforated in the tape in place of the error.

(5) Feed the tape to a transmitter distributor connected to a typing unit. Compare the message typed by this means with the copy typed during operation of the equipment at KBD & TAPE. No copy is produced while the teletypewriter is perforating tape from the TAPE position; therefore, to get typed copy for checking the perforated message, feed the tape to a transmitter distributor.

(6) When perforating tape while transmitting (KBD & TAPE), the margin warning bell will sound before the last six characters at the end of the line.

(7) When perforating tape without transmitting (TAPE), the signal lamp within the character counter will light up before the last six characters at the end of the line. The indicator of the character counter dial will indicate 66 at this point on Teletypewriter TT–7/FG and 70 on Teletypewriter TT–8/FG. Operation of LTRS, FIGS, or LINE FEED key does not cause the character counter to register. When the CAR RET key is operated, the indicator of the character counter should return to its zero position. On teletypewriter TT–7/FG, the CAR RET and LINE FEED keys can be operated from either the FIGS or LTRS position. On Teletypewriter TT–8/FG, these functions operate from the LTRS position *only*.

d. TESTING TRANSMITTER DISTRIBUTOR. The transmitter distributor can be loaded with perforated tape and used to send to a typing unit on a local circuit. If this unit does not operate properly, refer to TM 11–2222.

e. REPERFORATOR. A reperforator can be connected to the transmitter distributor or perforator transmitter by a local circuit. If the reperforator does not function properly, refer to TM 11–2223.

21. Line-Up Procedure

a. GENERAL. Line-up procedure for a teletypewriter circuit includes arranging for supply of line current, adjusting line current, and adjusting the line relays of the teletypewriters. Connections that must be completed at the table of Teletypewriters TT–7/FG and TT–8/FG to

supply line current and power with instructions for adjustment are contained in paragraph 18. Refer to paragraphs 476 to 480 for relay adjustment.

(1) When a teletypewriter circuit terminates at a switchboard, circuit line-up is directed by the switchboard operator who usually has facilities, such as a milliammeter, readily available for quick checking and adjusting. Similarly, most telegraph carrier terminal stations will have men available to switch or plug measuring instruments into a circuit and to make adjustments without seriously disrupting service. Line-up of a circuit between two stations is directed by the station operator at the higher headquarters. Line-up of a circuit between two stations of equal authority is directed by the station having the lower numerical designation.

(2) Operators at both the control and noncontrol stations usually can communicate by telephone preparatory to lining up a circuit. When they cannot, communication can be carried on by a system of break signals. Break signals can be observed on a meter such as that of a line unit used with field equipments and on the meter of a switchboard. The following system of break signals can be used to avoid confusion when lining up a circuit:

(*a*) One 3-second break means: "Stop transmission. I am through with my adjustment and will send repeated space bar signals."

(*b*) Two 3-second break signals sent by a control station means: "Arrange to supply line current."

(*c*) Three 3-second break signals mean that further line current adjustment is necessary and that the local operator should send repeated space bar signals.

b. Line-up With Other Equipments. Teletypewriters TT-7/FG and TT-8/FG can be lined up with such equipment as follows:

(1) Teletypewriter sets EE-97-( ), EE-98-( ), and EE-102. These are tactical or field teletypewriter sets.

(2) Reperforator Teletypewriter Sets TC-16 and TC-17.

(3) Telegraph Central Office Set TC-3.

(4) Repeater Set TC-18 (Terminal, Telegraph).

(5) Telegraph Terminal CF-2-A or CF-2-B.

(6) Telegraph Terminal Set AN/TCC-1, Telegraph Terminal TH-1/TCC-1, and Filter F-2/GG.

c. Supplying Line Current. It is sometimes necessary for both terminals to supply line (loop) current. When only one station supplies line current, the operator at the control station usually will make the necessary loop current adjustments with one or both slide-wire resistors in the table. When Teletypewriters TT-7/FG and TT-8/FG are required to supply line current, follow the instructions given in paragraph 18*j*.

(1) *Loop resistance.* For special or emergency use, select the correct flat type resistors. On the teletypewriter base, back of the typing unit, are two slide-contact type mountings, each of which contains a flat type line pad resistor that may be connected in the signal line circuit if necessary. These resistors have three terminal prongs and are tapped (off-center) to provide a choice of three different resistances for each resistor unit. The 600-ohm unit may be strapped to provide either 200 or 400 ohms, and the 800-ohm unit, to provide either 300 or 500 ohms. The top slide mounting is connected to terminals 69 and 70 which, in turn, are connected to terminals 33 and 34. The bottom resistor mounting is connected to terminals 68 and 67. These terminals are connected in turn to terminals 35 and 36. Refer to figure 268.

(2) *Example.* In the send loop, 400 ohms are required and the 600-ohm resistor is in the top slide mounting. Disconnect the loop wire from terminal 34 and reconnect it to terminal 33, thereby inserting 600 ohms; then strap (short) the 200-ohm section of the 600-ohm unit to provide 400 ohms in the send loop circuit or in both the send and receive loops if they are in series.

(3) *Strapping.* If both resistors are required, terminal 33 may be strapped to 36 and the loop wire moved from 34 to 35.

d. Completing Circuit Line-up.

(1) Send repeated space bar signals when requested.

(2) When a 3-second break signal is received from the control station, stop sending space bar signals. If the control station requires further space bar signals to complete an adjustment, three 3-second signals will be received. When the control station has completed the necessary adjustments, the operator at that station will send a test message. If accurate copy is received, the line-up procedure in one direction has been completed correctly. The operator at the local station then may send a test message. Acknowledgment from the control station that the test message has been received correctly will complete the line-up procedure and indicate that the circuit is ready to handle traffic.

(3) If correct test copy is not received, test and adjust the RY–30 line relay in accordance with instructions in paragraphs 476 through 480. Commonly, the cause of line failure is a poor line connection due to bad splices, damaged insulation, or poor ground connection. If line trouble is suspected, refer to the local maintenance activity for corrective measures.

22. Procedure for Removing Equipment From Service

a. General. Teletypewriters TT–7/FG and TT–8/FG can operate on several circuits simultaneously. The stations in each circuit, therefore, must be notified when operation is to be discontinued or interrupted. If only one operating component is removed, only the stations in the circuit concerned need be notified. The procedure given in *b* below applies when either the entire equipment or a single operating component is removed from service.

b. Step-by-Step Procedure.

(1) Notify the distant station or net that the local station (or one of the components) is to be removed from service. The proper operating procedure normally is directed by current Department of the Army directives and local SOI (signal operations instructions) or SOP (standing operating procedure).

(2) If the station is connected to a switchboard, notify the switchboard operator and then remove the equipment from the line.

(3) If the station is connected to a field teletypewriter that uses a line unit, instruct the operator at the field station to adjust line current accordingly.

23. Operating Features

a. General. The keyboard of a teletypewriter is essentially similar to the keyboard of a conventional typewriter. The following differences, however, are to be noted: The keyboard of a typewriter has four rows of keys, whereas a model 15 teletypewriter keyboard has only three rows. On a typewriter, the type basket is stationary and the platen travels from right to left during the typing process. On a teletypewriter, the platen is held stationary, but the type basket travels from left to right. The nontyping functions of a typewriter, such as the return of the platen for starting a new line, the shift operations, and the paper feed are direct manual operations. On a teletypewriter, these functions are performed electromechanically by pressing keys on the keyboard. The typewriter can print either lower case or capital letters, whereas the model 15 teletypewriter prints only capitals. The speed at which a typewriter can be operated varies considerably, depending on the skill of the operator, whereas the teletypewriter is designed to operate at a predetermined regular rate. Teletypewriters TT–7/FG and TT–8/FG, when transmitting into a line, must be operated with a uniform rhythm to prevent omissions in copy because of speed in excess of that for which the teletypewriter is adjusted. This requirement is not critical when tape is perforated with a keyboard perforator, but it is good practice to maintain a uniform rhythm at all times. The operating features of Teletypewriters TT–7/FG and TT–8/FG are explained in *b* and *c* below.

b. Function Keys. The following keys (figs. 7 and 8) are used to perform the nonprinting functions of these teletypewriters:

(1) *Space bar.* This bar, located at the bottom of the keyboard (fig. 7), is used to send spaces (as between words). It will send spaces as long as it is held down.

(2) *CAR RET (carriage return).* Pressing this key returns the type basket to the left to start a new line of typing.

(3) *LINE FEED.* This key is pressed to feed the paper upward one or two spaces, as adjusted, to present a clean surface upon which to start the next line.

(4) *FIGS (figures).* This key shifts the machine to print numerals, punctuation marks, or symbols.

(5) *LTRS (letters).* This key is used to shift the machine from the FIGS position to print letters again.

(6) *BELL (FIGS S).* Operating this key (which is the upper case position of the S key) after pressing the FIGS key will ring a signal bell locally and at the distant stations. Do not confuse this bell with the margin warning bell.

(7) *STOP (FIGS H).* On Teletypewriter TT–7/FG, pressing this key (remote motor stop feature) stops the motor units of all equipments in the circuit. On Teletypewriter TT–8/FG, keys FIGS and H only print a symbol required in weather communication.

(8) *Blank key.* Pressing this key on Teletypewriter TT–7/FG twice, when the S E N D—R E C—B R E A K key is at SEND, will move the key to REC. On Teletypewriter TT–8/FG, operating the blank key results in typing a dash (—).

c. Margin Adjustment. The left and right margins of the teletypewriters are adjusted as directed in paragraphs 371 and 372. An operator is not authorized to make these adjustments.

24. Operating Precautions

a. General. The teletypewriter operator must develop touch, speed, and regularity so that errors are avoided while a maximum allowable speed is maintained. Operation of the keyboard during transmission is the same whether or not a perforator transmitter or reperforator in the line is perforating tape.

(1) *Touch.* Strike the keys lightly. Striking them too heavily may result in errors.

(2) *Speed.* The normal speed of a teletypewriter is approximately 61 wpm. When operating in circuits connected to British teletypewriter equipments, the speed is increased to approximately 66 wpm (app III). Attempting to operate the keyboard more rapidly than normal will result in errors and will not increase the speed of transmission above that for which the machine is adjusted.

(3) *Rhythm.* Do not strike any key before the code signal of the key previously struck has been transmitted. Avoid the tendency to send frequently used words, such as *at*, *the*, and *that* more rapidly than other combinations. A steady, deliberate operating rhythm results in fewer errors and dropped-out characters.

b. Characters Per Line. The margin warning bell rings six characters before the end of a line. Be careful not to overtype the last character. This bell rings on the 66th printed character for lines of 72-character length and on the 70th for lines of 76-character length. For the bell to ring on Teletypewriter TT–7/FG, the character count must reach 66. For Teletypewriter TT–8/FG, this character count should be 70 (pars. 7 and 19).

c. Carriage Return and Line Feed. To begin a line at the left margin of the paper, strike the CAR RET key and then operate the LINE FEED key to move the paper up one line. On Teletypewriter TT–8/FG, the CAR RET and LINE FEED keys will operate only in the LTRS (or lower case) position. It is good practice to press the CAR RET key twice (this function is the most critical as to speed) to reduce the possibility of error.

d. Tape. When tape is being perforated without transmitting to the line, the character counter operates instead of the margin warning bell. The warning lamp lights each time the character counter of Teletypewriter TT–7/FG indicates 66. For Teletypewriter TT–8/FG this character count is 70.

e. Paper, Ribbon, and Tape.

(1) *Paper.* Install the roll of paper in the machine as described in paragraph 14. The paper is fed around the platen and out of the machine through a slot formed by the edge of the glass window and the hinged cover at the top of the teletypewriter (fig. 6). The paper can be torn off against the edge of the glass window after each message. Various types of

paper, including rolls, that will furnish one or more carbon copies may be used. The type and kind depend on the local requirements.

(2) *Ribbon.* Install the ribbon of a teletypewriter as instructed in paragraph 14. The ribbon oscillates vertically and is transported laterally with each printing operation.

(3) *Tape.* Blank tape for the perforator is held in the tape reel housing attached to the typing unit cover. It is fed into the perforator mechanism where the punching operation takes place. In addition to the perforations for each character or function to be transmitted from the tape, a line of feed holes is punched in the center of the tape. The feed holes are engaged by the tape feed pins in the perforator mechanism. A similar sprocket pulls the tape through the transmitter distributor when it is sending. The tape produced by a nontyping reperforator is identical with the tape produced by the perforator transmitter of these teletypewriters.

25. Teletypewriter Operator

The teletypewriter operator must handle traffic as prescribed in Department of the Army directives and local SOI and SOP. He must get the message through, observe security regulations at all times, use the equipment to transmit official traffic only, and perform only those maintenance and adjustment procedures that are within his authority.

26. Starting Procedure

a. Applying Power.

(1) *Rectifier power unit.* See that the a-c input cord (plug P503) to the rectifier power unit is plugged firmly into receptacle J605 (fig. 28). Operate switch S501 on the rectifier and S603 (figs. 273 and 275) at the front of the table to ON.

(2) *Motor unit.* Operate the motor ON-OFF switch (fig. 2) upwards to ON.

(3) *Transmitter distributor.* Operate the transmitter distributor motor power switch to ON.

(4) *Reperforator.* See that the line cord of the reperforator, if one is used, is inserted in the appropriate line jack at the rear of the table (fig. 28). Insert the a-c cord of the reperforator receptacle J612 (fig. 274). See that the d-c cord is inserted in receptacle J611 (fig. 274). Operate ON-OFF switch S1101 of the reperforator to ON.

b. Selecting Type of Operation. Teletypewriters TT–7/FG and TT–8/FG always send neutral type signals. They can be set to receive either neutral or polar type signals (par. 129), however, by use of the polar-neutral key on the perforator transmitter.

(1) *Neutral.* To receive neutral type signals, pull out the polar-neutral key (fig. 9).

(2) *Polar.* To receive polar type signals, push in the polar-neutral key. To transmit on a polar or polarential basis, connect Teletypewriters TT–7/FG and TT–8/FG to the line through a terminal repeater or other type of pole-changing equipment (par. 9).

c. Operating Control Lever. Set the operating control lever (fig. 6) for the kind of keyboard operation to be conducted.

(1) To produce only typed copy, set the lever at KEYBOARD.

(2) To produce typed copy and perforated tape, set the lever at KBD & TAPE.

(3) To produce perforated tape without transmitting to the line, set the lever at TAPE.

d. Line Switching Key.

(1) *Switch settings.* The line switching key can connect the equipment to either of two line circuits or to the local test circuit. To connect the equipment to either of the two line circuits to which the key is connected (figs. 274 and 275), operate the switch to either its extreme left or extreme right position. To connect the equipment to the local test circuit, operate the switch to its middle position.

(2) *LINE TEST jacks.* The pair of TEST jacks in the jack block of the table service assembly can connect the equipment to the local test circuit. To connect the equipment to either the signal loop or the circuit to which these TEST

jacks are connected (fig. 274), plug the two teletypewriter cords into the pair of jacks desired (LINE or TEST). In either case, plug the send cord (black-shelled plug) into the jack marked BLK and the receive cord (red-shelled plug) into the jack marked RED.

e. SEND—REC—BREAK KEY. Move the SEND—REC—BREAK key (fig. 6) to BREAK. Hold the key at BREAK for approximately 2 or 3 seconds. This will start the motors of all teletypewriters in the same circuit if they have been stopped previously by remote control and if motor switches are at ON position. To receive, move the key to REC. This bypasses the transmitting contacts, which prevents accidental interruption, and the machine then will print from line signals only. To transmit, move the key to SEND. The teletypewriter can send or receive with the key at this position. This key also can be reset to the REC position by operating the blank key twice in succession or by opening the line for a time interval equal to 2 revolutions of the transmitting cam sleeve at any teletypewriter in the same signal loop circuit (par. 128). The SEND—REC—BREAK key consists of an upper and lower lever. The small upper lever must be released (pressed down) to move the key to the lowest or BREAK position. The other lever can be moved manually from REC to SEND, or from SEND to REC, without releasing the latch.

27. Operating Teletypewriter Set

a. GENERAL. Arrange the equipment for the type of operation to be conducted (par. 9). Operation of the teletypewriter consists of setting switches and operating keys and making the possible necessary adjustments for signal line characteristics. Most of the items mentioned are covered in paragraphs 10 and 26. The information below outlines, generally, the operation of these teletypewriters.

b. KEYBOARD. Set the polar-neutral key to the appropriate position (par. 129). Strike the keys with firm, evenly-spaced strokes. To start a new line, press LTRS, *CAR RET*, *CAR RET* and LINE FEED keys in succession. (Note that the CAR RET key is pressed twice). Press the space bar to insert spaces between words or word groups. The space bar will send repeated spaces as long as it is held down. To send letters, press the LTRS key and then the keys for the desired letters. To send figures, punctuation marks, weather symbols, and other characters or functions marked on the keytops, press the FIGS key and then the keys for the desired characters. After the message is sent, check the finished copy. If it is desired to signal a distant operator, use the BELL key (fig. 7).

c. OPERATOR'S MAINTENANCE. The authority of the operator to perform maintenance functions is limited. The functions performed usually are the replacement of supplies (such as tape, paper, and ribbon), observation of the equipment during operation, and making certain routine maintenance checks. Installation or replacement of supplies is discussed in paragraph 14. The equipment performance checklist (par. 30) enables the operator to determine whether the equipment is functioning properly.

28. Operating Tests

a. Check the motor speed as outlined in paragraph 20 and observe whether the governor holds its setting.

b. Set the rangefinder (par. 19).

c. Turn the crank to be sure that the paper feeds evenly and does not tear.

d. Operate the LINE FEED key. Check the line feed for both single and double spacing between lines by operating the single-double line feed lever to the desired position.

e. Operate the CAR RET key. Check for positive action and the return to the left-hand margin without bouncing.

f. Observe the action of the ribbon feed mechanism while typing to be sure it oscillates and feeds each time a character is typed. Check to see that the ribbon winds correctly in both directions and that the ribbon reverses correctly at both ends.

g. Test the manual carriage return feature by operating the carriage return lock bar.

h. Test the setting of the margin (end-of-line) warning bell by typing CAR RET, LINE FEED, and FIGS followed by 1234567890; repeat until it can be determined that the margin bell on the teletypewriter rings on the 66th or the 70th character, depending on the type of machine.

i. Hold the space bar down to check the continuous spacing feature of the keyboard.

j. Test the remote motor control stop feature by operating the CAR RET, LINE FEED, FIGS, and STOP (upper case H) keys.

k. Test the remote motor control start feature by a 2- or 3-second break signal (SEND—REC—BREAK key held in extreme downward position).

l. Test the operation of the signal bell by operating the FIGS and BELL (upper case S) keys.

m. Operate the LTRS and FIGS keys in succession, and notice that the platen shifts from the LTRS position to the FIGS position and *vice versa* with positive action. Check the operating procedure to determine whether the unshift-on-space feature is to be used. If this feature is not to be used, check the equipment carefully to be certain that this feature is made inoperative and that the platen returns to the LTRS position *only* when the LTRS key is operated. This check is of particular importance because any equipment that has the unshift-on-space feature adjusted differently from the rest of the system becomes a source of trouble. The trouble is increased when the equipment operates in a circuit with cryptographic equipment.

n. Check the type alinement by operating FIGS, 2, LTRS, and W in succession across the page and note whether the characters are on an even line.

o. Check the general typing functions of the teletypewriter by typing a test sentence several times. A typical test sentence is: THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 TESTING (followed by a carriage return and a line feed). Check all type pallets to see that they print clean, properly positioned characters.

p. With the SEND—REC—BREAK key in the REC position, test the keyboard to be sure that the sending mechanism is inoperative and that nothing can be transmitted.

q. With the SEND—REC—BREAK key in the SEND position, type two consecutive blank characters to determine that the SEND—REC—BREAK mechanism will move automatically to the REC position (operates in LTRS position only on TT-8/FG).

r. With the SEND—REC—BREAK key in SEND position, type one blank character alternately with any other letter or number character to determine that the single blank characters do not affect the SEND position of the SEND—REC—BREAK key mechanism.

s. Punch a test message in tape and transmit it from the transmitter distributor to the typing unit by switching the line switching key to test.

29. Stopping Procedure

a. Notify stations on the circuits that operation is to be interrupted or discontinued.

b. Follow local SOI and SOP for operating procedure.

c. Operate all ON-OFF switches to their OFF positions.

30. Purpose and Use of Equipment Performance Checklist

a. GENERAL. The equipment performance checklist (*f* below) helps the operator to determine whether these teletypewriter sets and/or their associated circuits are functioning properly. The checklist gives the items to be checked, normal results of these checks indicating correct operation, and corrective measures for the operator to take if operation is not correct.

b. ITEM. This column lists the parts or units to be checked.

c. ACTION OR CONDITION. This column gives the settings of various switches and controls or the action to be taken to check operation of the equipment for each item listed in the first column.

d. NORMAL INDICATIONS. This list includes the audible and visible signs that the operator should obtain for each action or condition listed in *c* above. If these signs are not obtained, refer to the column headed *Corrective measures.* No meter readings are given because the equipment normally does not have a meter.

e. CORRECTIVE MEASURES. The corrective measures which appear in this column are those that the operator is authorized to apply. When he does not understand instructions, he should refer the case to an experienced mechanic. When the measure or series of measures listed for a trouble do not apply to or clear that trouble, and/or the instruction (ch. 4) appears in the corrective measure column, it means that the repairs must be made only by an experienced teletypewriter mechanic. If these checks indicate line or cable trouble rather than teletypewriter trouble, report the trouble to the wire chief or any proper maintenance authority the commanding officer may direct.

f. EQUIPMENT PERFORMANCE CHECKLIST. Check the items in the preparatory section of this list in the order given. The items are arranged in the sequence in which these operations are performed during installation of the equipment.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
	1	Ground	Check connections at printer and table ground screw terminals. ***Caution:*** Be sure that all power switches are in the OFF position while checking connections.	No resistance or voltage (shock potential) between teletypewriter or table and ground. Grounded loops carry current (pull up selector magnet armature) when battery is applied to proper end of line.	Refer to paragraph 18 and figures 268 through 276.
	2	Transmitter-distributor.	Mounted on top of table to make proper contact to signal and power circuits through contacts of mounting. Tape-stop (or ON-OFF) switch at OFF.	Refer to TM 11-2222	Refer to paragraph 31.
PREPARATORY	3	Perforator transmitter.	Operating control lever set for desired type of operation. (KEYBOARD, KBD & TAPE, or TAPE). Polar-neutral key set for type of operation.	Performs only those functions for which settings have been made.	Refer to paragraphs 6 and 9.
	4	Power unit: A-c frequency and voltage selector taps.	Set to match power source. Be sure that terminal screws are tightened securely. Power switch on. Tubes and neon bulb installed Cover closed.	Motors and target lamp operate when their switches are operated to ON.	Check for good fuses of correct value. Check cords and connections. Refer to chapter 4.
	5	Power unit: Rectifier transformer taps and all cords for teletypewriter table and power unit.	Have been previously set for correct d-c output by teletypewriter mechanic with meter. All power and line cords are plugged in or properly connected. Switches at ON.	Steady line current of correct value permits normal operation and good copy.	Check to verify with switchboard operator or someone with meter in circuit and/or refer to chapter 4.
	6	Line terminal board in electrical service assembly of table.	Signal line conductors connected to proper terminals for method of operation to be conducted. Correct polarity of battery or ground, or grounded battery connected to proper terminals on board. Correct resistance in lines (loops).	Teletypewriters run closed on steady marking current when not sending or receiving. Switchboard or terminal equipment obtains correct meter readings.	Check with terminal or switchboard operator. Refer to paragraph 18 or chapter 4. *Note.* If the line is open or out of service, the printer may be tested by operating the line switching key to test position or plugging the red- and black-shelled plugs into their TEST jacks in the table.
	7	Typing unit	Paper, tape, and ribbon properly installed and operating. Copyholder installed Motor switch at OFF.		Refer to paragraph 14 for installation of paper, tape, ribbon, and copyholder.

START EQUIPMENT PERFORMANCE

Item No.	Item	Action or condition	Normal indication	Corrective measures
8	Table	All switches in proper position. Table grounded. Teletypewriter centered on pad on top of table. All plugs in proper receptacles and jacks. Rectifier centered on shelf in back part of table. Correct fuses in place.	Current available to motor, line, and terminal board.	Refer to paragraph 18.
9	Typing unit and keyboard.	Power connected with all switches operated to ON position.	With motor running, teletypewriter runs closed (quiet) on closed line or when plugged in TEST jacks.	Check and clean all transmitting contacts, teletypewriter line cords and plugs, and pressure contacts between typing unit and the base and keyboard. Refer to chapter 4.
10	Motor switch	With rectifier power unit switch at ON, operate base unit motor switch to ON position.	Unless previously stopped by remote motor control, the motor should start (TT–7/FG only).	Refer to item 11 below
11	SEND — REC — BREAK key.	With switches the same as in item 10 above, operate the key to BREAK for two to three seconds. Both key levers must be held down; then release levers.	Motor unit should be running or should start when line is closed again by releasing lever of TT–7/FG.	Check all cords and connections. Check spring pressure contacts at front part of motor base. Check fuses. Refer to chapter 4.
12	Typing unit and perforator transmitter.	All switches at ON. Press several keys (one at a time) for test. (Equipment has been adjusted and lined up as directed in paragraphs 19, 20, and 21.).	Teletypewriter runs closed (quiet) on steady marking current when not sending or receiving. Receives good copy when remote station sends and also receives good copy from own sending if half duplex.	Insert teletypewriter send and receive plugs in TEST jacks in table (red in RED and black in BLK as marked) and check range as directed in paragraph 19. If still bad copy, refer to chapter 4. If good copy, check for line trouble or refer to proper authority. Replace plugs in LINE jacks.
13	Blank key	Lift SEND—REC lever to SEND. Press blank key *twice*. Prints and spaces only in FIGS position of TT–8/FG.	The SEND—REC lever moves from SEND to REC the second time the blank key is depressed.	Refer to chapter 4.
14	Signal bell	Press FIGS key, then S key.	Signal bell should ring	Refer to chapter 4.
15	LTRS key and FIGS key.	Press FIGS key, then LTRS key (alternately) several times. Teletypewriters also may be adjusted to unshift (return to LTRS position) on both space and LTRS.	Platen should rise to upper case when FIGS key is pressed and return to lower case when LTRS key is pressed.	Refer to chapter 4.

EQUIPMENT PERFORMANCE

Item No.	Item	Action or condition	Normal indication	Corrective measures
16	CAR RET. manual carriage return from any position on all teletypewriters.	Type bar carriage at end of typed line. (Should also work from any part of typed line.) Operates in LTRS position only on TT–8/FG.	Type bar carriage returns to left.	Refer to chapter 4.
17	Margin warning bell.	Hold space bar down until type bar carriage reaches end of line.	Bell should ring six characters before end of line.	Refer to chapter 4.
18	Line feed.	Press LINE FEED key (usually operated after CAR RET to give the carriage sufficient time for return operation). LINE FEED operates only in LTRS position on Teletypewriter TT–8/FG.	Paper rolls up one or two spaces as adjusted.	Refer to chapter 4.
19	Space bar.	*a.* Pressed down momentarily.	*a.* Inserts single space (as between words).	Refer to chapter 4.
		b. Held pressed down. Space operation also moves platen from FIGS to LTRS position unless unshift-on-space mechanism is locked out (fig. 15).	*b.* Sends repeated spaces while held operated.	
20	Motor and governor.	Hold space bar down with carriage at extreme left.	Margin warning bell rings.	Refer to paragraph 19 for accuracy with speed indicator. Refer to chapter 4.
		a. TT–7/FG.	*a.* At the end of 11 seconds.	
		b. TT–8/FG.	*b.* At the end of 12 seconds.	
		Motor should run 3 to 5 minutes before speed is checked.		
21	Perforator mechanism.	*a.* Keyboard control operating lever at KEYBOARD.	*a.* Operation of keyboard should result in typed copy only.	*a.* Refer to chapter 4.
		b. Keyboard control operating lever at KBD & TAPE.	*b.* Perforated tape should be produced in addition to typed matter.	*b.* Refer to chapter 4.
		c. Keyboard control operating lever at TAPE.	*c.* Tape should be produced, but typed matter should not.	*c.* Refer to chapter 4.
		d. Backspace control operated.	*d.* Tape should move back one space.	*d.* Refer to chapter 4.

EQUIPMENT PERFORMANCE STOP

Item No.	Item	Action or condition	Normal indication	Corrective measures
22	Character counter	Keyboard control operating lever set at TAPE.	Teletypewriter TT-7/FG: Warning lamp lights when dial indicator shows 66 characters have been perforated. Teletypewriter TT-8/FG: Warning lamp lights at 70. Character counter will not register on LTRS, FIGS, or LINE FEED and character counter returns to zero on CAR RET on both sets.	Check lamp. Refer to chapter 4.
23	Transmitter distributor.	Connected in series with typing unit. Line switching key at test position.	Typing unit should produce typed copy of matter sent by transmitter distributor.	Refer to TM 11-2222.
24	Remote motor control.	Perforator transmitter and typing unit in series (single-loop, half-duplex). Operate keys as follows:		Refer to chapter 4.
		a. FIGS key	*a.* Platen shifts to FIGS position.	
		b. H (STOP) key. *Note.* Teletypewriter TT-7/FG has this feature (Teletypewriter TT-8/FG does not).	*b.* Motor stops. Affects all TT-7/FG teletypewriters in circuit the same.	
		c. Operate the motor switch to OFF after restarting motor.	*c.* Motor should stop	Refer to chapters 3 and 4.
25	Transmitter distributor.	*a.* Operate the tape-stop switch to OFF.	*a.* Tape and distributor brush should stop.	*a.* Refer to TM 11-2222.
		b. Operate the transmitter distributor switch at the table to OFF position (toward rear).	*b.* Motor should stop	*b.* Refer to chapters and 4.
26	Disconnecting rectifier power unit from power source.	Operate the rectifier power supply a-c switch on table to OFF position (toward rear) after restarting all motors.	All motors should stop. All tubes, lamps, and power are off.	Refer to chapters 2, 3, and 4.
27	Rectifier power unit.	Throw power switch (down) to OFF. (Power to this unit should have been disconnected by action of item 26 above.)		Refer to chapter 4.

g. TEST OPERATIONS. If the typing unit, perforator transmitter, and transmitter distributor are connected to separate lines, proceed as follows to test the operation of these units.

(1) Plug the cord from the typing unit into the RED TEST jack.

(2) Plug the cord from the perforator transmitter into the BLK TEST jack.

(3) Change the wiring at line terminal blocks E603, E604, or E605 so that the transmitter distributor is in series with the typing unit.

(4) Set the line switching key at test position.
(5) Operate as outlined above. Normal indications of satisfactory operation are those listed above in the equipment performance checklist.

31. Operation With Transmitter Distributor

a. GENERAL. The transmitter distributor (fig. 10) is a motor-driven device which translates code perforations punched in paper tape into electrical impulses and transmits these impulses as a five-unit, start-stop teletypewriter code of the same type as is transmitted from the perforator transmitter. The transmitter distributor is designed particularly for automatic operation where large amounts of traffic must be handled without delay. All model 14 transmitter distributors are similar in appearance and are self-contained units, identified by a basic code designation 4TXD. The transmitter distributor which is part of Teletypewriters TT–7/FG and TT–8/FG has the code designation 4TXD200AA.

b. APPLICATION. The transmitter distributor may be used in any teletypewriter circuit to replace keyboard transmission. Some means must be available, however, for producing the required perforated tape. The transmitter distributor does not contain relays in its signal circuit and therefore can be inserted in a neutral loop or connected to any signal line when the proper connections are made. Most model 14 transmitter distributors used by the Army are wired for *neutral* operation to conform to other teletypewriter equipment used by the Army, but they may be operated on *polar* circuits when worked through repeaters and similar pole-changing equipment or when minor wiring changes are made. Polar operation is not recommended for Army use except in emergencies.

c. WIRING. External wiring for the power and signal lines and the control circuits of the transmitter distributor terminate at a slip connection block located on the bottom of the base where contact is made with associated connections on the table. Because the bottom of the base is flanged so that it slides easily and firmly on a mounting plate, the transmitter distributor may be installed or removed without the aid of tools. Resistors and capacitors used in the circuits of the unit are located in a space in the bottom of the base.

d. MOTOR. Transmitter distributors are supplied with motors that can be adjusted for either 2,102 or 2,308 rpm and which may be used with interoperation with British equipment.

e. DISTRIBUTOR. The distributor assembly is mounted on the base between the motor and the tape transmitter. The assembly includes a distributor disk, distributor brush assembly, main shaft and associated gears, clutch, cams, and other parts necessary for the control of the actual transmission of the teletypewriter code impulses.

f. TAPE TRANSMITTER. The tape transmitter is mounted on the base directly in front of the distributor assembly. It includes the tape contact levers, marking and spacing contact banks, transmitter top plate, and other parts required for tape feeding and tape sensing.

32. Transmitter Distributor Controls and Contacts

a. TRANSMISSION CONTROL. A tape stop switch is located on the front of the tape transmitter and bears the designation OFF-ON. The tight tape stop lever extends along the right-hand side of the transmitter distributor and stops transmission if the tape becomes tight or snarled. An end-of-tape stop mechanism (sometimes called a tape-out mechanism) is used on some transmitter distributors to stop transmission when there is no tape in the transmitter. Without the end-of-tape stop mechanism, transmitter distributors transmit the LTRS signal continuously whenever the tape runs out until the equipment is turned off or until a new piece of tape is inserted in the transmitter distributor. With the transmitter distributor sending copy to a receiving teletypewriter, operate the tape stop switch to OFF; transmission should stop immediately. Operate the tape stop switch back to ON; transmission should be resumed without error. Allow the tape to run out out of the transmitter. Units equipped with the end-of-tape stop mechanism should stop transmission as the end of the tape passes an end-of-tape stop pin.

b. TESTING TRANSMISSION. Insert a perforated tape bearing a test sentence repeated four or five times in the tape transmitter. A typical test sentence is THE QUICK BROWN FOX JUMPED OVER A LAZY DOY'S BACK 123456789ø TESTING (followed by two operations of the CAR RET key and one operation each of the LINE FEED and LTRS combination in that sequence). With the motor running, lower the tight

tape stop lever and operate the tape stop switch to ON. The transmitter distributor should begin transmitting. Check the copy being printed on the receiving teletypewriter. Check the feed holes in the tape after the tape has passed through the transmitter. If the feed holes are torn or pulled, check the adjustment of the feed lever adjusting screw.

c. Checking Tape Sensing Mechanism. Insert a piece of tape with repeated LTRS combinations in the tape transmitter and turn the motor by hand in a clockwise direction. Observe whether all the tape pins pass through the associated perforations in the tape. If any tape pin fails to pass through a hole, check for a bind in the associated contact lever and readjust according to instructions in T M11–2222.

d. Control Circuit. Check the strapping. Restrap the tap-stop magnet resistor, if required, for operation on the available power supply (fig. 274).

e. Preoperational Tests. Give the transmitter distributor a thorough preoperational check. After any necessary readjustments are made, connect the equipment to the power supply and make the following test:

(1) Start the motor and illuminate the target on the governor shell with a flashlight or other source of light. Pluck the tuning fork (or strike it gently on the heel of the hand) and view the black and white spots on the illuminated target through the shutters on the vibrating tuning fork. The speed of the motor is correct when the spots appear to stand still.

(2) If the equipment appears to be running too fast or too slow, make an additional check of the speed by running a tape with 92 feed holes through the transmitter distributor. The length of time required to run this tape through is exactly 15 seconds if the motor is adjusted for standard 368.1 opm.

33. General Functioning of Transmitter Distributor

a. All transmitter distributors function in the same general manner, regardless of the different equipment or power supplies with which they are operated. Since they transmit five-unit, start-stop teletypewriter code signals that are identical electrically with the code transmitted from a keyboard of any ordinary teletypewriter operating at the same speed, the keyboards of Teletypewriter TT–7/FG and TT–8/FG are left available for use in perforating additional message tape without interfering with the message being transmitted to the signal circuit.

b. Perforated tape inserted into the tape transmitter is advanced one row of perforations (corresponding to one character or function) at a time by the tape feed mechanism. Tape sensing pins move upward and press against the tape when there are no perforations above the pins, but pass through any perforations that are directly above the pins. When a tape sensing pin passes through a perforation, the contact tongue associated with that pin makes contact with its lower (marking) contact screw. When there is no perforation, the tape sensing pin is held down by the tape which in turn holds the associated contact tongue against its upper (spacing) contact screw. Each contact tongue is wired directly to its associated segment on the distributor disk.

c. The distributor transmits to the signal line, in proper sequence and speed, the marking and spacing impulses set up by the contact tongues of the tape transmitter.

d. Transmission is controlled by a local circuit within the transmitter distributor consisting of a tape-stop magnet, a switch, and two sets of contacts, all wired in series. The circuit is closed to start transmission and is opened by the switch, by the end-of-tape contacts, or the tight tape contacts, either by hand or automatically, to stop transmission. When transmitter distributors are used with certain associated equipment, the control circuit may be extended into the associated equipment to provide additional control. In most cases, the circuit extension consists of another pair of contacts connected in series with the wiring within the transmitter distributor.

e. All transmitter distributors have been adjusted properly before being packed for shipment at the factory. Before either new or used equipment is put into operation, however, inspect and lubricate it if necessary. Whenever definite information is not available as to the present condition of the equipment, make several checks to be sure that the adjustments have not shifted.

Check the following items (and any other items observed to be in questionable condition):

(1) Turn the motor by hand in the direction of normal rotation (distributor brushes revolving clockwise). Be sure there is no bind or excessive backlash between the motor pinion and the main shaft gear, or that there are no binds in other parts of the equipment. *Do not turn the motor backward (distributor brushes revolving counterclockwise) because the brushes may catch on the edges of the commutator segments and may be either broken or bent badly.*

(2) Check the distributor brushes to see that they are making contact with the commutator segments and that they have the proper tension and position with respect to the reference line on the distributor disk. Readjust if necessary.

(3) See that the tape stop arm clears the stop cam lug when the tape stop magnet is held in its operated position and that the stop arm fully engages the stop cam lug when the armature is released. Readjust if necessary.

(4) Insert a piece of perforated tape into the tape transmitter. Turn the motor by hand in the direction of rotation and observe whether the tape advances one full row of perforations for each complete turn of the main shaft. If the tape moves *either* more or less than one full row of perforations, adjust the mechanism to meet the requirements given in TM 11-2222.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

34. Emergency Procedure

If the teletypewriter breaks down, proceed as follows:

a. Notify the maintenance unit at the station.

b. Notify other stations on the circuit of the trouble and estimate the length of time required before operation can be resumed.

c. Check the equipment in accordance with the preventive maintenance procedures outlined in chapter 3.

d. Try to determine visually the location of the trouble. Determine whether it is electrical or mechanical and in which of the components it has occurred. If the trouble seems to be in the power or signal circuits, report it to the proper maintenance authority.

35. Operation Under Adverse Climatic Conditions

a. Operation and maintenance of teletypewriter equipment in arctic, tropical, or desert regions creates a number of problems peculiar to those regions. Moisture condensation due to extreme humidity causes short circuits and cross-fire. Deterioration of parts due to rust and corrosion may lead to a complete breakdown of the equipment. Dust, dirt, or sand encountered in desert regions will affect operation and may lead to a breakdown.

b. Keep the equipment as dry as possible to prevent corrosion. In extremely cold regions, heat the shelter in which the teletypewriter is installed and avoid changes (drops) in temperature. Whenever possible, make sure that ground rods, if used, are driven below the frost line.

c. The information in paragraphs 36 through 38 is intended as a general guide when it becomes necessary to operate the teletypewriters under adverse conditions.

36. Operation in Arctic Climates

Before placing the equipment in operation:

a. Provide a source of heat.

b. Use special lubricants designed to protect the equipment at extremely low temperatures. Apply kerosene freely to the type bar segments, but be careful to confine it to the segments only.

c. Let the equipment warm up before placing it under load. Let the motor units run for *at least* 15 minutes.

d. At extremely low temperatures, metals contract at different rates, and normal clearance in the mechanical parts of the equipment is disturbed. Metal parts also crystallize, become brittle, and break under load when exposed to these conditions; therefore, do not attempt to operate these teletypewriters at temperatures below 40° F.

37. Operation in Tropical Climates

a. In tropical regions, the equipment is expose to conditions of extreme heat and humidity an therefore, must be protected against the effe

moisture and fungi. Refer to paragraph 47 for moistureproofing and fungiproofing these teletypewriters.

(1) Provide adequate ventilation around the motor units and the rectifier power unit to prevent overheating. Use approved lubricants specified for the particular region.

(2) Check the condition of the weatherproof coating. If it is damaged, apply another coat as soon as possible.

(3) Keep the equipment clean. If possible, screen the shelter against entry of insects.

b. In tropical areas, teletypewriter sets may be installed in tents, huts, or, in some cases, dugouts. If installed underground, and frequently if equipment is set up in swampy areas, moisture conditions are more acute than normal in the tropics. Generally, under these conditions, ventilation is very poor, and the relatively high humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than that of the surrounding area. Place lighted electric bulbs under the equipment to minimize this action. Often, one bulb must be kept lighted continuously to maintain a constant temperature.

c. Be careful to lubricate gears and friction clutch felt washers properly in high temperatures. Do not *overlubricate*.

38. Operation in Desert Climates

Conditions in desert regions are similar to those in tropical areas except for the humidity. Dryness of the atmosphere may require more frequent lubrication. Dirt and dust can damage bearings and moving parts of the mechanisms. When it becomes necessary, measures similar to those given for tropical conditions are applied to insure efficient operation of the equipment.

a. Protect the equipment against dust, dirt, and sand.

b. Provide adequate ventilation to prevent overheating.

c. See that proper lubricants are used to protect the equipment. The chief problem that arises while operating in desert areas is the great amount of dust and dirt that accumulates in the moving parts of the teletypewriter. The solution to this problem is to house the equipments in dustproof shelters. Such buildings, however, require air-conditioning facilities. When a suitable building or shelter is found, use all available materials to make it as dustproof as possible. Hang wet sacking over the doors and windows and cover the inside walls with heavy paper. If tents are used, the side walls should be secured well and banked with dirt to prevent flapping in the wind. Provide the tents with double flaps; buildings should have double doors to serve as light traps or baffles.

d. Do not tie power cords, signal cords, or other wiring connections to either the inside or outside of tents, since desert areas are subject to sudden winds which are capable of jerking the connections loose or breaking the lines.

e. Make frequent preventive maintenance checks.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

39. Tools and Materials

Tools and materials listed below should be on hand for immediate use when preventive maintenance procedures are started.

a. Those tools which are part of either Tool Equipment TE–50 or TE–50–A are issued especially for teletypewriter maintenance work.

b. Expendable materials listed below may be obtained through regular supply channels.

Description	Signal Corps stock No.	Code No.*
Contact burnisher	6R41065C	265C
Carbon tetrachloride	6G184.1	
Oil, lubricating, Teletype part No. 88970.	6G1325	KS–7470
Oil, lubricating, preservative, special (PL-Special) U. S. Army spec No. JAN–L–644.	6G1318.1	
Grease, lubricating, Teletype part No. 88973.	6G650	KS–7471
Grease, lubricating, special (GL), Ordnance spec No. AXS637.	6G673.7	
Paper, cleaning, Bell Seal bond, ¼ x 2½.	6M750	KS–7188

* WECo code numbers.

Note. Do not use gasoline as a cleaning fluid for any reason. Solvent, dry-cleaning (SD) is available as a cleaning fluid through established supply channels. Oil, fuel, Diesel, may be used for cleaning purposes when solvent (SD) is not available. Carbon tetrachloride will be used as a cleaning fluid only where inflammable solvents cannot be used because of the fire hazard and for cleaning electrical contacts, including relay contacts, plugs, and commutators. A satisfactory substitute for use in cleaning the exterior of teletypewriter equipment (black wrinkle finish) when solvent (SD) is not available can be prepared by mixing 1 pint of Oil, engine (OE 10) and 1 gallon of white range fuel.

c. Establish routine schedules for preventive maintenance at intervals necessary to keep the equipment in operating condition. The frequency of such maintenance procedures depends on the amount of use of the equipment and the areas in which it is used.

40. Special Tools

a. GENERAL. The detailed repair instructions in chapter 4 refer to the use of tools which are not furnished as part of Tool Equipment TE–50 or TE–50–A. The additional tools, or their equivalents, normally are available in kits used at repair shops where extensive teletypewriter repairs are made. When the additional tools are not available, suitable substitutes can be improvised. The additional tools referred to are listed below.

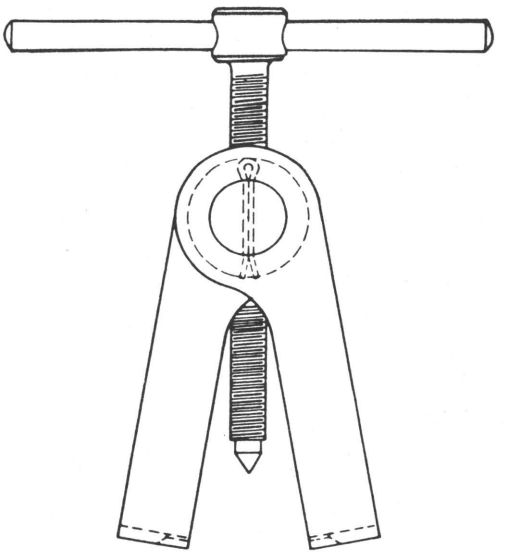
Name of tool	Description or use	Signal Corps stock No.
Bearing puller (fig. 33).	For removing all types of teletypewriter motor armature bearings.	4T84020
Undercutter, mica	For undercutting commutator segments.	6R46290
Handwheel	Metal; about 2 inches in diameter with extension which screws onto the right end of the main shaft.	4T74803
Pliers, short-nosed	Heavy, 6 inches long, 1 inch wide; general use.	6R4774–6

d. DRILLS, TAPS, DIES, AND CLAMPS. A set of carbon or high-speed steel drills of various sizes

and either a hand or electrically operated drill should be available for making new parts or reworking old parts. These items usually will be available at field or depot repair shops where Teletypewriters TT–7/FG and TT–8/FG are repaired. Taps and dies for several common sizes of screws and bolts and clamps of suitable size also should be available.

c. Welding and Brazing Equipment. In emergencies, many broken parts may be welded or brazed. This work, however, is highly specialized and should be done only by thoroughly experienced personnel at repair shops completely equipped for this purpose.

Caution: Welded or brazed parts must be alined properly, and they must be free of excessive build-ups which reduce clearances below minimum requirements.



TM2216-83

Figure 33. Bearing puller.

Section II. LUBRICATION AND PRESERVATION

Note. A Department of the Army Lubrication Order covering Teletypewriters TT–7/FG and TT–8/FG is not issued.

41. Lubricants

The following table lists the lubricants necessary when servicing Teletypewriters TT–7/FG and TT–8/FG:

Approved symbols	Standard nomenclature
KS–7471	Grease, lubricating, special (GL).
KS–7470	Oil, lubricating, preservative, special (PL-Special).
OE 10	Oil, engine, SAE 10 (OE 10) (emergency commercial substitute.)*
88975	Grease gun for ball oilers (motor).

*When the temperature is so high that lubricating oil KS–7470 runs off th parts, oil (OE 10), may be substituted.

42. Lubrication Schedules

Schedule lubrication to allow for variations in wear resulting from differences in temperatures and in average hours of daily use.

a. Schedule When Operating at Average Temperatures. The recommended lubrication schedule for operation under average temperature conditions is given in the following table:

Operation schedule	Lubrication schedule
Up to 8 hours per day	Every 30 days.
8 to 12 hours per day	Every 20 days.
12 to 16 hours per day	Every 15 days.
16 to 24 hours per day	Every 10 days.

Note. Refer to paragraphs 34 through 38 for lubrication instructions to be followed in extreme weather and emergency conditions.

b. Schedule For Main Shaft. The interval between lubrications of the main shaft should be one-fourth as long as the interval between lubrications scheduled for the rest of the equipment (*a* above).

43. Detailed Lubrication Instructions

a. Methods of Applying Grease.

(1) *General.* When grease is specified, use special lubricating grease (KS–7471). Note carefully the information following the item in the lubrication charts (par. 46) indicating location, number of points, the amount or method of applying the lubricant, and any differences between the initial and later lubrication. Grease both loops of all springs that exert a tension of 2½ pounds or more.

(2) *Filling grease gun.* Fill the grease gun furnished as part of Tool Equipment TE–50 or TE–50–A in the following manner:

(*a*) Unscrew the lubricant tube from the cap casting.

(*b*) Place the opened end of the lubricant tube over the opening in the filling washer in the can of proper lubricant. Press down on the lubricant tube until the tube is filled. If the cans of lubricant available are not equipped with filling washers, press the metal follower against the back end of the lubricant tube and fill the lubricant tube by using a clean wooden paddle or the fingers. Tamp the lubricant down solidly in the tube by pounding the closed end sharply against the palm of the hand. Continue to add lubricant and tamp until the tube is filled completely.

(*c*) Screw the lubricant tube back into the cap casting just enough to hold the tube in place. Insert a rod, screw driver, pencil, or similar object through the perforated end of the lubricant tube and press the metal follower into the tube to expel any air that may be trapped in the tube. When the lubricant begins to ooze past the threads, tighten the lubricant tube securely into the cap casting.

(*d*) Operate the handle back and forth several times until the lubricant is pumped from the nozzle. The grease gun then is ready for use. If the lubricant does not flow from the nozzle in a solid stream when the handle is operated, it is an indication that all the air is not expelled from the lubricant tube. Invert the gun and pound the cap casting end against the palm of the hand to jar the lubricant into the pump cylinder.

(3) *Greasing pressure fittings.* To grease parts equipped with pressure fittings (ball oilers), place the nozzle of the grease gun squarely against the grease fittings and operate the handle. Test. the grease gun *before* greasing the pressure fittings to determine how much grease is injected for each full operation of the handle. *Do not overlubricate the equipment.*

(4) *Greasing flat surfaces.* To grease flat surfaces, hold the nozzle of the grease gun against the surface, tilted at an angle of approximately 45°. Operate the handle until sufficient grease is ejected. If the surface is long, operate the handle slowly and, at the same time, move the nozzle of the gun along the surface to form a continuous ribbon of lubricant. The lubricant may be pumped out onto the fingers or the end of a screw driver for transfer into hard-to-reach places that cannot be contacted directly with the grease gun.

b. Methods of Applying Oil.

(1) *General.* Unless grease is specified, apply 1 or 2 drops (or more when specifically indicated) of oil KS–7470 to the parts specified in the lubrication charts. Oil (OE 10) may be substituted if oil KS–7470 is not available.

(2) *Filling oiler.* Fill the oiler furnished as part of Tool Equipment TE–50 or TE–50–A by unscrewing the top and removing the pump. Fill the tube with the proper lubricant and replace the pump. Tighten the top.

(3) *Use of oiler.* After filling the oiler, or when starting to use the oiler after it has been standing for some time, operate the pump handle until oil is forced out of the nozzle and then adjust the stop beneath the pump handle for the desired flow of oil. Turn the adjusting screw in a counterclockwise direction to reduce the flow of oil and in a clockwise direction to increase the flow of oil. The adjustable stop beneath the pump handle may be moved to one side to make the stop inoperative.

(4) *Use of wire for applying oil.* A piece of No. 22 B & S gage wire dipped ½ inch into oil and immediately touched to a lubrication point is an approved method of applying 1 or 2 drops of oil. The main advantage of this method is that it avoids overlubrication.

44. Preparation for Lubrication

a. GENERAL. To lubricate the teletypewriter thoroughly, take it out of service and partially disassemble it as outlined in *b* below. Fill the grease gun and oiler (part of Tool Equipment TE–50 or TE–50–A) (par. 43*a* (2) and *b* (2)).

b. DISASSEMBLY. To facilitate lubrication of various parts and units, disassemble as follows:

(1) Disconnect the power.
(2) Remove the cover.
(3) Remove the roll of paper, paper spindle, and the ribbon from the typing unit.
(4) Remove the typing unit from the base; then remove the type bar carriage.
(5) Remove the keyboard.

c. CLEANING. With a soft clean brush or a clean, lint-free cloth lightly dampened with solvent (SD), clean all parts to be lubricated. Wrap the cloth around the end of a screw driver or an orange stick to remove old grease and oil in hard-to-reach places. Wipe dry with a clean, lint-free cloth before lubricating.

d. LUBRICATION. Location of the parts of the teletypewriter to be lubricated is shown in figures 34 through 50. The type of lubricant to be used and specific instructions for lubricating each part are given in the charts (par. 46). Items need not be lubricated in the sequences given in the charts, but all points must be lubricated. Do not lubricate the teletypewriter while the motor is running. After lubricating, wipe off excess lubricant with a clean, lint-free cloth. Do not apply lubricants in excess of the quantities recommended. Wipe off excess oil.

45. Lubrication Under Unusual Conditions

Reduce the interval in the appropriate schedule (par. 42*a* and *b*) by one-half when operating in tropical or desert climates (pars. 34 through 38). When lubricating the equipment at frequent intervals, avoid accumulations of excessive oil.

46. Lubrication Charts for Teletypewriters

The charts in this paragraph list the type of lubricant and the quantity to be applied. Item numbers are grouped by units and include all points to be lubricated. The item numbers are shown on referenced illustrations (figs. 34 through 50). *Observe the normal movement of parts to determine the exact location of wearing surfaces that require lubrication if there is any doubt.*

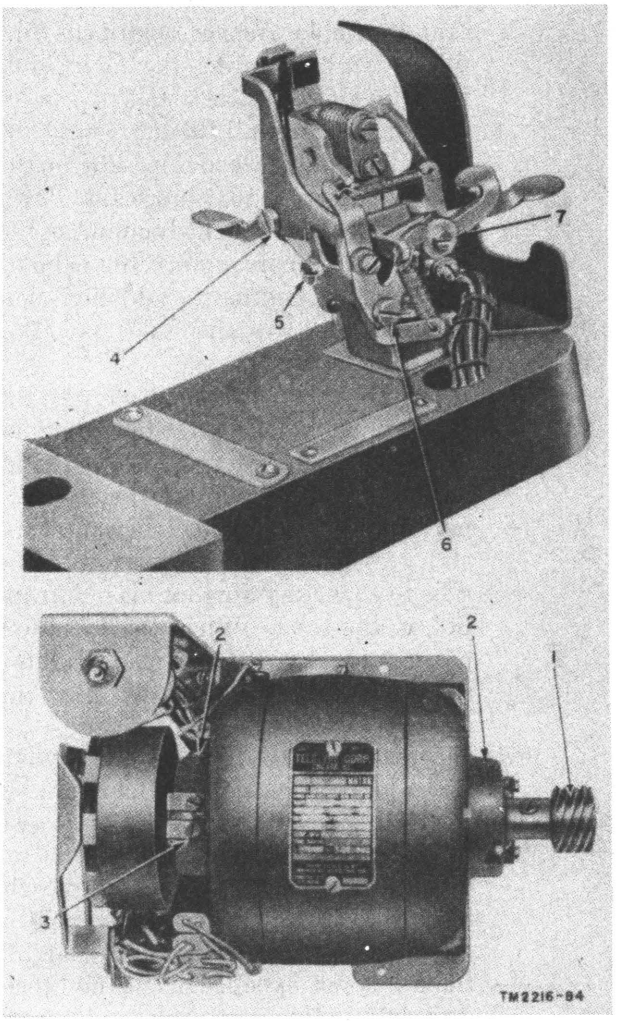


Figure 34. Lubrication points, motor unit and base.

a. MOTOR UNIT AND BASE.

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
		Motor unit		
1	34, 46, 50	Motor pinion and main shaft gear	KS–7471	Apply sparingly.
2	34	Motor bearing oilers (2)	KS–7471 or KS–7470.	Apply grease with gun or apply 4 or 5 drops of oil in each if grease is not available.
3	34	Governor adjusting lever pilot screw	KS–7470	1 or 2 drops.
		Base (SEND—REC—BREAK mechanism)		
4	34	Operating lever shoulder screw	KS–7470	1 or 2 drops.
5	34	Lower contact lever shoulder screw	KS–7470	1 or 2 drops.
6	34	Stop lever shoulder screw	KS–7470	1 or 2 drops.
7	34	SEND—REC—BREAK, levers at mounting screw.	KS–7470	1 or 2 drops in each.

b. PERFORATOR TRANSMITTER.

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
		Bottom of perforator transmitter unit		
101	35	Key levers, key lever shaft, and rear comb slots (64 points)	KS–7470	1 or 2 drops.
102	35	Selector bar guide slots (22 points)	KS–7470	1 or 2 drops.
103	35	Y levers at bearing slots and arms (34 points)	KS–7470	1 or 2 drops.
104	35	Y lever connecting links—connections with extensions and Y levers (18 points).	KS–7470	1 or 2 drops.
105	35	Selector levers and contact operating lever at bearing shaft (6 points)	KS–7470	1 or 2 drops.
106	35	Universal bar bearings (2 points)	KS–7470	1 or 2 drops.
107	35	Locking levers at point of engagement with Y lever links (5 points)	KS–7470	1 or 2 drops.
108	35	Counter control cam levers (5) at pivot points and at points of engagement with key levers (10 points).	KS–7470	1 or 2 drops.
		Top of perforator transmitter		
109	37	Key levers at front comb slots (32)	KS–7470	1 or 2 drops.
110	37	Space bar loop at bearings and at point of engagement with its key lever (3 points).	KS–7470	1 or 2 drops.
111	37	Transmitting shaft (3 points)	KS–7470 and KS–7471.	Fill oil cups and grease gear.
112	36	Transmitting cam sleeve on all cams at felts and at top and bottom of cam follower (9 points).	KS–7471	Light grease film.
113	37	Transmitting clutch on sliding members, between teeth, and on cam surface (3 points).	KS–7470	1 or 2 drops.
114	36	Locking loop at bearings and roller (3 points)	KS–7470	1 or 2 drops.
115	37	Contact levers at bearing shaft and guide slots (12 points)	KS–7470	1 or 2 drops.
116	36	Locking levers at bearing slots and at points of engagement with the contact lever (10 points).	KS–7470	1 or 2 drops.
117	36	Clutch throw-out lever bearings (2 points)	KS–7470	1 or 2 drops.
118	36	Intermediate pawl at pivot and lower extension (2 points)	KS–7470	1 or 2 drops.
119	36	Trip-off pawl at joint and camming surface (2 points)	KS–7470	1 or 2 drops.
120	36	Keyboard control operating lever at pivot and detent (2 points)	KS–7470	1 or 2 drops.
121	36	Keyboard control operating lever extension at point of engagement with repeat space rod or cut-out (2 points).	KS–7470	1 or 2 drops.

b. PERFORATOR TRANSMITTER—Continued

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
122	36	Repeat space rod at point of engagement with space bar loop extension and at bracket (2 points).	KS–7470	1 or 2 drops.
123	36	Y lever connecting link extensions at left end connections (6 points)	KS–7470	1 or 2 drops.
124	36	Selector fingers at selector lever connections, guide slots, and at point of engagement with punches and armature lever (22 points).	KS–7470	1 or 2 drops.
125	36	Armature lever at two oil holes	KS–7470	1 or 2 drops.
126	36	Antichatter contact lever at pivot and point of engagement with the adjusting screw (2 points).	KS–7470	1 or 2 drops.
127	36	Punch block at punches and guide pins (10 points)	KS–7470	1 or 2 drops.
128	37	Feed roll at bearings, ratchet teeth, and star wheel (4 points)	KS–7470	1 or 2 drops.
129	37	Tape tension lever bearings (2 points)	KS–7470	1 or 2 drops.
130	37	Backspace lever at shoulder screw bearings (2 points)	KS–7470	1 or 2 drops.
131	37	Backspace pawl bearing screw	KS–7470	1 or 2 drops.
132	37	Feed roll detent at roller and pivot (2 points)	KS–7470	1 or 2 drops.
133	37	Feed pawl bearing	KS–7470	1 or 2 drops.

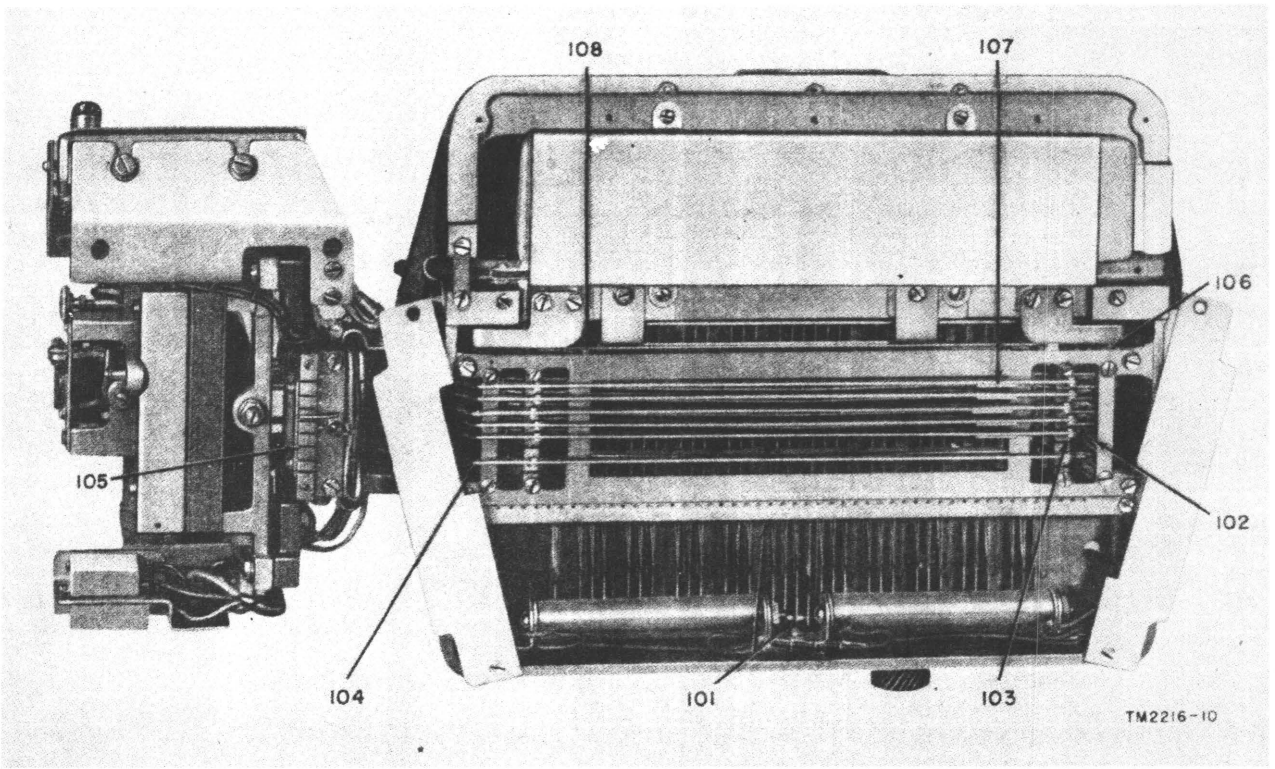


Figure 35. Lubrication points, bottom of perforator transmitter.

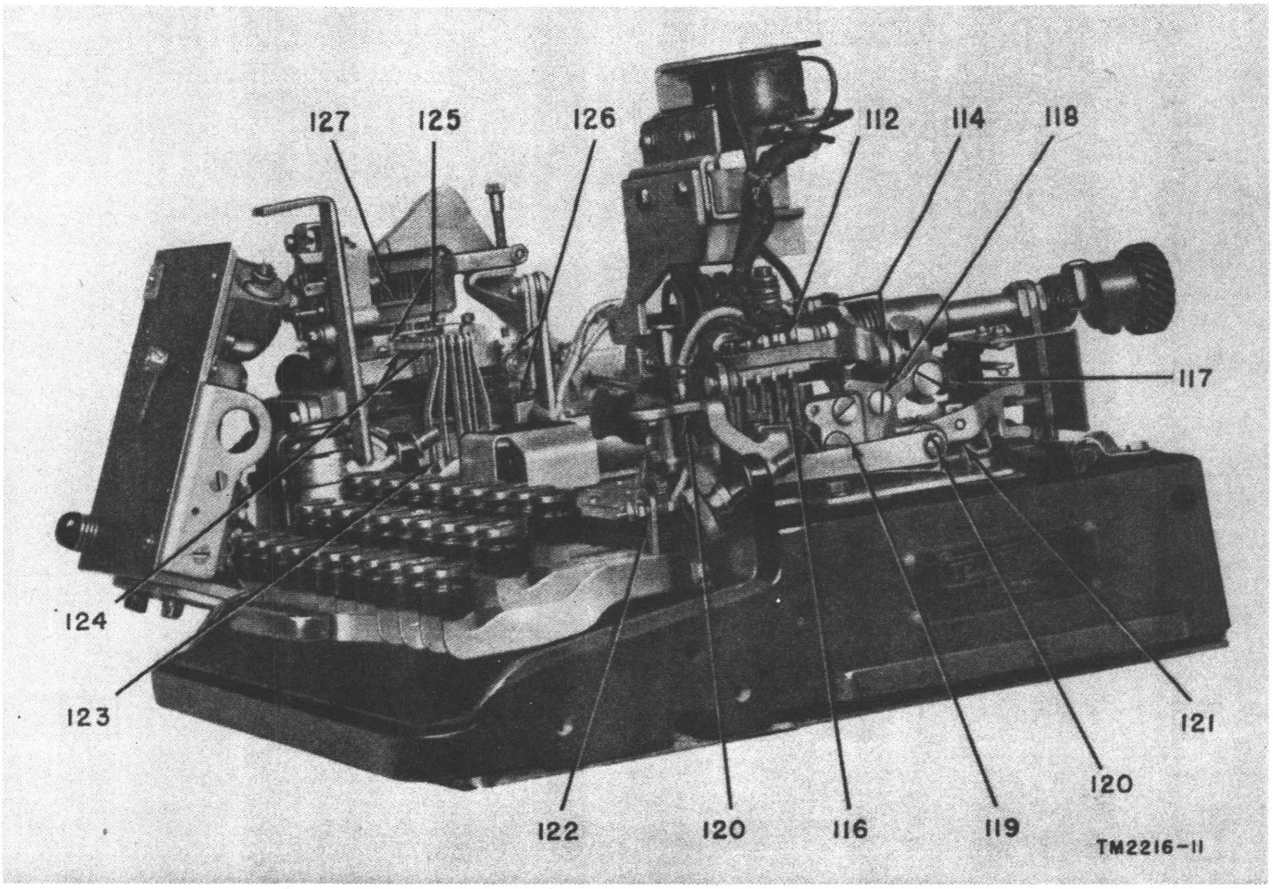


Figure 36. Lubrication points of perforator transmitter from top right side.

c. COUNTER UNIT.

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
		Note. **Prevent oil from getting between the pole faces of the magnets and the armatures.**		
134	38	Counter and release magnet armature bearings (4 points)	KS–7470	1 or 2 drops.
135	38	Feed pawl bearing screw	KS–7470	1 or 2 drops.
136	38	Check latch pawl at bearing screw and at point of engagement with the adjusting screw (2 points).	KS–7470	1 or 2 drops.
137	38	Release latch at bearing screw and on latching surface (2 points)	KS–7470	1 or 2 drops.
138	38	Ratchet wheel—on teeth, outer bearings, and in drum (4 points)	KS–7470	1 or 2 drops.
139	38	Contact lever bearing and cam (2 points)	KS–7470	1 or 2 drops.
140	38	Dash pot plunger	KS–7470	1 or 2 drops.

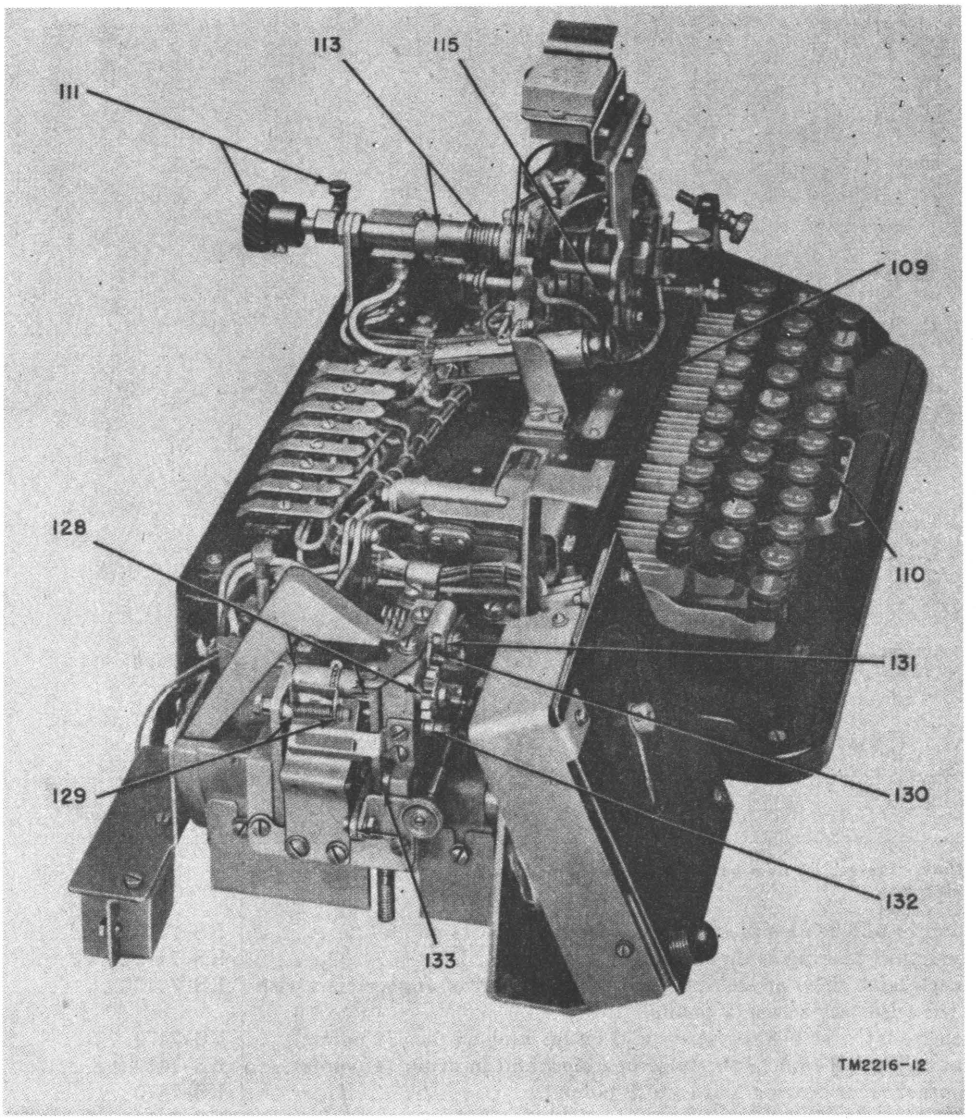


Figure 37. Lubrication points of perforator transmitter from top left side.

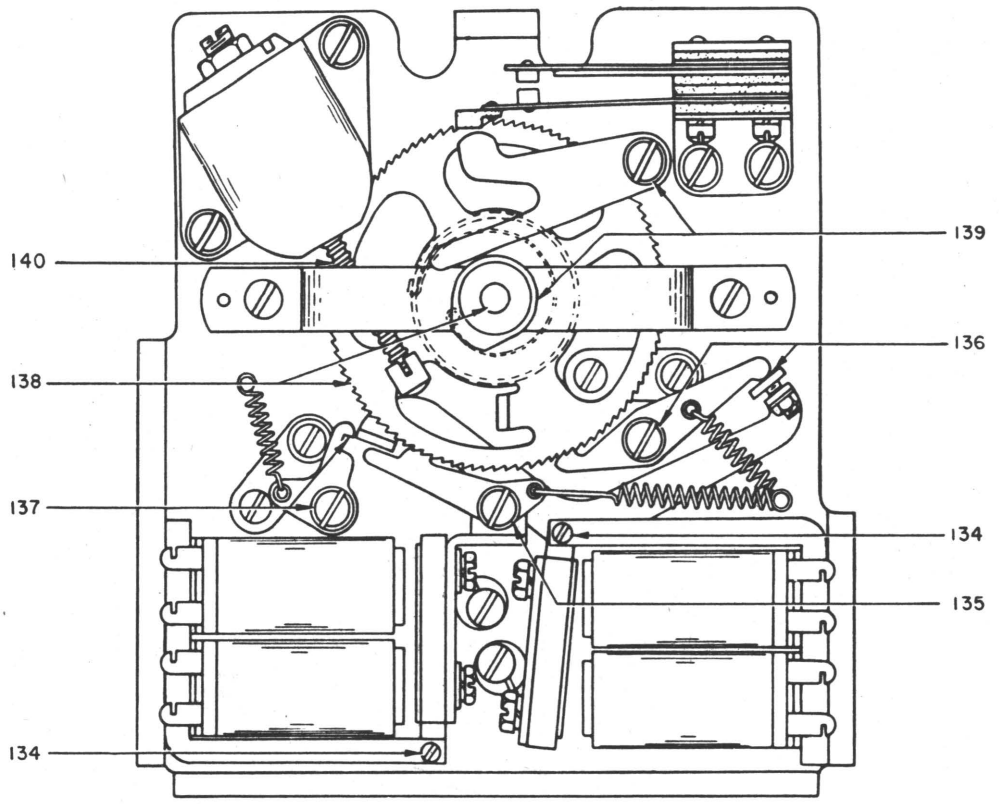


Figure 38. Lubrication point diagram, counter unit. TM2216-13

d. TYPE BAR CARRIAGE ASSEMBLY.

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
201	39	Type bars at each of 26 segment slots	KS–7470	1 or 2 drops.
202	39	Code bars, at posts	KS–7470	1 or 2 drops.
203	39	Code bar bell cranks, on wearing surfaces	KS–7470	1 or 2 drops.
204	39	Pull bar bail, on guide rollers and guide surfaces.	KS–7470 and KS–7471	Apply 1 or 2 drops of oil, then apply grease; then apply 1 or 2 drops of oil on the grease.
205	41	Pull bar bail plunger surface and rollers, and surface of pull bar bail guide post.	KS–7470 and KS–7471	Apply the same as for item 204 above.
206	41	Pull bar bail plunger guide roller (operating bail roller).	KS–7471 and KS–7470	Apply the same as for item 204 above.
207	41	Carriage support rollers	KS–7470	1 or 2 drops.
208	41	Ribbon reverse bail	KS–7470	1 or 2 drops.
209	41	Ribbon feed shaft bearings	KS–7470	1 or 2 drops (3 oilholes).
210	41	Ribbon feed pawl feed lever	KS–7470	1 or 2 drops.
211	41	Ribbon feed pawl pivot screw and wearing surfaces.	KS–7470	1 or 2 drops.
212	41	Ribbon feed ratchet	KS–7470	1 or 2 drops.
213	40	Ribbon lockout bar, at type bar segment slot.	KS–7470	1 or 2 drops.
214	39	Ribbon vertical feed shaft, on upper and lower bearings.	KS–7470	1 or 2 drops.
215	39	Ribbon feed mechanism gears	KS–7470	1 or 2 drops.
216	40	Ribbon spool shafts, on bushings (remove spools).	KS–7470	2 or 3 drops.
217	41	Ribbon reverse shafts, upper and lower bearings, arms, pawls, and levers.	KS–7470	1 or 2 drops.
218	40	Margin bell pawl, at bottom of pawl	KS–7470	1 or 2 drops.
219	40	Ribbon shift lever and roller	KS–7470	1 or 2 drops.
220	40	Ribbon oscillator lever shoulder screw and carriage casting slot.	KS–7470	1 or 2 drops.
221	40	Spacing rack teeth, spacing gear, and travel	KS–7470	1 or 2 drops.
222	41	Ribbon reverse detent roller	KS–7470	1 or 2 drops.
223	41	Ribbon feed shaft detent	KS–7471	Apply sparingly.

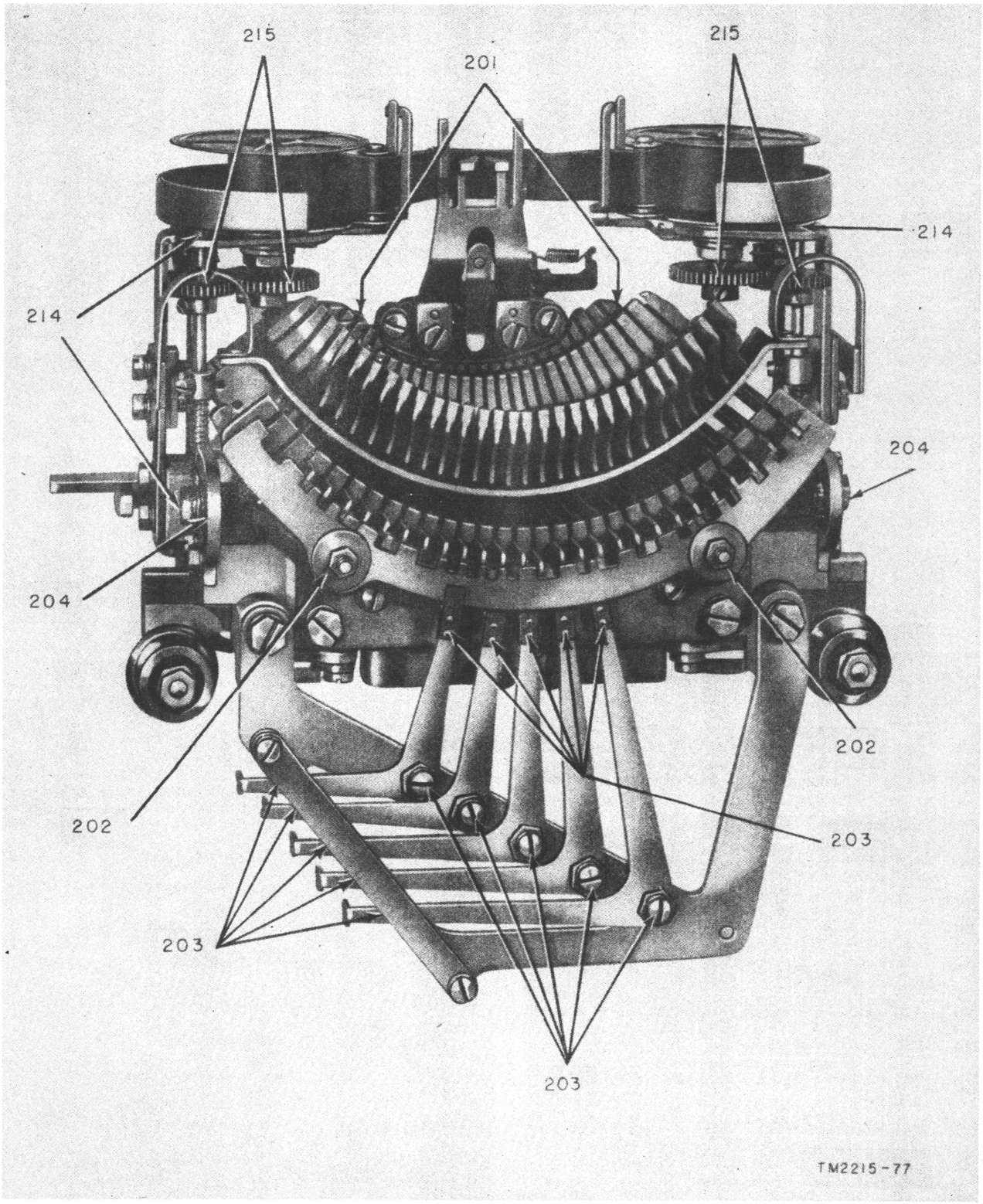


Figure 39. Lubrication points, front of type bar carriage.

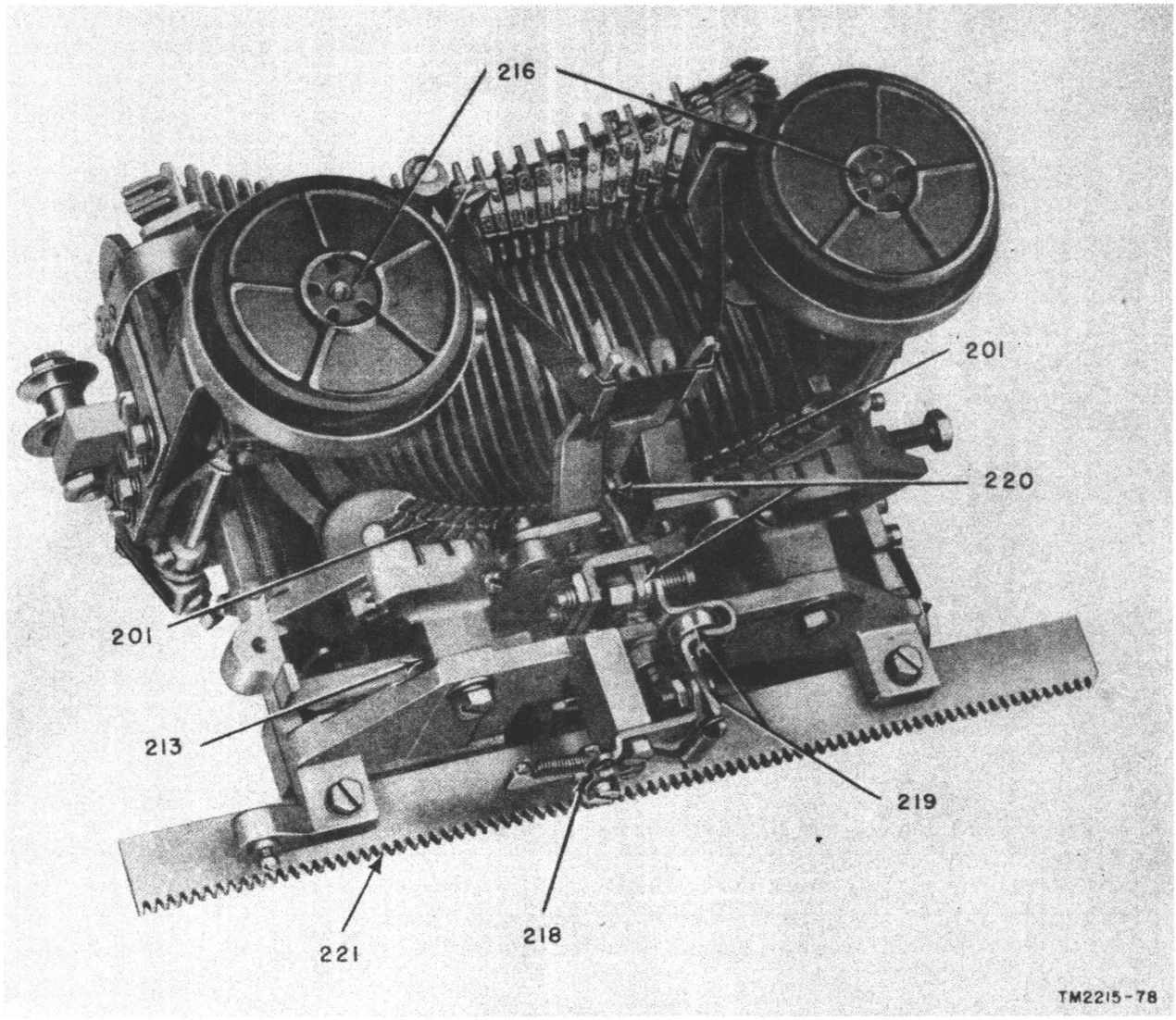


Figure 40. Lubrication points, top and rear of type bar carriage.

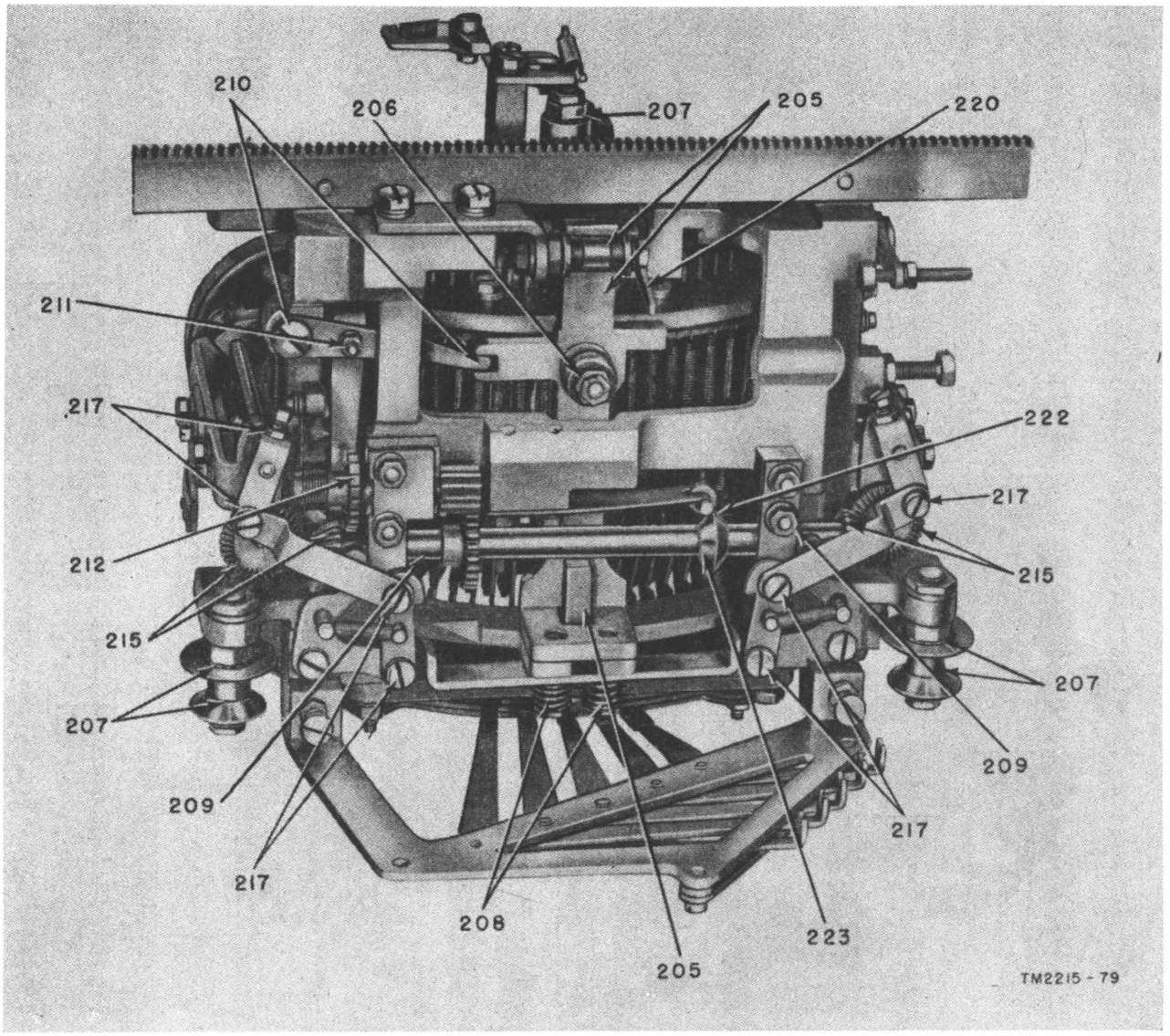


Figure 41. Lubrication points, bottom of type bar carriage.

e. TYPING UNIT PRINTS, BUT RANGEFINDER HAS POOR RANGE.

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
		Bail unit assembly		
301	42	Bail assembly shaft bearings (2 oil cups, new style)	KS–7470	Fill cups.
302	42	Between spacing pawls	KS–7470	1 or 2 drops.
303	42	Function bail and printing bail operating arm bearings.	KS–7470	1 or 2 drops at each point.
304	42	Function lever bail roller (2 bearings)	KS–7470 and KS–7471.	Apply 1 or 2 drops of oil, then grease; then 1 or 2 drops of oil on the grease.
305	42	Function lever bail roller surface	KS–7471	Apply film of grease.
306	42	Function bail and printing bail operating arm rollers.	KS–7471	Apply the same as for item 304 above.

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
		Bail unit assembly—Continued		
307	44	Printing bail blades where pull bar bail plunger guide roller engages blades (inside of both blades).	KS–7470	1 or 2 drops.
308	44	Printing bail, adjusting screw head	KS–7471	Apply sparingly.
		Vane frame assembly		
309	43	Function levers, in vane frame slots	KS–7470	1 or 2 drops.
310	43	Function levers and motor-stop contact levers, in slots in SEND—REC—BREAK mechanism plate.	KS–7470	1 or 2 drops.
311	43	Push bars and latch bars, in function lever comb	KS–7470	1 or 2 drops.
312	44	Sixth vane extension spring in slot in letters (unshift) push bar (pilot).	KS–7470	1 or 2 drops.
313	44	Vane pivot (pilot) screw bearings	KS–7470	1 or 2 drops.
314	44	SEND—REC—BREAK mechanism intermediate lever mounting screw and reset lever shoulder and pivot screws. (Do not get oil on friction spring washer of SEND—REC—BREAK mechanism T lever.)	KS–7470	1 or 2 drops.
315	44	Vanes along front edges, where bell cranks' slotted ends slide in engagement with vanes.	KS–7470	1 or 2 drops.
316	44	Sixth vane detent roller (back of vanes)	KS–7470	1 or 2 drops.
317	43, 44	Locking function lever (6 points)	KS–7471	Apply grease in notches.
		Spacing shaft assembly		
318	43, 45	Vertical spacing shaft in upper bearing; lower bearing, fill oil cup.	KS–7470	1 or 2 drops.
319	45, 43	Carriage return clutch, driven and driving member prongs.	KS–7470	1 or 2 drops.
320	43, 46	Spacing gear	KS–7471	Apply sparingly.
		Carriage return mechanism		
321	45	Carriage return latch bar, at point of engagement with latch.	KS–7471	Apply sparingly.
322	45	Carriage return clutch release fork wearing surface and operating lever bearings.	KS–7470	1 or 2 drops.
323	45	Carriage return latch bar, reset bar, and operating lever shoulder screw.	KS–7470	1 or 2 drops.
324	45	Carriage return lock bar latch link upper shoulder screw.	KS–7470	1 or 2 drops.
325	45	Carriage return spring drum bearing	KS–7470	1 or 2 drops.
326	45	Carriage return spring drum release lever shoulder screw.	KS–7470	1 or 2 drops.
327	45	Lock bar latch link lower shoulder screw	KS–7470	1 or 2 drops.
328	45	Upper arm latch, bell crank lower shoulder screw	KS–7470	1 or 2 drops.
329	45	Lock bar and upper arm latch, bell crank shoulder screw.	KS–7470	1 or 2 drops.
330	45	Lock bar latch and left-hand side frame shoulder screw.	KS–7470	1 or 2 drops.
331	45	Dash pot piston rod; rubbed over surface of piston	KS–7470	1 drop.
332	45	Dash pot lever mounting screw, roller mounting pilot screw, and at point of contact with left-hand margin adjusting screw.	KS–7470 and 7471.	Apply sparingly, oil screws and roller, apply grease at point of impact from carriage return.

e. Typing Unit Prints, but Rangefinder has Poor Range—Continued

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
		Carriage return mechanism—Continued		
333	44	Type bar carriage assembly; upper and lower track, surfaces and groove.	KS–7470	1 or 2 drops.
334	45	Carriage return spring; through oil hole in drum	KS–7470	1 or 2 drops.
335	45	Spacing stop lever and shoulder screw	KS–7471	Apply sparingly.
336	45	Carriage return operating lever stop screw	KS–7471	Apply sparingly.
		Signal bell function		
337	50	Signal bell hammer arm and arm operating lever bearings.	KS–7470	1 or 2 drops.
338	50	Signal bell reset bar and latch bar shoulder screw	KS–7470	1 or 2 drops.
339	43	Signal bell latch bar, at point of engagement with latch.	KS–7471	Apply sparingly.
		Shift-unshift mechanism		
340	50	Shift link shoulder screw and shift and unshift push bar shoulder screws (3 points).	KS–7470	1 or 2 drops.
341	50	Shift lever shoulder screw	KS–7470	1 or 2 drops.
342	50	Shift (horizontal) link extension and shift lever joint.	KS–7470	1 or 2 drops.
343	50	Shift vertical link shoulder screw	KS–7470	1 or 2 drops.
		Line feed function		
344	50	Line feed push bar and ine feed bail shoulder screw	KS–7470	1 or 2 drops.
345	50	Line feed bail mounting shaft	KS–7470	1 or 2 drops.
346	50	Line feed vertical link and line feed bail shoulder screw.	KS–7470	1 or 2 drops.
		Margin bell		
347	50	Margin bell camshaft, 2 bearings	KS–7470	1 or 2 drops.
		Main shaft		
351	46, 47	Main shaft	KS–7470	Hold right end of teletypewriter up about 6 inches and remove oil plug. Fill shaft until oil runs out of the left end.
352	46	Main shaft clutch, driven member	KS–7470	Oil freely.
353	43	Main shaft clutch throw-out lever pivots	KS–7470 and KS–7471.	Apply sparingly; oil, then grease, then oil. 1 or 2 drops before and after greasing.
354	46	Main shaft friction washers (4 points)	KS–7470	Saturate with oil.
355	46	Locking cam and felt washer on selector cam assembly.	KS–7470	1 or 2 drops on cam, saturate felt washer.
356	46	Selector cam sleeve, on each cam peak (6 points)	OE 10 or KS–7470.	1 or 2 drops each.
357	46	Main shaft right ball bearing	KS–7470 and KS–7471.	Apply 1 or 2 drops of KS–7470, turn shaft; apply thin coat of KS–7471; turn shaft a few turns; apply 1 or 2 drops of KS–7470.
358	46	Main shaft left ball bearing	KS–7471 and KS–7470.	Apply the same as for item 357 above.
359	46	Thrust bearing, on end balls	KS–7470	1 or 2 drops.

e. Typing Unit Prints, but Rangefinder has Poor Range—Continued

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
		Main shaft—Continued		
360	46	Spacing clutch spring coils	KS–7470	Permit oil to flow between prongs of driven member of spacing clutch and worm gear sleeve.
361	46	Spring which compresses friction washers of selector cam assembly.	KS–7470	Apply sparingly to coils (oil will flow between prongs of nut on main shaft and friction disk which engages this nut.
362	46, 47	Spacing gear unit; stop sleeve unit of spacing clutch, and printing bail cam unit in 2 oilholes.	KS–7470	1 or 2 drops.
363	46	Main shaft clutch camming surface	KS–7470	1 or 2 drops.
364	46	Printing bail and function bail cam surfaces	KS–7471	Apply sparingly.
365	46	Spacing escapement ratchet teeth	KS–7471	Apply sparingly.
		Selector unit		
375	48	Armature bearings (2 points)	KS–7470	1 or 2 drops.
376	49	Trip latch plunger, trip latch, bell crank lever, and stop lever of rangefinder assembly.	KS–7470	1 or 2 drops.
377	48	Swords and selector levers, between separating plates.	KS–7470	1 or 2 drops on each plate.
378	48	T levers, on all points of contact	KS–7470	1 or 2 drops.
379	48	Armature locking lever at mounting post and contact surface.	KS–7470	1 or 2 drops.
380	48	Locking wedge, at point of engagement with locking lever. (Selector cam sleeve is listed under main shaft.)	KS–7470	1 or 2 drops.
		Motor stop mechanism		
381	43, 48	Motor stop pawls shoulder screw and both motor stop lever bearings. (Right bearing under right side of sword separating plates.)	KS–7470	1 or 2 drops.
382	43, 48	Motor stop release lever bearing, eccentric and contact surfaces, motor stop contact lever bearing and at points where contact lever wears motor stop lever extension and protrudes through break mechanism plate in front of typing unit. (Points not marked are under selector or typing unit.)	KS–7470	1 or 2 drops.

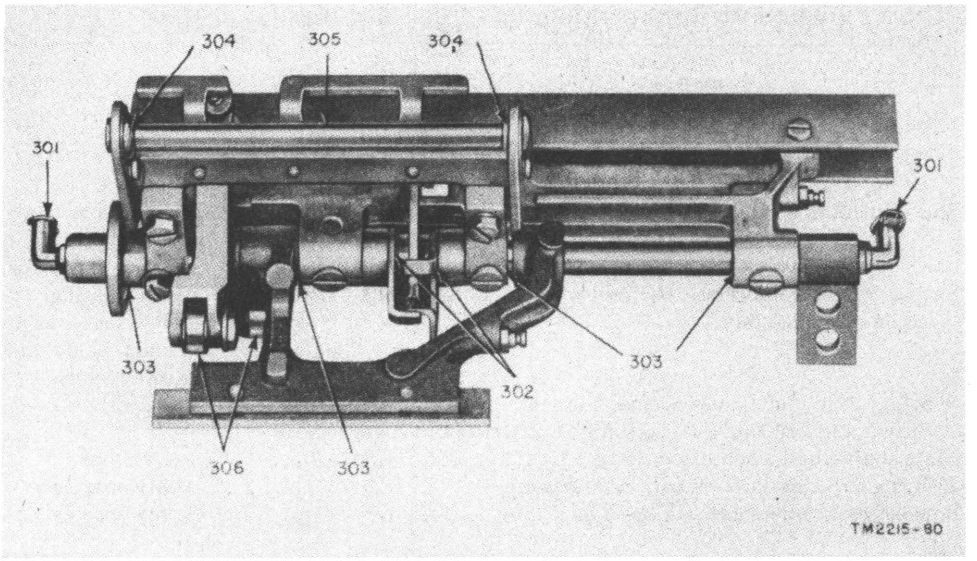


Figure 42. Lubrication points, bail unit assembly.

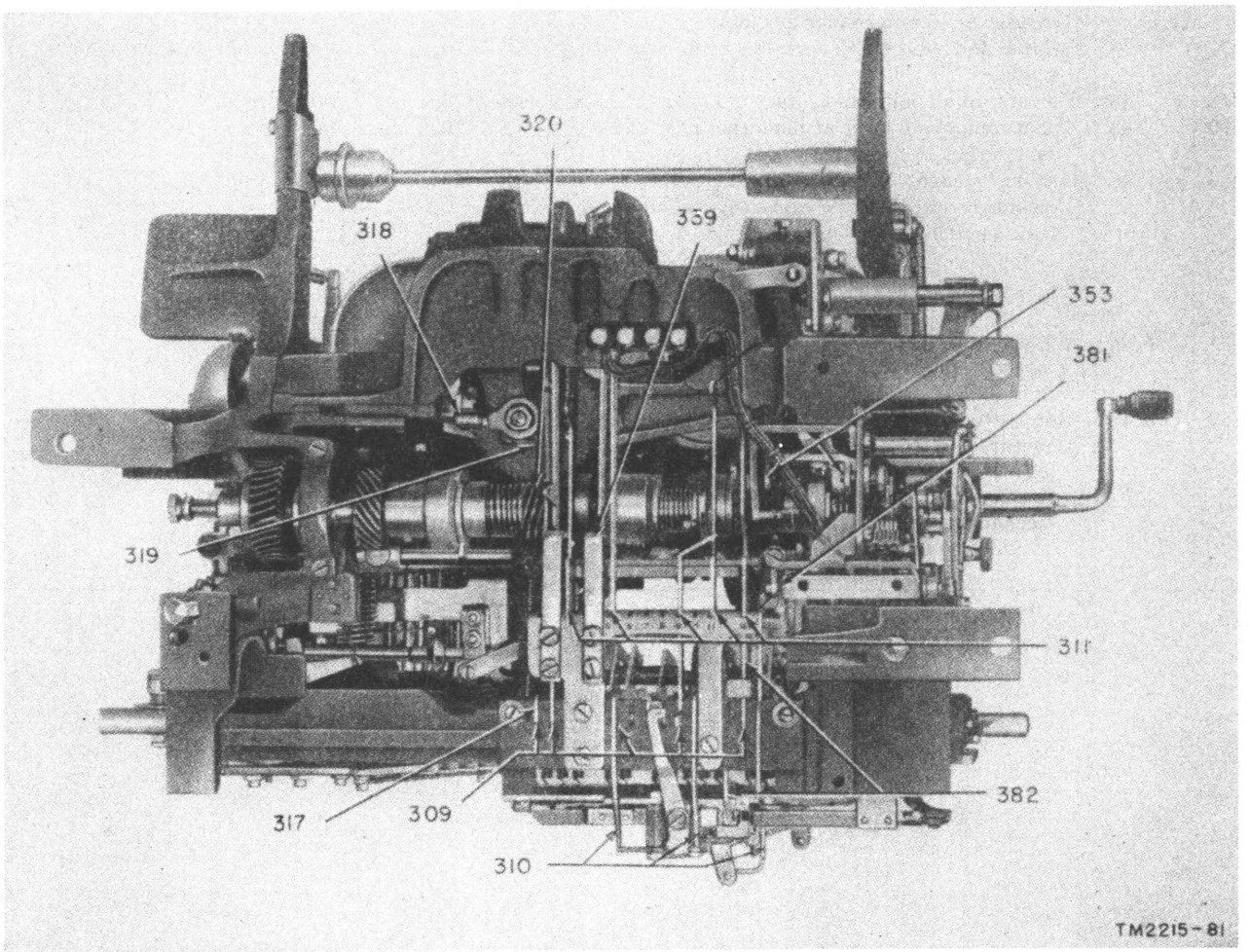


Figure 43. Lubrication points, bottom of typing unit.

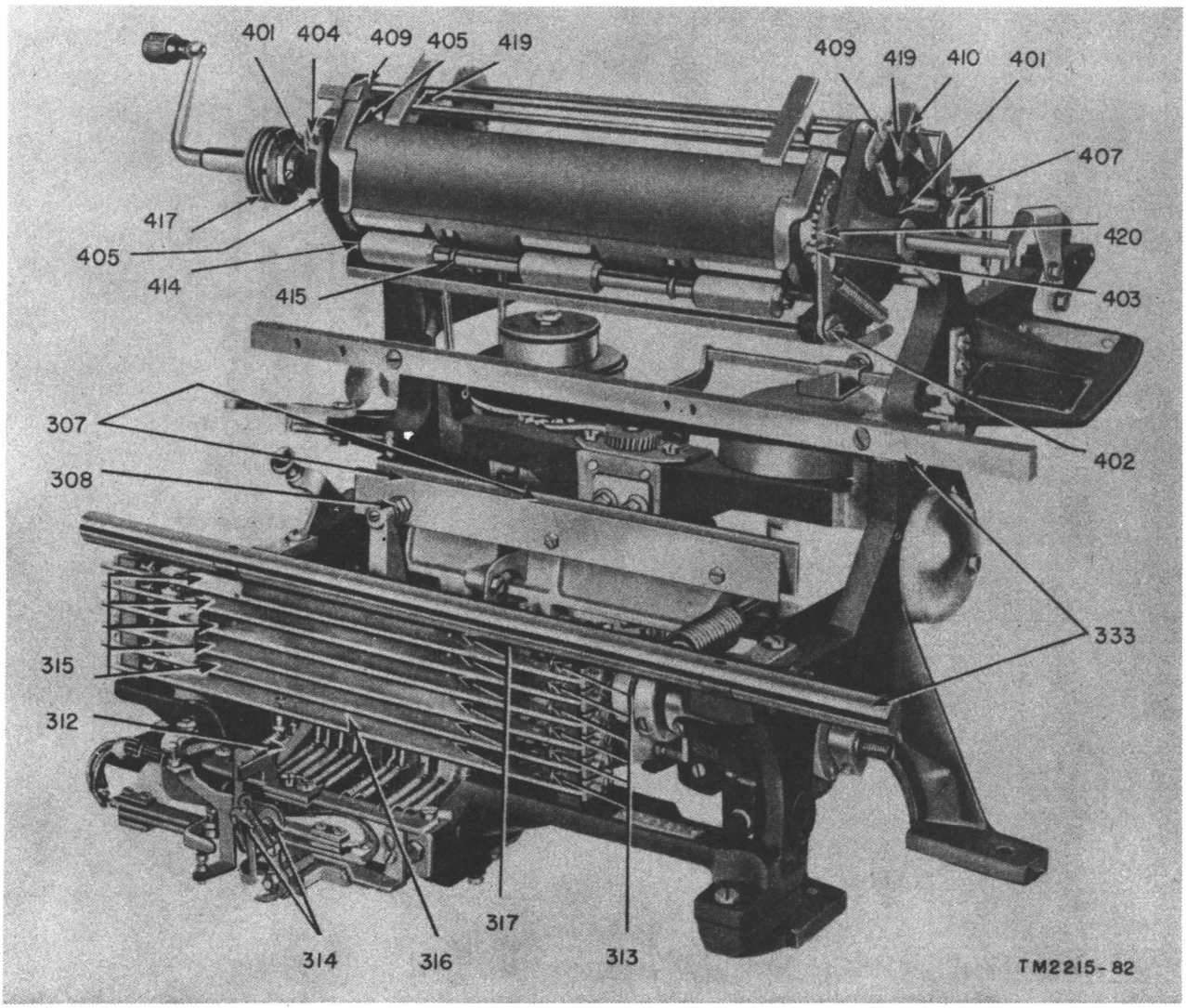


Figure 44. Lubrication points, front of typing unit.

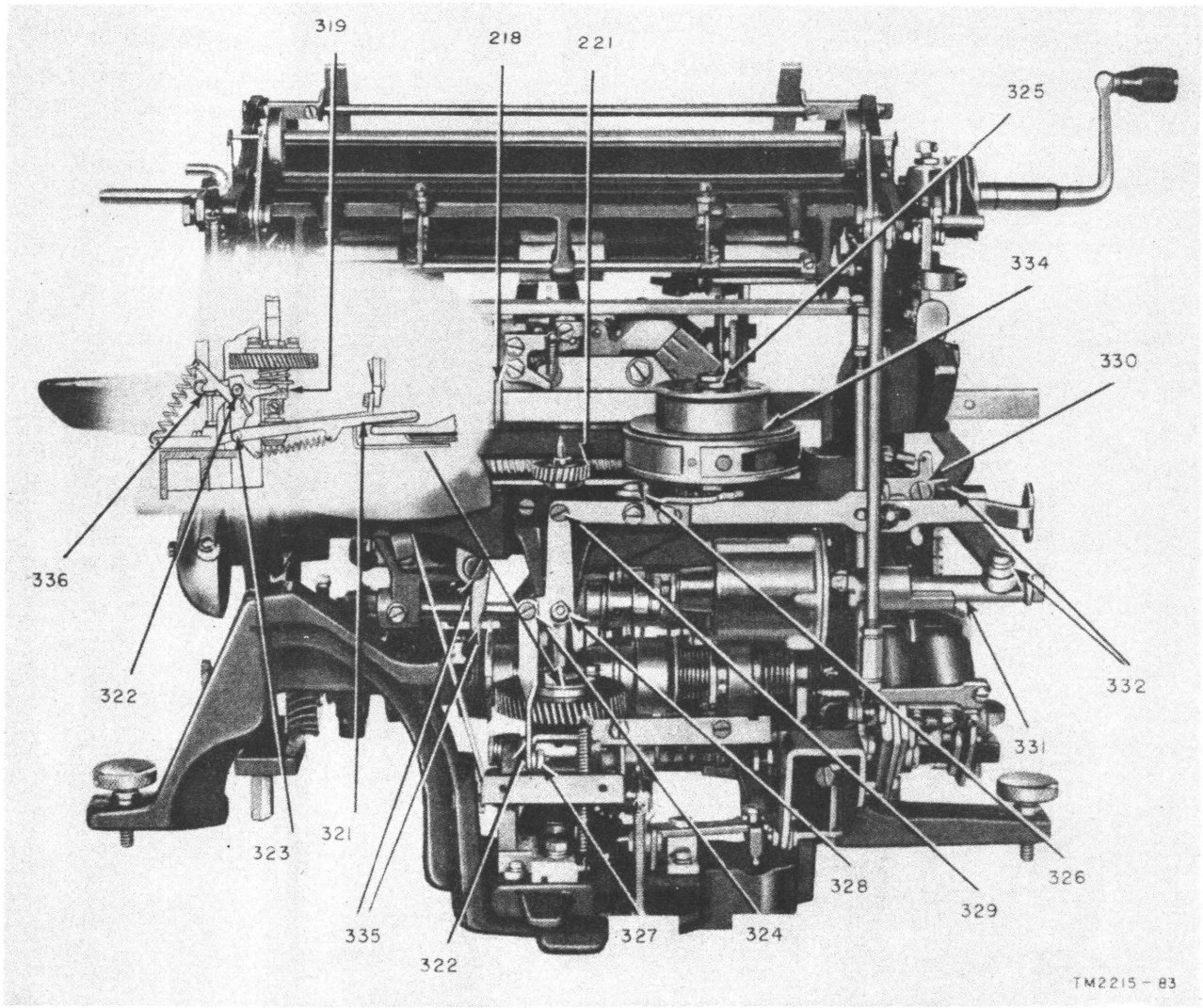


Figure 45. Lubrication points, carriage return mechanism.

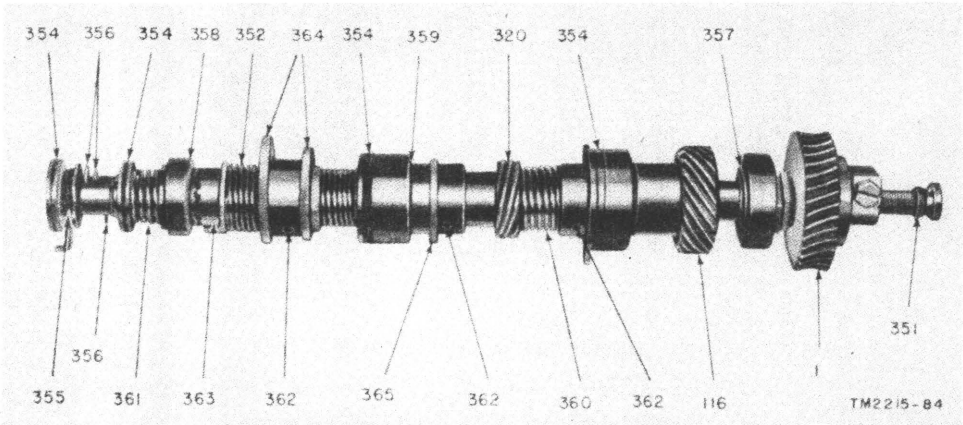


Figure 46. Lubrication points, main shaft assembly.

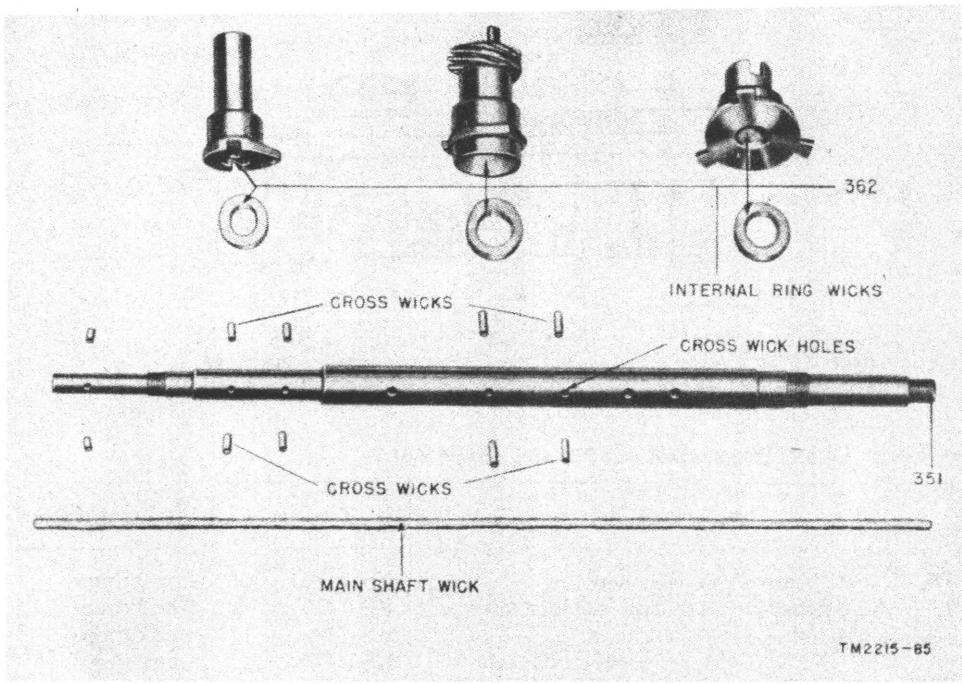


Figure 47. Lubrication wick positions in main shaft assembly.

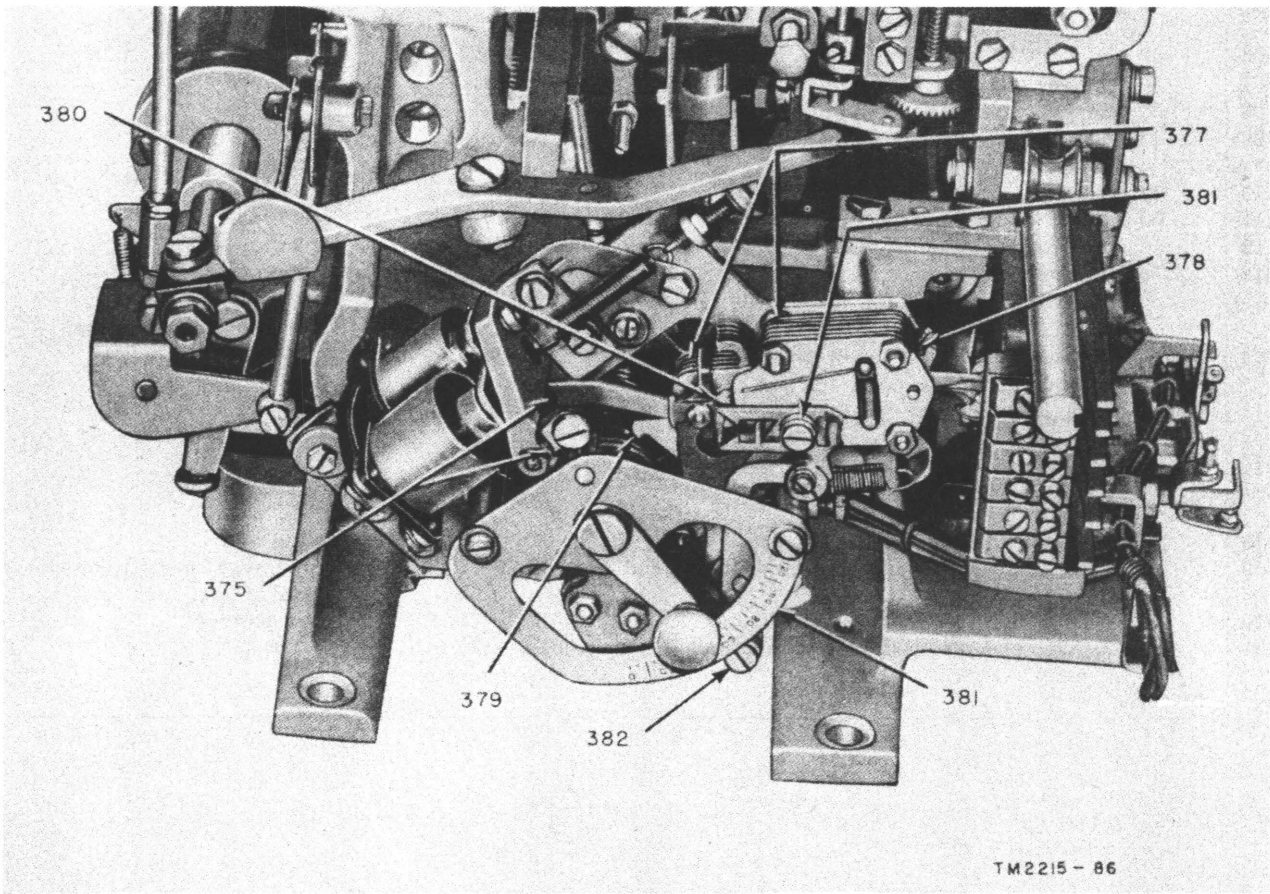


Figure 48. Lubrication points, selector mechanism.

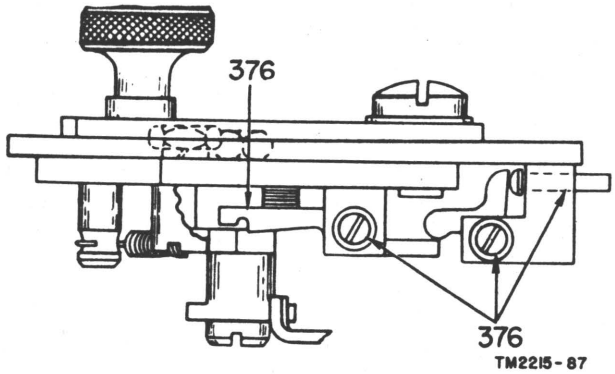


Figure 49. Lubrication points, selector mechanism rangefinder.

f. Typing Unit Less Type Bar Carriage Assembly.

Item No.	Fig. No.	Name of part	Lubricant	Method and quantity
401	44	Platen shaft bearings, in each shaft hub	KS–7470	1 or 2 drops.
402	44	Line feed detent lever eccentric shoulder screw	KS–7470	1 or 2 drops.
403	44	Line feed detent roller	KS–7470	1 or 2 drops.
404	44	Single-double line feed lever between flat line feed detent spring and line feed detent cam, and where single-double line feed lever fits into groove in platen shaft hub.	KS–7470	1 or 2 drops.
405	44	Line feed pawl and single-double line feed lever shoulder screw.	KS–7470	1 or 2 drops.
406	50	Platen shift detent roller	KS–7471	Apply sparingly.
407	50	Platen unit (pilot screws); bearings, bushings	KS–7470	1 or 2 drops.
408	50	Line feed and shift vertical links (upper ends)	KS–7470	1 or 2 drops.
409	44	Paper finger supporting arms and paper guide bearings.	KS–7470	1 or 2 drops.
410	50	Paper straightener rod lever bearings	KS–7470	1 or 2 drops.
411	50	Paper straightener rod supporting bearings	KS–7470	1 or 2 drops.
412	50	Pressure roller release shaft and crank bearings	KS–7470	1 or 2 drops.
413	50	Pressure roller release cams, release lever bearings, and spring adjusting lever shoulder screws (6 points).	KS–7470	1 or 2 drops.
414	44	Pressure roller shafts, on bearing surfaces (2 shafts, 4 points).	KS–7470	1 or 2 drops.
415	44, 50	Pressure rollers (at each end and between rollers, at spacer junctions).	KS–7470	1 drop on each.
416	50	Letters and figures stop screws (2 points)	KS–7471	Grease ends.
417	44	Platen friction disk assembly—felt washers (with disks spread apart).	KS–7470	Saturate with oil.
418	50	Paper-spindle bearings	KS–7470	1 or 2 drops.
419	44	Line feed check lever shaft bearings (each end)	KS–7471	Apply grease sparingly or 1 or 2 drops of oil if sticking.
420	44	Line feed detent ratchet	KS–7471	Apply sparingly.
421	50	Left end of platen shaft before installing platen crank.	KS–7470	1 or 2 drops.

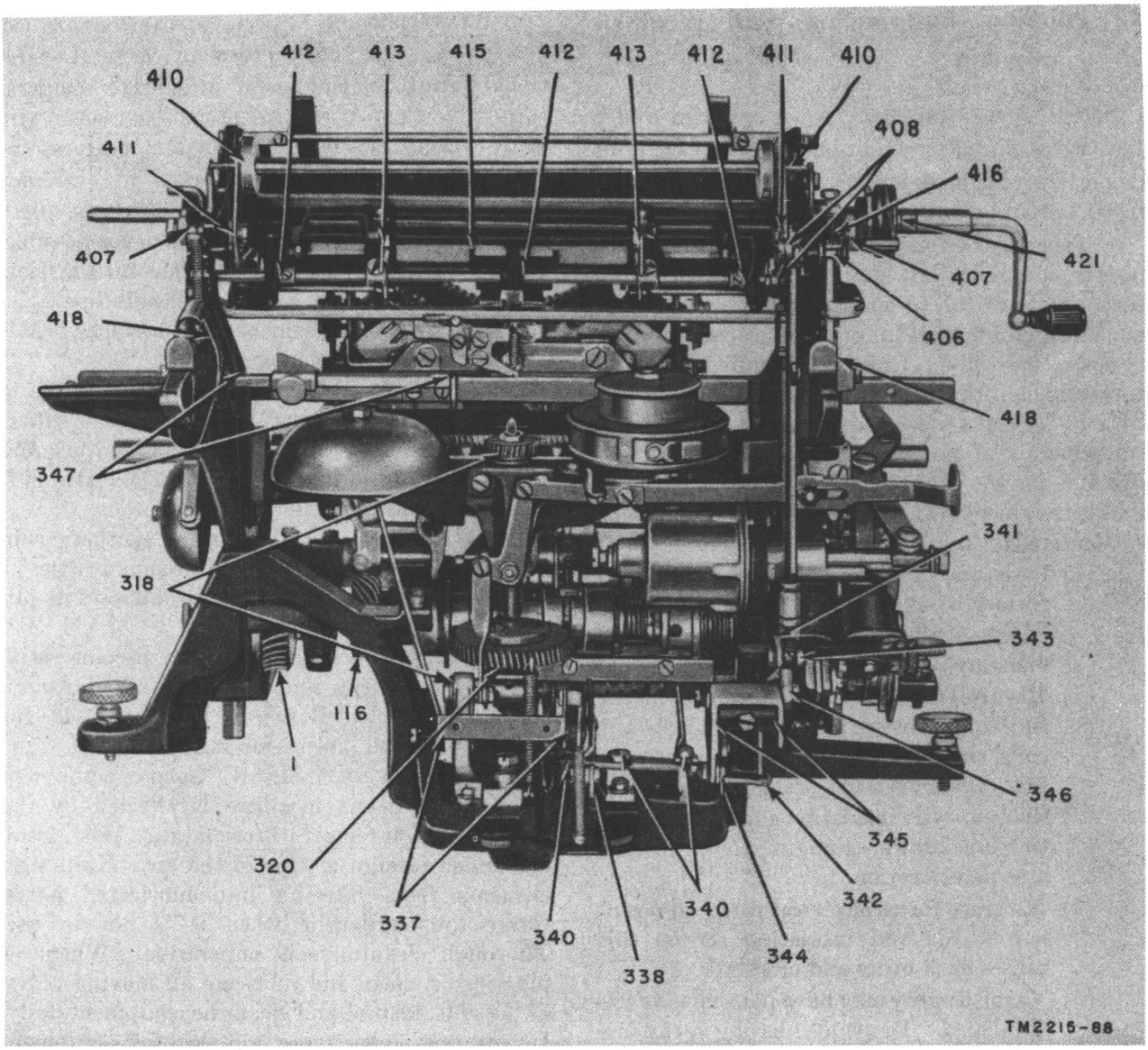


Figure 50. Lubrication points, rear of typing unit.

g. Motor Unit Bearings.

(1) The motor bearings are packed with grease before the motor leaves the factory and under ordinary operating conditions need no additional lubrication for approximately 2 months. At regular lubricating intervals, 1 or 2 strokes of the plunger of the gun should apply sufficient grease to each bearing.

(2) To lubricate, press the nozzle of the gun against the ball oiler pressure fitting and force the grease into the hole by pushing on the plunger of the gun. Be careful that the bearings are not overloaded; overloading will result in the grease oozing out of the end castings and being forced into the motor, or being thrown on other parts of the mechanism. After lubricating, run the motor for a few minutes and then wipe off any excess grease that has been forced out of the ends of the castings. Each time the gun is used for lubricating a motor bearing, the plunger first should be depressed slightly to make sure that grease will be delivered.

Note. Refer to TM–11–2222 for lubrication of transmitter distributors and to TM 11–2223 for lubrication of reperforators.

47. Painting, Rustproofing, and Weatherproofing

Signal Corps equipment, when operated under the severe climatic conditions which prevail in tropical, arctic, or desert regions, requires special treatment and maintenance.

a. TROPICALIZATION. Because fungus growth, insects, corrosion, salt spray, and excessive moisture are harmful to most materials, a special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. Refer to TB SIG 13 for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and for the supplies and equipment required in this treatment. The following problems may be encountered:

(1) Resistors, capacitors, coils, chokes, transformer windings, etc., fail because of the effects of fungus growth and excessive moisture.

(2) Electrolytic action, often visible in the form of corrosion, takes place in resistors, coils, chokes, transformer windings, etc.; this causes eventual breakdown.

(3) Hook-up wire insulation and cable insulation breakdown. Fungus growth accelerates deterioration.

(4) Moisture forms electrical paths on terminal boards and insulating strips; this causes flash-overs and crosstalk.

(5) Varnish spray may have poisonous effects if inhaled. To avoid inhaling spray, use a respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth. Never spray varnish or lacquer near an open flame. Do not smoke in a room where varnish or lacquer is being sprayed. The spray may be highly explosive.

b. MOISTUREPROOFING AND FUNGIPROOFING AFTER REPAIRS. If the coating of protective varnish has been punctured or broken during repair and if a complete treatment is not needed to reseal the equipment, apply a brush coat to the affected part. Be sure the break is sealed completely.

c. WINTERIZATION. Special precautions are necessary to prevent poor performance or total operational failure of equipment in subzero temperatures. Most signal equipment can be used in winter if difficulties common in low temperatures are anticipated and precautions taken to overcome these difficulties. For operation purposes, place the equipment in heated rooms whenever possible. Refer to TB SIG 66, for complete information. The following problems may be encountered:

(1) *Steel.* Steel shrinks and becomes brittle in subzero temperatures.

(2) *Glass.* Glass is especially susceptible to sudden temperature changes. The difference between a low air temperature and the warmth of human breath may be sufficient to shatter glass.

(3) *Rubber.* Certain types of synthetic rubber are unreliable and become brittle.

(4) *Canvas.* Canvas freezes and loses its pliability in cold weather.

(5) *Lubricants.* Lubricants become stiff, cause drag, and also cause moving parts to stick. Refer to paragraph 43 for detailed lubrication instructions.

d. DUSTPROOFING. Signal Corps equipment operated in desert localities is affected by the extremely high temperatures and dirt, dust, sand, and other foreign matter in the air. Keep such elements from filtering into lubricated parts. Cover the equipment when it is not in use. Thorough cleanliness is imperative. Whenever practicable, clean and lubricate all moving parts. If possible, inspect and clean the equipment daily. In any case, inspect any air cleaning equipment or similar protective devices every day and clean them whenever it is necessary. Refer to TB SIG 75. The following problems may be encountered:

(1) *Lubricants.* Lubricants become thin and drain rapidly from moving metal and fiber parts. Refer to paragraph 43 for detailed lubrication instructions.

(2) *Foreign matter.* Foreign matter, such as dirt, dust, and sand, acts as an abrasive and causes excessive wear, clogs air cleaners, and impedes the flow of air.

Note. Service the transmitter distributor according to TM 11-2222 and the reperforator according to TM 11-2223.

Section III. PREVENTIVE MAINTENANCE SERVICE

48. Definition and Importance of Preventive Maintenance

a. MEANING. Preventive maintenance means making periodic, systematic checks and adjustments on equipment to sustain top efficiency and to minimize unwanted interruptions. The purpose of preventive maintenance is to prevent breakdowns and, therefore, the need for repair. The purpose of trouble-shooting and repair is to locate and correct *existing defects.*

b. IMPORTANCE. The importance of preventive maintenance cannot be overemphasized. Failure or inefficient operation of a piece of equipment may cause the failure of an entire communications system. Most of the operations in this section are of the organizational maintenance type.

49. Preventive Maintenance Techniques

a. Most of the mechanical and electrical parts used in teletypewriter equipment require routine preventive maintenance. Definite and specific methods are needed.

b. The type of maintenance necessary is determined by field conditions. For example, dust encountered on dirt roads during cross-country travel filters into equipment regardless of preventive measures used. Rapid changes in weather (such as heavy rain followed by blistering heat) or excessive dampness, snow, and ice cause corrosion of exposed surfaces. Without frequent inspections and the necessary tightening, cleaning, adjusting, and lubricating operations, equipment will not be dependable.

c. Rotating machinery such as motors, cams, shafts, etc., can be checked by feel to determine if electrical connections, bushings, etc., overheat. The maintenance man must be familiar with the normal operating temperatures of the equipment to recognize signs of overheating. It is important that the feel operation be performed as soon as possible after shut-down and always before performing any other maintenance.

d. Inspection is most important. The inspector must know how to check for required clearances, tensions, and adjustments of mechanical assemblies. A careless observer will overlook evidences of minor trouble. Although these minor defects may not interfere at once with the performance of equipment, valuable time and effort are saved if they are corrected before they lead to major breakdowns. Note the state of cleanliness, lubrication, amount of wear, adjustment and placement, tightness, clearance, tension, overheating, noise, and moisture accumulation. Inspect for:

(1) Cleanliness, by examining carefully all surfaces where dust, dirt, excessive oil, or grease may accumulate. In tropical and high humidity locations, look for fungus growth, mildew, and accumulations of moisture.
(2) Inadequate or excessive lubrication.
(3) Excessive wear (indicated by loose fittings, bearings, etc.).
(4) Adjustment and improper placement, by determining that all mechanical and electrical parts are adjusted properly and in their original positions.
(5) Looseness by sound and by testing any connection, assembly, or mounting that normally is fastened in a rigid position. Before tightening any screws, bolts, or nuts, determine whether they are part of an adjustment. If so, tighten in accordance with the detailed requirement and adjustment procedures given in chapter 4 and check all related adjustments.
(6) Clearance between specified points, by feeling, sighting, or inserting gages as specified.
(7) Spring tensions, by using the appropriate special spring scale in the exact manner as shown in the illustration accompanying each spring tension requirement.
(8) Overheating, as indicated by discoloration, blistering, or bulging of the parts or surface of the container, by leakage of insulating compounds, and by oxidation of metal contact surfaces.

e. Tightening applies only to bolts, screws, and fasteners holding items rigidly in place. Correct tightening procedure requires use of the proper type of tools. Do not tighten screws, bolts, and nuts carelessly. *Do not tighten parts or apparatus requiring clearance or tension.*

f. Cleaning as applied to external surfaces of cabinets, bases, panels, frames, etc., is the normal dusting and wiping process. Cleaning equipment interiors, including delicate electrical and me-

chanical parts, requires detailed, specific procedures for each assembly. This cleaning normally is performed as part of the preventive maintenance routines listed in the schedule form in paragraph 64. Detailed cleaning instructions for major overhauls are given in paragraph 152. Clean items marked with the letter C in the schedule (par. 64) only when inspection shows it to be necessary.

g. Adjustments are made when they are necessary to maintain normal operating conditions. Be careful in selecting the proper tools and gages. Many adjustments must be made in a particular sequence. *Each* adjustment must meet *all* requirements for clearance, spring tension, speed, and other tolerance limits. If *one* adjustment is changed, check *all* related adjustments. This check may involve a certain amount of duplication, but there are no practical short cuts when making overlapping functional adjustments. Detailed instructions for specific requirements and adjustments are given in chapter 4.

h. Lubrication refers to the application of oil or grease to all rotating shafts and bearings, cam rollers, sliding surfaces, and other moving parts. Lubrication may include the application of oil to metal surfaces on parts. Complete all lubrication in accordance with instructions given in chapter 3.

Note. See paragraph 47 for instructions on weatherproofing.

50. Preventive Maintenance Procedure

a. Preventive maintenance procedure is divided into two classes: work that can be completed while the teletypewriter is in service, and work that requires that the teletypewriter be taken out of service. For preventive maintenance for the transmitter distributor, refer to TM 11–2222. For preventive maintenance for a reperforator, refer to TM 11–2223.

b. The first class of work is limited to the operations performed on the exterior of the teletypewriter, the perforator transmitter, the typing unit cover, the table, and the rectifier power unit.

c. Detailed information pertaining to the individual test requirements and adjustments of complicated parts and mechanisms are not included in this section. The preventive maintenance checklist (par. 64) includes references to detailed instructions required when making adjustments during preventive maintenance procedures.

d. Preventive maintenance procedures for common classes of parts are grouped as follows:

Typing unit cover and transmitter distributor exterior
Table
Perforator transmitter
Cords, cables, and wiring
Terminal blocks and slip connections
Keys and switches
Rectifier power unit

e. Detailed preventive maintenance instructions are arranged as follows:

Preparation for preventive maintenance (teletypewriter out of service)
Table
Base
Motor unit
Typing unit (less type basket)
Type basket
Perforator transmitter, including beyboard and character counter
Rectifier power unit

f. When worn, broken, or defective parts are found, repair or replace them as directed in chapter 4. After all preventive maintenance work has been completed (including detailed lubrication procedure), reassemble the teletypewriter and make the following adjustments and tests: motor speed, rangefinder setting, and local operating tests. When any adjustment is made or changed, *always* check adjustment of related parts.

51. Preventive Maintenance for Teletypewriter Exterior (Equipment in Service)

a. Typing Unit Cover.

(1) Inspect the typing unit cover and the housing of the perforator mechanism and tape reel that are part of this cover. Look for dents, cracks, marred painted surfaces, rust, corrosion, broken glass, loose or missing screws, escutcheons, faulty hinges, and damaged metal flaps (over the polar-neutral key, rangefinder, and perforator mechanism). See that the tape reel cover is in good condition and fits securely over the tape reel housing. See that the copyholder is in good condition.

(2) Tighten all loose screws, hinges, escutcheons, and the copyholder.

(3) Clean the outer surfaces of the typing unit cover with a piece of cheesecloth slightly moistened with water. To remove oil, grease, or gummy stains on the outer surface of the cover, moisten a cloth slightly with solvent, (SD). Remove rust spots from exposed metal surfaces by rubbing with an oily cloth. As soon as possible, clean away any oil, then repaint the exposed metal surface. Clean the exterior of the transmitter distributor while cleaning the typing unit cover. For preventive maintenance of the transmitter distributor, refer to TM 11–2222.

b. Table.

(1) Inspect the table for breaks or cracks in the metal. Look for marred painted surfaces, missing or loose screws, and dust, dirt, or corrosion, especially at the back of the table and on the rear shelf.

(2) Tighten all loose screws and other fastenings. If loose power receptacles, jacks, and terminal boards at the back of the table are found, refer to paragraph 66. See that the supports of the rear shelf are secure and that the rubber foot at the bottom of each leg of the table is in place. Tighten the screws that hold the metal panels at the back of the table.

(3) Clean the outer or painted surfaces of the table; use cheesecloth and water, or solvent (SD). Use a suitable brush to clean out dust and dirt which may accumulate in the corners of the rear shelf. Repaint exposed metal surfaces.

c. Perforator Transmitter Keyboard.

(1) Inspect the keyboard for cracked key levers and see that the keyboard frame is secure and is not cracked or broken.

(2) Tighten the thumbscrews that hold the keyboard casting to the base. Check that the keytops are secure on each key lever.

(3) Clean keytops, keyboard frame, space bar and the top of the table immediately under the keyboard. Use a damp cloth to clean keytops. Do not use solvent (SD) on rubber keytops. Remove rust by rubbing with an oily cloth. Repaint exposed metal surfaces.

(4) Lubricate the key lever guide bar.

d. Rectifier Power Unit.

(1) *Make sure that power has been disconnected before touching this unit.* Inspect the exterior of the rectifier power unit for loose screws and fastenings. See if the door can be fastened securely. Look for cracks and dents and distortion of the rectifier power unit cover. See that the cover fits securely over the electrical parts.

(2) To tighten cable and cord clamps and electrical connections, remove the protective cover of the rectifier power unit. Tighten the fastening screws that hold the cover in place and those that secure the door. If cords and cable appear loose, refer to chapter 4.

52. Preparation for Preventive Maintenance Inspection (Equipment Out of Service)

a. For a thorough preventive maintenance inspection, the teletypewriter must be taken out of service and partially disassembled as outlined in *b* below. Prepare a suitable work table or bench upon which to place the components after their removal from the teletypewriter table. Spread several sheets of paper under and around the work table to catch small parts that may be dropped during disassembly.

b. Remove the equipment from service and disassemble it as follows:

(1) Disconnect the power from the teletypewriter by pulling the power cord from the power source. If power leads are connected directly to a power terminal board, open the service switch before disconnecting these leads. If there is no service switch, disconnect the power leads (using lineman's gloves) at terminals 21 and 22 on power terminal board E601. Be careful not to short-circuit the power leads by allowing them to touch each other or any grounded part of the equipment. Always tape exposed ends of live conductors.

(2) Disconnect the power cords from the rectifier at the receptacles and power connections in back of the table.

(3) Disconnect the operating components by pulling the red and black plugs out of their respective jacks. Disconnect the signal lines at line terminal board E603,

E604, or E605. Always tag each signal line as it is removed from a terminal to indicate polarity, location at the line terminal board, and type of signal (neutral, polar, or polarential) characteristic of the related circuit.

(4) Remove the typing unit cover as follows:

(*a*) Remove the paper from the copyholder and the tape from the tape reel housing and perforator mechanism. Remove the platen crank.

(*b*) Lift off the typing unit cover and set it aside. Place the tape reel housing cover on the copyholder so that it will not be lost or mislaid.

(5) Remove the following components in the order indicated:

(*a*) The keyboard and perforator mechanism attached to it by loosening the thumbscrews that hold the assembly to the base. Set the entire assembly aside and protect it against dust and damage.

(*b*) The three large, flat, knurled screws that hold the typing unit to the base. Lift the typing unit off the base and set it upon a work table or bench so that it is supported by the hexagonal studs on the bottom of the typing unit. Cover the typing unit and protect it against dust, dirt, or damage.

(*c*) The relay from the base if servicing is necessary. Set the relay aside in a safe place where it cannot be damaged.

(*d*) The mounting screws that hold the motor unit to the base. Lift off the motor unit and replace the screws in the base to prevent loss. Set the motor unit aside and protect it so that the governor will not be disturbed.

(*e*) The base, so that the cords and wiring at the right front corner can be pulled through the cut-out hole in the table top. Do not force the plugs at the ends of the cords through the cut-out hole.

(*f*) The transmitter distributor from its mounting on top of the table. Lift the front of the unit first to release it from its mounting, then slide it out with its cover in place, and set it aside in a safe place.

(*g*) The rectifier off its shelf at the back of the table. Place it where it will not be damaged or dropped. Protect it against entry of dust and dirt.

(*h*) The table, move so that the wiring and electrical fittings at the back can be reached easily.

53. Preventive Maintenance of Teletypewriter Table

a. INSPECTION.

(1) *Top.* Inspect the protective pad and the steel channels that hold it in place. Look for worn spots and cut or frayed edges on the protective pad. Locate broken, cracked, or bent edges, and corroded or rusted places. Note the condition of the transmitter distributor mounting.

(2) *Ends and front.* Inspect the ends of the table. They are made of sheet steel and may be cracked or dented, or the paint may be marred and exposed surfaces may be rusted. At the lower left front of the table top is the chad box. In front of the chad box are located the transmitter and rectifier switches. In the front edge of the table is the tape out key. Examine these points for dirt, rust, and corrosion. See that the switches are tight and that they operate normally. If they do not operate normally, refer to paragraph 192.

(3) *Back of table.* Inspect the electrical outlets, a-c—d-c switch, fuseholders, LINE and TEST jacks, and other electrical connections. Look for loose mounting screws, dirt, dust, rust, or corrosion. Examine the mounting holes into which are fastened the screws that hold the protective metal plates in position. Observe any bent, cracked, or broken metal or bakelite receptacles or fittings. See if the terminal boards are held securely in place.

b. TIGHTENING.

(1) *Top.* Tighten all mounting screws of the transmitter distributor mounting. If it is necessary to tighten electrical contacts, first refer to chapter 4. Tighten the rails or metal moldings that hold the protective pad in place. Restore them to their normal condition by bend-

ing the edges carefully. Tighten the chad box if necessary.

(2) *Back of table.* Tighten all metal protective plates on the back of the table. If necessary, replace or tighten the signal or power line terminal boards and connections. Tighten the jack blocks, electrical outlets, and receptacles. Do not remove them to tighten conductors that terminate at these connection devices.

c. CLEANING.

(1) *Top.* Brush away all dust and dirt, and clean corroded places on the table top. Use an oily cloth to remove rust spots. Repaint exposed metal surfaces. Use a stream of clean, dry air to blow out dust from between the transmitter distributor contact springs. If the protective pad on top of the table cannot be cleaned, replace it. To remove gummy, oily, or greasy spots from the tabel top, use cheesecloth moistened with solvent (SD).

(2) *Front.* Brush dust and dirt from the under surface of the table. If necessary, blow dust out of the chad box.

(3) *Back of table.* Brush all dust and dirt from the shelf upon which the rectifier power supply rests. Use a suitable brush or a stream of clean, dry air to clean out the compartment in which the line terminal boards are located. Do the same in the power terminal board compartment. Blow all dust and dirt out of the compartment that holds the jacks and line resistors. If jack springs and resistors require tightening or other attention, refer to chapter 4. Remove all corrosion and rust, and paint all exposed metal surfaces. Do not damage the weatherproof coating that protects the conductors which terminate at electrical receptacles, outlets, and jacks.

d. ADJUSTMENTS. The only parts of the table that may require adjustment are:

(1) Electric power connections and contacts in power terminal boards, plugs, resistors, receptacles, and outlets.

(2) Electrical signal circuit contacts in line terminal boards, LINE jacks, and the transmitter distributor mounting.

(3) A-c,—d-c switch, line switching key, tape out switch, and transmitter distributor and rectifier a-c switches. Adjust these items as directed in chapter 4.

e. LUBRICATION. The only part of the table that may require lubrication is the transmitter distributor mounting, which has two rails onto which the transmitter distributor slides. Lubricate these rails.

54. Preventive Maintenance for Teletypewriter Base

a. Inspect the base for loose screws, cracked or chipped paint, broken or damaged metal parts, cracked or broken electrical contacts, and insulating materials. Adjust, repair, or replace fuse block, electrical outlets, and electrical terminals and contacts as directed in paragraph 192.

b. Tighten all screws, nuts, and bolts of the base. See that the terminal boards, electrical outlets, and fuse blocks are securely in place. If spring contacts such as those that complete the electrical circuits to the typing unit, motor unit, perforator transmitter, etc., and the SEND–REC–BREAK contacts require tightening, refer to paragraph 488. See that the corner mounting feet at the bottom of the base unit are tight, and that the bottom plate is fastened securely. If the motor switch requires attention, refer to paragraph 192.

c. Use a lint-free cloth or soft brush to clean the base. Use a stream of clean air to blow out dust and sand from inaccessible places. Use an oily cloth to remove rust spots. Clean away all corrosion and any oil that may have dripped onto the base from the typing unit or the motor unit. The bottom plate of the base may be removed, if necessary, to clean under the surface containing the keyboard, motor unit, and typing unit spring contacts. *Do not attempt to clean contact springs.* Repaint all exposed metal surfaces. Renew the weatherproof coating, if necessary (par. 47). Remove dust from resistors and capacitors in the relay mounting. To clean the electrical spring contacts and the SEND–REC–BREAK mechanism contacts, refer to chapter 4. Clean only the outside cover.

d. Adjust the base as instructed in paragraph 488.

e. The rails upon which the keyboard transmitter slides onto the base, and certain other points, may require lubrication (par. 46).

55. Preventive Maintenance for Motor Unit

a. The motor should turn freely, smoothly, and quietly when turned by hand or when operated under power.

b. Check the motor unit for evidences of overheating, which may be indicated by discoloration or a smell of burned insulating material. Look for a loose pinion holding screw, loose governor (to shaft) holding screw, motor mounting screws, looseness of the target, and for a broken or bent governor adjusting bracket. See that the lamp, switch, and lamp housing are in good condition. If they are not in good condition, refer to chapter 4.

c. Tighten the screws that hold the motor to the motor unit base plate. See that the governor adjusting bracket, governor adjusting lever, target lamp, and lamp housing are secure. Tighten the pinion on the motor shaft if necessary. Tighten the governor on the motor shaft. *Do not adjust the motor plate adjusting screw* (fig. 216). Refer to paragraph 197.

d. Clean the exterior of the motor only. If the commutator is marked or dirty, clean it as instructed in chapter 4. Remove all dust, dirt, grease, and corrosion from the outside of the motor, external motor governor contacts, and motor mounting plate. See that the governor is clean and that the wires leading to the motor are intact and clean. If they are oil-soaked and require replacement, proceed as directed in paragraph 197. Repaint all exposed metal surfaces.

e. Adjust the motor unit, governor adjusting bracket, and governor adjusting lever as directed in chapter 4. Adjust the motor alinement as instructed. Make other adjustments of the motor unit in accordance with instructions in chapter 4.

f. Lubricate the motor unit in accordance with instructions in section II of this chapter.

56. Preventive Maintenance for Typing Unit (Less Type Bar Carriage)

Remove the type bar carriage and set it aside where it will be protected from dust, dirt, and damage.

a. Inspect the typing unit for:

(1) Cracks or other damage to the frame casting.

(2) Loose, broken, or missing mounting screws.

(3) Bent, broken, or worn levers, vanes, rollers, bearings, shafts, gears, etc., and see that all parts move freely.

(4) Missing, broken, or distorted springs and spring posts.

(5) Binding, excessive wear, or damage to the main shaft and associated gears, bearings, cams, clutches, and springs.

b. Tighten loose screws, bolts, or nuts, *only if they are not a part of some adjustment.* If part of an adjustment, adjust only according to chapter 4.

c. Use a piece of clean cheesecloth (or other lint-free cloth) folded over a stick of wood of appropriate size to remove all grease, oil, and accumulated dust and dirt. Clean between the vanes, between the printing bail blades, between the function levers, and in other relatively hard-to-reach places. Be careful not to bend or distort metal linkages. Use a clean cloth to remove oil or grease from all accessible surfaces. Do not permit dirt, grit, or other foreign matter to drop into bearings or on working surfaces. Wipe each bearing with a piece of clean cloth. Loosen the rangefinder retaining screws. Remove the left screw completely and slip the rangefinder off the remaining screw (with the slotted screw hole). Use a piece of clean cloth folded over a stick to remove oily deposits of dirt, dust, paper lint, etc., from the outer surface of the selector magnet mechanism and rangefinder. Flush the selector mechanism by pouring a small amount of solvent (SD) between the separator plates. Repeat the flushing process as necessary. Use only about 1 tablespoonful of solvent (SD) each time. Do not disassemble the selector mechanism unless the foreign material cannot be removed by flushing. Only qualified personnel will disassemble the selector mechanism. *Relubricate after cleaning.*

d. To remove the glaze and aid in eliminating paper slippage, wipe the platen surface with a piece of clean cheesecloth lightly dampened with solvent (SD). *Use solvent (SD) sparingly on rubber platens. Excessive amounts of solvent (SD), swell the rubber and cause it to split, making the platen unfit for further use.*

e. Make only those adjustments directed in paragraph 64, unless trouble or defects are found. These adjustments are to be made only by thoroughly experienced personnel equipped with the necessary tools, gages, spring scales, etc. The

exact requirements for these adjustments, and the others if necessary, are given in chapter 4.

f. Lubrication instructions for the typing unit are given in paragraphs 41 through 46.

57. Preventive Maintenance of Type Bar Carriage

a. Inspect the type bar carriage for the following:

(1) Missing mounting screws, bolts, and loose parts.
(2) The frame for cracks or other damage.
(3) Each bell crank, code bar, and type bar to determine that parts are not bent or distorted, and that they are in good condition, and operate freely.
(4) Each type bar for missing or damaged type pallets.
(5) Levers, gears, shafts, and bearings for signs of excessive wear, or damage, loose parts, or excessive oil or grease.
(6) Missing, broken, or distorted springs.

b. Tighten all loose screws, bolts, and parts except those that need adjustment.

c. Prepare a pad of cheesecloth large enough to cover an area about 8 inches square. Insert this pad between the type bars and the backstop to catch dirt and cleaning fluid (solvent (SD)).

(1) Wipe the face of the type pallets with a piece of cheesecloth moistened in solvent (SD). *Do not bend the type bars.*
(2) After the pallets are dry, brush them with a clean, dry typewriter brush (part of Tool Equipment TE–50 or TE–50–A).
(3) Tilt the type bar carriage and flush the solvent (SD) through the segment slots. *Flushing with solvent (SD) destroys existing lubrication. Relubricate the parts after they are thoroughly dry.*

d. Refer to chapter 4 for necessary adjustments. Adjust the type bar carriage as required. Refer to paragraphs 41 through 46 for lubrication instructions.

58. Preventive Maintenance of Perforator Transmitter

a. Inspect the perforator transmitter for the following:

(1) Cracks or other damage to the frame and the mechanical linkages that connect the perforator mechanism to the keyboard assembly. Make sure that the character counter dial, warning lamp and housing, and dial glass are in good condition.
(2) Loose, missing, or broken screws, nuts, bolts, fastenings, and electrical connections. Frayed or broken wire insulation.
(3) Levers, pawls, latches, selector bars, springs, bearings, etc. See that all parts move freely and are not damaged or broken.
(4) Missing, broken, or illegible keytops.
(5) Missing, broken, or distorted springs.
(6) Damaged or broken drive shaft gear and associated gear clutch and bearings for binding. Check the contacts of the operation control lever and the punches and guides of the perforator mechanism. See that the backspace adjustment and the key pressure adjustment are in good operating order.

b. Do not tighten parts requiring clearance or tension adjustments. For tightening electrical connections, refer to chapter 4.

c. Clean the perforator transmitter keyboard as follows:

(1) Clean the keytops with a piece of cloth moistened in water. *Never use solvent (SD) on rubber keytops.*
(2) Blow out or brush away dust and debris in the perforator mechanism and around the mechanical levers that connect it to the keyboard.
(3) For complete disassembly, repair, or adjustment instructions, refer to chapter 4. When disassembled, normally inaccessible points of the equipment may be reached for cleaning.

d. For adjustment of the perforator transmitter (including character counter and warning lamp) and keyboard, refer to chapter 4.

59. Preventive Maintenance of Rectifier

Place the rectifier power unit on a table or bench. Lift off the cover.

a. Inspect for loose connections, damaged or broken parts, and defective or burned-out wiring. Look for evidences of overheating, noting whether the transformer, filter reactor, and the heater transformer appear to be discolored. Look for

loose cable or cord connections and for loose connections at the tap and fuse and cord panels.

b. Tighten all loose screws, bolts, nuts, cable clamps, etc. See that the terminal screws on the tap and fuse and cord panels are tight. *Do not attempt to tighten adjustment screws on the time delay relay.* If adjustment of this relay is required, refer to chapter 4. Do not turn the potentiometer adjustment. Adjust the potentiometer only as directed in paragraph 490.

c. Use a suitable brush, a stream of clean dry air, or cheesecloth to clean away dust, dirt, and oily or gummy deposits. To remove stains or dirt that cannot be removed with a cloth dampened in water, use a cloth dampened in a small quantity of solvent (SD). Remove all rust spots with an oily rag. Repaint all exposed metal surfaces, and restore weatherproof coatings. To remove corrosion from fuses or fuseholders, use No. 000 sand paper or crocus cloth and wipe clean with a dry cloth.

d. For adjustments to be made to the rectifier power unit, refer to paragraph 490.

60. Preventive Maintenance of Cords, Cables, and Wiring

a. Preventive maintenance procedure covered in this paragraph applies to the wiring located in the following items: the base, the typing unit, the perforator transmitter, the motor unit, and the rectifier power unit. Wires which are tied together or cabled sometimes are called wiring harness. Wiring on equipment operated in all kinds of weather and moved over various terrain is subjected to severe punishment; therefore, check the wiring frequently.

b. Inspect for kinks and poor supporting means, cracked or deteriorated insulation, frayed or cut insulation at connecting or supporting points, and strain due to improper placement.

c. Tighten ground connections, loosened fasteners, cable clamps, and wiring connections. A loose or inefficient ground may interfere with operation of the equipment in a manner difficult to trace, and also may nullify lightning protection for equipment and personnel. Repair loose or broken soldered connections.

d. Clean connector straps by removing and scrubbing them with a clean brush dipped in solvent (SD). Dry thoroughly with a cloth. If connectors are corroded, clean them with No. 0000 sandpaper. The contact surface of a connector always should be clean and bright. Remove corrosion, rust, dirt, and dust from ground connections. Make sure that the outer insulating cover of cords and cables is wiped clean. If necessary, use a clean cloth moistened in water. Never use oil or solvent (SD) on rubber insulation. If the weatherproof coating of fabric-covered wire requires renewal or repair, refer to paragraph 47. Clean plugs with polish, metal, paste (Sig C stock No. 6G1516).

e. Adjustment of wiring normally is arranged so that it does not interfere with operation of mechanical parts. It may be necessary to resolder connections or to replace wiring or conductors when they become worn or damaged. To replace wiring, refer to chapter 4.

61. Preventive Maintenance of Terminal Boards and Slip Connectors

Blocks used as receiving, connecting, and distributing points for electrical circuits usually are made of a strip of insulating material and one or more types of electrical connectors. These devices may be either solder or screw terminals, contact springs, or contact lugs. They require little preventive maintenance unless the wiring has been changed.

a. Inspect terminal boards for cracks, breakage, dirt, and loose connecting or mounting screws. Examine the connections for mechanical defects (broken or stripped screws and threads), dirt, grease, and corrosion.

b. Tighten loose screws, lugs, and mounting bolts. Use tools of the correct size. Do not strip threads by exerting too much force. Solder loose or broken connections.

c. Use a clean dry brush to clean the terminal boards. Wipe off excess moisture with a clean dry cloth. When necessary, the insulation strips may be cleaned with a cloth moistened in solvent (SD). Wipe thoroughly and remove all lint. Remove and clean corroded or loose connections with a piece of No. 0000 sandpaper or crocus cloth. Use carbon tetrachloride to clean electrical contact surfaces of all connecting devices.

d. Adjust the spring tension of contact springs when necessary. To increase spring tension, grasp the spring near its anchor point with a spring bender or a pair of duck-billed pliers. Twist the tool slightly in the direction in which it is desired

to increase the tension, and move the tool continuously along the slight bow (or curvature) in the spring. Test the action of the spring after each adjustment. Keep all soldered connections intact. If resoldering is necessary, refer to chapter 40.

e. *Never* lubricate an electrical contact.

62. Preventive Maintenance of Keys and Switches

a. All keys and switches on the teletypewriters are grouped as a common class. No specific information is provided for any particular key or switch.

b. Inspect the mechanical action of each key and switch. Look for dirt or corrosion. Operate each key or switch to see that it moves freely. Observe the amount of spring tension and any excessive looseness.

c. Tighten loose screw lugs and mounting bolts. Remove loose connections which are dirty or corroded, and clean them before tightening or soldering. Tighten switch connections and repair broken solder connections.

d. Wipe off excess moisture. Clean the exterior surfaces of keys and switches with a stiff brush moistened in solvent (SD). *Never apply solvent (SD) to rubber keytops.* Clean corroded and dirty contacts. Use a burnishing tool to polish contact surfaces after cleaning with abrasives such as No. 0000 sandpaper, crocus cloth, or a contact file. If contacts are pitted or burned, use the contact file to restore the surfaces and then polish with a burnishing tool.

e. Refer to chapter 4 for instructions covering the adjustment of keys and switches.

f. Never lubricate an electrical contact surface. If mechanical linkages require lubrication, refer to section II of this chapter for the necessary instructions.

63. Preventive Maintenance Schedules and Records

Prepare a chart that shows the various teletypewriter sets in the installation, the average number of hours of operation daily, the dates the routines are scheduled, and the dates when and by whom completed. Base the schedule upon accurate information and revise it from time to time as conditions change. The record form used may cover time intervals of 1 month, 2 months, or any other period desired by the officer in charge of the installation. Recommended time intervals for equipment routines are:

a. Equipment in operation 12 to 24 hours daily: routine every 10 days.

b. Equipment in operation 8 to 12 hours daily: routine every 15 days.

c. Equipment in operation 8 hours or less daily: routine every 30 days.

d. The above time intervals for equipment routines are based on operating conditions found in an average business office in the continental United States. When equipment is operated in localities where there are extreme temperatures, excessive moisture, dust, dirt, or sand, or other adverse conditions, establish the routine schedules on whatever intervals are necessary to keep the equipment in operating condition.

64. Preventive Maintenance Checklist for Teletypewriters TT–7/FG and TT–8/FG

a. Preventive Maintenance by Operators.

Item No.	What to check	When to check	How to check
1	Teletypewriter exterior	Daily	Inspect for damaged places, chipped paint, dirt, dust, rust, corrosion, and loose or missing screws. Tighten all loose screws. Clean with clean dry cloth slightly moistened with solvent (SD) to remove oil, grease, or foreign matter. Wipe with dry cloth.
2	Rectifier	Daily	Check for cleanliness. Clean with clean dry cloth in same manner that item No. 1 is cleaned.
3	Motor speed	Daily	Check and adjust motor speed.

b. Preventive Maintenance by Field Maintenance Personnel.

Item No.	What to check	When to check	How to check
1	Typing unit (less type bar carriage).	X*	*a.* Clean all mechanical parts; inspect and adjust rangefinder setting, the armature trip-off eccentric screw adjustment, and the selector armature end play and locking wedge. Inspect, clean, and adjust the magnet bracket, the carriage return latch bar latch, and the carriage return lock bar latch eccentric screw. *b.* Inspect spring posts (2½-pound (or more) tension). *c.* Inspect the function bail cam roller, the function lever bail roller pivot bearings, the printing bail cam roller, and the cam roller pivot bearings. *d.* Inspect, clean, and adjust relays. *e.* Inspect and adjust the platen assembly, the dash pot, and the left-hand margin adjustment. *f.* Inspect, clean, and adjust the motor stop contacts and the slip connections. *g.* Lubricate the entire mechanism.
2	Type bar carriage	X	*a.* Inspect and clean all mechanical parts. *b.* Inspect and adjust the ribbon mechanism; check the type bar backstop. *c.* Lubricate the entire mechanism.
3	Perforator transmitter	X	*a.* Clean all mechanical parts. *b.* Inspect, clean, and adjust the transmitting and perforating contacts. *c.* Inspect, tighten, and clean the terminal board and the wiring. *d.* Inspect and clean the polar-neutral key. *e.* Lubricate the entire mechanism.
4	Base	X	*a.* Inspect and clean all mechanical parts. *b.* Inspect, tighten, and clean terminal boards, clip connections, cords, wiring, and plugs. *c.* Clean and adjust the send-receive-break mechanism. *d.* Inspect and clean the motor switch. *e.* Lubricate the entire mechanism.
5	Motor unit	X	*a.* Clean the exterior. *b.* Check general over-all condition. *c.* Inspect and tighten the motor pinion gear. *d.* Inspect and clean the armature commutator, brushes, and brush holders. *e.* Inspect and clean the governor. *f.* Inspect, tighten, and clean the wiring and the light switch. *g.* Lubricate the entire motor unit.
6	Table	X	Inspect, tighten, and clean the entire table, especially terminal boards, switches, wiring, and jacks.
7	Rectifier	X	*a.* Clean the entire rectifier. *b.* Inspect, tighten, and clean cords and wiring. *c.* Inspect, tighten, clean, and adjust the tap panel. *d.* Check the fuses and fuse holders.

*Indicates when operations are to be performed and is determined by average hours of use as follows:

Hours of use	Normal temperatures	Tropical temperatures
Up to 8 hours per day	Every 30 days	Every 15 days.
8 to 12 hours per day	Every 15 days	Every 10 days.
12 to 24 hours per day	Every 10 days	Every 7 days.

SHEET NO. 4

YEAR 1945

PREVENTIVE MAINTENANCE ROUTINE SCHE

TYPE OF EQUIPMENT AND SET NO.			APRIL			MAY			JUNE		
MODEL 15 TELETYPEWRITER SET NO. 1		DATE SCHEDULED	10	20	30	10	20	30	10	20	30
		DATE COMPLETED	9	20	30						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	24	COMPLETED BY	GH	JJ	JJ						
MODEL 15 TELETYPEWRITER SET NO. 2		DATE SCHEDULED	--	15	30	--	15	30	--	15	30
		DATE COMPLETED	—	14	31						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	12	COMPLETED BY		MK	MK						
MODEL 19 TELETYPEWRITER SET NO. 1		DATE SCHEDULED	10	20	30	10	20	30	10	20	3
		DATE COMPLETED	10	21	30						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	24	COMPLETED BY	GH	JJ	JJ						
MODEL 19 TELETYPEWRITER SET NO. 2		DATE SCHEDULED	--	15	30	--	15	30	--	15	
		DATE COMPLETED	—	15	31						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	12	COMPLETED BY		JJ	MK						
MODEL 15 TELETYPEWRITER SET NO. 3		DATE SCHEDULED	--	--	30	--	--	30	--	--	
		DATE COMPLETED	—	—	29						
AVERAGE NUMBER OF HOURS OF OPERATION DAILY	8	COMPLETED BY			MK						

24 HOURS DAILY OPERATION

12 HOURS DAILY OPERATION

8 HOURS DAILY OPERATION

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Figure 51. Typical preventive maintenance routine schedule.

Section IV. TROUBLE SHOOTING

65. Definition of Trouble Shooting

a. General. Several factors must be considered before an attempt is made to locate trouble in equipment. The information and trouble analysis charts in this section are intended to provide a step-by-step procedure for the inexperienced trouble shooter and a ready reference for the experienced trouble shooter. The origin of a trouble report and the manner in which a trouble is detected determine the procedure.

b. Source of Trouble Reports. Figure 52 is a typical equipment record card, and figure 53 is a typical trouble record. Reported troubles may be divided into two classes:

(1) Troubles reported in a manner to indicate they probably result from failure in the teletypewriter or in associated equipment or connecting facilities. Sometimes these troubles are intermittent and require extensive checks of all equipment and facilities. Substitution of teletypewriters or units known to be in good condition is often the fastest method of proving which part of a circuit is involved in the intermittent trouble.

(2) Troubles which are readily apparent, or which definitely are identified by a trouble report as being in a particular part.

c. Troubles Detected by Inspection. Trouble found during routine check of the equipment, or during a major overhaul, usually are of a definite nature. These troubles may require detailed analysis; use special testing equipment.

EQUIPMENT RECORD CARD

Equip and No.	Location	Telephone No.	Date Installed
EE-9 7	BEAVER	BEAVER	5/23/45
Type Circuit	**Remarks**		**Associated Equip**
SIMPLEX	5 MILES FIELD WIRE (ON GROUND) TO REPEATER, CKT 310/10		TG-30
Connected to	**Length of Line**		**Line Crnt. Sply.**
DEXTER	30 MILES		LOCAL

TROUBLE RECORD

Reported				Test Showed	Trouble Found	Cleared		
Date	Hour	By	Trouble			Date	Hour	By
5/24/45	1300	HW	CAN'T SEND	SHORT CKT.	SHORT CKT AT	5/24/45	1320	OC

(over)

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Figure 52. Typical equipment record card.

TELETYPEWRITER TROUBLE RECORD

TG-7-B MODEL	SERIAL NUMBERS: 85784 BASE; 63528 KEYBOARD; 101264 MOTOR UNIT; 81754 TYPING UNIT			SET NO. 12		
DATE / TIME	REPORTED BY	TROUBLE REPORTED	DISPOSITION	DATE	TIME	CLEARED BY
17 JAN 0725	W.E.C.	MOTOR FAILS TO START.	REPLACED MOTOR FUSE.	17 JAN	0728	H.M.G.
26 JAN 1945	P.G.C.	PAPER TEARS.	READJUSTED PAPER GUIDE.	26 JAN	2005	W.R.R.
2 FEB 1030	W.E.C.	PRINTS INCORRECT LETTERS AT TIMES.	TIGHTENED SCREW IN RANGE FINDER ASSEMBLY.	3 FEB	0630	R.F.H.

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Figure 53. Typical trouble record.

d. Trouble Analysis. Thorough knowledge of the sequence of operation for each functioning element is of fundamental importance. The trouble shooter must be able to determine quickly whether trouble is in a particular assembly. The appearance of a particular operating failure may indicate immediately the exact location of a faulty adjustment or damage. If the failure cannot be determined, it is necessary to observe carefully which functions operate properly and which do not.

e. Process of Elimination. By determining which of the transmitting, receiving, and common functions of a teletypewriter operate properly and which do not, the trouble shooter will save considerable time and effort. The trouble analysis charts, which list commonly observed faults, are of considerable assistance in determining the best

sequence and testing procedure for a particular condition. By sending to, and receiving from, a teletypewriter known to be in good condition, trouble can be proved to be in the transmitting, receiving, or common functions. The local or dummy testing circuit in the table is used when a second teletypewriter is not readily available. When a definite observed fault is found, refer to paragraph 79 for the related list of indicated conditions, and select the items that logically could be the cause of the fault.

f. Localizing Trouble. When it is determined by observation or testing which of the assemblies or functions cause trouble, isolate or localize the trouble in a particular electrical circuit or mechanical element. The trouble analysis charts provide reference data for both electrical and mechanical failures. Information on the best procedures for locating the more common troubles is contained in paragraphs 70 through 78.

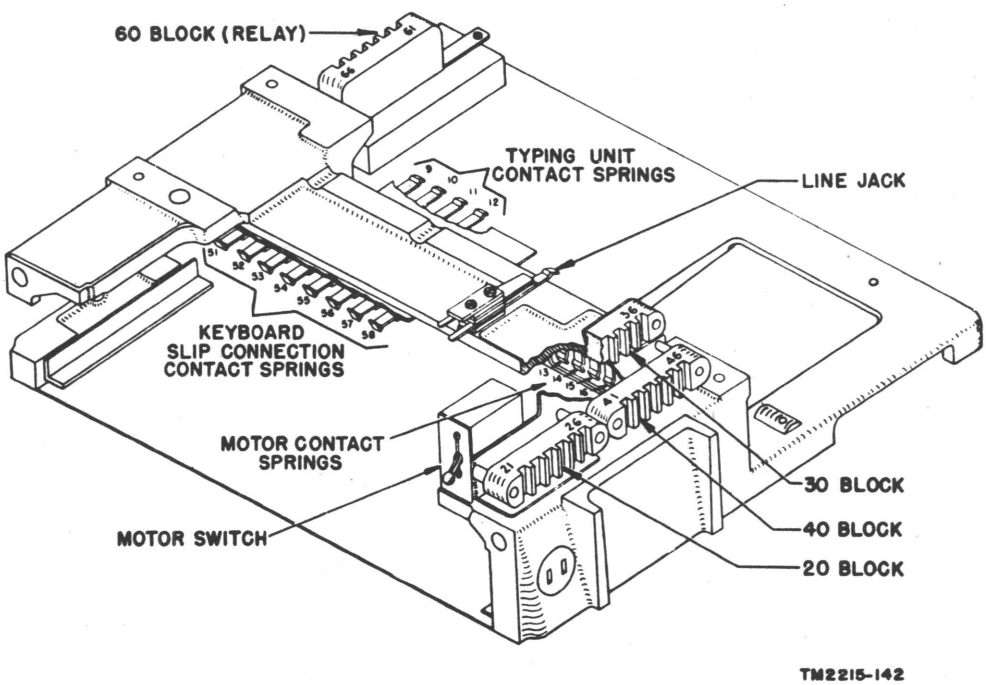


Figure 54. Base terminal boards and contacts.

66. Localization of Electrical Troubles

a. General. Electrical circuits in a teletypewriter are provided with connecting terminals at points where it is necessary to connect or disconnect circuits or units (fig. 54). Do not disturb the wiring any more than necessary during testing and inspection. The majority of electrical troubles are found at contacts in switches and jacks, or where insulation on wires or between metal parts is damaged. The repairman must be familiar with the use of schematic and wiring diagrams (figs. 268 through 276) and use them while making point-to-point checks of the teletypewriter circuits. Schematic wiring diagrams of external equipment to which the teletypewriter is connected furnish information helpful to the repairman in setting up circuits for testing and localizing trouble. Detailed procedure for localizing electrical troubles is furnished in paragraph 68 for the power and signal circuits.

b. Testing Procedure. Actual procedures for locating electrical troubles vary, depending on whether the work is done by organizational repair personnel equipped with Test Unit I–236 or Multimeter TS–297/U or at field or depot repair shops, where more accurate testing apparatus is available. In either case, the use of a wiring diagram such as is shown in figure 55 is helpful in making point-to-point checks of the unit tested. All of the more common troubles can be located with these test units, and the data in paragraphs 67 through 69 are arranged to start with their use. The data also give additional information for use by field or depot repair personnel responsible for

major overhauls. When available, use a milliammeter or a voltohmmeter to locate electrical trouble.

c. Testing Capacitors. Three possible trouble conditions that may occur in capacitors are opens, shorts, and leakage. Leakage is a flow of current through a capacitor that is partially shorted. The I–236 and the TS–297/U are used for testing capacitors. Two other methods for testing capacitors are the spark test ((1), (2), and (3) below) and the ohmmeter test ((4) below). *Be careful to avoid shock when handling charged capacitors or leads that are connected to a power source, especially when the item of equipment containing the capacitor under test is in operation.*

(1) In the spark test, the capacitor is charged and then discharged by shorting the capacitor terminals with a screw driver or other similar means and observing the spark that is produced. Also, the terminals of a capacitor can be connected to a telephone headset or test receiver for the tester to listen for a click. Instructions for making the spark test are given in (2) and (3) below.

(2) To test a capacitor of .1 uf (microfarad) or higher value, proceed as follows:

(*a*) Disconnect the capacitor from the circuit in which it is used.

(*b*) Connect the capacitor with suitable leads to a source of 90 volts dc or more.

(*c*) Disconnect one of the leads after a few moments.

(*d*) After approximately 1 to 2 minutes, short the capacitor terminals with a screw driver. If a capacitor is in good condition, a spark will jump between the screw driver and one of the terminals. An open capacitor or one that is shorted gives off no spark. For this test, disconnect the capacitor from the rest of the circuit in which it is used. An associated resistor or other device can serve as a path by which the charge in the capacitor may leak away. Therefore, to subject it to the spark test, it is always best to remove the capacitor from the circuit.

(3) For capacitors of a value less than .1 uf disconnect the capacitor from the circuit ((*a*) above). Charge it in the same way as a capacitor of larger value is charged. Wait ½ minute, then connect the tips of a telephone headset, or a test receiver, across the capacitor terminals. A click should be heard in the receiver if the capacitor is in good condition. An open or shorted capacitor will produce no click.

(4) The ohmmeter method generally is used when a capacitor to be tested is of a value of .01 uf or greater. When a good capacitor of sufficient size is connected to a ohmmeter, the meter needle will *kick* upscale, and then return to its original position; this indicates an open circuit. A shorted capacitor gives a steady meter reading, depending on the resistance of the short.

d. Testing Resistors and Circuit Continuity. Use the test unit, the multimeter, or any ohmmeter to test resistors or to check circuit continuity. Before measuring resistance or making continuity tests with any instrument that furnishes its own testing battery, disconnect the teletypewriter completely from all external power and signal circuits; otherwise false measurements may result, and there is danger of damaging the instrument. In most cases, resistors may be measured and circuit continuity may be checked without disconnecting any of the circuit elements. Parts of the circuits that are connected in parallel must be isolated before accurate tests or checks are made. Connect individual circuits to the proper power supply for making point-to-point voltage and current checks. *Do not attempt to measure resistance with an ohmmeter while current from the rectifier power unit is flowing in the circuits.*

e. Circuit for Testing. A normal 60-ma current in a closed circuit (consisting of the send and receive circuits connected in series) is required to localize electrical troubles in the signal circuit. When a test is made with this arrangement, it is referred to as operating in a local or dummy loop to distinguish it from a regular connection with a second teletypewriter. The tables, used with Teletypewriters TT–7/FG and TT–8/FG, contain local test circuits in which the operating components may be connected. These circuits are set up by setting the line switching key to its middle (or test) position or pulling the red- and the black-shelled teletypewriter plugs from the LINE jacks and inserting them into their respective TEST jacks. After a major overhaul, make checks by using this test circuit. The perforator transmitter

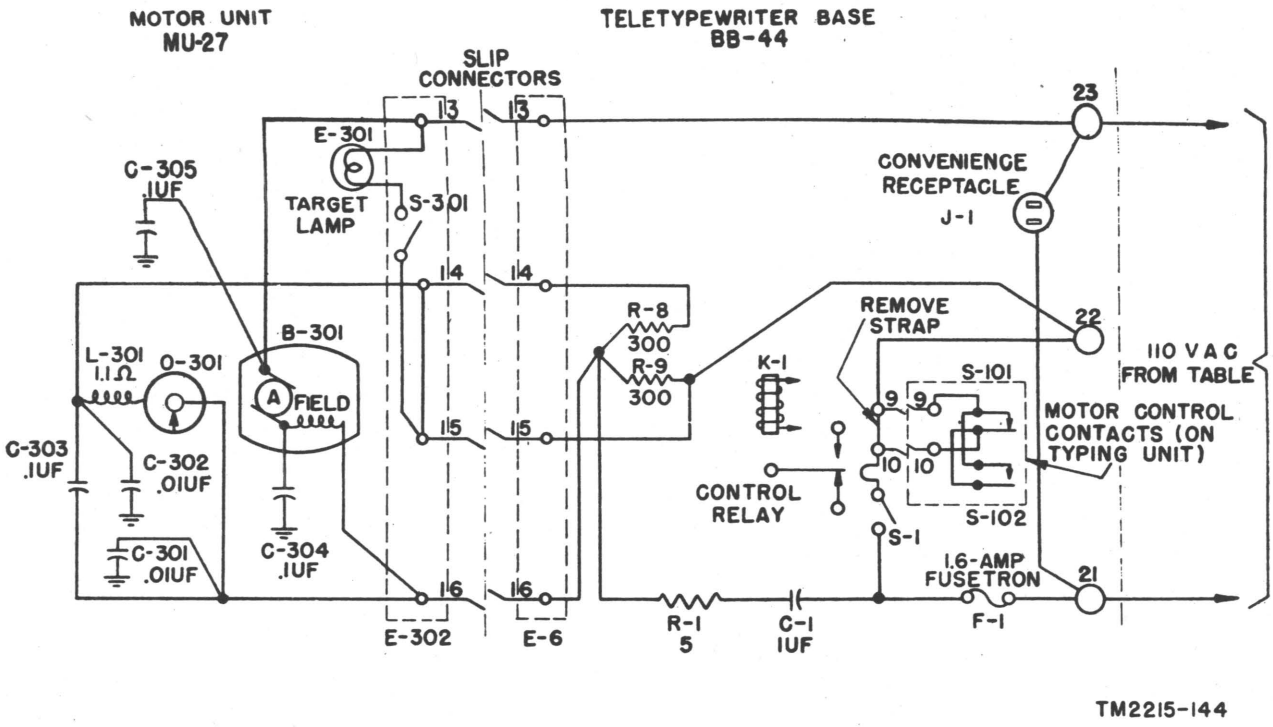


Figure 55. MU—27 teletypewriter motor circuit.

and/or the transmitter distributor can be connected to the typing unit or a second teletypewriter can be connected through the TEST jacks (fig. 28) to serve as a standard for comparison (using the send plug of one teletypewriter and the receive plug of the other).

67. Use of Test Unit I–236 or Multimeter TS–297/U for Localizing Electrical Trouble

The following information is intended only as a guide when these units are used (fig. 54).

a. General. The I–236 and the TS–297/U are designed particularly as lightweight, durable test equipments for use by organizational repair personnel. They are used to test continuity and voltages in place of other delicately constructed instruments normally available to field and base personnel for use during major overhauls of the teletypewriter.

b. Voltage Checking. When localizing power troubles, use Multimeter TS–297/U or Test Unit I–236 for making on-line voltage checks of the various parts of the power circuit. Set the switches on Test Unit I–236 as follows: SW1 at the INT V position; and SW2 at the NEON & MAZDA position. For tests that indicate no voltage, or low voltage, neither lamp will light. Voltages that are less than the normal line voltage can be compared by observing the change in brightness of the Mazda bulb on the line voltage and then on the voltage being tested.

c. Checking Continuity. To make continuity tests used in localizing trouble in signal circuits, arrange the test unit as follows:

(1) Set switch SW1 at EXT V.
(2) Set switch SW2 at NEON.
(3) Insert the power plug of the test unit into a 115-volt a-c power outlet.
(4) Connect the test leads to the same terminals used in making tests with an ohmmeter. The neon lamp will not light if open circuits exist. The neon lamp will light if shorts or high resistance exists between the leads. If the voltage is 115 volts dc and switch SW2 is set at NEON & MAZDA, resistances of a value greater than 200 ohms will prevent the neon lamp from lighting. Directions for use of the multimeter are given in TM 11–5500.

68. Localization of Electrical Power Troubles

Power troubles may appear in various ways. If the motor unit of the teletypewriter does not run, or if it cannot be brought up to the proper speed, the trouble may be either external or within the teletypewriter. The following step-

by-step procedure is used to locate the trouble:

a. Testing Line Voltage. Check the line voltage with a suitable a-c voltmeter. If the line voltage is between 110 and 125 volts, with the teletypewriter connected to the power line, and the motor switch is on, the trouble is within the teletypewriter.

b. Testing Rectifier Power Unit A-C Circuit. Test the a-c input circuit of the table; follow figure 275; test the a-c input cord by which power is delivered to the rectifier power unit; test the output cord that connects to the 20 block (fig. 54); test the a-c circuit from the plug to the terminals on the power block at the right-hand front corner of the base (by which power is connected to the motor unit). These are terminals 21 and 23 on the 20 block.

c. A-C Circuit to Motor Unit. Refer to figures 268 through 276 and test the a-c circuit to the motor unit. If the circuit tests described in *b* above show that there is no interruption of continuity and that the desired voltage is available at the motor unit, test the motor unit. Refer to paragraph 158 for information relative to test and repair of motor units. If the voltage delivered to the rectifier power unit is of the proper value, but the a-c output to the motor is either too low or not available at all, check the connections of the a-c output cord at the cord panel of the rectifier power unit. If the a-c input is of proper value but the a-c voltage output is too low or not available, check the connections at the tap and fuse panel of the rectifier power unit. *If the d-c output fails to become available within approximately 1 minute after the power switch is turned on, make sure that:*

(1) The input fuse (lower one on the main terminal panel) is not burned out.

(2) The plate transformer fuse (upper one on the terminal panel) is not burned out.

(3) The front make contact of the relay (contact nearest the door of the cabinet) is in contact with its associated contact.

(4) The filaments on both grid-controlled rectifier tubes are lighted.

(5) The bimetal pulls the relay armature down. If the bimetal does not pull the relay armature down, check the back contacts (normally closed) of the relay. These contacts in multiple are in series with the primary winding of the heater transformer. If the bimetal is inoperative and these contacts are making, the heater transformer is probably at fault. The unit may be started manually by depressing the relay armature with a stick or another piece of nonconducting material. Once closed, the relay coil will hold in. If the d-c output rises considerably or if the rectifier output does not regulate properly, either the neon lamp and/or the amplifier tube may be defective.

(6) A high enough output voltage can be obtained. If it cannot, one or both of the rectifier tubes need replacement. If the line voltage drops considerably below the a-c input line voltage setting, the d-c output voltage will drop. In this case, use the lower a-c input line tap to match the actual line voltage.

(7) The time-delay relay holds down magnetically and the bimetal remains hot. Check the relay coil and/or resistor in series with the time-delay relay. This can affect both the a-c and d-c outputs.

Note. The actual and schematic wiring of the REC–30 rectifier is shown in figures 272 and 273. Refer to paragraph 195 for repair instructions covering the rectifier power unit.

d. Testing D-C Circuits. D-c is supplied by the rectifier power unit through an output cord of that unit. This cord plugs into an outlet under the back of the table. Refer to the schematic and actual wiring diagrams of the rectifier power unit, the table, the base, and the local circuits of the teletypewriter (figs. 268 through 276). Use a d-c voltmeter of suitable range to test continuity of the circuits shown in the diagrams. Use a suitable ohmmeter to test the resistors shown in the diagrams. The values of these resistors are indicated in the diagrams. To check capacitors, refer to paragraph 66*c*. Refer to paragraph 195*d* for tests of the d-c circuits of the rectifier power unit.

e. Testing Signal Circuits. The signal circuits of the teletypewriter consist of the wiring of the table by which the transmitting components and typing unit are connected to the signal lines These circuits terminate at line and battery ter minal boards and include the wiring to the jacl blocks. The test circuit is considered a signal cir cuit. In addition, the connection points on th send and receive boards of the base, and the sli contacts of the keyboard transmitter, transmitt

distributor, and typing unit are terminal or connection points in the signal circuit at which continuity readings may be taken.

f. Location of Grounds. Grounds may be caused by insulation wearing off wiring; this would result in contact between the conductors and the frame of the teletypewriter. In addition, faulty capacitors, resistors, or terminals may cause the various electrical circuits to become grounded. Test for grounds as follows:

(1) Disconnect the teletypewriter from all external power and signal circuits.
(2) Connect one lead from an ohmmeter to the frame of the teletypewriter.
(3) Touch the other lead to connection points and terminals of the different circuits.
(4) Any continuous appreciable indication on the meter signifies a ground. Disregard the short flashes of the neon lamp on Test Unit I–236 (if it is used), or the slight kick of the needle of the voltohmmeter. These indications occur when test leads first are connected to the equipment and are due to the initial charging and discharging of the capacitors in the circuit. Usually a terminal that gives the greatest indication, or reading, shows which side of the circuit is grounded.

69. Circuit Continuity Tests

a. When the test circuit is connected, current should flow. This indicates that the send and receive circuits of the teletypewriter are closed. If no current flows, then one of these circuits must be open. To test the continuity of the receive circuit, short the send plug or connect a jumper across the send circuit at terminals 1 and 2 on table terminal board E603 or terminals 32 and 34 on the 30 block (fig. 54). To test the continuity of the send circuit, short the receive plug or terminals 3 and 4 on the table line terminal board or terminals 41 and 42 of the teletypewriter base 40 block (fig. 54).

b. When the circuit is closed, send RY's and test sentences from the keyboard to check the teletypewriter as a unit. If the machine operates without error, assume that the teletypewriter is trouble-free except possibly for speed which must be checked separately if it is in doubt. If the receive circuit is shorted internally, the teletypewriter will run open. These tests will indicate whether the trouble is in the send or receive circuit. If the transmitter circuit is shorted, the receive circuit will not respond.

70. Localization of Trouble in Send Circuit

a. General. Trouble within the send circuit can be localized by using Test Unit I–236, Multimeter TS–297/U, an ohmmeter, or a voltmeter with battery in series. The send circuit is shown in figure 56. It consists of the transmitter contacts, keyboard transmitter slip contacts, and associated wiring. In addition, the SEND—REC—BREAK key and keyboard shunt contacts with associated wiring are parts of the send circuit. The cord and wiring through the send block to the signal circuit wiring of the table are also integral portions of the send circuit. To localize trouble in the send circuit of the teletypewriters, follow the wiring and schematic diagrams of the keyboard transmitter and table (figs. 268 to 276). In these diagrams, the location and electrical value of the resistors and capacitors in the send circuit are indicated.

b. Location of Opens. Remove the typing unit and attach test leads to the terminals of line terminal board E603, E604 or E605, to which the line conductors of the send circuit are connected. Then, progressively, test the continuity of the table wiring, base wiring, and wiring of the keyboard transmitter by which the transmitter contacts are connected to the outgoing line conductors. For example, if the second circuit tests open at the line terminal board, remove the send plug from the send jack (black). If this does not remedy the trouble, the open must be in the table wiring. The open may be caused by loose connections, broken wiring, or a defective line jack. Normally, line continuity can be tested from the line terminals on the send block of the base to the line terminals on the line terminal boards in the table. Refer to the wiring diagrams for the various methods of operation when making continuity tests of the line circuit, because the connections for each method of operation may differ. Observe whether the teletypewriter is supplying line current. If it is, one or both of the two line resistors which are installed in the electrical service assembly of the table are in series with a line and will have to be considered. These resistors are of 2,500 ohms each and may be adjusted so that the teletypewriter supplies line current of 60 ma.

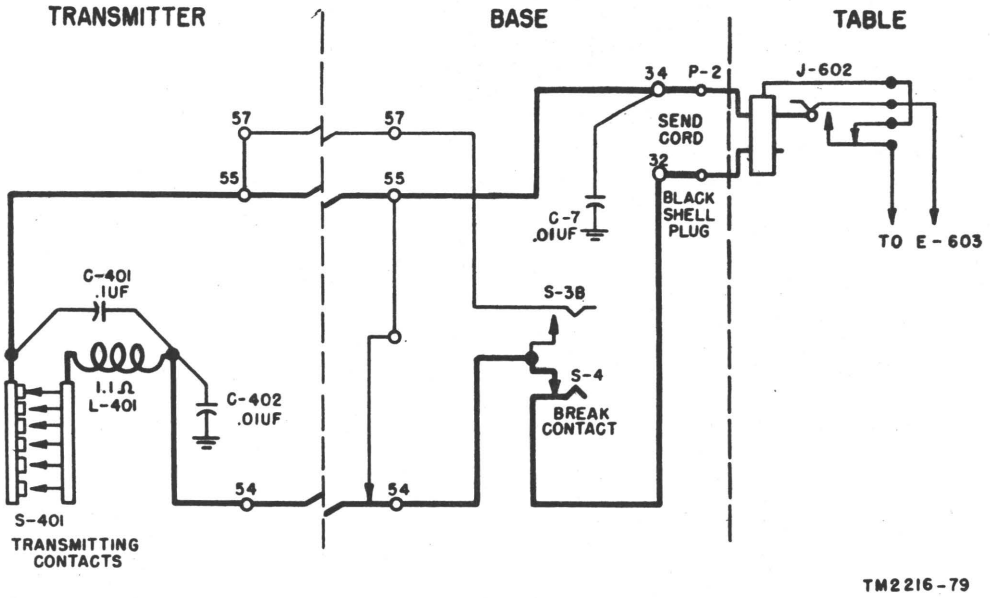


Figure 56. Teletypewriter send circuit.

Therefore, if the reading on an ohmmeter used to test continuity indicates a relatively high resistance, check whether the teletypewriter is connected to supply line current. In case of an indication showing an open circuit that cannot be located readily, check the connections of the line resistors.

c. Location of Shorts. Shorts in the send circuit may be located in much the same manner as described for location of opens. The main difference is that in locating an open, continuity is tested between both ends of each conductor of a circuit. When locating a short, take a reading across both conductors of the circuit. The line terminal boards of the table and base provide convenient test points. When testing for short circuits, as well as for opens, in the send circuit, refer to the appropriate diagram showing the wiring arrangement for the method of operation.

71. Localization of Trouble in Receive Circuit

(figs. 57 and 268)

a. General. Continuity tests to locate trouble in the receive circuit are conducted in a manner similar to that used for locating shorts or opens in a send circuit. The wiring diagrams for the various methods of operation will show the circuits at the table that are used for sending and those that are common to both functions. The circuits involving the perforator transmitter and/or transmitter distributor jacks also may be part of the receive circuit, or in some cases, they may be connected to independent lines. Refer to the appropriate wiring diagrams and the basic principles of type of operation in use when testing these circuits.

b. Locating Opens. The receive circuit includes the wiring of the table to the receive block on the base through the receive jack (red) in the jack block. Included in the receive circuit are the line relay and the selector magnet. The low-inductance and low-impedance relay prevents direct electrical connection between line and selector magnets. The resistance of the winding of these elements of the circuit are given in figures 57 and 268. Continuity tests of the receive circuit may be conducted in a manner similar to that used to locate opens in the send circuits (par. 70). Tests should be made from each convenient terminal or connection point of the table, base, and typing unit.

c. Locating Shorts. Shorts may be located by conducting tests as outlined in paragraph 70*c*. Resistance readings that are relatively high may be due to the resistance of the magnet coils or the windings of the relay. Refer to the wiring diagrams to determine the values of the resistors in the receive circuit and the circuits through the relay contacts that normally should be closed, and those that normally should be open.

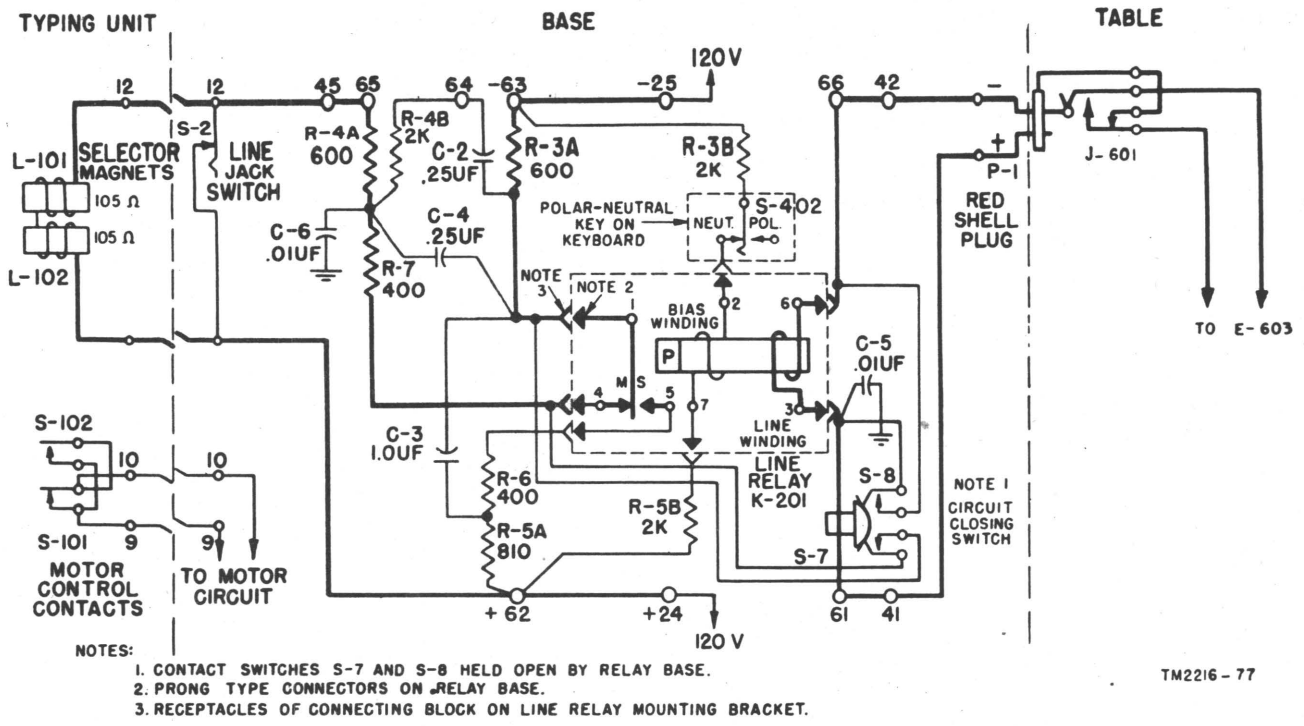


Figure 57. Teletypewriter receive circuit.

72. Introduction to Localization of Mechanical Troubles

a. When a mechanical function fails to operate, or operates in a faulty manner, isolate the trouble. The trouble may be in a particular adjustment, or series of adjustments, or it may be in a particular assembly. Experience of the repairman and over-all condition of equipment indicate which of the two methods described below is the better approach to localizing various troubles.

(1) One method involves checking the individual requirements for all adjustments in an assembly or mechanism. Use the data found in the detailed adjustment requirements (pars. 207 through 490) to determine the sequences to be followed.

(2) The other method involves setting up the vanes or selecting mechanism by hand, and completing the operation by manually rotating the motor, shaft, gear, or cam that normally drives the assembly. This method is quicker when only one adjustment is involved and the remainder of the mechanism is in good condition. In such instances, only related adjustments need to be checked. In some cases, faulty operation may be observed only when the mechanism is power-driven.

b. Additional aid in locating mechanical troubles may be obtained from records of previous troubles and adjustments.

c. The procedure for localizing mechanical troubles may be divided into the effects of the trouble observed, as follows:

(1) Teletypewriter does not start (par. 73).

(2) Typing unit runs open (par. 74).

(3) Perforator transmitter runs open (par. 75).

(4) Teletypewriter scrambles letters and functions (par. 76).

(5) Certain functions do not operate correctly (par. 78).

73. Locating Trouble When Teletypewriter Fails to Start

a. Electrical Trouble. Refer to paragraph 66 for electrical power troubles and figure 55 for the motor circuit. Electrical trouble in the motor circuit may be due to mechanical adjustment of contacts, and the tests for electrical trouble should locate these troubles.

(1) The motor stop contacts are connected through contacts 9 and 10 of the typing unit slip contacts. The resistance between these two contacts should measure about 1 ohm or less. Short these con-

tacts. If the motor runs, the trouble is in the contact adjustment between the typing unit and the base.

(2) If there is voltage between terminals 13 and 15 of the motor, short the governor brush springs. If the motor speeds up, check the brush spring tension. The trouble may be due to dirty or burned governor contacts or a broken governor spring.

b. Excessive Motor or Main Shaft Load. Turn the motor by hand. If it cannot be turned easily, make the following tests to locate the cause of binding.

c. Binding at Main Shaft Drive Gear. Remove the screws that hold the typing unit to the base. Try to turn the motor by hand. If the motor turns easily, the motor pinion was binding on the main shaft gear.

d. Motor Bearings Bind. Remove the typing unit and turn the motor by hand. If it does not turn easily, the motor bearings are probably defective.

e. Main Shaft Binds. With the typing unit removed, try to turn the main shaft by hand. If it will not turn, or if great effort is required to turn it, proceed as follows:

(1) Hold the selector magnet armature to the mark position (fig. 58). Turn the shaft, if possible, until the selector cam sleeve and bail cam do not turn when the shaft is turned. If the main shaft still binds, the trouble is within the main shaft assembly.

(2) Remove the main shaft and check the main shaft bearings and the various friction clutches for excessive binding or friction.

f. Transmitter Shaft Binds.

(1) Check the gear clearance of the transmitter shaft drive gear when the typing unit and keyboard transmitter both are secured to the base.

(2) Rotate the shaft by hand with either the keyboard or typing unit removed to check the binding of the transmitter shaft bearings.

74. Locating Trouble When Typing Unit Runs Open

a. Electrical Trouble. Press the selector armature to the mark position. If the armature does not bind and the teletypewriter runs closed, assume that the trouble is electrical. If the teletypewriter does not run closed with the armature in the mark position, the trouble is mechanical and is within the typing unit.

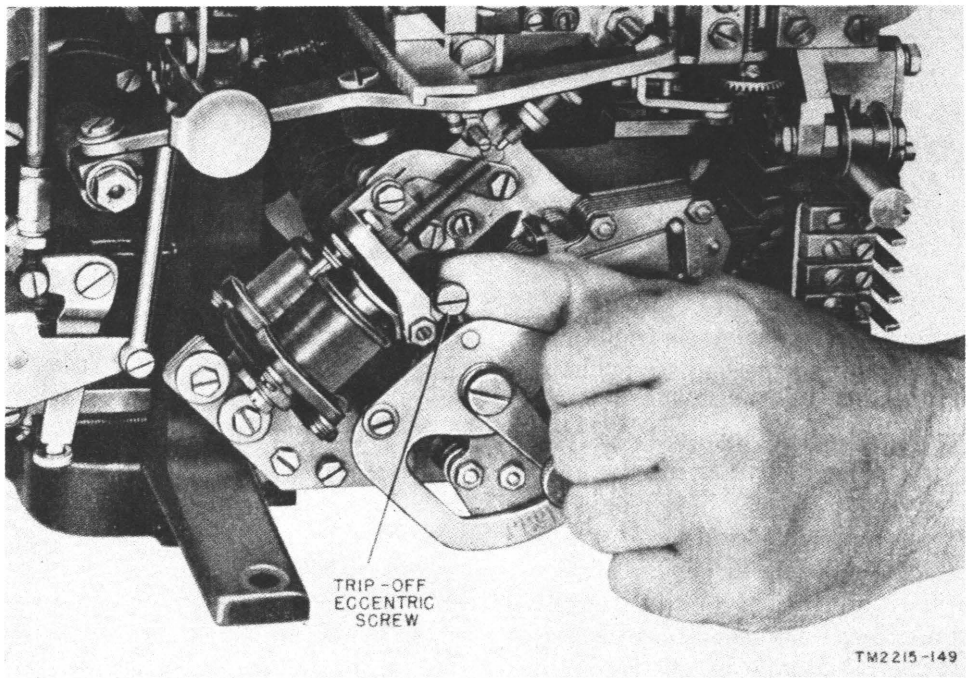


Figure 58. Selector armature held in mark position by hand.

b. SELECTOR TRIP-OFF MECHANISM.

(1) Examine the selector cam sleeve when the selector magnet is in the mark position. If the sleeve rotates, the trouble is in the selector trip-off mechanism.

(2) Loosen the trip-off eccentric screw and turn it until the screwhead does not touch the trip-latch plunger. If the selector cam sleeve does not stop rotating, the trouble is in the stop lever.

(3) Remove the typing unit and turn the main shaft manually while holding the stop lever so that it does not rotate. If the selector cam sleeve is stopped after each revolution, the trouble may be in the trip latch or in the trip-latch spring.

c. MAIN SHAFT CLUTCH THROW-OUT LEVER. If the selector cam sleeve does not rotate when the selector armature is in the mark position, but the bail cam continues to rotate, the trouble is in the clutch throw-out lever.

(1) With the typing unit removed and the selector armature held in the mark position, rotate the main shaft slowly and examine the clutch throw-out lever.

(2) If the clutch throw-out lever does not engage the clutch throw-out cam, check for a missing spring or a broken or missing clutch throw-out lever.

(3) If the clutch throw-out lever engages the cam, check the clearance between the clutch jaws.

75. Locating trouble in Perforator transmitter

a. TRANSMITTER RUNS OPEN. If the transmitter runs open, make the following checks on the transmitter clutch throw-out lever:

(1) See if the clutch throw-out lever engages the throw-out cam. The clutch throw-out lever spring may be missing, or the clutch throw-out lever may be binding.

(2) Adjustment of the clutch throw-out lever eccentric.

(3) Adjustment of repeat space rod.

b. LOCATING TROUBLE IN PERFORATOR MECHANISM.

(1) *Adjustments.* The perforator mechanism is composed of many parts and requires many adjustments. A faulty adjustment causes the perforator to operate improperly or fail to operate. Three possible adjustments deserve special attention: adjustment of the feed roll detent eccentric, the punch operating lever adjusting screws, and the punch magnet.

(2) *Feed roll detent eccentric* (figs. 68 and 77). If the tape fails to feed when any character key is pressed (when the operating control lever is at either KBD & TAPE or TAPE), and the punch magnet armature is operating, the faulty adjustment (or damaged parts) may be in the mechanical series, feed roll pawl, feed roll, star wheel, feed roll detent, punch operating lever, right or left stop adjusting screws, or associated parts. If the detent eccentric is positioned so that the detent is too far to the left, or if the detent spring is broken or unhooked, the tape will fail to feed evenly, even though the feed pawl operates. Faulty adjustment of either punch operating stop adjustment screw or both may cause irregular tape feeding.

(3) *Punch operating lever adjusting screws.*

(*a*) *Bumpers.* The leather bumpers on the punch operating lever right and left stops wear and deteriorate with age. Thus, they may be the cause of faulty adjustment in perforators that have not been maintained regularly and properly.

(*b*) *Left stop adjusting screw.* If the left stop adjusting screw is out of adjustment, the clearance between the punches and their selector fingers will be faulty when the punch operating lever is against the left stop and the selector fingers are under the punches. The points at which the direction of travel of the feed pawl are reversed can be controlled to a limited extent. The feed pawl eccentric permits adjustment which will allow the tape to be fed without backlash, and will permit the proper clearance to be maintained.

(*c*) *Right stop adjusting screw.* If the tape is not perforated when the punch operating lever operates and the selector fingers are in position, the most probable cause of trouble is faulty adjustment of the right stop adjusting screw-

In this case, the right stop is adjusted too high. If the tape is perforated, but the leading edges of the feed holes indicate excessive pull by the feed roll, the punch operating lever right stop and the feed roll eccentric screw probably are set too low.

(4) *Punch magnet.* Apply 110 volts dc to terminals 52 and 53 (figs. 268 and 270). Set the operating control lever at KBD & TAPE and press one of the keys on the keyboard. Then set the control lever at TAPE position and press one of the keys on the keyboard. If the punch operating lever fails to operate, push up on the left-hand end of the punch operating lever to see if it moves freely. If it does, the punch magnet electrical circuit is open. The open is probably in that part of the circuit that is common between contact 53 and the second contact spring (counting from the top down) of the perforator control contacts. Note that it requires an effort of about 3 to 5 pounds to overcome the tension of the punch operating lever spring. If the punch operating lever operates in one of the positions mentioned above and does not operate in the other, it indicates that the punch magnet circuit is open. The open, in this case, is probably not in the common section, but in that section of the circuit associated with the particular position of the operating control lever that prevents operation of the punch operating lever.

c. Locating Trouble in Character Counter.

(1) *At TAPE position.* The character counter operates only when the operating control lever is at TAPE position. In this condition, all the contacts of the operating control lever must close. With these parts checked, or known to be in good order, signs of trouble in the character counter mechanism are:

(*a*) Indicator fails to advance when a character key is operated.

(*b*) Indicator fails to return to zero when the CAR RET key is operated.

(*c*) Warning lamp fails to light when a predetermined number of characters are perforated.

(2) *Indicator fails to operate properly.* Adjustments that may cause faulty operation of the indicator include: the counter contacts and counter control unit, counter magnet armature eccentric stop, counter feed pawl, and the check latch pawl. These are not all of the adjustments that may go out of order. For example, loose set acrews in the indicator will cause the indicator to fail to advance or restore properly.

(3) *Counter control contacts, counting pair.* If the circuit through the counting pair (fig. 270) of the counter control contacts (S403A) and the counter magnet coil is open, the armature will not be pulled up when power is applied to terminals 52 and 53. If the armature is not pulled up, it is impossible for it to cause the indicator to advance when the counter control contacts are opened again. It is the release and then the falling back of the counter magnet armature, under the action of the feed pawl spring, that causes the indicator to advance. If the counter magnet fails to attract the armature when the counter control contacts are closed manually, it is an indication that the counter magnet circuit may be open. If the magnet armature operates properly but the indicator does not advance, the feed pawl or ratchet wheel may be damaged or badly worn, or the feed pawl may be failing to engage the ratchet wheel teeth. To correct the trouble it is necessary to replace the worn or damaged parts, or to correct the feed pawl adjustment. If the indicator advances and returns to its original position as the counter magnet armature is operated, the latch pawl probably is not engaging the teeth on the ratchet wheel. Should this happen with the indicator at its zero position, the feed pawl may be failing to push the release latch far enough to the left to unlatch the release lever. This, in turn, would hold the latch pawl out of engagement while the teeth on the ratchet wheel. Faulty adjustment of the release latch bracket or a bent or damaged feed pawl are possible causes of this trouble.

(4) *Counter control contacts, release pair.* The release pair of the counter control contacts (S403B) is normally open. If the indicator fails to return to zero when the CAR RET key is pressed, the release mechanism is probably out of adjustment. A visual examination of these contacts will determine whether they are being closed when the CAR RET key is pressed. It also will determine whether the failure of the contacts to close is caused by faulty operation of the counter control unit or maladjustment of the contact springs and stiffeners. If the release magnet is open, the release magnet armature will not be drawn up when the release pair of the counter control contacts is closed manually. An ohmmeter will reveal an open release magnet circuit (fig. 270). If the fiber extension on the counter control operating lever does not move (or does not move far enough) to the right (or left) as the CAR RET and LINE FEED keys are operated, alternately, the cause of the trouble is faulty adjustment of the counter control unit or damage to some of its parts.

(5) *Ratchet wheel spring.* If the indicator fails to return to zero when the feed pawl and the latch pawl are disengaged from the ratchet wheel, the trouble is probably due to a broken or unhooked ratchet wheel spring.

(6) *Dash pot.* If the counter mechanism fails to return to zero, or stops several spaces before reaching that point and will not return to (or remain on) zero from a dial position which indicates only a few characters, air may be escaping from the dash pot too slowly. Indications that air is escaping too slowly from the dash pot are: bouncing of the indicator when it returns from the farthest point of its travel on the dial and the failure of the indicator to return to zero quickly enough from the dial marking for eight spaces to prevent more than one space to register on the counter when the CAR RET and any character key are operated quickly in succession.

(7) *Signal lamp.* If the lamp fails to light, the lamp may be burned out, or the circuit may be open at any point between terminals 52 and 53 and the lamp. Also, the signal lamp contact springs may be so damaged or bent that they do not close, or the contact lever may be so bent or damaged that it fails to operate the signal lamp contact springs. The contact cam set screw may be loose; this permits the indicator shaft to turn in the cam. This results in the failure of the contact lever or the signal lamp operating contact springs to function. If the lamp cannot be extinguished, the cricuit is not opened when the indicator returns to zero. The cause of the trouble may be a bent signal lamp operating contact spring or a short circuit across the contacts. It also may mean that the contact bracket is out of adjustment; the set screw in the contact cam may have loosened while the high part of the cam was under the contact lever. This set screw holds the contacts closed while the indicator shaft turns in the cam. If the lamp does not light at the proper time, the contact cam probably is located at an improper place on the indicator shaft.

76. Typing Unit Garbles Characters and Functions

a. There are several possible sources of trouble external to the typing unit that cause scrambling of letters and functions. Such trouble may be due to external line characteristics, improper line current, wrong speed or other defects in a distant teletypewriter, or external relays which cause a biased signal to be received. To eliminate line troubles, set up a dummy signal circuit as explained in paragraph 66*e*.

b. If a second typing unit in good working condition is available, localize the trouble to a given equipment by replacing the major units with units that are working properly. (Adjustment of gears and points of contact with a new unit must be checked before they are operated.

77. Testing Typing Unit With Test Circuit

Adaptations of test circuits vary with the experience of repair personnel. The sequences of testing given below are recommended for gen-

eral use by all personnel involved in the repair of typing units.

a. Set up a test circuit as explained in paragraph 66*e*.

b. Type test sentences to see if errors still occur.

c. Remove the cover and check the code position of the vanes for each letter or operation. Refer to figure 4 for the teletypewriter code. The first five vanes (counting from the top down) set up the code; the front edges of the vanes are tilted down for a mark signal and up for a space signal. The front edge of the sixth (bottom) vane tilts down when the platen is in the LTRS position and up for the FIGS position. The platen should move up or down to correspond with the desired function.

d. Use the RY combination to get complete reversal of the five selectors and vanes. Any vane that is sticking can be detected readily.

e. With the motor switch turned to OFF position, operate the R and Y keys, and slowly turn the motor in its normal direction of operation. Watch the operation of the selector unit and the selector armature. Poor transmitter contacts or improper contact adjustment may cause one or more of the transmitter contacts to space instead of mark.

f. With the typing unit removed, hold the vanes in the proper code positions for letters that will not print correctly and turn the main shaft by hand. If the letter is not operated, check the code bars to see if they are sticking or determine if the bell cranks require adjustment.

g. If no results are obtained from the test described in *a* through *f* above, the trouble is probably in the adjustment of the selector unit. After checking the tension of the selector armature spring, make a complete adjustment of the selector unit according to the requirements given in chapter 4. Trouble in the selector unit probably will be evident only if the teletypewriter is power-driven.

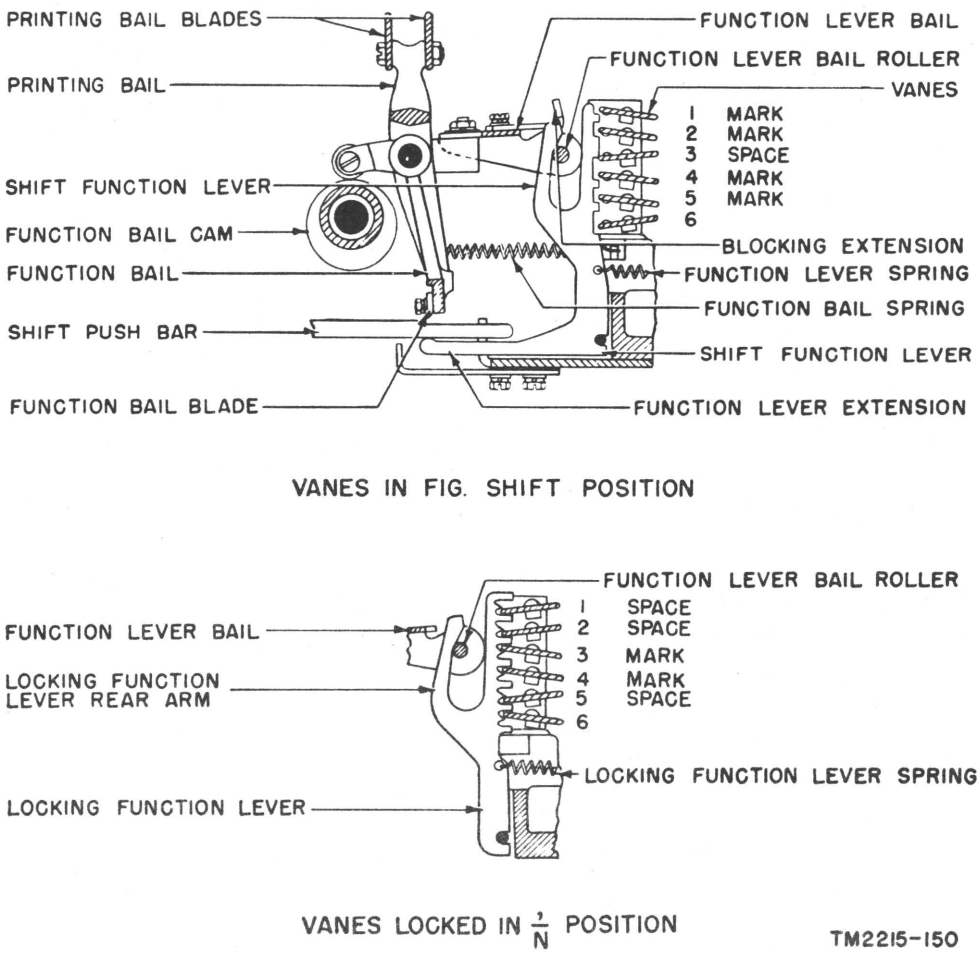


Figure 59. Vanes locked in position.

78. Locating Trouble When Certain Functions Do Not Operate Correctly

If the typing unit operates correctly with the exception of one or two functions or letters, the trouble usually is in the adjustments and parts common to the operation of only these functions or letters. In such cases, trouble seldom is found in the selecting mechanism, vanes, or code bars. The trouble can be located quickly by the following action.

a. Remove the typing unit and set the vanes by hand to the code of the function or letter, and with the platen in the proper position, make sure that the sixth vane also is in the proper position. Turn the main shaft until the function bail and printing bail operate.

b. Watch the operation of the function lever or the code bars involved. If the function lever operates, but the function is not completed, examine the function bail when the main shaft is turned again. The trouble can be found by progressively following the action of the levers from the function lever to the final action of the function.

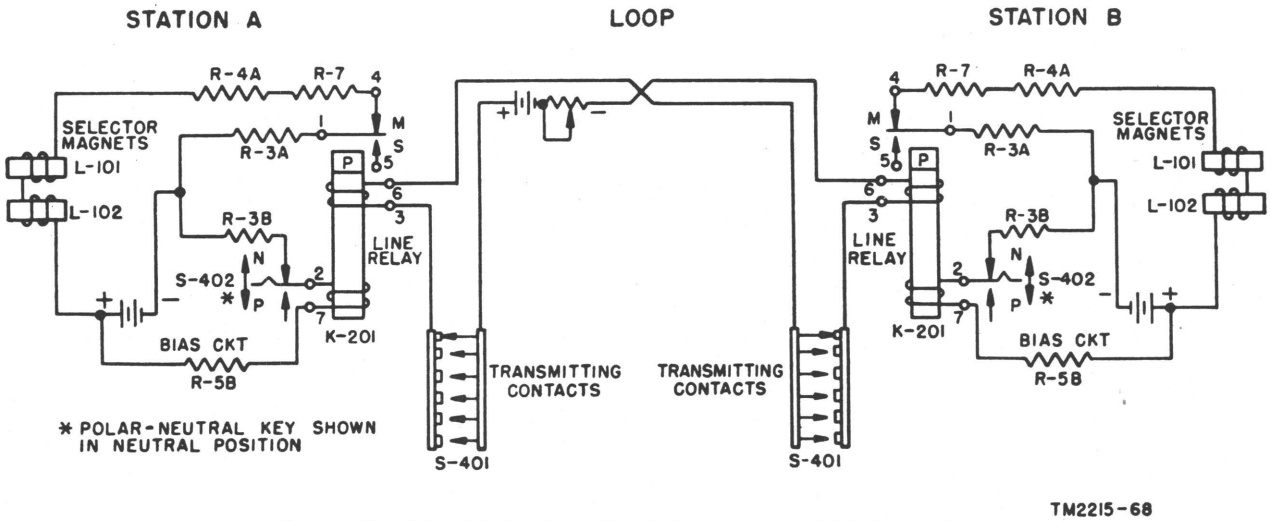


Figure 60. Simplified schematic of interconnected teletypewriters.

79. List of Trouble Conditions for Teletypewriters TT–7/FG and TT–8/FG

The following chart is an index to *a* through *r* below which analyze trouble in various components and indicate possible remedial measures:

Subparagraph	Condition	Observed fault
a	Power on	Fails to start.
b	Starts	Runs open.
c	Runs closed	Cannot send.
d	Runs closed	Cannot receive.
e	Prints	Rangefinder has poor range.
f	Prints	Scrambled letters or occasional errors.
g	Prints	Fails to shift or unshift.
h	Prints	Fails to line feed properly.
i	Prints	Fails to space properly.
j	Prints	Fails to carriage return properly.
k	Prints	Ribbon remains motionless or does not oscillate.
l	Prints	Ribbon does not reverse.
m	Prints	Bell does not operate (letter S prints correctly).
n	Prints	Letter S does not print (signal bell operates with platen in *LTRS* position).
o	Prints	Motor stop fails to operate.
p	Prints	More or less than 72 characters per line or margins uneven.
q	Prints	Margin bell does not operate on 66th character.
r	Prints	Teletypewriter emits grinding noise.

a. Teletypewriter Fails to Start.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Power source	Open, low voltage, or poor voltage regulation. Fuse.	Use another power source. Replace. fuse.	139	195	490.
2	Fuse, motor circuit	Fuse open or missing	Replace with good fuse.			
3	Motor stop contacts	Contacts open or dirty	Clean; check tension and continuity.	126		279.
4	Motor stop mechanism	Contacts do not close. Mechanism fails to release.	Adjust	126		271 through 280.
5	Governor contacts	Contacts open, dirty, or burned away.	Clean or replace and adjust contacts.	84	170	462.
6	Base contacts	Open contacts between base and typing unit.	Clean and adjust contacts	133	192	472.
7	Motor (internal)	Open windings; poor brushes.	Replace brushes or motor	83	161 through 166	470.
8	Main shaft	Clutches dry or bearings frozen tight.	Locate and correct trouble in typing unit.	85	185 and 186	247 through 252.

b. Motor Starts, but Typing Unit Runs Open.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	External circuits.					
	a. Line to outside	*a.* Line open or shorted	*a.* Inform wire chief			
	b. D-c voltage source	*b.* No voltage, voltage low, or wrong polarity.	*b.* Replace fuse or reverse polarity.	132 and 139	195	490.
	c. Line unit	*c.* Jack dirty, line fuse operated, or open wiring: switches in wrong position.	*c.* Replace fuse, correct switch positions, or replace unit.	(TM 11-359)		(TM 11-359.)
	d. Signal turnover	*d.* Space received instead of mark.	*d.* Reverse line leads if on polar operation.	18	18	
2	Wiring	Damaged or excessively oil-soaked wiring.	Repair or replace		47 and 192*c*	
3	Selector magnet	Circuit open or shorted	Check back from receiving plug.	98	184	285.
4	Perforator transmitter	Circuit open	Check back from black send plug.	86	175	380 through 460.
5	Selector trip off eccentric screw.	Operates trip latch when armature is in mark position.	Adjust screw	98	184	284.
6	Main shaft clutch throw-out lever.	Loose spring or binding	Adjust	102	186	248.
7	Base contacts	Contacts dirty or open	Clean and adjust	131, 133, and 192	192	472 through 476.
8	Line relay	Contacts dirty	Clean	134	192	476 through 481.

c. Typing Unit Runs Closed but Cannot Send.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	SEND—REC—BREAK key.	Key in REC position	Move key to SEND position.	127	192	488.
2	Transmitter circuit contacts, wiring, and line jack.	Contacts or wiring shorted	Locate and remove short circuit.	134	170, 175, 179, and 192.	397 and 398.
3	Transmitter plug	Plug shorted	Remove short; replace plug	82 and 86		
4	Trip-off pawl eccentric screw (keyboard).	Trip-off pawl does not engage intermediate pawl.	Readjust eccentric screw	98	183	394.
5	Trip-off pawl spring	Spring weak or broken	Readjust or replace spring	98	183	395.
6	Transmitting shaft	Shaft binding	Free, oil, and adjust shaft	86 and 89	178	381.

d. Typing Unit Runs Closed but Cannot Receive.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	External equipment	Improper relay adjustment, improper switch positions, or wiring faults.	Refer to technical manual on external equipment.	(TM 11-359)		
2	Selector armature spring	Spring loose or broken	Adjust or replace	98 through 100	183 through 188	212b.
3	Selector armature or stops	Armature pivots binding	Loosen and adjust	97 through 100	183 through 188	262 through 270.
4	Selector trip-off eccentric screw.	Does not operate trip latch plunger.	Adjust	98 through 100	183 through 188	284.
5	Main shaft clutch throw-out lever.	Not operated by sixth cam of selector cam sleeve.	Adjust	102	185 and 186	248.
6	Vanes	Vanes stuck in LTRS or FIGS position; bell cranks not on vanes properly.	Adjust clearances	97 through 100 and 119.	183 through 191	259.
7	Line relay and wiring	Reversed bias circuit	Check wiring	18 and 134	192	476 and 481.

e. Typing Unit Prints, But Rangefinder Has Poor Range.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Motor	Speed incorrect	Adjust with tuning fork	83	158 and 167	461.
2	Motor governor	Governor contacts	Clean or replace	84	170	462.
3	Line current	Current too low or too high	Adjust to 60 ma or use line unit and adjust bias.	18 through 21 and 139 (TM 11-359).	18 through 21 and 195.	132, 133, and 490.
4	Selector armature, armature stops or magnet, and trip-off mechanism.	Improper spring tension or adjustments.	Adjust tension. Check all armature and magnet adjustments.	98	183 and 197	212, 262, and 270.
5	Selector armature pivots	Pivots are too tight	Adjust pivots	98	183	265 and 270.
6	Binding of swords, T levers, vanes, bell cranks, or code bars.	Adjustments too tight, wrong lubricant, or dirt in moving parts.	Clean and adjust	100	183	259, 264, and 352.
7	Bell cranks	Improper adjustment	Adjust	100	183	352.
8	Selector cam sleeve	Worn sleeve	Replace	85, 98, 99, and 100	183	247.
9	Teletypewriter at other end of circuit.	Teletypewriter slow or fast	Request check of motor speed			
10	Selector mechanism, printing bail, and clutch.	Improper adjustment	Make complete adjustment	97 through 105	183	262 through 287.
11	Line and intermediate or terminal equipment.	Various line or equipment troubles.	Clear own teletypewriter with local test and speed check; then refer to wire chief.	21		211.
12	Line relay	Incorrect or no bias current. Relay out of adjustment. Dirty contacts.	Check wiring; correct and adjust.	133 and 134	192	476 and 481.

f. Typing Unit Prints but Scrambles Letters or Prints Occasional Errors.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Line current	Current too low or too high	Adjust to 60 ma or adjust line relay bias if receive relay is used.	(TM 11-359) 18 through 21 and 139.	195	19, 132, 489, and 490.
2	Rangefinder	Improper setting	Adjust to center of operating limits.	99	183	212.
3	Keyboard sending contacts	Contacts dirty or improperly adjusted.	Clean and adjust	86, 127, and 138	179	397, 398, and 486 through 488.
4	Motor speed	Motor speed too high; Shorted governor contacts or governor adjustment.	Remove short and check speed with tuning fork.	84, 131, and 135	167 through 174	211 and 462.
		Motor speed too low: Governor adjustment, contacts burned. Excessive main shaft friction clutch drag.	Adjust speed with tuning fork, clean or replace contacts. Lubricate main shaft gears and clutches.	84, 131, and 135	167 through 174	211 and 400.
5	See *d* and *e* above					

g. Typing Unit Prints but Fails to Shift or Unshift.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Figures and letters	Improper adjustment	Adjust	117 and 118	183 and 188 (typing unit, general).	291 and 292.
2	Shift detent	Detent spring too strong	Adjust	117 and 118	183 and 188	300 and 301.
3	Function bail spring	Spring too weak	Adjust tension	113	183 and 188	260.
4	Shift link turnbuckle	Turnbuckle loose	Adjust turnbuckle	117	183 and 188	288 through 302.
5	LTRS and FIGS function levers.	Improper spring tension or spring broken.	Adjust or replace	114, 119, and 120	183 and 188	293.
6	Function bail blade	Blade worn, chipped, or out of adjustment.	Replace or adjust	113	183 and 188	296.
7	Platen	Pilot screws out of adjustment.	Replace or adjust	113 through 119	183 and 188	289.

h. Typing Unit Prints but Fails to Line Feed Properly.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Single-double line feed detent	Improper adjustment	Adjust	123	183 through 188	305.
2	Line feed function lever spring.	Spring broken or missing	Replace	112 through 114	183 through 188	293.
3	Line feed link turnbuckle	Adjustment	Adjust	122	183 through 188	308.
4	Line feed detent spring	Spring missing or broken	Replace	122	183 through 188	310.
5	Line feed detent	Improper adjustment	Adjust	122	183 through 188	307.
6	Pressure roller release cam	Wrong position or wrong adjustment.	Adjust	124	183 through 188	317.
7	Pressure roller springs	Springs missing or broken	Replace	124	183 through 188	318.
8	Line feed check screw	Improper adjustment	Adjust	122	183 through 188	312.
9	Line feed check lever	Improper adjustment	Adjust	122	183 through 188	314.
10	Line feed check lever spring	Spring missing or broken	Replace or adjust	122	183 through 188	315.
11	Line feed pawl spring	Spring missing or broken	Replace	122	183 through 188	311.
12	Function bail blade	Blade chipped or worn; adjustment.	Replace or adjust	113	183 through 188	296.

i. Typing Unit Prints but Fails to Space Properly.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Space function lever spring	Spring broken or missing	Replace	96, 106, and 120	183 through 188	294.
2	Spacing escapement pawl operating arm.	Arm bent or screw missing	Replace and adjust	106	183 through 188	327.
3	Spacing rack	Teeth missing; rack broken or loose.	Replace and/or adjust	106	183 through 188	353.
4	Right margin adjusting screw.	Improper adjustment	Adjust	106*b* and 107	183 through 188	372.
5	Carriage guide screw	Screw binding	Adjust	116	183 through 188	351.
6	Carriage support rollers	Rollers bind	Adjust or replace	116	183 through 188	244.
7	Spacing lever, stop bracket	Improper adjustment	Adjust	106	183 through 188	349.
8	Carriage return latch bar latch.	Improper adjustment	Adjust	116	183 through 188	339.
9	Left margin adjusting screw	Improper adjustment	Adjust	116	183 through 188	371.
10	Spacing stop lever spring	Spring broken or missing	Relpace	106	183 through 188	350.

Note. Possible trouble may be found in adjustment of the spacing shaft bearing bracket or lock-bar joint or in blocking of the function lever bail.

j. Typing Unit Prints but Fails to Carriage-Return Properly.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Carriage return drum spring	Weak tension, or spring unhooked or broken.	Tighten, engage, or replace	116	183 through 191	356.
2	Carriage return draw strap	Draw strap unhooked or broken.	Adjust or replace	116	183 through 191	
3	Carriage guide screw	Binding	Adjust	106 and 116	183 through 191	351.
4	Carriage support roller bearings.	Rollers binding	Lubricate, adjust, or replace	106 and 116	183 through 191	244.
5	Carriage return function lever spring.	Spring missing or broken	Replace	114	183 through 191	345.
6	Carriage return reset bar spring.	Spring missing or broken	Replace	116	183 through 191	344.
7	Carriage return operating lever spring.	Spring missing, broken, or weak.	Replace	116	183 through 191	346.
8	Carriage return latch bar latch.	Bent or rounded edge; adjustment.	Repair, replace, or adjust	116	183 through 191	339.
9	Reset bar	Reset bar missing or broken	Replace		183 through 191	339 and 344.
10	Carriage return operating lever stop.	Stop does not allow lever to disengage clutch.	Adjust	116	183 through 191	343.
11	Spacing shaft lower bearing bracket adjustment.	Improper clearance between gears.	Adjust	106 and 120	183 through 191	251.
12	Spacing rack adjustment	Rack binding	Adjust	106 and 120	183 through 191	353.
13	Function bail blade	Blade chipped or worn; improper adjustment.	Adjust or replace	113	183 through 191	296.
14	Carriage return lock bar latch eccentric screw.	Eccentric screw adjustment	Adjust	116	183 through 191	340.

k. Typing Unit Prints, but Ribbon Remains Motionless or Does not Oscillate.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Ribbon spool shaft and feed shaft spur gears, and vertical and horizontal feed shaft bevel gears.	Gear set screws loose or missing; spur gears do not mesh.	Adjust, tighten, and replace missing parts.	108	183 through 191 (typing unit, general).	220 and 223.
2	Vertical feed shaft collar	Collar loose	Adjust collar for correct spring compression.	108	183 through 191	218, 223, and 225.
3	Horizontal feed shaft detent spring.	Missing or improper adjustment.	Replace or adjust	108	183 through 191	219.
4	Ribbon	No reverse eyelet near end to operate ribbon reverse arm.	Replace ribbon			14.
5	Ribbon reverse shaft link adjustment.	Improper link position	Adjust	109	183 through 191	228.
6	Ribbon feed pawl spring	Spring loose or missing	Replace			216.
7	Ribbon oscillator lever spring.	Spring loose or broken	Replace	110	183 through 191	236.
8	Ribbon oscillator lever	Lever broken or caught in slot.	Replace or adjust	110	183 through 191	373.
9	Ribbon lock-out bar	In locked-out position	Change position	130	183 through 191	374.
10	Ribbon spools, brackets, or cups.	Not seated on spool shaft and pin.	Adjust			224.

Note. Possible trouble also may be found in ribbon shift lever bracket or vertical ribbon feed shaft.

l. Typing Unit Prints, but Ribbon Does not Reverse.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Ribbon reverse eyelets	Eyelets missing or too near ribbon end.	Replace ribbon			14.
2	Ribbon feed shaft detent spring.	Spring adjustment TT	Adjust	108 and 109	183 through 191 (typing unit, general).	219.
3	Vertical ribbon feed shaft collar.	Collar loose	Adjust and tighten	108	183 through 191	220, 225, and 227.
4	Ribbon reverse link	Improper angular adjustment.	Adjust and tighten	109	183 through 191	228.
5	Ribbon reverse pawl springs	Springs missing or broken	Replace and check tension	109	183 through 191	232.

m. Typing Unit Prints, but Bell Does Not Operate (Letter S Prints Correctly).

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Bell function lever spring	Spring missing or broken	Replace	112 through 114	183 through 188	337.
2	Sixth vane	Vane binds or connecting links missing or broken.	Adjust or replace defective parts.	97, 98, and 119	183 through 188	258.
3	Function bail blade	Blade missing, chipped, or worn; improper adjustment.	Replace or adjust	113	183 through 188	296.
4	Bell hammer arm	Arm binds at pivots	Adjust pivots	125	183 through 188	
5	Bell operating lever spring	Spring missing or broken	Replace	125	183 through 188	335.
6	Bell reset bar spring	Spring missing or broken	Replace	125	183 through 188	336.
7	Bell hammer backstop	Improper adjustment	Adjust	125	183 through 188	334.
8	Signal bell latch bar	Bar worn; latch adjustment	Replace or adjust	125	183 through 188	333.

n. Typing Unit Prints, but Letter S Does Not Print and Signal Bell Operates When Platen Is in Ltrs Position.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (paf. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Sixth vane	Vane is binding; vane extension out of adjustment or broken.	Adjust or replace	119	183 through 188	257 through 259.
2	Signal bell function lever	Lever broken or chipped at sixth vane.	Replace	114 and 125	183 through 188	337.
3	Bell latch bar latch	Latch missing, bent, or broken.	Replace	125	183 through 188	332 and 333.
4	Bell latch bar or reset bar or respective springs.	Defective	Replace	125	183 through 188	332 through 336.

o. Typing Unit Prints, but Motor Stop Fails to Operate.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Sixth vane	Vane binds or does not operate.	Adjust	119	183 through 191	258.
2	Motor stop lever spring or motor stop lever bracket.	Broken or missing spring or bracket loose.	Replace or adjust	126	183 through 191	272 and 278.
3	Motor stop pawl spring	Missing or broken spring	Replace	126	183 through 191	277.
4	Motor stop pawl backstop	Improper adjustment	Adjust	126	183 through 191	275.
5	Motor stop pawl or lever backstop screw.	Binds stop pawls	Adjust	126	183 through 191	274 and 275.
6	Motor stop lever eccentric	Improper adjustment	Adjust	126	183 through 191	273.
7	Motor stop release lever	Eccentric adjustment	Adjust	126	183 through 191	276.
8	Contact spring	Incorrect tension or contact clearance.	Adjust contact clearance or tension.			279.
9	Motor stop contacts	Contacts fused, shorted internally, or effectively shorted by wiring.	Open motor stop contacts; locate and clear shorts.	126	183 through 191	363 and 364.
10	Motor stop function lever spring.	Tension adjustment; spring missing or broken.	Adjust or replace	126	183 through 191	280.
11	Heavy motor stop contact springs.	Improper adjustment	Bend to proper clearance			363 and 364.
12	Function bail blade	Blade chipped or worn; adjustment.	Adjust or replace	113	183 through 191	296.

p. Typing Unit Prints More or Less Than Required Characters per Line or Prints Uneven.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Left margin adjusting screw	Screw loose or missing	Tighten or replace; adjust in or out until left margin is even.	7, 24b, 97, and 116	183 through 191 (typing unit, general).	371.
2	Right margin adjusting screw.	Improper adjustment or wrong position.	Adjust for required characters per line; adjust for even, right margin.	7, 24b, 97, and 116	183 through 191	372.
3	Right margin detent spring	Loose or missing	Replace	7, 24b, 97, 116, and 107.	183 through 191	243 and 372.
4	Carriage return spring	Incorrect spring tension	Adjust	116	183 through 191	356.
5	Dash pot	Vent screw adjustment; piston binding.	Adjust or lubricate	116	183 through 191	379.
6	Spring stop lever	Binds	Lubricate or adjust	106 and 120	183 through 191	349.

q. Typing Unit Prints, but Margin Bell Fails to Operate on Proper Character.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Bell hammer spring	Spring missing or broken	Replace	107	183 through 191	330.
2	Margin bell cam	Improper adjustment	Adjust	107	183 through 191	376.
3	Margin bell pawl spring	Spring missing or broken	Replace	107	183 through 191	238.
4	Margin bell pawl	Pawl binding or missing	Adjust or replace	107	183 through 191	376.
5	Bell hammer arm shaft	Binding	Adjust	107	183 through 191	329*a* and 376.

r. Typing Unit Prints but Emits Grinding Noise.

Item No.	Items to be checked	Possible trouble	Corrective action	Operation theory (par. ref)	Repairs (par. ref)	Adjustments (par. ref)
1	Typing unit mounting screws.	Screws loose	Tighten	14 and 97	155	74.
2	Main shaft bearings	Bearings broken or burned	Replace; lubricate	85, 100, and 102	185 and 186	247.
3	Motor mount adjusting screws.	Improper drive gear clearance.	Adjust	14	158	367.
4	Transmitting shaft	Fiber gear worn or bearings worn.	Replace worn parts	86 and 89	176	210, 380, and 381.
5	Transmitter clutch throw-out lever.	Clutch clearance	Adjust	86 and 89	178	387.
6	Main shaft clutch throw-out lever.	Improper clutch clearance	Adjust	102	185 and 186	248.

CHAPTER 4

FIELD MAINTENANCE

Section I. GENERAL

80. Scope

The repair and maintenance instructions contained in this chapter are intended for field maintenance. They are applicable for all purposes of repair through and including rebuilding. The extent of repair performed by any particular unit having field or base maintenance responsibility is limited only by the tools and test equipment available and by the skill of assigned personnel.

81. References

For specific units and/or services, refer to the table of contents and the index. Refer to TM 11–2222 for information about the transmitter distributor, and to TM 11–2223 for information covering reperforators.

Section II. THEORY OF OPERATION

82. General Theory of Operation

a. General. Teletypewriters TT–7/FG and TT–8/FG are motor-driven electromechanical devices that interchange typewritten messages between two or more points connected by appropriate communication channels. Basically, each typewriter converts mechanical motion into electrical impulses when transmitting. When receiving, they convert electrical impulses into mechanical motion. The material in this section of the manual discusses the sequence of mechanical operations of the transmitting equipment that results in the transmission of electrical impulses, and the final mechanical action at the receiving teletypewriter necessary for the typing of messages. The components discussed in this section are the perforator transmitter with its associated keyboard and character counter, the typing unit (fig. 61), the base unit, the table, the rectifier, and the motor unit.

b. Electrical.

(1) *Power circuits.* The power circuits of Teletypewriters TT–7/FG and TT–8/FG consist of the incoming power lines, wiring, switches, fusing devices, and receptacles at the table. In addition, the base upon which the motor unit is mounted contains wiring and slip connections by which power is brought to the motor unit. The motor of the transmitter distributor is similarly connected to the power lines by the spring contacts of the transmitter distributor mounting on top of the table. The power circuits shown in figures 272 and 274 are discussed in paragraph 132. The rectifier power unit is discussed in paragraph 139.

(2) *Signal circuits.* The incoming signal lines, as well as the conductors for the send circuits, are completed by means of the line terminal boards at the table. The signal LINE jacks (fig. 28) are used to connect the typing unit and perforator transmitter to the line. The transmitter distributor is connected to its circuit by the spring contacts of the mounting on top of the table. Signal circuits of Teletypewriters TT–7/FG and TT–8/FG are arranged so that the transmitting contacts of the perforator transmitter normally will be in series with the receiving (line) winding of the relay or the selector magnets of the receiving unit with which they com-

municate. The local selector magnet (through the line relay) also receives transmission from both remote and local transmitting contacts, except when the equipment is arranged for independent sending and receiving.

(3) *Local circuits.* Local circuits of these teletypewriters are those by which the selector magnets, the counter unit magnets, the signal lamp, and perforator magnets are operated. The local circuits are discussed in paragraphs 65 through 79 and shown in figures 268 through 276. These figures show the arrangement of the terminal boards on the base by which power and signal circuits are completed to the various assemblies and operating components. A local test circuit also is provided. The line switching key (fig. 2) can be operated so as to connect the operating components of these teletypewriters in this test circuit. Loop current adjustment for the local test circuit is provided for by the 2,500-ohm slide-wire resistor R602 (fig. 274). R601 and R603 are used when these teletypewriters supply current to the line.

c. MECHANICAL. The mechanical operations that are performed by Teletypewriters TT–7/FG and TT–8/FG are described in the following paragraphs. Adjustment data for the mechanical assemblies appear in paragraphs 207 to 490. Figure 61 shows the mechanical arrangement of the typing unit. Figure 62 shows the receive mechanism.

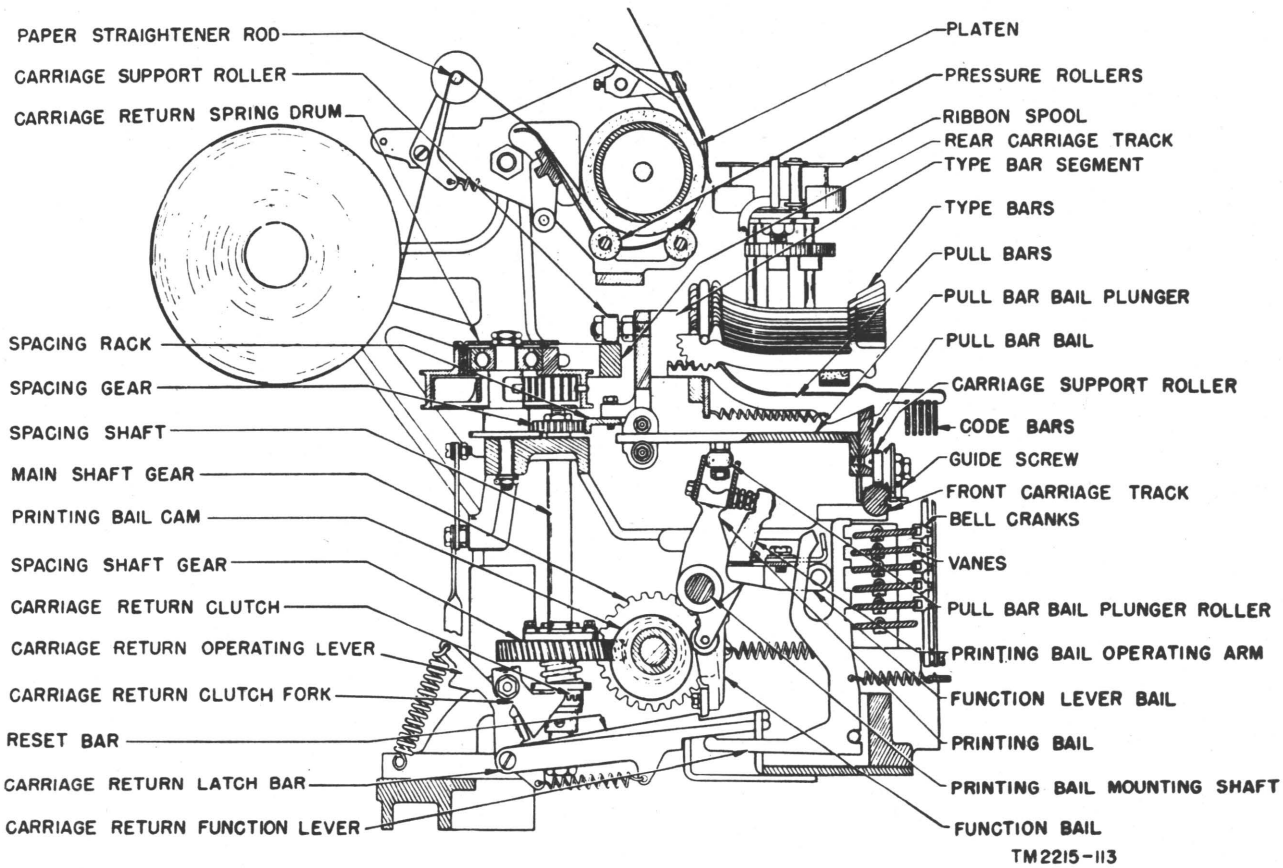


Figure 61. Typing unit, cross-sectional diagram.

83. Motor Unit

a. DESCRIPTION AND PURPOSE. The motor unit is mounted on a base plate. It consists of a motor with a governor, a rotating target, a lamp and lamp bracket. The lamp is used to illuminate the target during adjustment of motor speed. The motor is series-wound and operates on 60-cycle ac, or 25-,

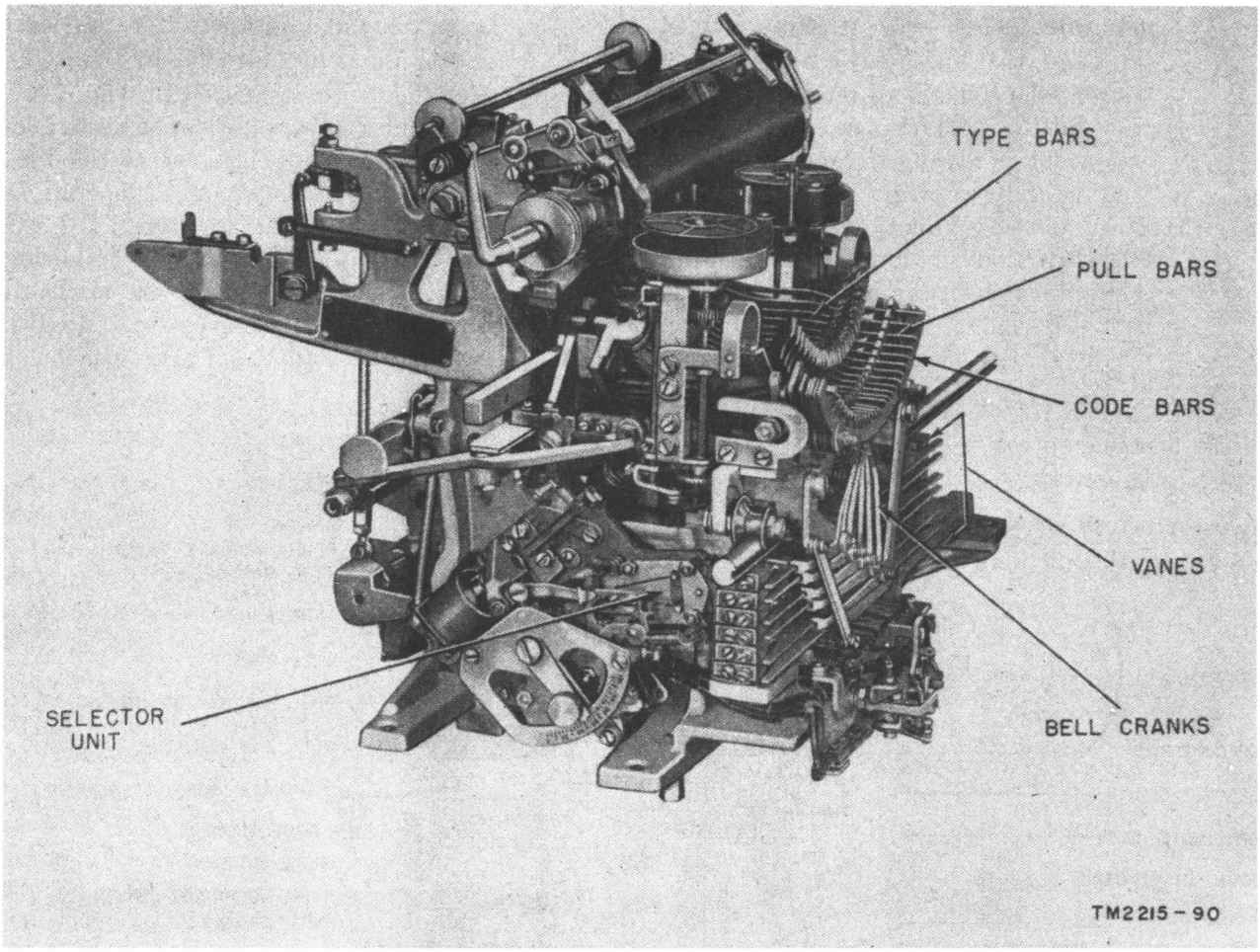


Figure 62. Typing unit, showing receive mechanism left, front view.

40- and 50-cycle adjusted motor voltage. Power for the typing unit is provided by gearing to the shaft of the motor. The motor mounting plate may be moved laterally for proper horizontal alinement with the main shaft gear. A motor adjusting screw provides for proper vertical alinement. Figure 63 shows the motor unit mounted on the base unit; figure 64 is a diagram of the governor.

b. Operation. The motor operates continuously at 2,100 rpm. Power is provided by connections on the cord panel of the rectifier power unit. The motor speed is adjusted with the speed adjusting wheel. Proper speed is determined with the speed indicator (tuning fork) and target (par. 19).

84. Governor

(figs. 63 to 66)

a. Description and Purpose. The governor is attached to the end of the motor shaft opposite the end where the motor pinion is fastened. The governor resembles a flywheel and has a series of white and black spots painted upon its outer rim. The alternate black and white segments constitute the target by which correct speed is determined with the speed indicator. The speed adjusting wheel extends through the governor cover and is turned by using the governor adjusting bracket and governor adjusting lever. This governor and two parallel resistors control the speed of the motor. The resistors are connected across the governor contacts.

b. Operation.

(1) The governor contacts are opened when centrifugal force enables the contact arm to overcome the tension exerted upon it by the contact arm spring. When the contacts open, the two parallel resistors are connected in series with the motor windings. The total voltage applied to

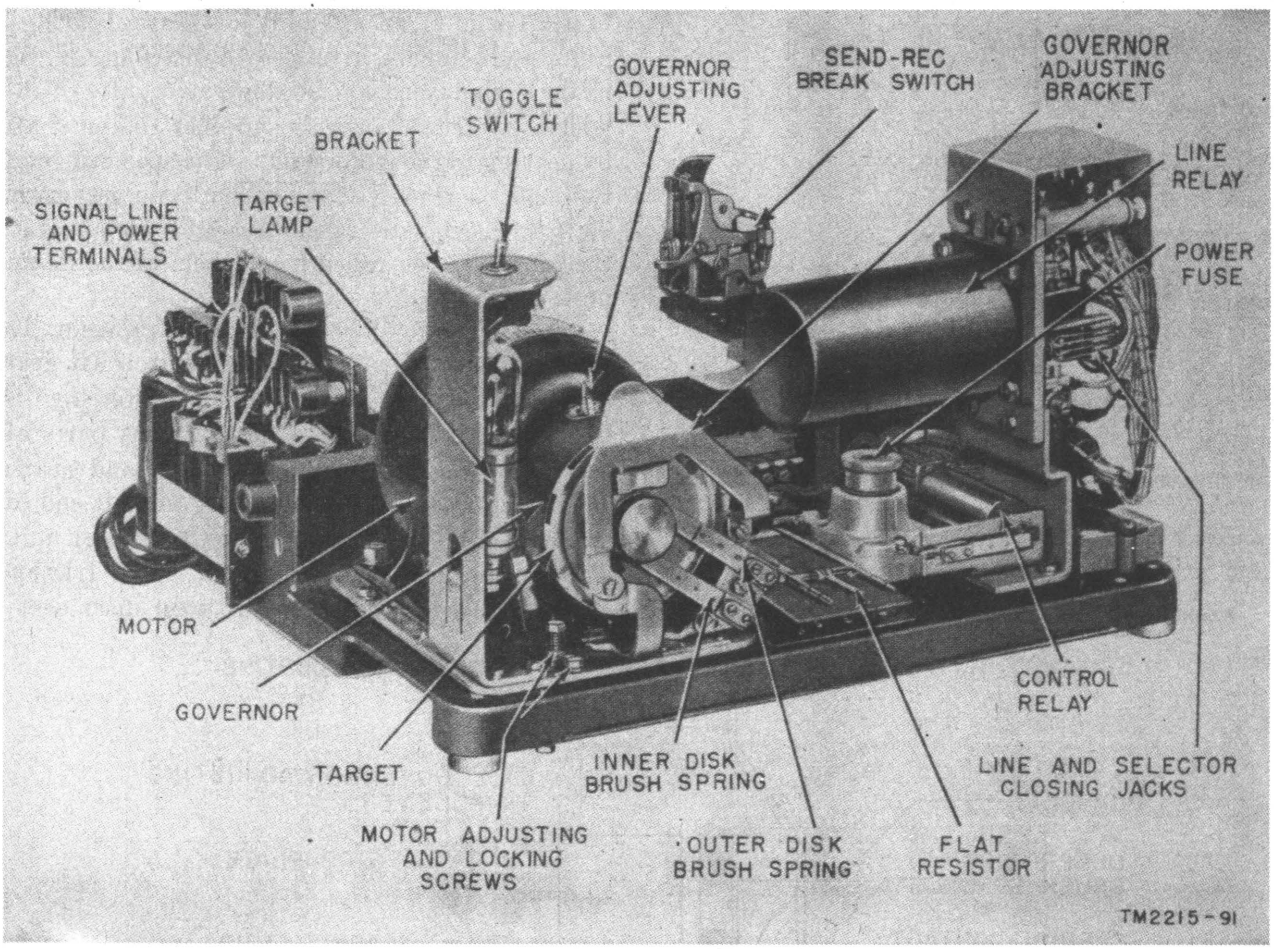


Figure 63. Motor unit mounted on base.

the motor windings now is reduced by the voltage drop across the resistors, and the motor slows down.

(2) When the governor contacts close, the resistor is short-circuited and the full value of the external line voltage is applied to the motor windings; this increases the motor speed.

(3) The speeds at which the governor contacts open and close are controlled by the amount of tension exerted by the contact arm spring. Turning the speed adjusting wheel (to which the spring is fastened) will increase or decrease the tension of the spring.

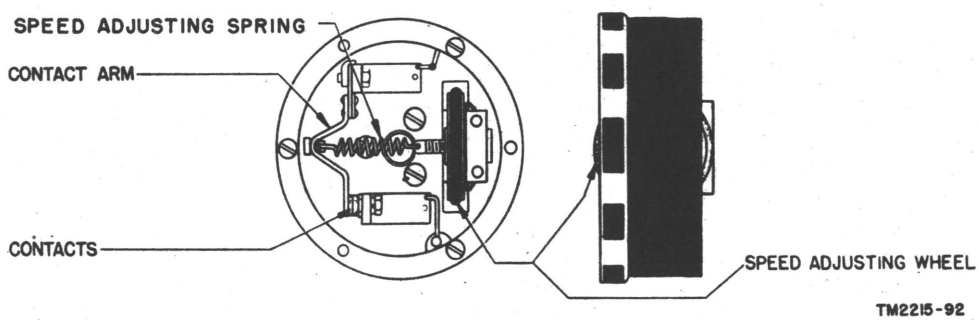


Figure 64. Motor governor diagram.

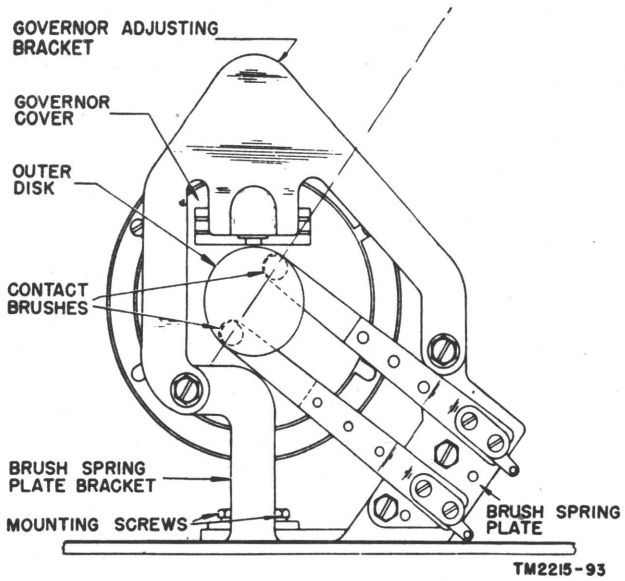


Figure 65. Governor adjusting bracket assembly.

unit. On it is an assembly of gears, bearings, cams, and clutches, arranged to distribute power to the various mechanically operated parts of the teletypewriter. Power is supplied to the shaft by gearing to the motor unit. The speed of rotation and the timing of the various cam actions in both the keyboard transmitter and typing unit, therefore, are controlled by the rpm of the motor unit.

b. Operation. When the motor is rotating, the main shaft revolves because the main shaft gear is meshed with the motor pinion. Power then is distributed by the shaft to the various parts of the machine through clutches, cams, and gears. The selector cam sleeve fitted over the left end of the main shaft delivers power to the selector unit. This is accomplished through two friction clutches, each composed of two steel disks sepa-

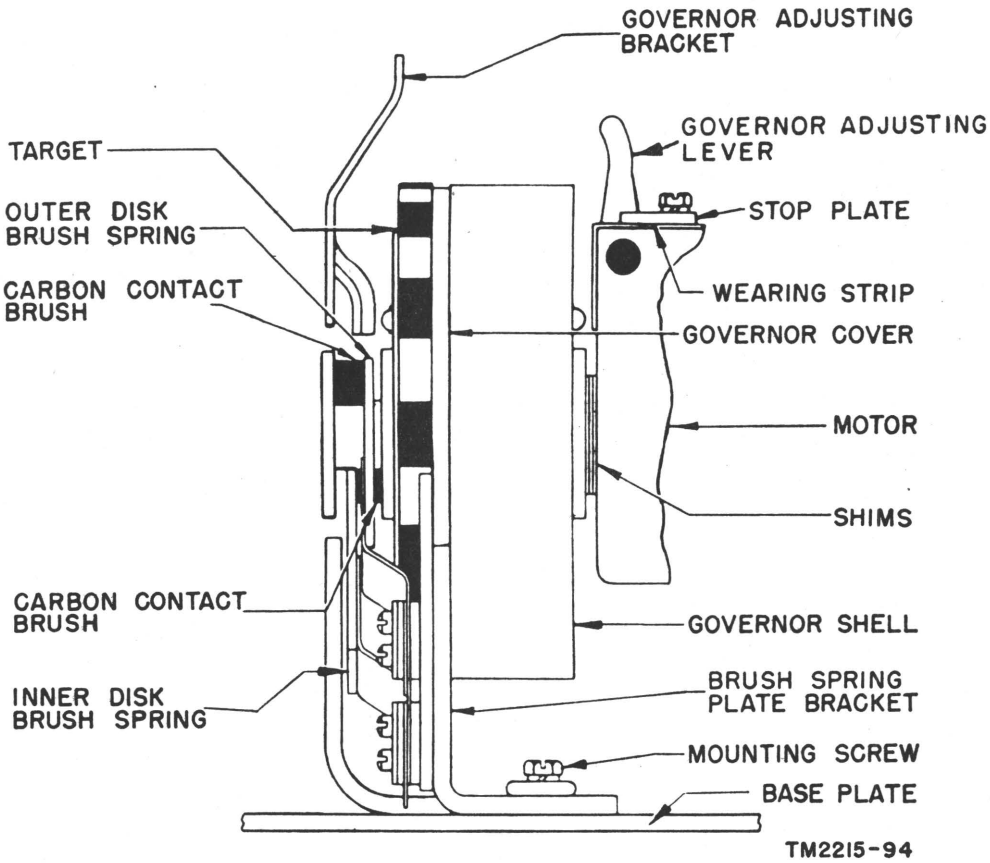


Figure 66. Motor governor, side view.

85. Main Shaft

(fig. 67)

a. Description and Purpose. The main shaft is mounted upon, and extends across, the typing

rated by a felt washer. Operation of the main shaft clutch under control of the selector unit causes the function bail cam and the printing bail cam to rotate with the main shaft. The function bail cam and the printing bail cam, in turn,

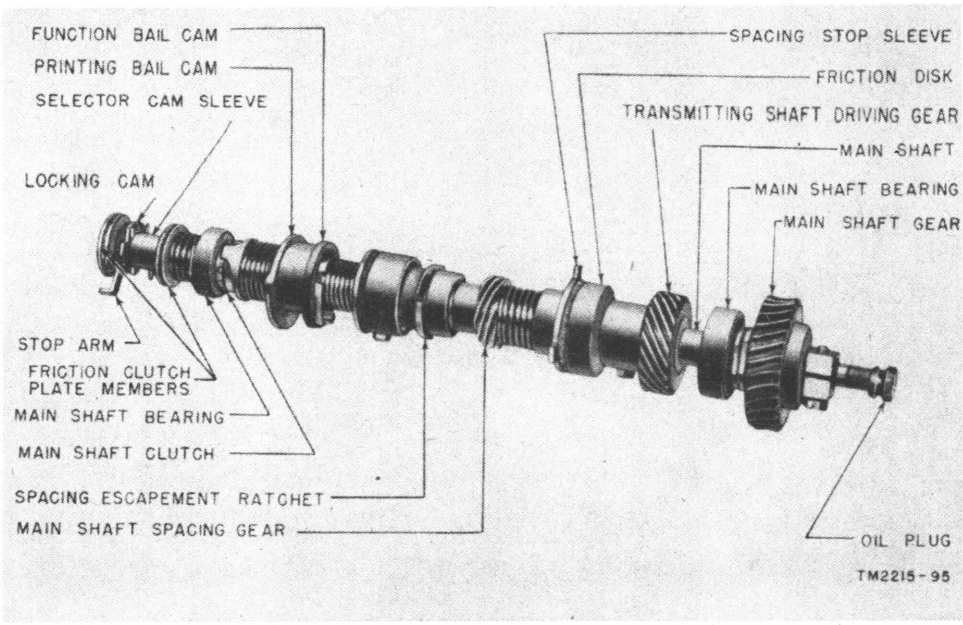


Figure 67. Main shaft.

operate the function bail and the printing bail in the typing unit. These, in turn, furnish the direct power for the function or printed character previously selected by the selector unit. The spacing gear on the main shaft meshes with the spacing shaft gear in the typing unit, and delivers power to the spacing mechanism (par. 106). The transmitting shaft driving gear supplies power to the transmitting shaft of the perforator transmitter.

86. Perforator Transmitter

(figs. 9 and 68–72)

a. Description and Purpose. The perforator transmitter consists of a keyboard, associated transmitter assembly, tape perforating mechanism and character counter (figs. 9 and 68). The perforator transmitter can be arranged to produce page copy alone, or page copy plus perforated tape, while transmitting to the line. In addition, it can produce perforated tape and/or page copy without transmitting to the line. The character counter and warning lamp operate only when the equipment is perforating tape. The entire assembly is installed upon the base in the front of the teletypewriter. The perforator mechanism and the character counter assembly are attached to the left-hand end of the keyboard casting. The transmitter assembly is located near the right-hand end of the keyboard. The perforator mechanism and character counter are protected by an extension of the typing unit cover. The keyboard control operating lever (fig. 68) extends through the typing unit cover.

b. Keyboard Mechanism.

(1) *Details.* The keyboard mechanism is mounted upon a casting. It consists essentially of a set of key levers, two selector bars for each unit of the five-unit code, one selector bar for the punch contacts, **Y** lever connecting links, and locking levers used in selecting the code combination to be transmitted. In addition, there are included a transmitting cam sleeve, contact levers, contact springs for transmitting the selected code, a universal bar, a trip-off pawl, an intermediate pawl and a clutch throw-out lever and clutch for starting and stopping transmission. Beneath the key levers are five pairs of parallel motion selector bars, a counter control contact operating mechanism, a universal bar, and a punch contact operating bar that extends the width of the keyboard. The keyboard is equipped with a space repeat device which permits the continuous transmission of space bar signals when the operating lever is at KEYBOARD or KBD & TAPE.

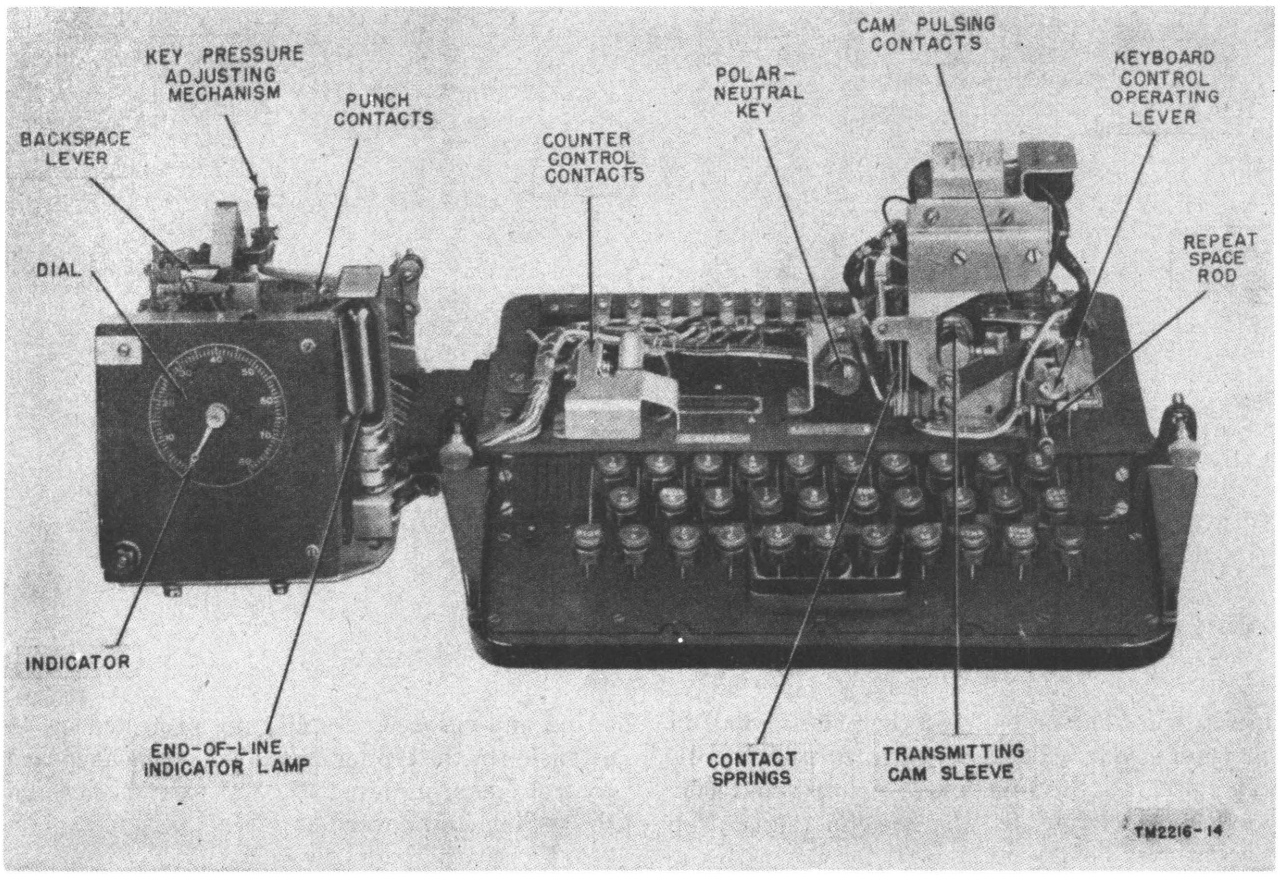


Figure 68. Perforator transmitter parts.

(2) *Operation.* The transmitting cam sleeve and its controlling clutch are supported by a transmitting shaft (fig. 80). The shaft derives its motive force from a gear mounted on the main shaft of the typing unit. This gear engages a drive gear on the rear end of the transmitting shaft of the perforator transmitter. The transmitting cam sleeve normally is held stationary because the clutch is disengaged by the clutch throw-out lever. The selector bars on the bottom of the keyboard may be moved up or down. These bars are provided with rectangular notches in their upper edges according to the requirements of the code. The notches in the front and rear selector bars of each pair are staggered so that there always will be a high portion on one of each pair in the path of each key lever. The ends of each pair of selector bars rest on the arms of **Y** levers (par. 90). When a key lever is depressed, the selector bars with their high portions in line with that key lever are moved downward. This causes the **Y** levers to move the other selector bar of the pair upward. When the *rear* bar of any pair is moved downward, the lower extension of the corresponding **Y** levers will be moved to the left; when the corresponding *front* selector bars are moved downward, the **Y** levers will be moved to the right. Each of the first five **Y** lever connecting links engages a locking lever and positions it to correspond with the signal impulse to be transmitted. Each locking lever controls the motion of a transmitting contact lever.

c. Perforator Mechanism.

(1) *Details.* The perforator mechanism consists essentially of a set of punches for perforating tape, a punch magnet, an armature lever for operating the punches, and a set of selector fingers. In addition, there are selector levers and **Y** lever

connecting link extensions, for selecting the punches, and a tape feed mechanism. The selector fingers rest in a slotted guide mounted on the armature lever in line with, but just below, the punches. The right end of each selector finger is attached to a selector lever that pivots on a mounting bracket at its lower end. A Y lever connecting link extension connects the left end of each Y lever connecting link to the central portion of its corresponding selector lever. The related selector finger will move to the right or left in accordance with the movements of the Y lever connecting links (fig. 71). The magnet armature is mounted on a centrally pivoted armature lever. When the armature is attracted, the right end of the armature moves downward and the left end rises to carry the left ends of the selector fingers upward. If a selector finger is in its *left* position when the armature lever rises, the corresponding punch will perforate the tape. With a selector finger in its *right* position, the finger moves upward, clears the punch, and the punch does not perforate the tape. The portion of the tape on either side of the line of feed holes is used for code perforations. Perforations represent marking impulses and blanks (unperforated portions) represent spacing impulses (fig. 75). Refer to TM 11–2222 for details of transmisison from tape by a transmitter distributor.

(2) *Operation.* When the operating control lever is set at **KEYBOARD**, no tape is punched. When the control lever is set at **KBD & TAPE**, and key lever pressed causes a set of cam pulsing contacts, located above the transmitting cam sleeve, to operate the punch magnet (fig. 73). When the operating control lever is set only at **TAPE**, the magnet is operated by a pair of punch contacts (fig. 72) mounted on the perforator bracket. With

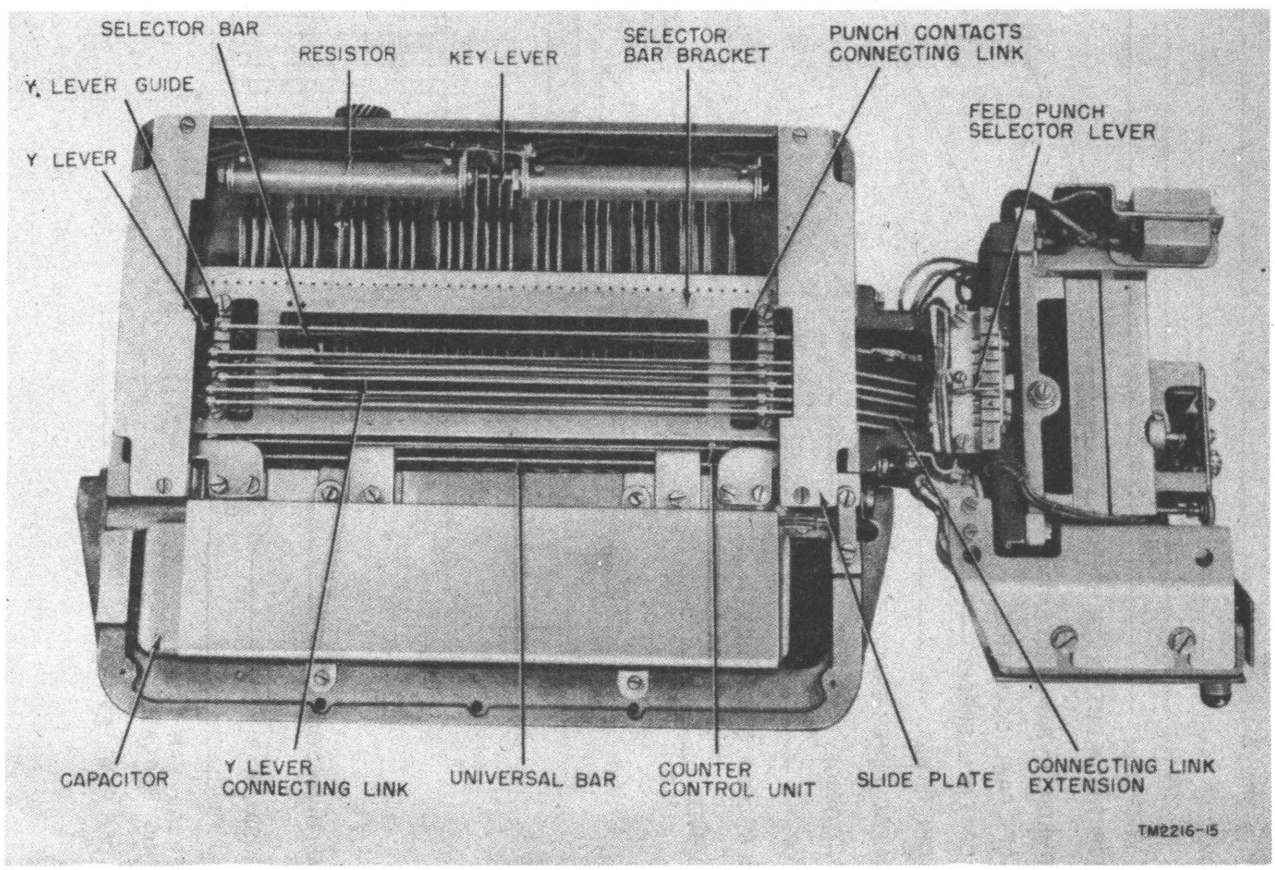


Figure 69. Perforator transmitter, bottom view.

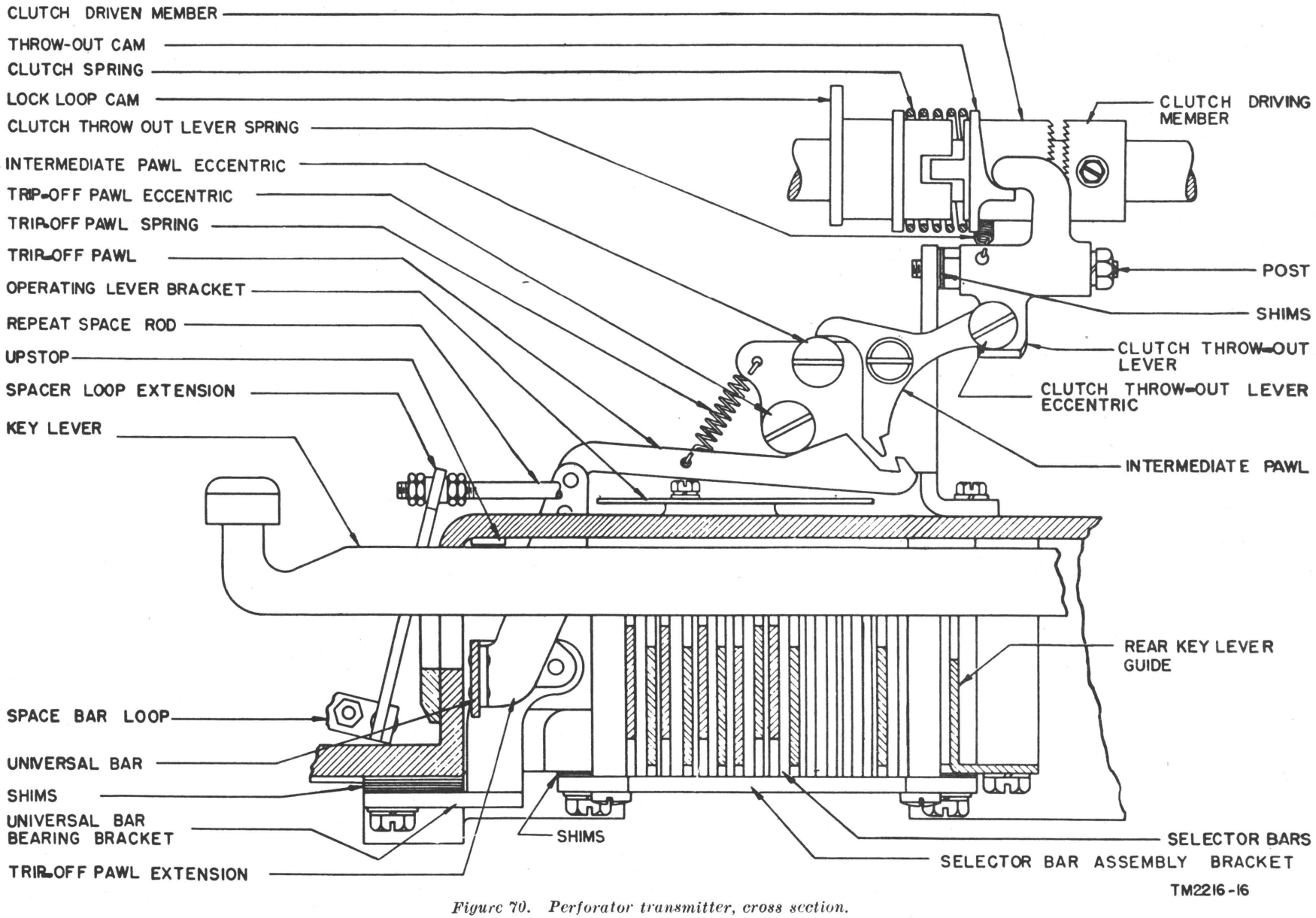


Figure 70. Perforator transmitter, cross section.

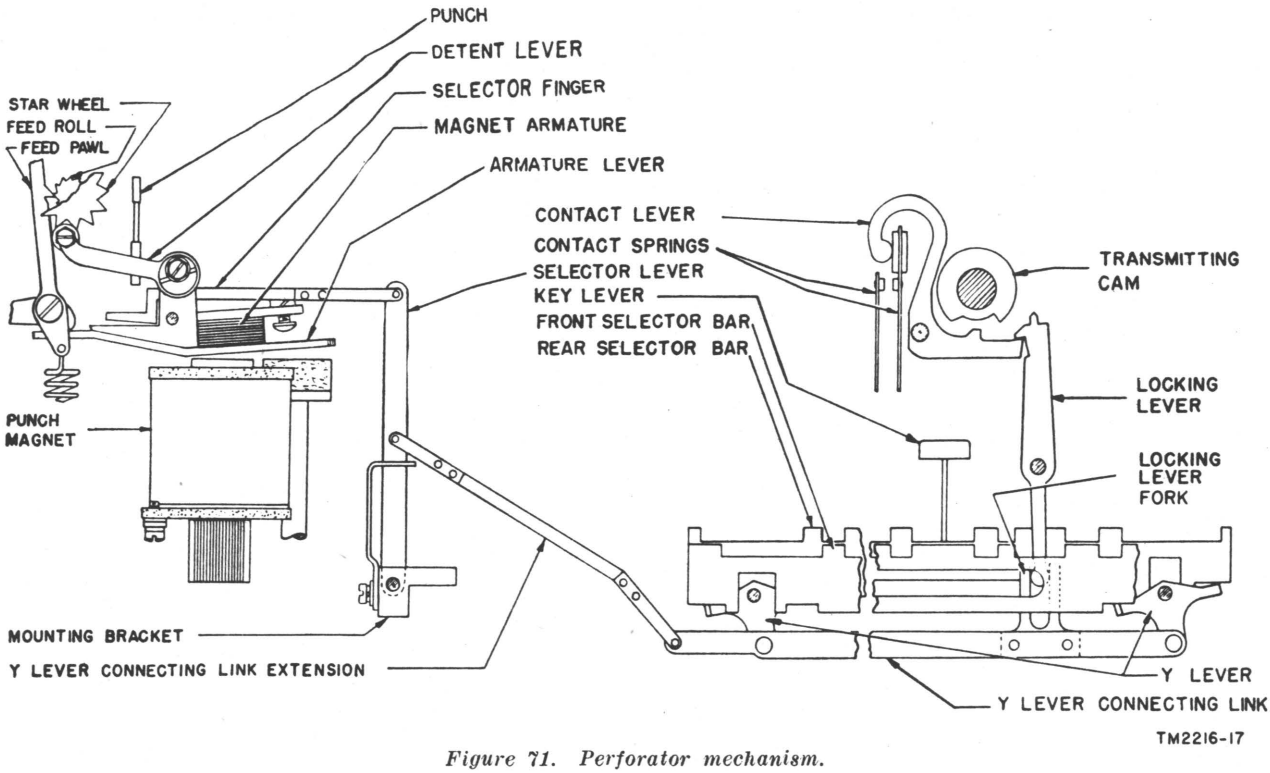


Figure 71. Perforator mechanism.

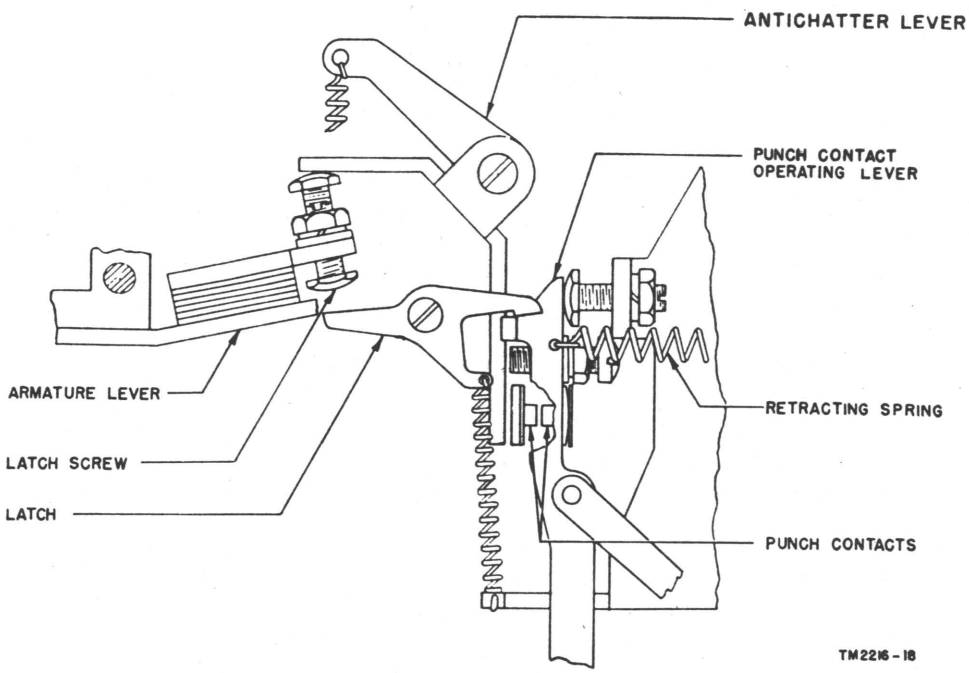


Figure 72. Punch contact and armature lever mechanism.

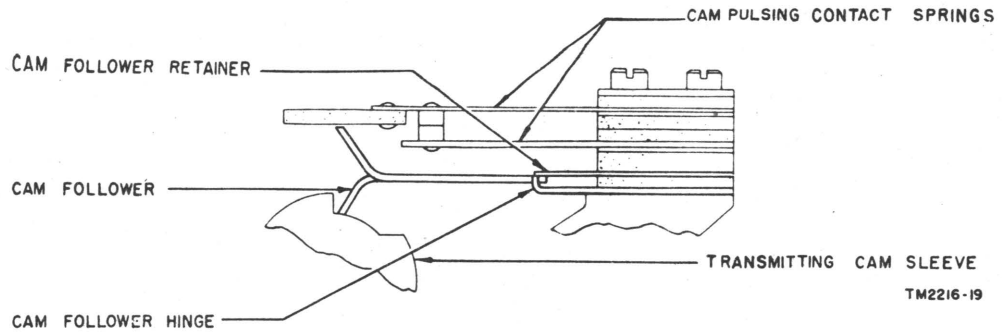


Figure 73. Cam pulsing contacts, old style.

the keyboard control lever in its upper or KEYBOARD position, all circuits controlled by the keyboard control contacts (fig. 74) are open and the punch magnet is not energized. With the keyboard control lever at KBD & TAPE, only the lower pair of control contacts are closed. This permits the punch magnet to be energized by the cam pulsing contacts. With the keyboard control contacts at TAPE, all of the keyboard contacts are closed, the universal bar is held depressed, and no direct keyboard transmission is possible. The operation of any key lever, in addition to setting up combinations on the selector fingers, also moves the punch contact operating bar downward. This causes the Y lever linkages (fig. 72) to move the upper end of the punch contact operating lever to the left (against its retracting spring), and permits the punch contacts to close.

Note. In recent models of Teletypewriters TT–7/FG and TT–8/FG new style cam pulsing contact assemblies are used. They are basically the same and operate similar to the old style contacts. Refer to figure 238 and to paragraph 411 for requirement and adjustment data.

87. Tape Feed Mechanism

a. Description and Purpose. The tape feed roll (fig. 76) is located to the left of the punches. Spaced at equal intervals around the feed roll is a series of projecting pins which engage the feed holes in the tape. A tape tension lever holds the tape against the feed roll and keeps the feed holes constantly engaged by the tape feed pins.

b. Operation. During the upward movement of the armature lever, the feed pawl engages the next tooth on the front end of the feed roll. When the armature lever moves downward, the tape feed roll revolves and the tape advances one character space. A star wheel (fig. 77) and detent insure equal spacing of the tape perforations.

88. Character Counter

(figs. 78 and 79)

a. Description and Purpose. The character counter (figs. 68 and 78) is an assembly that includes essentially a ratchet, counter magnet, a feed pawl for advancing the ratchet, and a latch pawl to retain the ratchet in its advanced position. In addition, there is a release magnet for disengaging both the feed and latch pawls from the ratchet, a set of contact springs to operate the warning lamp, a dial, and an indicator.

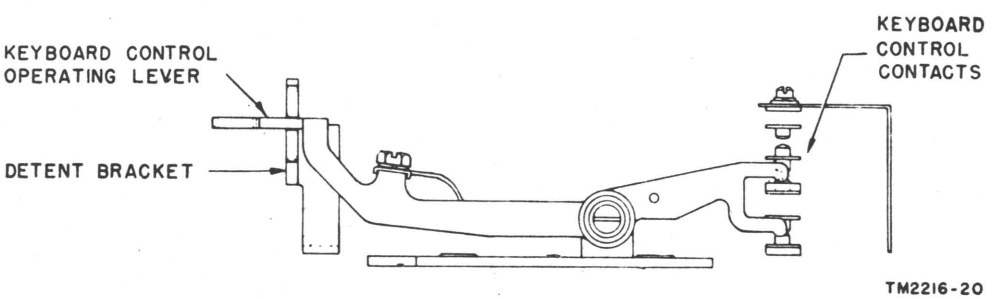


Figure 74. Keyboard control operating lever and contacts.

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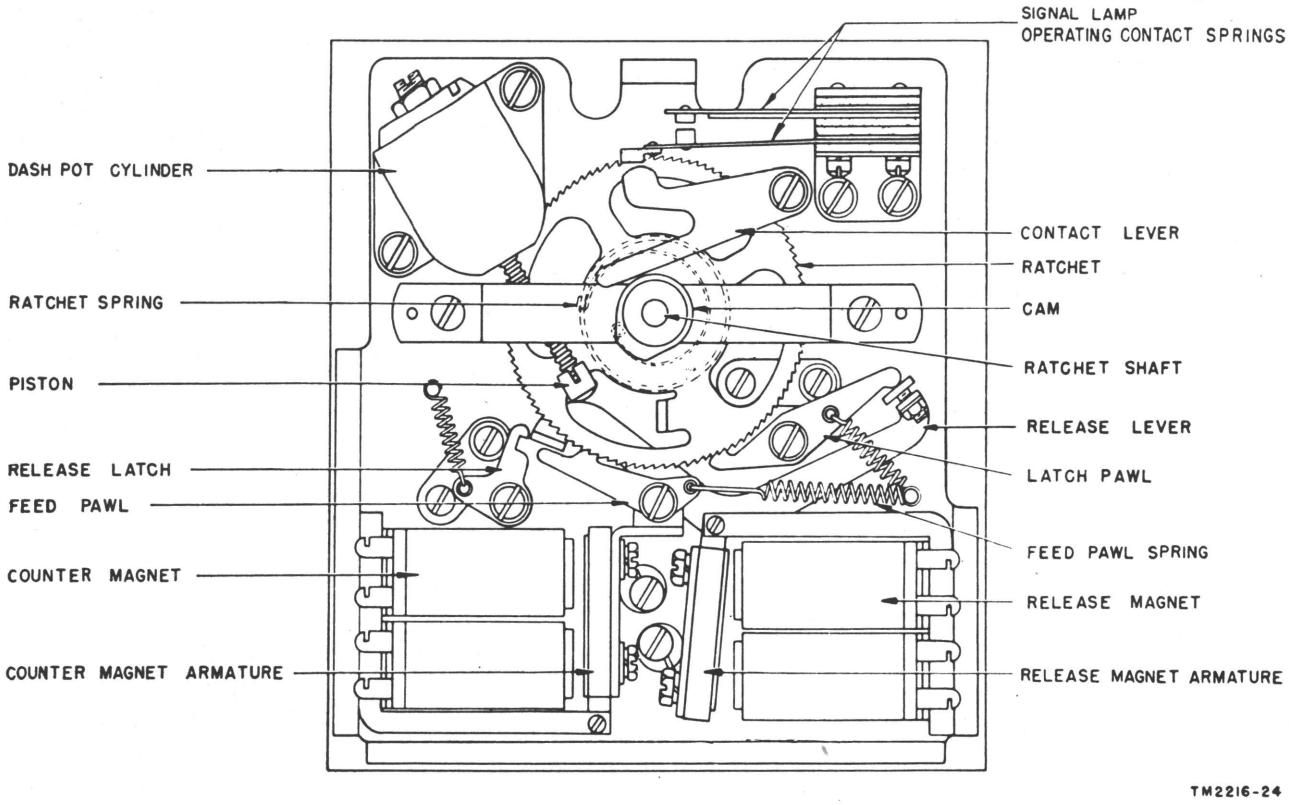


Figure 78. Character counter mechanism.

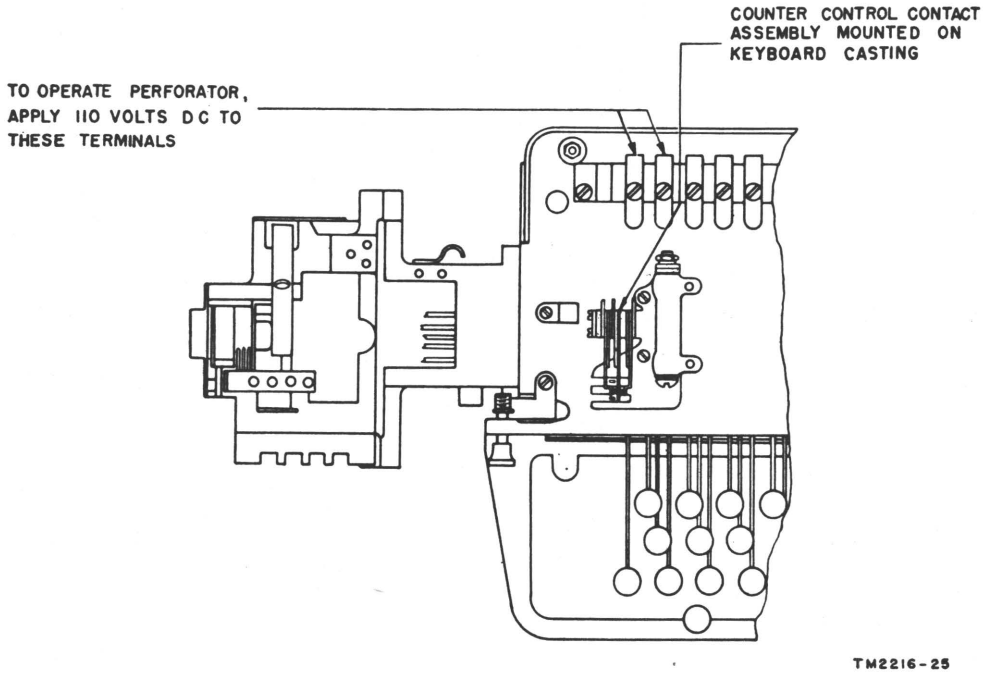


Figure 79. Counter control contacts and perforator trans-mitter slip contacts.

b. Operation.

(1) *Electrical.* The character counter dial and warning lamp operate at TAPE position only. The electrical circuit for the perforator transmitter is arranged so that when the punch contacts (fig. 72) close, the character counter operates. The counter control contacts are located on top of the keyboard castings at the left. These consist of three spring contacts (fig. 79) which control two circuits. Current is applied to the center contact and is carried to either the left or right control contact. The left contact is connected to the counter magnets and the right contact is connected to the release magnets. Since the left pair of counter control contacts normally is closed, the counter magnets are energized and the counter ratchets advance one tooth with each character or space operation of the perforator.

(2) *Mechanical.* When the counter magnet armature operates, it causes the feed pawl to engage the next tooth on the ratchet. As the armature releases, the feed pawl spring advances the ratchet one tooth and causes the indicator to register one space on the character counter dial. The latch pawl then engages the ratchet and holds it in its advanced position. When any function key lever, other than CAR RET, is pressed, the movement of the counter control mechanism causes the contact operating lever to open the left pair of counter control contacts. With both the right and left counter control contacts open, no current reaches the counter unit and the indicator remains stationary. When the CAR RET key is pressed, the movement of the counter control selector bars causes the contact operating lever to close the right contact pair. This connects the release magnet circuit so that the magnet operates. The operation of the release magnet armature causes the release lever attached to it to disengage both the feed and latch pawls from the ratchet. The ratchet spring then returns the ratchet to its starting position. A release latch holds the release lever operated and holds the pawls disengaged until the start of the next counting operation. A dash pot cylinder and piston are provided to act as a buffer for the return of the ratchet. A warning lamp is used in connection with the character counter. The operating contacts for this lamp are controlled by a contact lever which rides upon a cam attached to the indicator shaft. By positioning the cam on the shaft, the lamp contacts are arranged to close for any desired setting (character count).

89. Transmitting Cam Sleeve

a. Description and Purpose. All seven cams in the keyboard transmitting unit are arranged as a single cam sleeve mounted on the transmitting shaft (fig. 80). Each cam, except the lock loop cam, is circular in shape and has a notch which receives an extension on the related contact lever. The driven clutch member is slipped over the transmitting shaft and is connected by sliding members so that it can engage with the driving clutch member. When engaged, the driving clutch member furnishes the necessary power to revolve the transmitting cams. The design and mounting of the cams is such that the start, marking, spacing, and stop impulses transmitted by the sending contacts are of the desired length.

b. Operation. When a depressed key or space bar engages the clutch, the transmitting cam sleeve immediately starts to revolve. This causes the individual cams, one after the other, to operate the contact levers riding on the related cams (fig. 70).

90. Selector Bars

a. Description and Purpose (figs. 69 and 70). Beneath the key levers are five pairs of parallel motion selector bars, a counter control contact operating mechanism, and a universal bar which extends the width of the keyboard. The selector bars are guided at both ends so that they may be moved upward or downward. They are provided with rectangular notches on their upper edges according to the requirements of the code. The notches in the front and rear selector bars of each pair are staggered so that there always will be a high portion on one of the pairs in the path of each

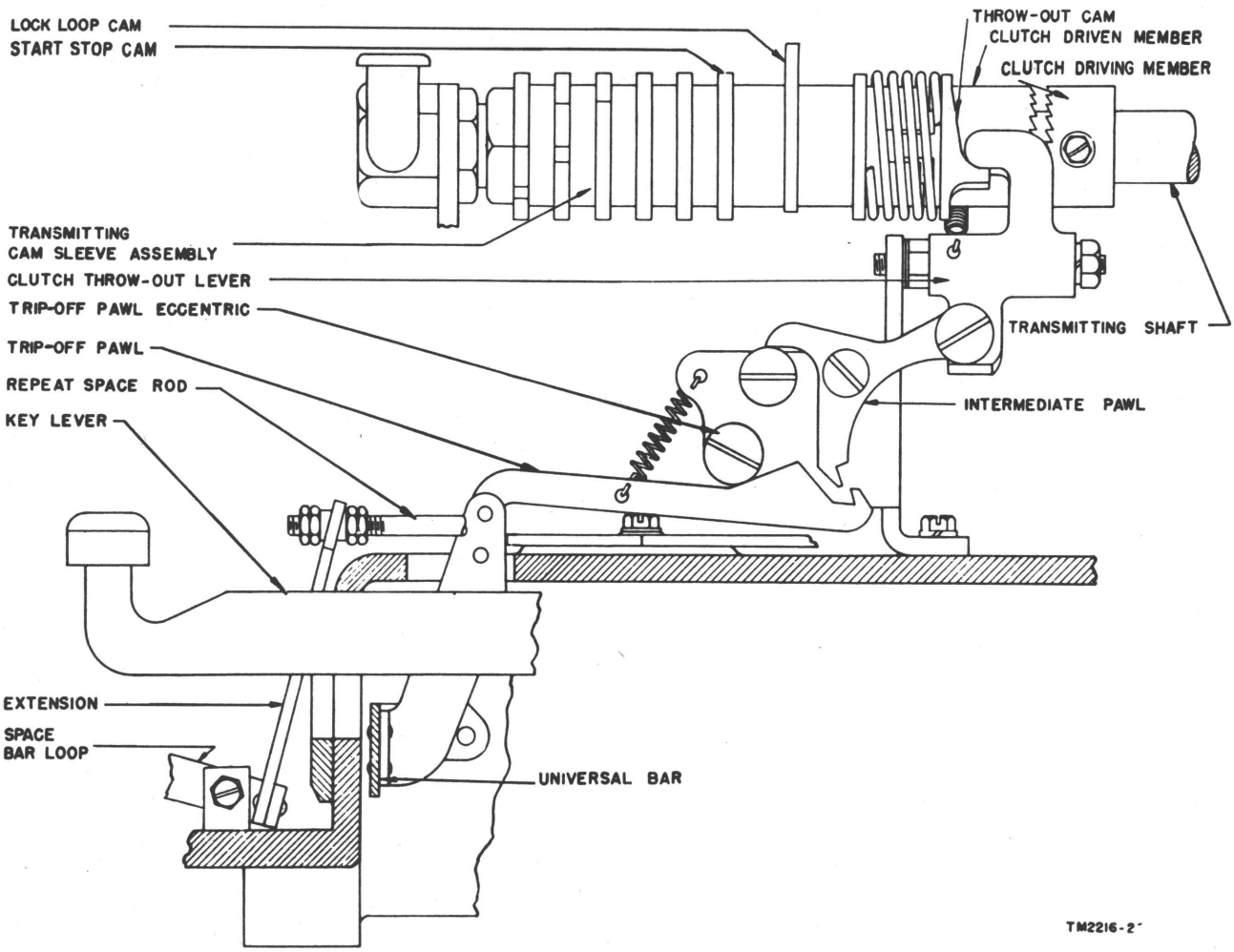


Figure 80. Transmitting cam and clutch assemblies.

key lever. The ends of each pair of selector bars rest on the arms of Y levers. The front bar of each pair rests on the left arms of the Y levers and the rear bar of each pair rests on the right arms.

b. Operation. When a key lever is depressed, the selector bars that have their high portions in line with that key lever are moved downward. This causes the Y levers to move the other bar of each pair upward. When the rear bar of any pair is moved downward, the lower extensions of the corresponding Y levers will be moved to the left; similarly, they will be moved to the right when the corresponding front selector bars are moved downward. Consequently, the Y lever connecting links which are attached to the ends of the lower extensions of the Y levers will be moved to the left when the rear selector bar is moved downward, and to the right when the front selector bar is moved downward. Each of the first five Y lever connecting links engages a locking lever and positions it to correspond with the transmitted signal impulse. Each locking lever controls the motion of a contact lever, either by allowing the contact lever to rotate on its pivot (because of the pressure exerted by the contact spring upon the contact lever, permitting the contact to close), or by engaging the contact lever; this prevents closure of the contacts. If the upper end of the locking lever is positioned to the left, corresponding to a spacing impulse, it engages the contact lever and prevents it from rising into the indent of its cam as the cam rotates. This holds the circuit open for that interval. If the upper end of the locking lever is positioned to the right, corresponding to a marking impulse, it does not interfere with the movement of the contact lever. Then, as the cam sleeve revolves, the contact lever riding on the cam sur-

face rises into the indent of the cam, and permits its contract to close and send out a marking impulse.

91. Universal Bar

The universal bar, which is connected to the trip-off pawl, controls the starting of the transmitting cam sleeve. It is pivoted at both ends so that the depressing of any key lever rotates it downward and moves the trip-off pawl forward. This action releases the clutch throw-out lever from the driven member of the clutch by means of the intermediate pawl, and allows the transmitting cams to start rotating. As the cams rotate, the impulses are transmitted in succession.

92. Vertical Locking Levers
(fig. 81)

a. Description and Purpose. Each of the five vertical locking levers is mounted with its lower end firmly engaging a notched projection on a Y lever connecting link. Each vertical locking lever is designed to control the movement of its associated contact lever in a manner which permits the contacts to close when the contact lever is in one position and prevents them from closing when it is in the opposite position.

b. Operation. When a Y lever connecting link moves the upper end of a locking lever to the left for a spacing interval, the locking lever engages the contact lever, prevents the contract lever from rising into the indent of the turning cam, and holds the circuit open for that impulse. When the Y lever connecting link moves the locking lever to the right for a marking impulse, the locking lever does not interfere with the movement of the contact lever. Then, as the cam turns, the contact lever (riding on the surface of the cam) rises into the indent and permits the contact to close so as to send out a marking impulse. As the five transmitting cams turn, the marking or spacing impulses (depending on the code combination) are transmitted in succession.

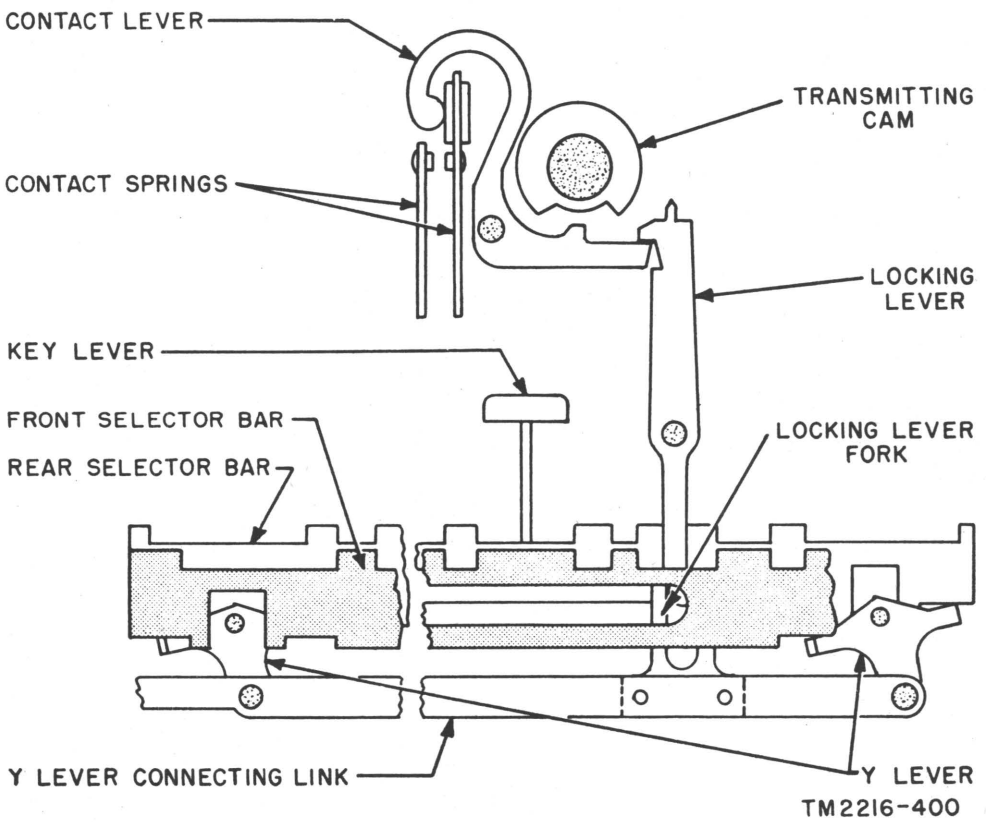


Figure 81. Vertical locking lever.

93. Start-Stop Cam

a. Description and Purpose. The start-stop cam (fig. 80) has the same general appearance as the other cams and controls the sixth contact lever which opens and closes a contact to produce both the start and stop impulses.

b. Operation. The start-stop contact is opened at the beginning of each revolution of the cam shaft to transmit the start (spacing) impulse of the code and is held open during the transmission of the five selecting impulses. After the fifth code impulse has been transmitted, the start-stop contact closes and sends the stop (marking) impulse to the line. The contract remains closed until a key or the space bar is depressed. Then the transmitting cycle is started again.

94. Lock-Loop Cam

a. Description and Purpose. The lock-loop cam is slightly larger than the other cams and is located on the end of the transmitting cam sleeve nearest the clutch. This cam and the associated lock loop locks the keyboard locking levers in such a manner that only one selection can be made at a time (for and during the course of a cycle or revolution).

b. Operation. As the transmitting cam sleeve completes a revolution, the lock loop allows the keys and space bar to be operated to set up a new selection. As soon as the selection is completed and the transmitting cam sleeve starts turning, the lock loop rides downward on its cam and holds the locking levers in position while a character is being transmitted.

95. Sequence Chart for Functioning of Perforator Transmitter

Figure 82 is a chart showing the sequence of operation for the parts and subassemblies of the perforator transmitting unit. Functions of these parts are described in paragraphs 86 through 95.

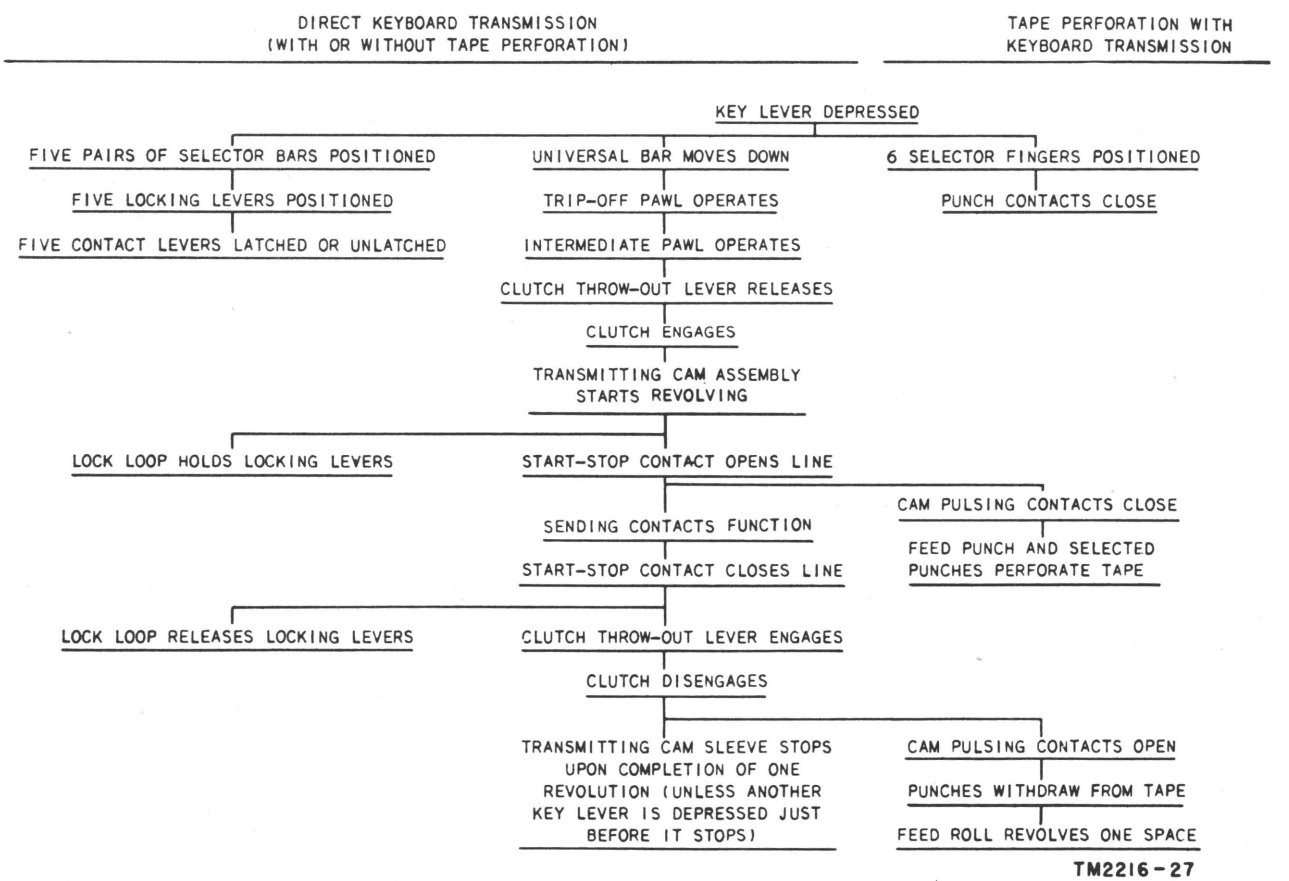


Figure 82. Perforator transmitter, functional sequence chart.

96. Space Repeat
(fig. 80)

The keyboard is equipped with a space repeat device which permits the continuous transmission of space bar signals when the keyboard control operating lever is in either the upper or the middle position. When the space bar is held depressed, the repeat space rod (fig. 68) attached to the space bar loop extension, will move the intermediate pawl forward and hold the clutch throw-out lever out of engagement with the projection on the driven clutch. Thus the transmitting cam sleeve is permitted to revolve continuously until the space bar is released.

97. Typing Unit

a. Description and Purpose. In a single assembly, the typing unit includes all of the mechanism, except the motor, required to convert code impulses into typewritten messages. The detailed functioning of the various parts and subassemblies of the typing unit are arranged to group the individual functions which occur as a train of actions.

b. Operation. All mechanically operated parts of the typing unit receive their motive force from the main shaft assembly. This assembly is connected directly through the main shaft gear to the motor pinion. When the motor revolves, it transfers power through the various cams, gears, and clutches to move the different parts of the typing unit. These parts move at the speed required to synchronize their mechanical action with the code impulses that energize electrically the selector magnets. The selector magnets, through the associated selecting mechanism, determine the operation of the typing unit in printing a symbol or performing a nonprinting function of the equipment. The nonprinting functions are—

(1) Platen *line feeds* (single or double space) when LINE FEED key is pressed.
(2) Type bar *carriage returns* from right-hand to left-hand side of typing unit when CAR RET key is pressed.
(3) Type bar carriage *spaces* when space bar is depressed.
(4) Platen shifts from letters position (corresponds to lower case or ordinary typewriter) to FIGS position (corresponds to upper case on ordinary typewriter) when FIGS key is pressed.
(5) Platen shifts from FIGS position (corresponds to upper case on ordinary typewriter) to LTRS position (lower case on ordinary typewriter) when LTRS key is pressed.
(6) On Teletypewriter TT–7/FG, depressing the *blank* (no designation) key twice in succession results in moving the SEND-REC lever to REC position. Depressing this key on Teletypewriter TT–8/FG results in printing a dash (–), if the FIGS key is pressed first.
(7) *Signal bell* operates at all stations in a circuit when the FIGS, then the BELL S keys, are pressed in that order.
(8) Motor *stops* (on Teletypewriter TT–7/FG only) when the STOP H key is pressed after the platen has been arranged in figures position by depressing the FIGS key.

c. Sequence of Operations. Charts and lists showing the sequence of operations for the different trains of action appear near the related text matter.

98. Selecting Mechanism

a. Description and Purpose. The selector unit (fig. 83) is located on the left end of the typing unit. It consists of two selector magnets, a selector armature, five selector levers, five swords, five T levers, and a selector mounting plate with posts and springs. The range finder assembly is associated with the selector unit. The selector unit mechanism translates the marking and spacing impulses of the signal received from the line into a series of mechanical actions. These actions cause the vanes on the front of the typing unit to be positioned according to the character or function assigned to each combination of five code impulses. The selector mechanism is controlled by the armature of the selector magnets which operate on the code impulses from the line or the polar relay. (During discussion of the action of the selector magnets, the polar type of line relay with which these teletypewriters are equipped is not always considered; it is possible, in an emergency, to connect the receiving signal loop directly to the selector magnets.) For description and action of the relay, refer to paragraph 134*a*(1). Normally, the selector magnet armature is pulled up (steady marking condition) and the stop arm

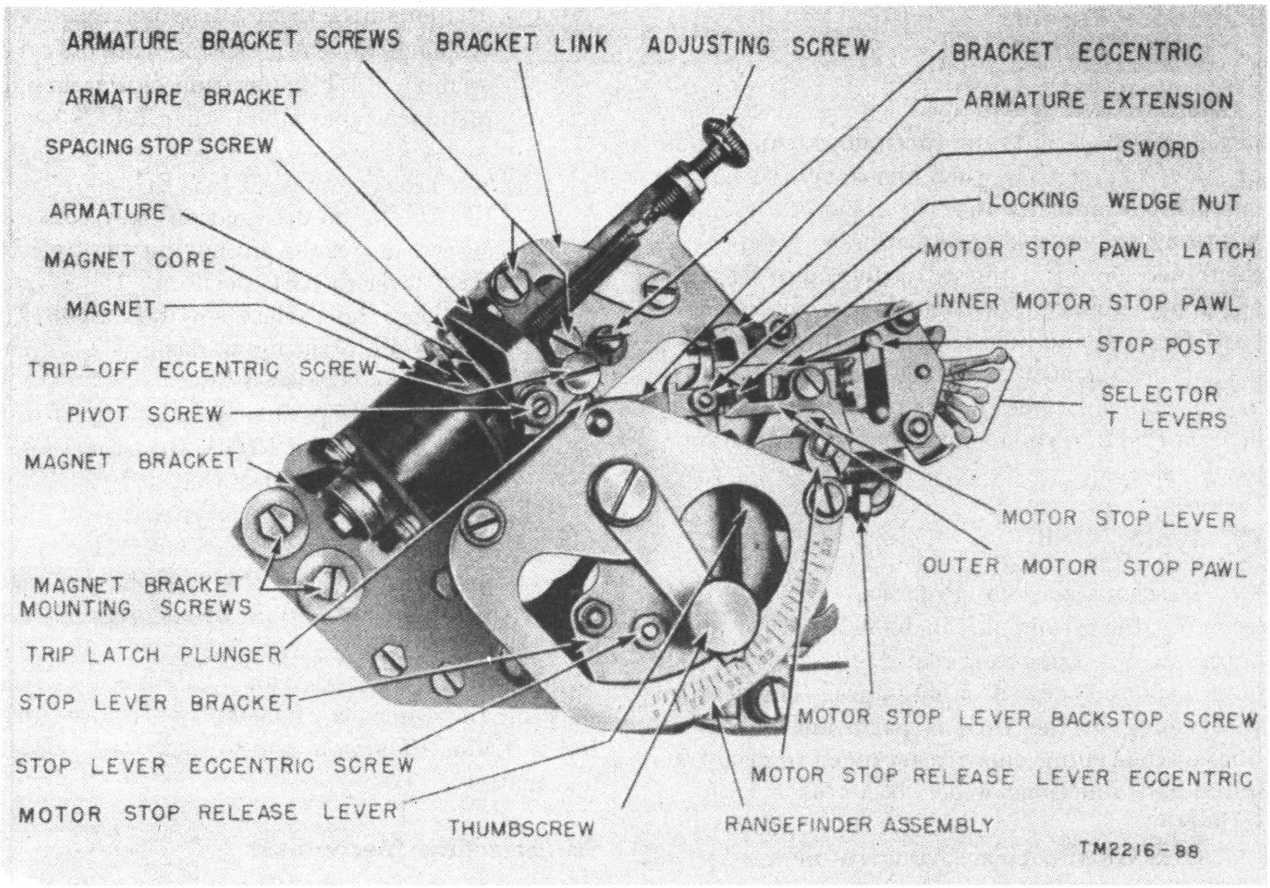


Figure 83. Selector unit.

rests against the stop lever, which in turn is held by the trip latch. The cam sleeve does not revolve because the stop arm, which is part of the selector cam sleeve, is engaged by the stop lever (fig. 84).

b. Operation. Upon receipt of a start impulse (spacing) by the selector magnets the armature is released, and is pulled away from the magnet pole pieces by the armature spring. This moves the trip latch out of engagement with the stop lever, releases the stop arm and allows the cam sleeve to rotate with the shaft. In turn, each of the vanes is operated through a T lever, a sword, a selector lever under spring tension and its associated cam on the cam sleeve (fig. 87). The train of action that results from the positioning of the vanes is discussed in paragraph 104.

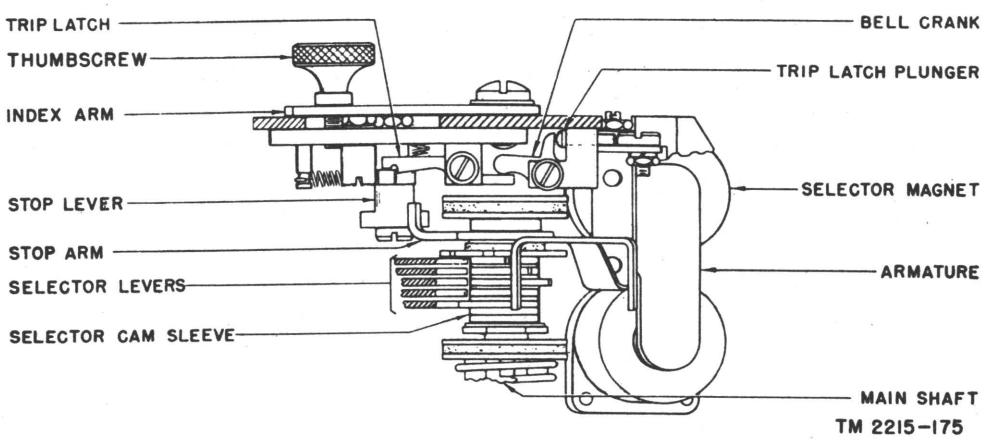


Figure 84. Selector unit, cross section.

99. Orientation of Selecting Mechanism (Rangefinder)

a. Description and Purpose. The rangefinder is associated directly with the selector unit (fig. 83). A stop lever, trip latch, index arm, scale, and thumbscrew are the principal parts of the rangefinder. The rangefinder is designed to adjust the relation between the start of the selector cam sleeve and the time the selector cams operate the selector levers. Adjusting the rangefinder is referred to frequently as orientation or taking the range of the teletypewriter.

Note. In recent models of Teletypewriters TT–7/FG and TT–8/FG a new style stop lever is supplied. Its operation is identical with that of the old style and it is interchangeable with the old style. Either may be supplied under Signal Corps Stock No. 4T6909.

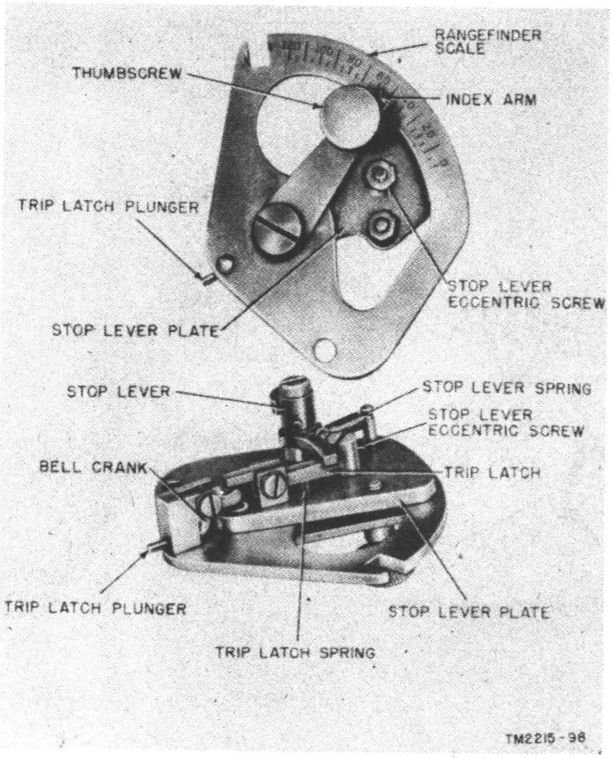


Figure 85. Rangefinder mechanism.

b. Operation. Move the index arm first toward one end and then toward the opposite end of the scale. Continue moving it until the exact points at both ends on the scale are found where the teletypewriter fails to print properly. Midway between these extremes is the most favorable position to utilize the receiving margin of the selector mechanism. Tightening a thumbscrew holds the index arm in adjustment. For tests and instructions for setting the rangefinder, refer to paragraphs 206 and 212.

100. Example of Selecting and Printing Operation

a. Assume that the code signal for the letter E is being received (code sequence for each combination is shown in figure 86). This will consist of space (start), mark, space, space, space, space, and mark (stop). At 368.1 opm (61 wpm), the first six impulses are each 22 milliseconds long whereas the last (stop impulse) is 31 milliseconds long. When the start impulse reaches the selector magnets, the armature is released. The armature pushes the trip latch plunger (fig. 84). This causes the trip latch bell crank to move the trip latch out of engagement with the stop lever and thus release the stop arm. The selector cam sleeve starts to rotate, and selector cam 1 engages selector lever 1 as the first selecting code impulse (marking) of the letter E is received. The marking impulse is a current impulse, and the magnet armature is attracted to the selector magnet pole pieces. This brings the upper end of the armature extension into the path of the upper arm of sword 1. When cam 1 engages selector lever 1, this lever is rotated counterclockwise, and carries with it sword 1. Sword 1 strikes the

| | | |

upper extension of the armature, and turns clockwise about its pivot (fig. 87). The sword then is positioned so that when cam 1 clears the selector lever, the selector lever spring moves the sword against the **T** lever 1.

b. This action brings the front edge of vane 1 down when it is released near the end of the selecting cycle. The associated code bar then is positioned to the left through the medium of bell crank 1 (figs. 87 and 88). As cams 2 through 5 engage the selector levers 2 through 5, the selector lever springs, through the selector levers, swords, and **T** levers, exert pressure against vanes 2 through 5. The front edges of these vanes will tilt up near the end of the selecting cycle when they are released from the locking function lever (fig. 95). With the front edges of these vanes tilted up, the corresponding code bars are moved to the right by the connecting bell cranks.

c. With the front edges of the vanes tilted down,

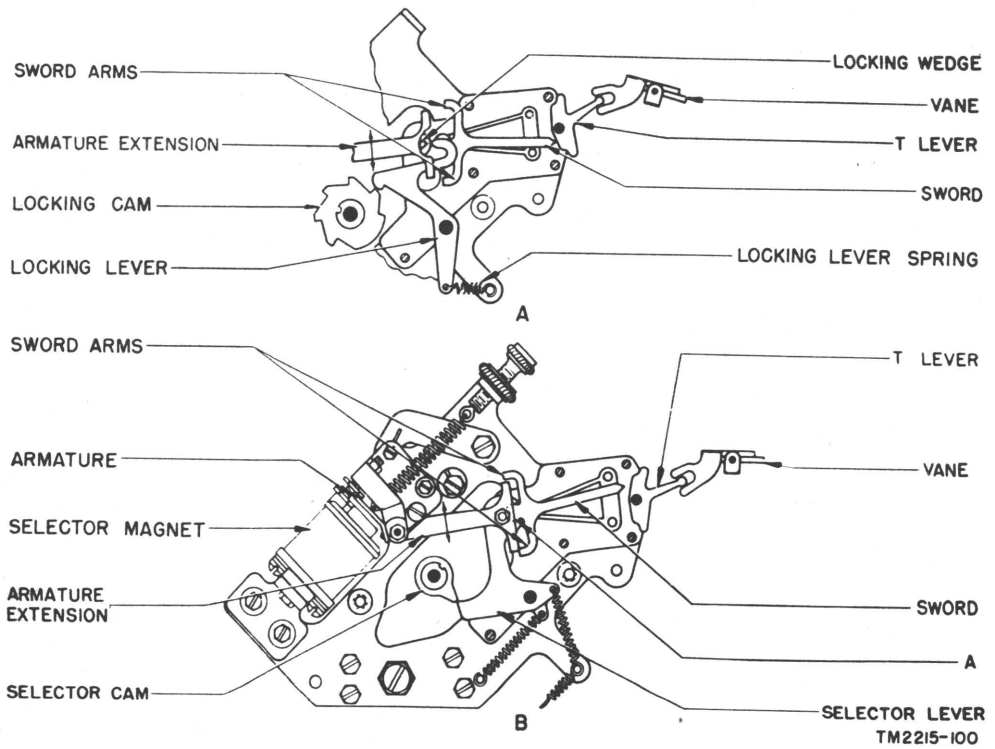


Figure 87. Selector and locking lever diagram.

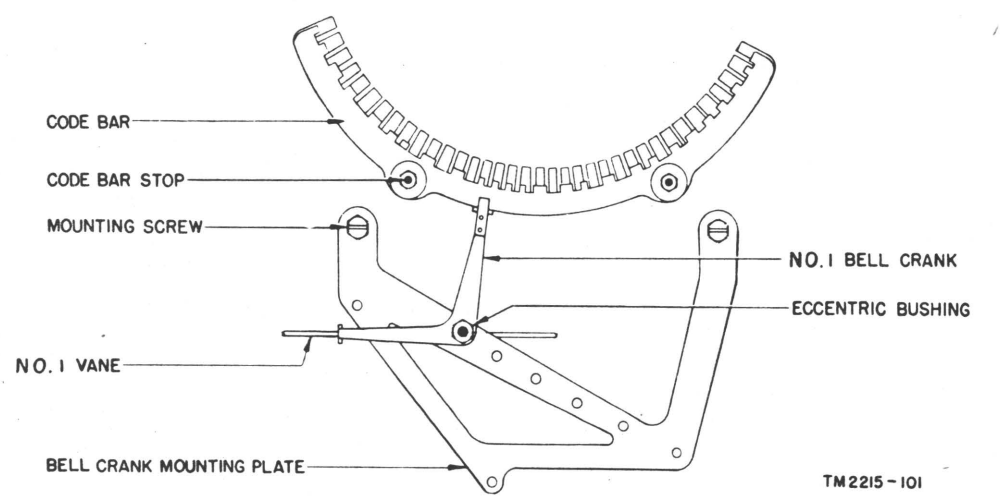


Figure 88. Vane, bell crank, and code bar linkage.

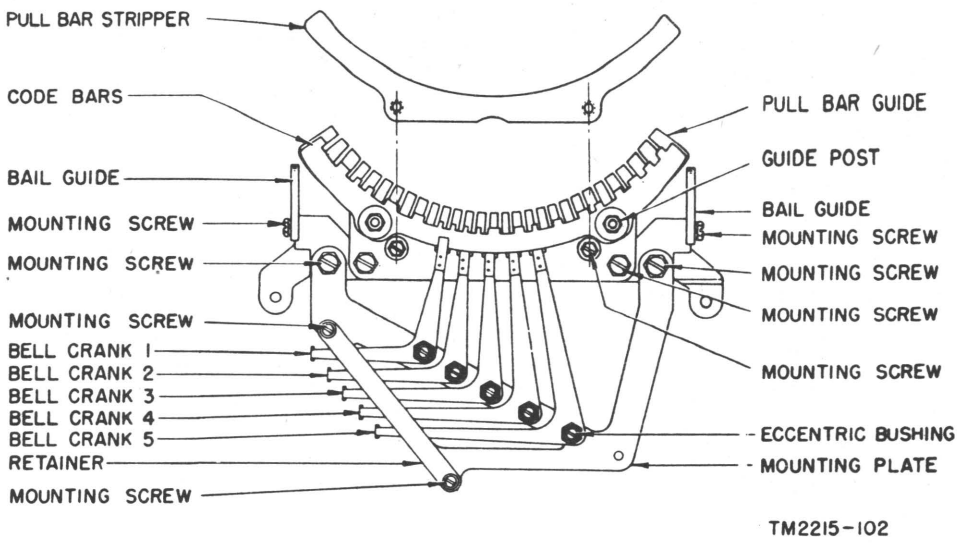


Figure 89. Code bar bell crank assembly.

the bell cranks move the corresponding code bars to the left. With code bar 1 positioned to the left and code bars 2 through 5 positioned to the right, one notch in each code bar is opposite the E pull bar. The sixth cam (fig. 91) releases the main shaft clutch and allows the printing bail and function bail cams to make 1 complete cycle. The printing bail cam permits the printing bail to be pulled forward by its spring. The E pull bar is pulled down by its spring into the path of notches set up by the code bars. The pull bar bail moved by the printing bail carries the pull bar forward and causes the type bar to strike the platen and print the letter E. Figure 90 is a sequence chart showing operation of the selecting mechanism.

101. Locking Cam and Locking Lever

a. Description and Purpose. The locking cam (A, fig. 87) has five high and five low surfaces, for the five selecting impulses, on its periphery against which the locking lever is held by its spring. The purpose of this cam and lever is to hold the armature extension firmly in position just long enough to insure correct positioning of each sword.

b. Operation. During a code sequence when the swords are being positioned by striking the armature extension arms (at the moment that any cam is operating the corresponding selector lever), a low portion of the locking cam is presented to the locking lever. The armature extension then is held firmly in position by the V-shaped extension of the locking lever engaging the V-shaped locking wedge on the armature extension. When the locking lever is riding a high portion of the locking cam, the locking lever extension is held away from the locking wedge and the armature can move freely in response to the received impulse.

102. Main Shaft Clutch Throw-Out Lever

a. Description and Purpose. The main shaft clutch throw-out lever (fig. 91) consists of a clutch stop arm and a throw-out arm. The extension of the clutch stop arm rides on the driven clutch member of the main shaft and the throw-out arm rides on the sixth cam. The clutch throw-out lever causes the driven member to be cammed out of engagement with the driving member. When this occurs, the rotation of the printing and function bail cams is blocked until all five impulses of the selecting sequence have been received at the selector magnets. Thus, no printing or function is performed before all the impulses are received.

b. Operation. The sixth cam on the selector cam sleeve releases the main shaft clutch. This allows the printing and function bail cams (fig. 91) to perform 1 complete revolution. At the end of each revolution of these cams the clutch stop arm engages the cam surface on the driven clutch member and moves it out of engagement with the driving clutch member. Immediately after the five selecting impulses are recevied, and just as the fifth selector lever is sliding off the peak of its cam, the peak of the sixth cam strikes the clutch throw-out arm. The clutch throw-out arm then moves the clutch stop arm out of engagement with the projection on the driven clutch member. Im-

mediately after the completion of the selection of any character or function, the printing and function bail cams rotate 1 revolution. This causes the printing of a character or the performance of a function. Any character or function may be selected while the printing of the previous selection is taking place.

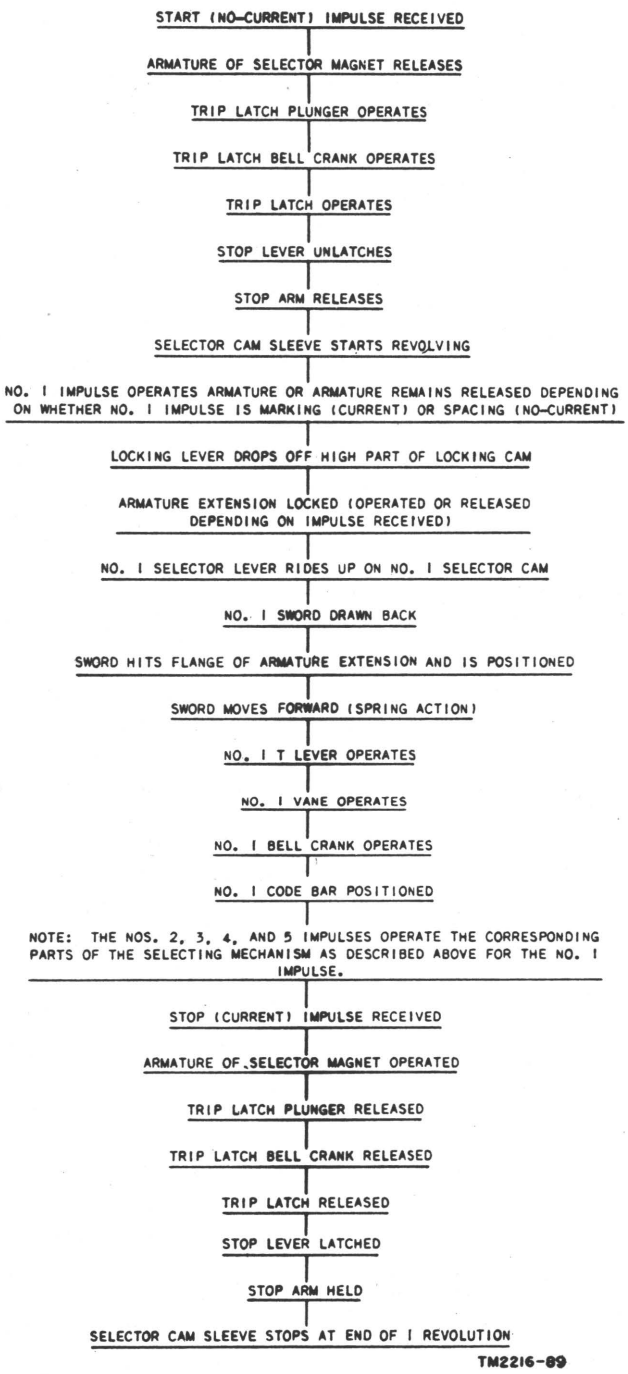


Figure 90. Selector mechanism, operation sequence chart.

103. Printing

(figs. 92 through 94)

a. Description and Purpose. On the bail mounting shaft are mounted the printing bail, printing bail operating arm, function bail, and two spacing escapement pawls (figs. 61 and 99). The printing bail spring, which is attached to the right end of the printing bail casting, holds the printing bail against the upper end of the printing bail operating arm. It also holds the operating arm roller against the printing bail cam on the main shaft. The tension of the spring causes the printing bail to follow the upper end of the operating arm and moves the pull bar bail forward. The position of the printing bail cam determines the position of the printing bail (fig. 61), except as noted in paragraph 102. The purpose of this mechanism is to control the completion of the operating cycle which follows immediately after the selecting cycle.

b. Operation. The actual printing of characters is not caused by the printing bail but by the pull bar bail which is controlled by the printing bail through the pull bar bail plunger roller. The roller (when the type bar carriage is in place) is set between the printing bail blades (figs. 61 and 93). This allows the carriage to move from left to right, and the pull bar bail to be moved backward and forward by the printing bail, regardless of the position of the type bar carriage. At the end of each revolution of the printing bail cam, the printing bail operating arm roller comes to rest on the high surface of its cam. The printing bail then is in its extreme rear position, carried there against the tension of the printing bail spring.

104. Type Bar Carriage Printing Mechanism

a. Description and Purpose. The printing mechanism on the type bar carriage consists of a pull bar bail, pull bars, type bars, and mounting parts. The printing is done mechanically by the action of the pull bar bail in throwing the type bar pallets against the platen. Between the printing bail blades is a plunger roller (fig. 61), which extends downward from the pull bar bail plunger. Thus, the movement of the printing bail applies a reciprocating motion to the pull bar bail to actuate the pull bars.

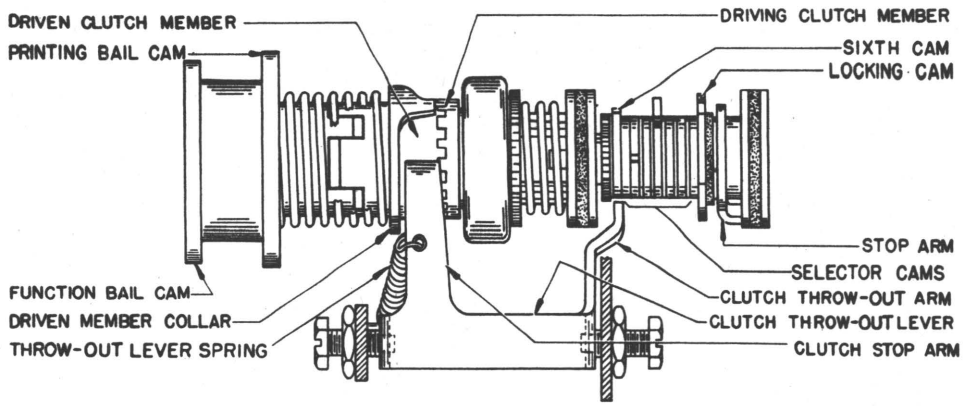


Figure 91. Section of main shaft.

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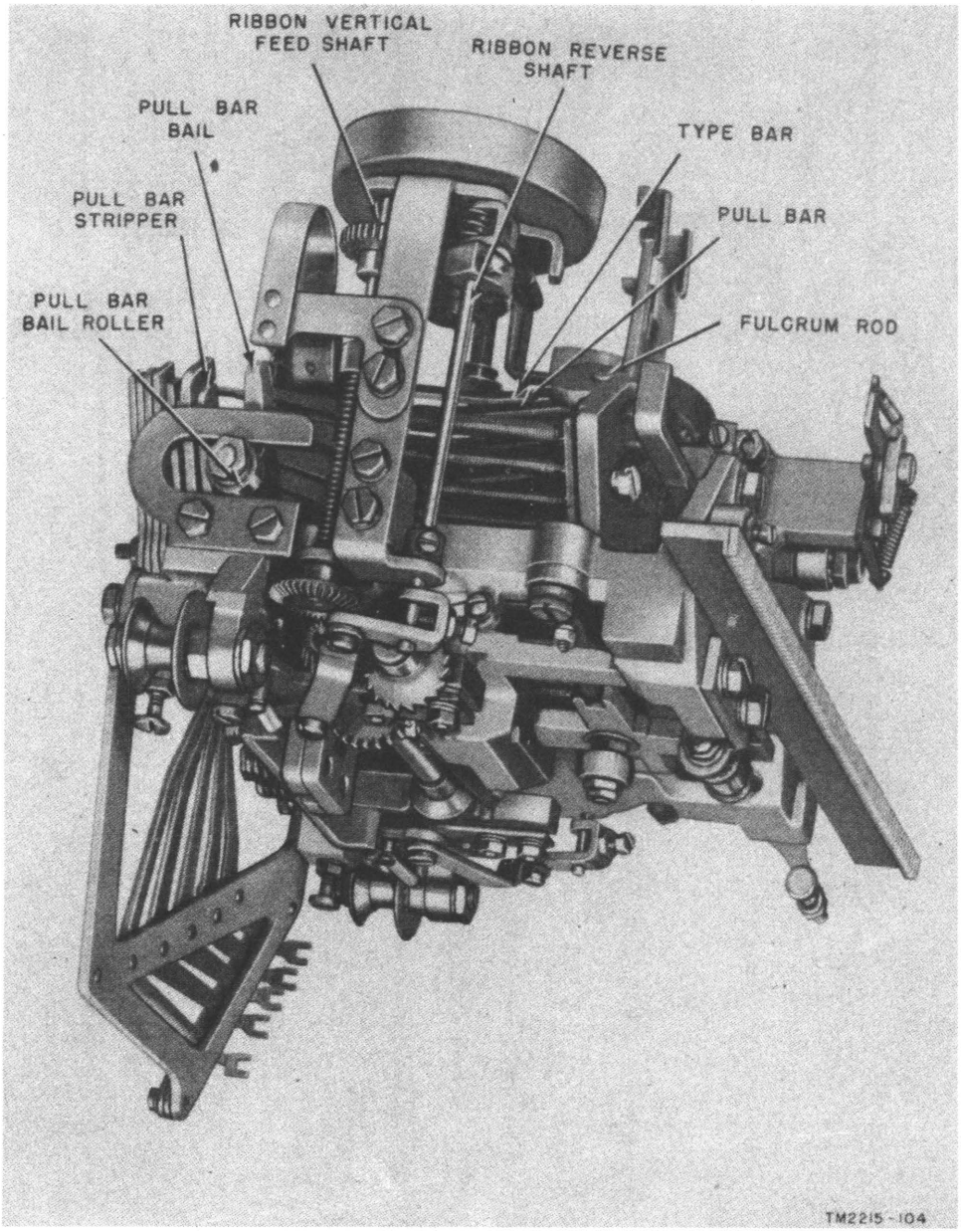


Figure 92. Type bar carriage, lower right-hand view.

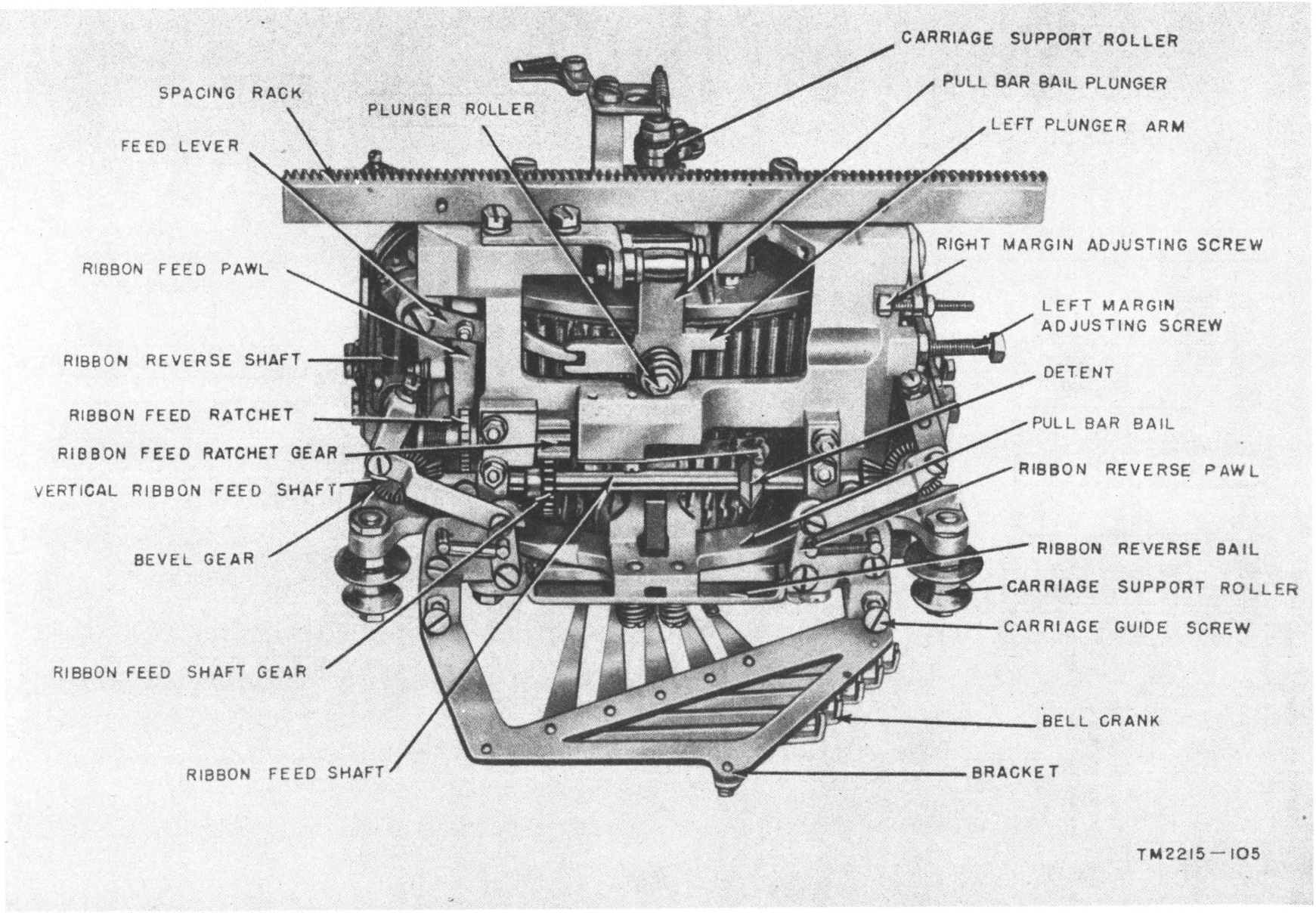


Figure 93. Type bar carriage, bottom view.

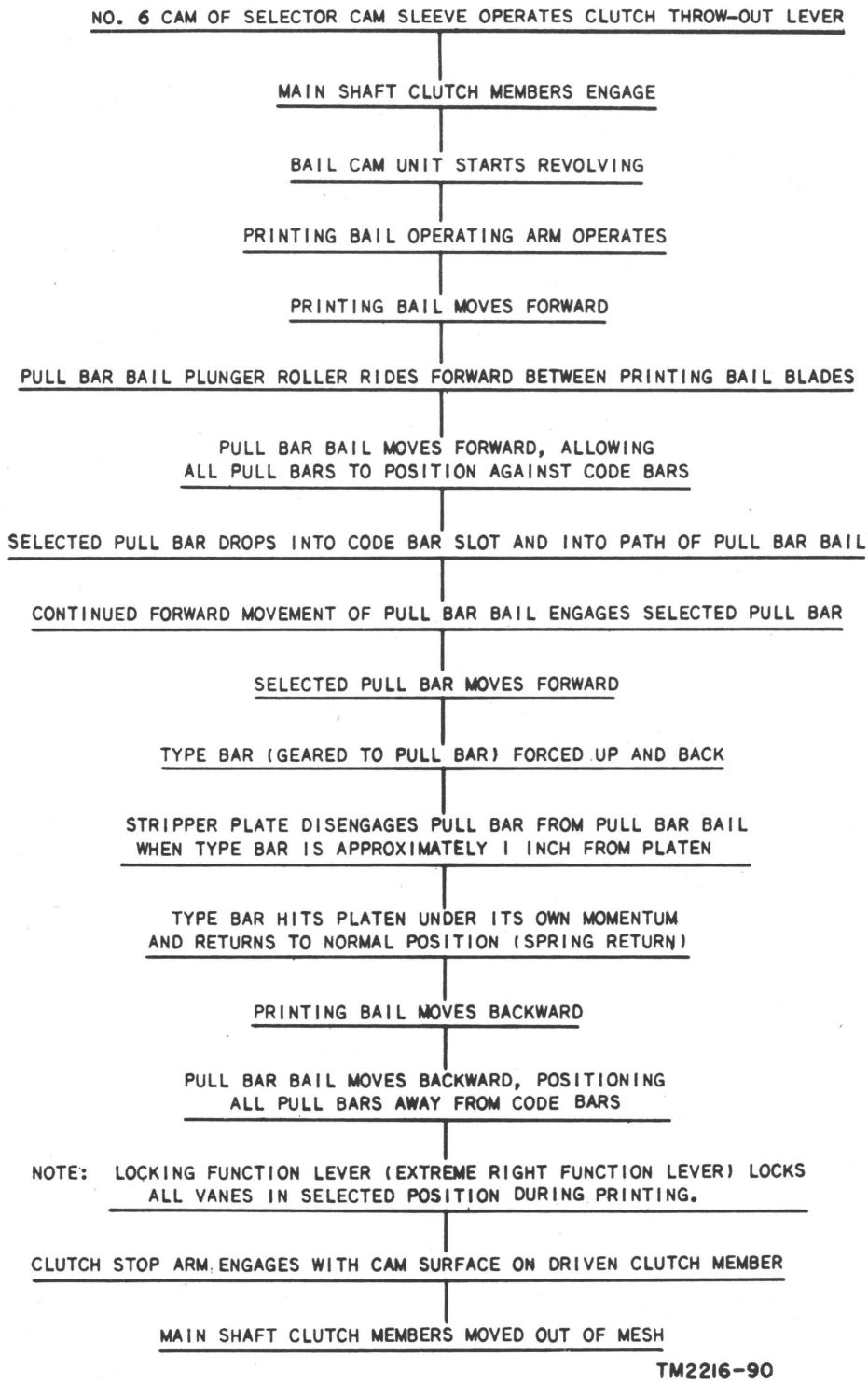


Figure 94. Printing mechanism sequence chart.

b. Operation. Selection of a type bar is determined by the setting of the five code bars. These are moved into position by the bell cranks (figs. 88, 89, and 93) which are controlled by the vanes. The code bars are arranged so that the notches in their upper sides will be alined to permit the selected pull bar to move down into the path of the pull bar bail. As the pull bar bail moves forward, it allows all pull bars to rest on the code bars under tension of the pull bar springs. The selected pull bar drops into the notch set up for it in the code bars, and this positions it lower (with respect to the bail) than the other pull bars. As the pull bar bail continues to move in its forward stroke, it engages a notch in the selected pull bar, but will clear all the other pull bars. The forward motion of the selected pull bar causes the associated type bar to move toward the platen. Before the pull bar bail reaches the limit of its forward motion a stripper plate (fig. 92), located below the pull bars, cams the selected pull bar off the bail, and the type bar is carried against the platen by momentum. As the printing bail arm roller rides to the peak of its cam to complete the printing cycle, the printing and pull bar bails move to their rear positions. The pull bars then will be raised clear of the code bars so that they are free to respond to the next selection.

105. Locking Function Lever
(fig. 95)

a. Description and Purpose. The locking function lever is the first on the right of the function levers mounted behind the vanes. The locking lever (fig. 95) locks the vanes in the selected position until a character has been printed or a function performed.

b. Operation. When the printing bail moves forward, the function lever bail roller moves downward off the high part of the function lever rear arm. This allows the locking function lever spring to pull the lever against the rear edges of the vanes. The locking function lever engages each vane whether in the marking or spacing position, and locks each vane in the selected position until the printing bail cam has revolved completely. The operation of the other function levers is covered under the related functions. Figure 94 is a sequence chart that illustrates the operation of the printing mechanism.

106. Spacing

a. Description and Purpose. For proper spacing between characters, the type bar carriage must be moved with each character printed. The type bar carriage is moved by the spacing gear which meshes with the spacing rack (fig. 100). The movement of the type bar carriage is facilitated by three carriage support rollers. Two of these rollers travel on the front track and the third travels along the rear track (figs. 93 and 96). The spacing rack is mounted on the rear of the type bar carriage casting and the spacing gear is attached to the upper end of the spacing shaft. The spacing shaft, extending downward, passes through the spacing shaft gear. Just above its lower bearing, the spacing shaft mounts the carriage return clutch, the lower member of which is fastened to the shaft. The return clutch members are engaged at all times, except when the carriage is being returned for the beginning of a line. The spacing shaft gear meshes with the spacing pinion on the main shaft. Spacing is controlled from the

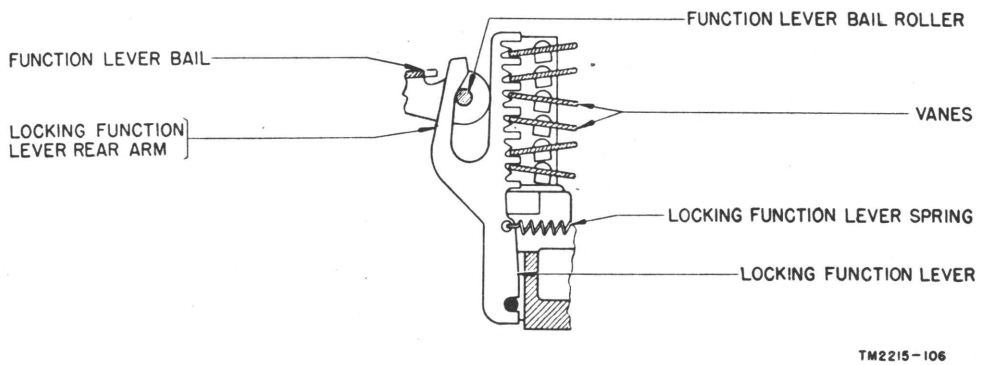


Figure 95. Locking function lever.

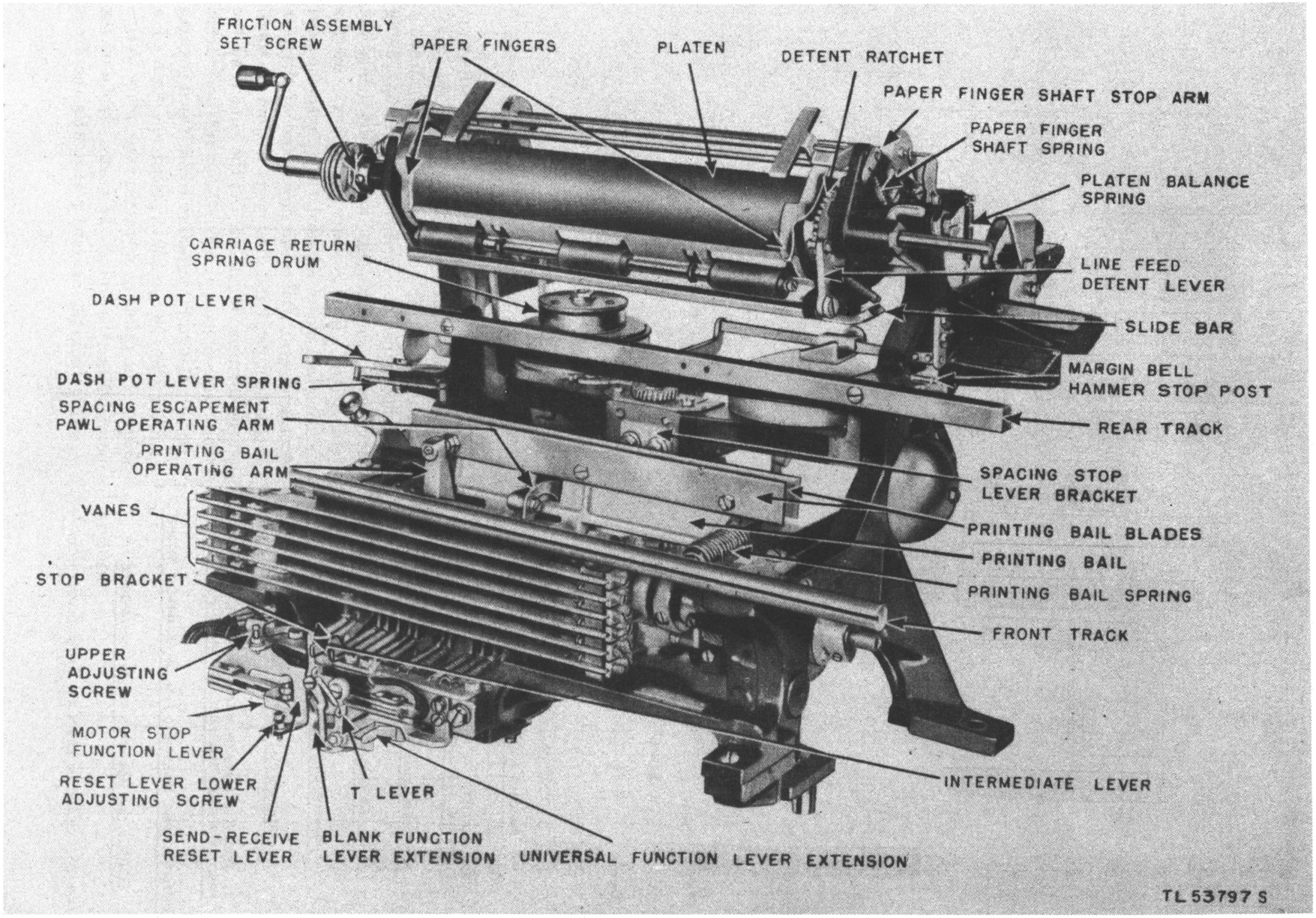


Figure 96. Typing unit minus type bar carriage.

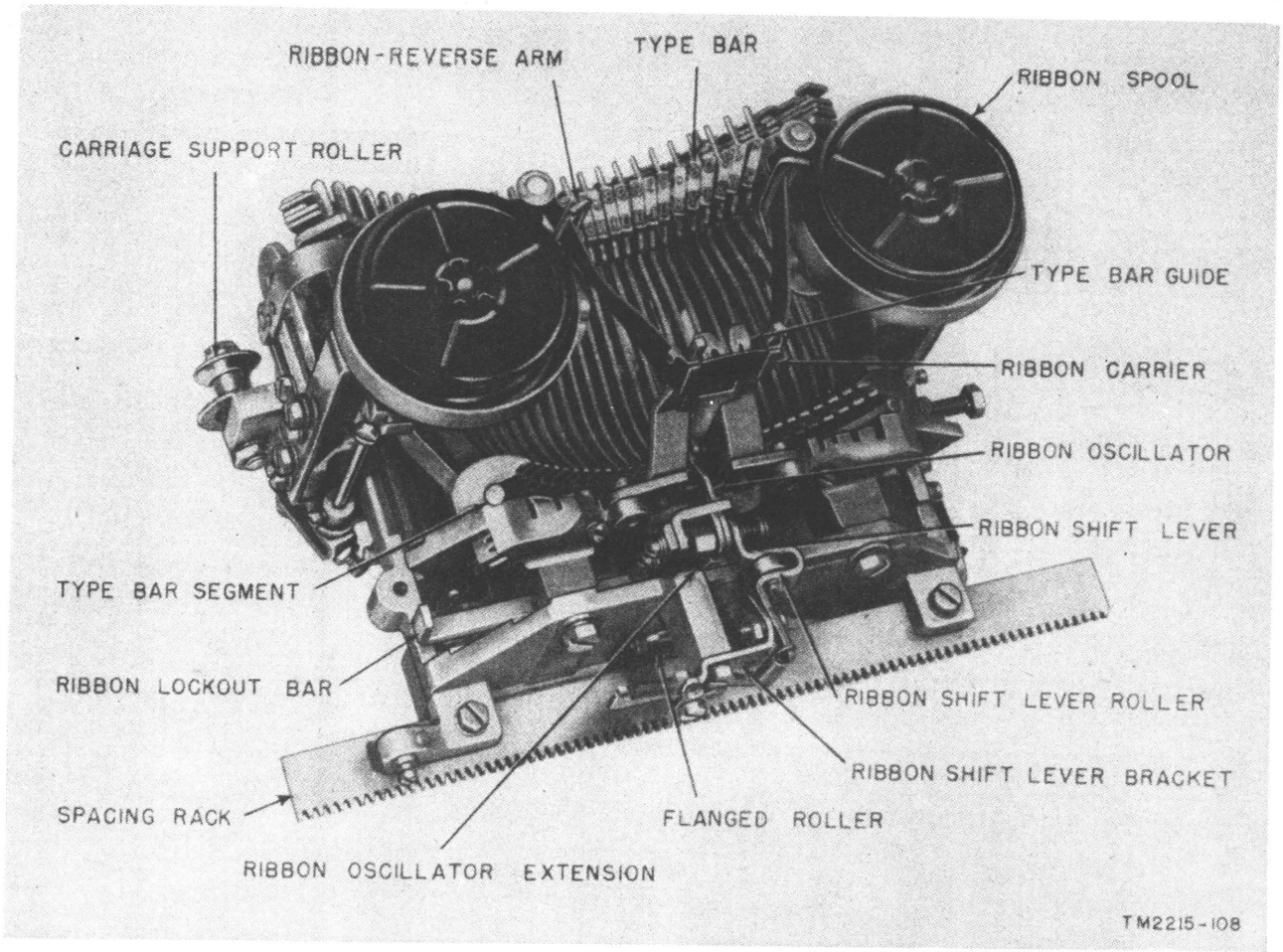


Figure 97. Rear view of type bar carriage.

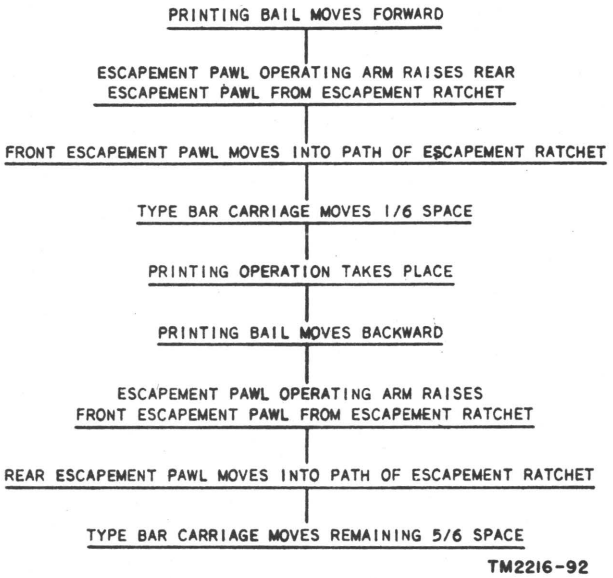


Figure 98. Sequence chart for spacing operation.

printing bail by operation of escapement pawls (*b* below).

b. OPERATION. The spacing action results from the following sequence of actions: With the printing bail in its rear position, the rear escapement pawl is engaged by one of the teeth on the spacing escapement ratchet (fig. 99). This holds the ratchet and spacing gears stationary. As the printing bail moves forward, the escapement pawl operating arm strikes the lower end of the rear escapement pawl and disengages it from the tooth on the escapement ratchet. At the same time, the front escapement pawl moves against the ratchet and into the path of another tooth which engages it after the ratchet has traveled one-sixth of a space. The printing operation takes place at this point. Near the end of the return stroke of the printing bail, the operating arm lifts the front

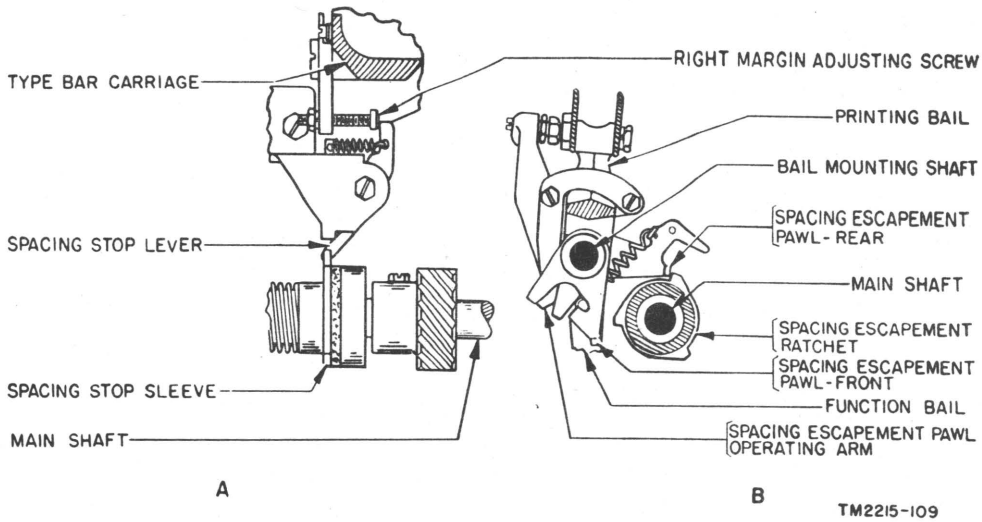


Figure 99. Spacing stop mechanism.

escapement pawl out of engagement with the escapement ratchet and, at the same time, the rear escapement pawl moves against the ratchet. This action permits the spacing mechanism to revolve sufficiently to space the carriage five-sixths of a space, at the end of which the rear escapement pawl engages a tooth on the ratchet. Another one-sixth of a space is added just before the printing of the next character. When the type bar carriage reaches the end of a line, the right margin adjusting screw (fig. 99) moves the spacing stop lever into the path of a projection on the spacing stop sleeve, blocks rotation of the spacing mechanism, and prevents further spacing of the carriage. A sequence chart for the spacing operation is shown in figure 98.

107. Margin Signal Bell

a. Description and Purpose. The margin signal bell is mounted in a vertical position on the right-hand side of the typing unit (figs. 100 and 101). This bell warns the operator that the type bar carriage is approaching the end of a line. The bell hammer is attached to the margin signal bell camshaft. An adjustable cam is fastened on the camshaft and forces the shaft to pivot when the cam is depressed.

b. Operation. The margin signal bell pawl on the type bar carriage depresses the margin signal bell cam which pivots the camshaft. This moves the bell hammer away from the bell and against the tension of its spring. When the bell pawl has been spaced beyond the cam, the bell hammer is released and its spring causes the hammer to strike the bell.

108. Ribbon Feed Mechanism

a. Description and Purpose. The type bar carriage ribbon mechanism consists of two ribbon spool cups and associated parts (figs. 25, 102, and 104) which are similar to the ribbon mechanism of the conventional typewriter. Each ribbon spool cup is mounted on a bracket which has a vertical ribbon feed shaft and a ribbon reverse shaft. The vertical ribbon feed shaft is engaged by the horizontal ribbon feed shaft. The end of the ribbon feed lever engages the notched extension of the pull bar bail plunger (fig. 102). The ribbon feed pawl which moves the ribbon feed ratchet is attached to the ribbon feed lever.

b. Operation. As the pull bar bail plunger travels back and forth, its notched projection engages the ribbon feed lever. This mechanism enables the ribbon to be moved enough with each printing operation to prevent the type bar pallets from striking the same place on the ribbon surface twice in succession. This is accomplished when the ribbon feed pawl (which is attached to the ribbon feed lever) advances the ribbon feed ratchet gear one tooth. The motion is transmitted to one of the ribbon spools through a train of gears and shafts, and the ribbon is wound from one spool to the other.

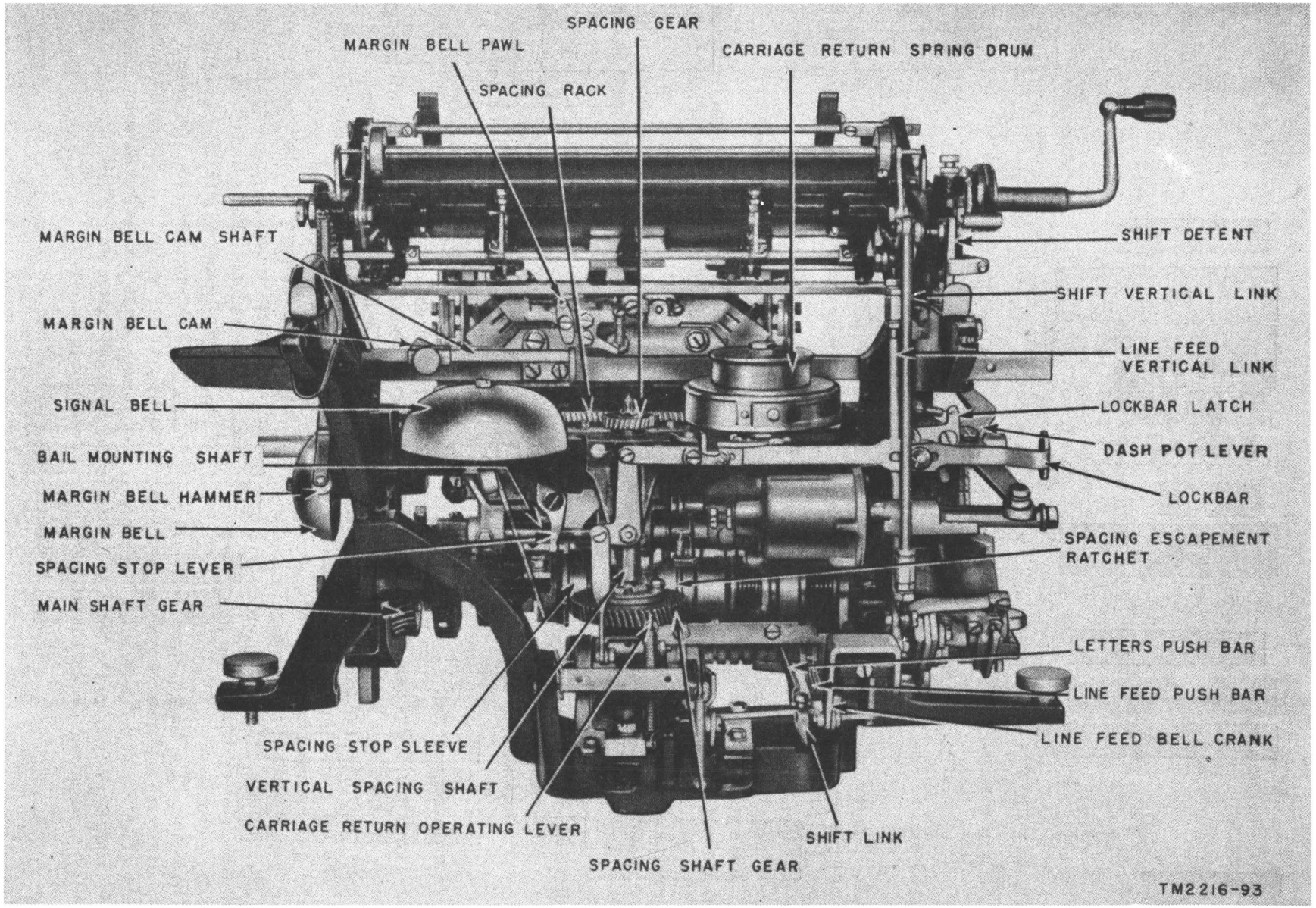


Figure 100. Typing unit, rear view.

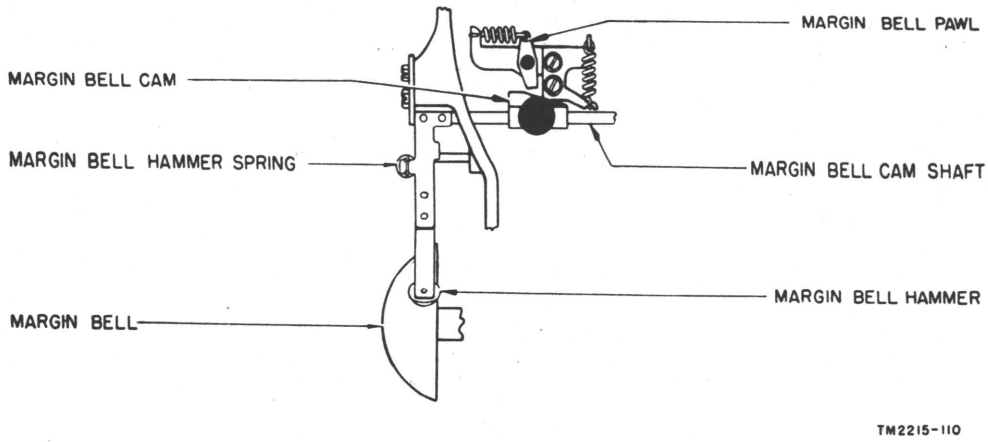


Figure 101. Margin signal bell mechanism.

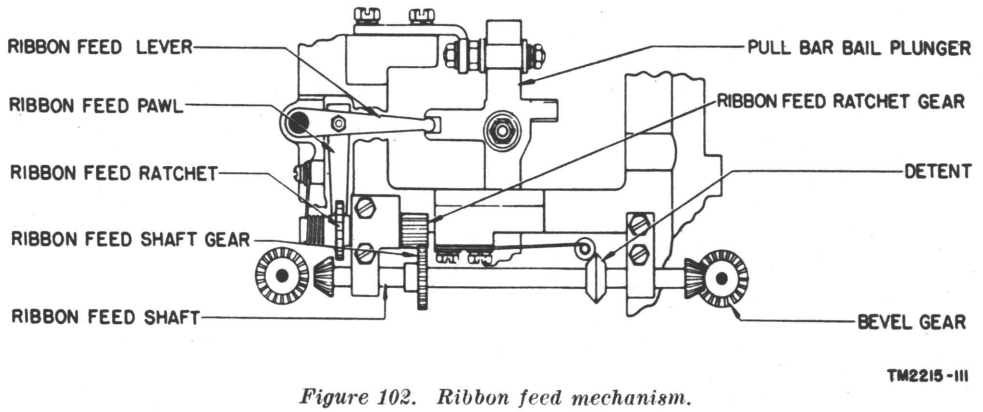


Figure 102. Ribbon feed mechanism.

109. Ribbon Reverse Mechanism

a. Description and Purpose. The ribbon reverse mechanism consists of the ribbon reverse arms and shafts and their associated parts (fig. 103). This mechanism automatically reverses the ribbon when the reversing eyelet in the ribbon engages and moves the ribbon reverse arm.

b. Operation. Assuming that the ribbon is being wound on the right ribbon spool (and is unwound almost entirely from the left ribbon spool), the eyelet in the ribbon near the end engaged by the left spool will contact the left ribbon reverse arm, and further winding of the ribbon moves that arm. This arm is fastened to the left ribbon reverse shaft. Rotation of the ribbon reverse shaft causes the left ribbon reverse pawl, through its associated parts, to move into the path of the ribbon reverse bail (fig. 103). Movement of the ribbon reverse bail, mounted on the pull bar bail plunger, toward the rear, causes the ribbon reverse bail to engage the left ribbon reverse pawl, and thus move the horizontal ribbon feed shaft to the left. The ribbon feed shaft gear on the right becomes disengaged, the one on the left becomes engaged, and the ribbon begins to wind on the left ribbon spool. The reversing operation for the other direction occurs in the

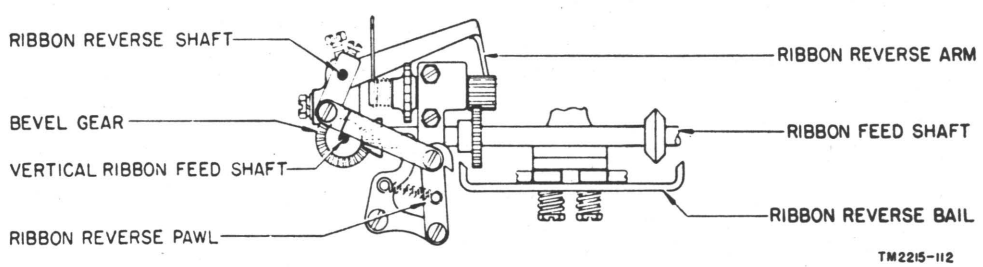


Figure 103. Ribbon reverse mechanism.

same way when the eyelet in the right end of the ribbon engages the ribbon reverse arm on the right ribbon spool cup bracket.

110. Ribbon Oscillator Mechanism

a. Description and Purpose. The normal position of the ribbon in its carrier is below the printing line, so as not to obscure a line being typed. The ribbon is raised before the type bar strikes it and is lowered after printing by the ribbon oscillator (fig. 104). The ribbon oscillator mechanism consists of a shift lever, ribbon shield, oscillator arm and spring, oscillator arm extension, and a shift lever roller and spring, all of which are mounted on the ribbon oscillator bracket.

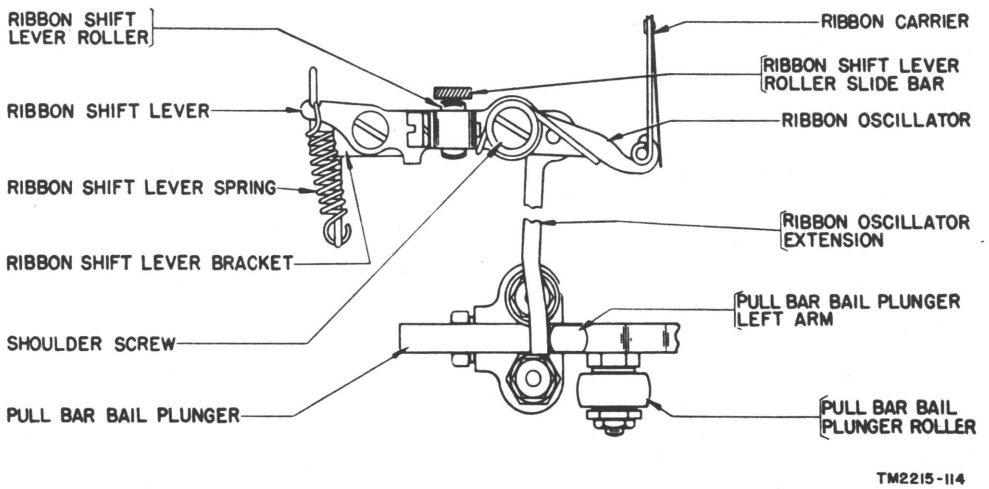


Figure 104. Ribbon oscillator mechanism.

b. Operation.

(1) *Platen in LTRS position.* The ribbon oscillator arm extension, which is fastened by an adjusting screw, is moved to the rear by an extension on the pull bar bail plunger, and rides in a slot in the carriage casting. When the pull bar bail plunger moves forward, the ribbon oscillator arm spring raises the arm and causes the ribbon shield (attached to the front of the arm) to raise the ribbon into the path of a type bar pallet. When the pull bar bail moves to the rear, pressure is exerted upon the ribbon oscillator arm extension and causes the mechanism to drop the ribbon below the printing line.

(2) *Platen in FIGS position.* The height to which the ribbon oscillator raises the ribbon is determined by the position of the ribbon shift lever roller. Both the oscillator arm and the extension are pivoted on the ribbon shift lever. The shift lever spring holds the shift lever roller against the slide bar and allows the ribbon oscillator spring to pull the ribbon oscillator assembly and ribbon to the printing position which, in this case, will be higher than that for printing letters.

111. Overlap of Selecting Cycle and Printing (or Function) Cycle

Through an overlap arrangement, the teletypewriter can perform a printing or function operation while the next selection is being stored in the receiving mechanism by the swords being set in the new selection order. Tension springs on the selector levers supply the energy required to complete the selection prior to the next printing or function operation when the mechanism is unlocked after a completed operation. The chart below shows the relationship between the operation of the previous selection and the setting up of the next selection.

Operation of previous selection	Locking of previous selection	Impulse of next selection being received and/or stored	Positioning of next selection vanes, bell cranks, and code bars
Selector cam sleeve stopped	Not locked	STOP	
Printing and function bail cams begin to turn; printing and function bails began to move.	Locking function lever starts forward to engage vanes.	START	Selector cam sleeve assembly begins to turn for the next selection.
Pull bar bail engages selected pull bar, or function bail engages a push bar.	Locked	1	Sword positioned and new selection stored.
Letter printed or function performed	Locked	2	Same as above.
Printing and function bails start to return to normal positions.	Locked	3	Same as above.
Printing and function bails nearly normal	Unlocked	4	Vanes 1 through 4 are set simultaneously.
Printing and function bails normal; main shaft clutch throw-out lever engaged by sixth cam.	Not locked	5	Vane 5 is positioned.

112. Operation of Functions
(figs. 95 through 107)

a. Description and Purpose. The typing unit can perform two primary types of operation. One type comprises those operations required to space and/or print characters. The other type is comprised of those operations necessary to perform nonprinting functions. The nonprinting functions are—BELL, blank, CAR RET, FIGS, LTRS, LINE FEED, and STOP. On weather communication keyboards and typing units, operation of the blank key in FIGS position prints a dash. The remote motor stop feature is not included. The functions are completed through the operation of separate function levers which are located behind the vanes in the front of the typing unit.

b. Operation. When the printing bail (fig. 105) is in its normal or rearmost position, the function lever bail attached to it holds the function levers away from the vanes. As the printing bail moves forward, the function lever bail roller moves off the high portion of the rear arm of the function levers. This permits the function lever springs to pull their levers against the vanes. The forward arms of the function levers are notched so that when a function combination is set up on the vanes, the selected function lever moves forward farther than the other function levers. The function lever extension then moves the selected push bar upward and into the path of the function bail or releases a latch bar to perform the correct function when selected.

113. Function Bail
(fig. 105)

a. Description and Purpose. The function bail is mounted on the bail mounting shaft. It is used to operate some of the functions and is moved

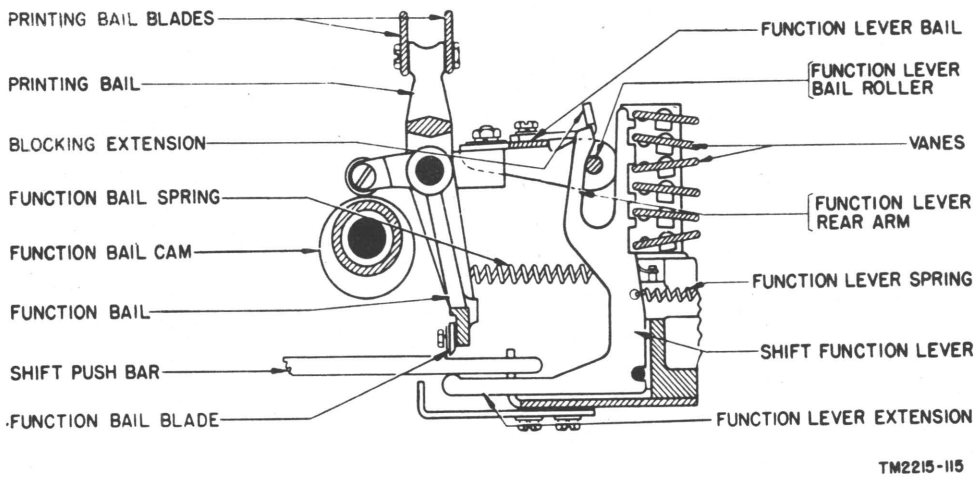


Figure 105. Function lever mechanism.

by the function bail cam. The function bail has a blade attached to its lower extremity which engages the function push bars and reset bars.

b. Operation. The function bail spring holds the function bail roller against its cam at all times. After the printing bail and function lever bail move far enough to release the function levers, the function bail roller starts to ride upward on its cam. The function bail blade moves toward the rear and engages and operates any reset bar in its path or any function push bar that may have been moved into its path by a function lever extension. The function bail then returns to its forward position. The function bail cam on the main shaft has not completed its revolution when the function bail comes to rest at the end of an operation. The roller rests between the low part and the peak of the cam.

114. Position of Function Levers

The position of function levers in the function lever guide are listed in the chart below, which shows the designations observed from the top and bottom of the typing unit (fig. 106).

Number on bottom	Function lever	Designation on top
1	Locking	None.
2	Carriage return	CR.
3	Figures shift	FIG.
4	Bell	BELL.
5	Universal	None.
6	Vacant	TAB.
7	Printing and space suppressor	None.
8	Sixth vane detent	None.
9	Unshift on space	SP.
10	Blank	BL.
11	Letters shift	LTRS.
12	Line feed	LF.
None	Motor stop	STOP.

115. Function Suppression

Teletypewriter TT–7/FG is arranged to suppress printing or spacing on both upper and lower case blank combinations. On Teletypewriter TT–8/FG, the lower case blank combination also suppresses printing and spacing, but it prints a dash when the upper-case blank combination is operated. On Teletypewriter TT–7/FG, the carriage return and line feed combinations operate from both the FIGS and LTRS positions. On Teletypewriter TT–8/FG, the carriage return and line feed functions operate only in the LTRS position (par. 119).

116. Carriage Return

(figs. 107 and 108)

a. Description and Purpose. A spring drum (fig. 100) is the source of power that returns the type bar carriage to the left margin by the use of a draw strap. The draw strap is connected behind the extreme right end of the type bar carriage casting and is fastened to a post on the spring drum.

b. Operation.

(1) When the carriage return function lever (fig. 108) moves into engagement with the vanes, the function lever extension moves the carriage return latch bar (fig. 108) up and out of engagement with its latch bar latch. The carriage return operating lever thus is released and (actuated by its spring) moves the carriage return clutch fork upward to disengage the upper carriage clutch member from the lower clutch member. The spacing shaft then can rotate independently of the spacing shaft gear. This permits the type bar carriage to be re-

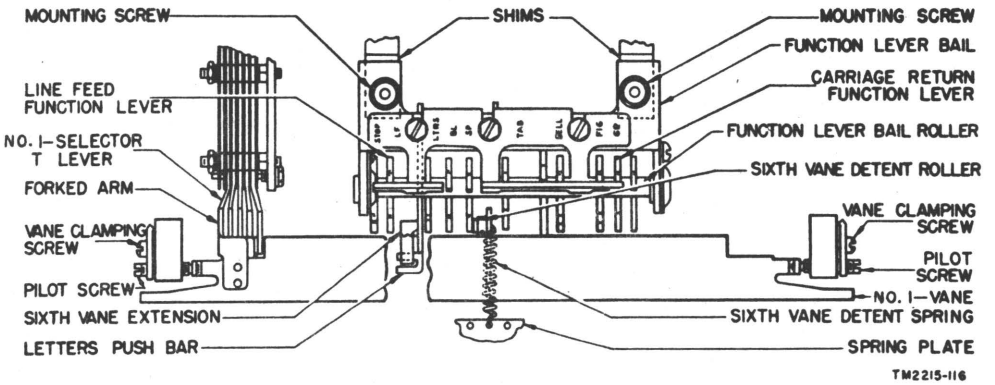


Figure 106. Function levers.

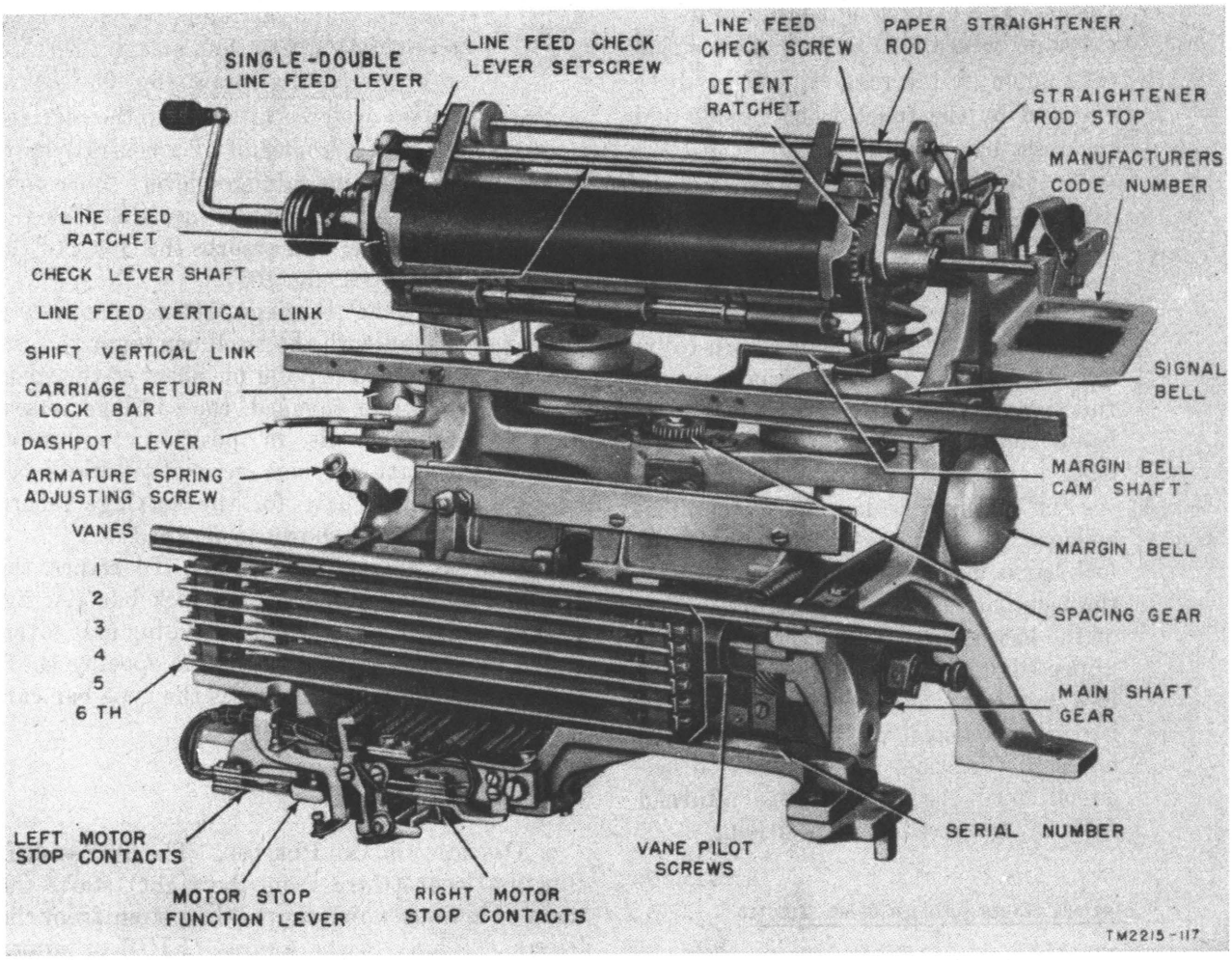


Figure 107. Typing unit with carriage removed.

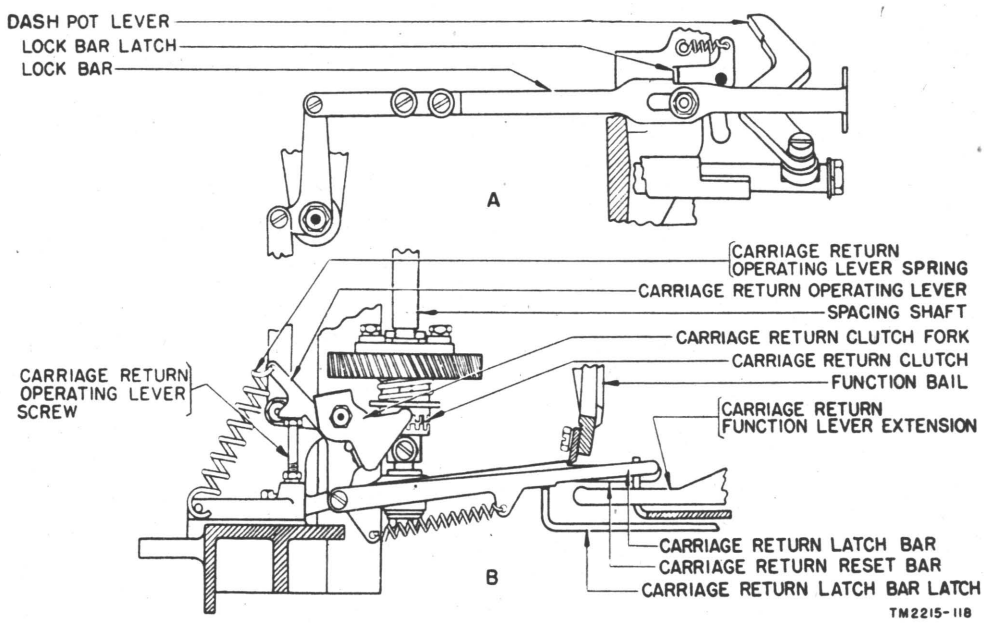


Figure 108. Carriage return mechanism.

turned to its extreme left position by the carriage return spring and draw strap.

(2) The notch on the reset bar then will be engaged by the function bail blade and the reset bar will be moved toward the rear. Because both the reset bar and the carriage return latch bar are pivoted on the same operating lever screw, the latch bar will be reset and engaged by the latch bar latch (fig. 108). In the meantime, the function lever bail will return to its normal position and the carriage return function lever extension will move down below the latching surface of the latch bar.

(3) As the carriage return clutch fork disengages the carriage return clutch, the lock bar is moved until its notch engages the lock bar latch. This sliding motion of the lock bar permits a shoulder in its upper edge to pass under and engage a lock bar latch mounted above the lock bar. Engagement of the lock bar latch holds the carriage return clutch disengaged until the carriage has returned fully to the extreme left position.

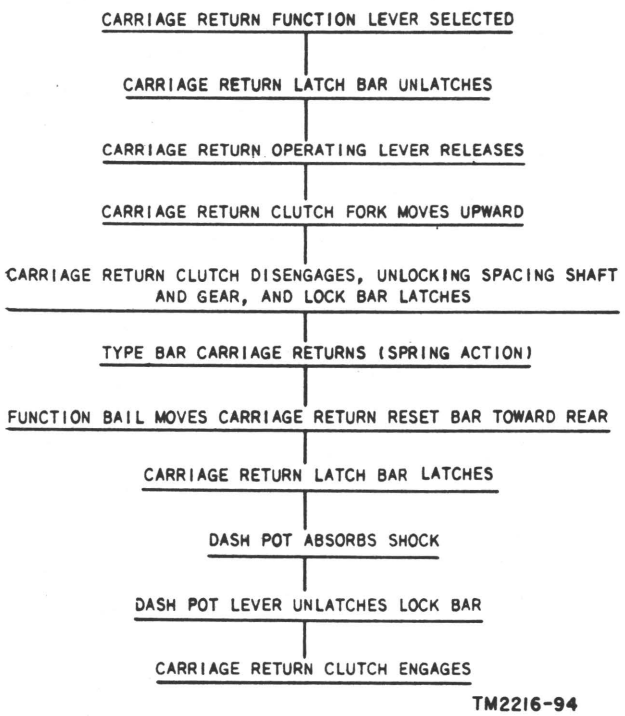


Figure 109. Sequence chart for carriage return.

(4) Just before the carriage reaches its position at the extreme left margin, the left margin adjusting screw (fig. 93 and A, fig. 108) which is attached to the carriage strikes the front end of a centrally pivoted dash pot plunger lever. The dash pot plunger is driven into the dash pot air chamber and absorbs the shock of the carriage (A, fig. 108).

(5) With the carriage return latch bar engaged with the latch bar latch and the driven and driving members of the spacing clutch engaged, the carriage return mechanism is in position to receive the next carriage return selection. A sequence chart for the carriage return function is shown in figure 109.

c. MANUAL CARRIAGE RETURN. To return the carriage manually, operate the lock bar (A, fig. 108) through the aperture in the typing unit cover. When the lock bar is pressed, the spacing shaft clutch is disengaged and causes the type bar carriage to return to the left margin.

117. Figures (Shift)

a. DESCRIPTION AND PURPOSE. The figures shift function lever (third from the right) starts the train of actions which moves the platen from the letters (LTRS) to the figures (FIGS or upper case) printing position. The function lever and its operation are described in paragraph 114. The function bail provides the force required to move the platen, through the push bar, shift link, and shift lever. The shift detent holds the platen assembly firmly in either the FIGS or LTRS position.

b. OPERATION. Selection of the FIGS function lever raises the FIGS shift push bar and brings its notch into the path of the function bail blade (fig. 105). This push bar, moved by the function bail blade, rotates the right end of a shift link (to which it is connected) toward the rear (fig. 110). As the shift link pivots, a shift lever, connected to its left end, rotates counterclockwise (viewed from left) and exerts a downward pull upon a vertical shift link that extends upward between the shift lever and the platen bracket. The rear platen assembly is moved downward while the platen roll rises to the FIGS position and is held there by its detent.

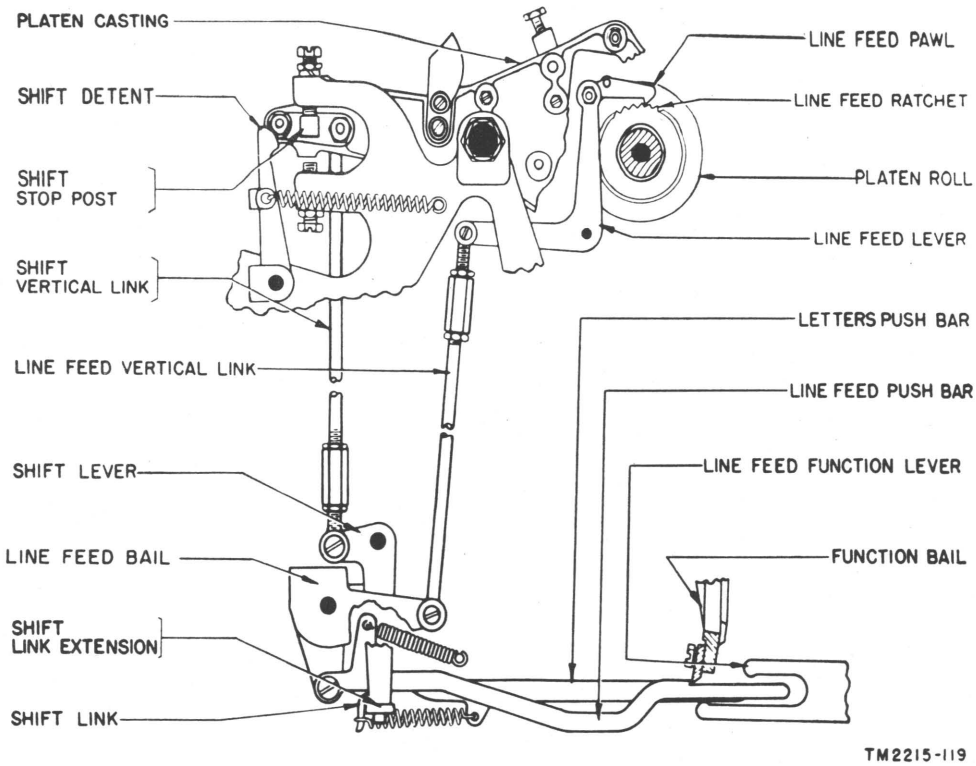


Figure 110. Platen shift and line feed mechanisms.

118. Letters (Unshift)

The LTRS push bar is connected to the left side of the shift link. When the push bar is operated by the function bail, the action at the platen assembly is reversed (with respect to FIGS position) and brings the platen down to the LTRS position.

119. Sixth Vane

The sixth vane controls the operation of the signal bell and the motor stop function (on Teletypewriter TT–7/FG only) through their function levers. The lower end of the spring attached to the sixth vane fits into the notch in the forward end of the LTRS push bar. With the platen at LTRS position, the rear edge of the sixth vane moves up and blocks the signal bell and motor stop function levers from engagement with the vanes. When the FIGS key is pressed, the LTRS push bar moves forward and causes the rear edge of the sixth vane to go to the lower position. This allows the signal bell or motor stop function lever to be selected and operated.

120. Spacing Function

Spacing, other than that accompanied by printing, is performed in the same manner as that described in paragraphs 104 and 106, except that there is no pull bar to be selected. Repeated spacing is accomplished by holding down the space bar until the desired number of spaces is reached.

121. Unshift-on-Space

a. Description and Purpose. Teletypewriters TT–7/FG and TT–8/FG can be arranged to shift from the FIGS to the LTRS position when the space bar is operated. Normally, however, the unshift-on-space feature of these teletypewriters is locked out, and the adjustment necessary to include this feature, if required, will be made only by authorized teletypewriter maintenance personnel. The information in *b* below is included to explain the unshift-on-space feature when the teletypewriter is adjusted to include this facility.

b. Operation (fig. 111). The teletypewriter shifts the platen from the FIGS to the LTRS position by the action of the space function lever. When the unshift-on-space feature is not required,

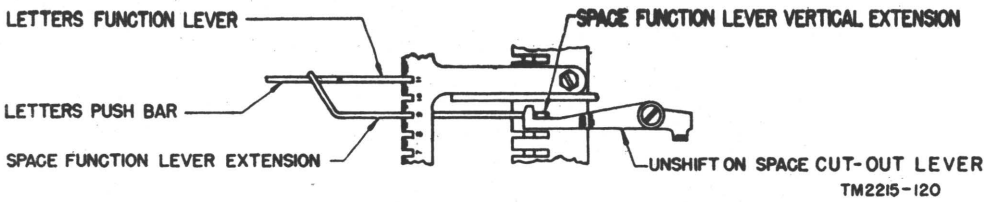


Figure 111. Unshift-on-space cut-out lever.

the unshift-on-space cut-out lever is moved into engagement with the space function lever projection. When required, the space function lever extension moves upward on a space combination and raises the LTRS push bar into the path of the function bail (fig. 110). The platen then shifts to the LTRS position.

122. Line Feed

a. Description and Purpose. The line feed function feeds the paper into the teletypewriter through a train of mechanical actions in response to the combination for LINE FEED received by the selector mechanism. When the first function lever on the left begins to move, motion is transmitted through the push bar, line feed bell crank, vertical link, feed lever, feed pawl, and feed ratchet (fig. 110). The function bail (fig. 112) moves the platen through the line feed mechanism and the feed ratchet which is attached to the left end of the platen. To maintain proper line interval when the paper feeds, the check lever, check lever shaft, check post, check screw, detent ratchet, and detent are provided. The check lever, check lever shaft, check post, and the check screw stop the turning of the platen. The detent ratchet (attached to the end of the platen) and the detent arm assembly hold the platen in the proper position.

b. Operation.

(1) When the line feed function lever (second from the left) is selected, its lower extension raises the line feed push bar into the path of the function bail blade (fig. 110). When the function bail moves toward the rear of the typing unit, the line feed push bar rotates the line feed

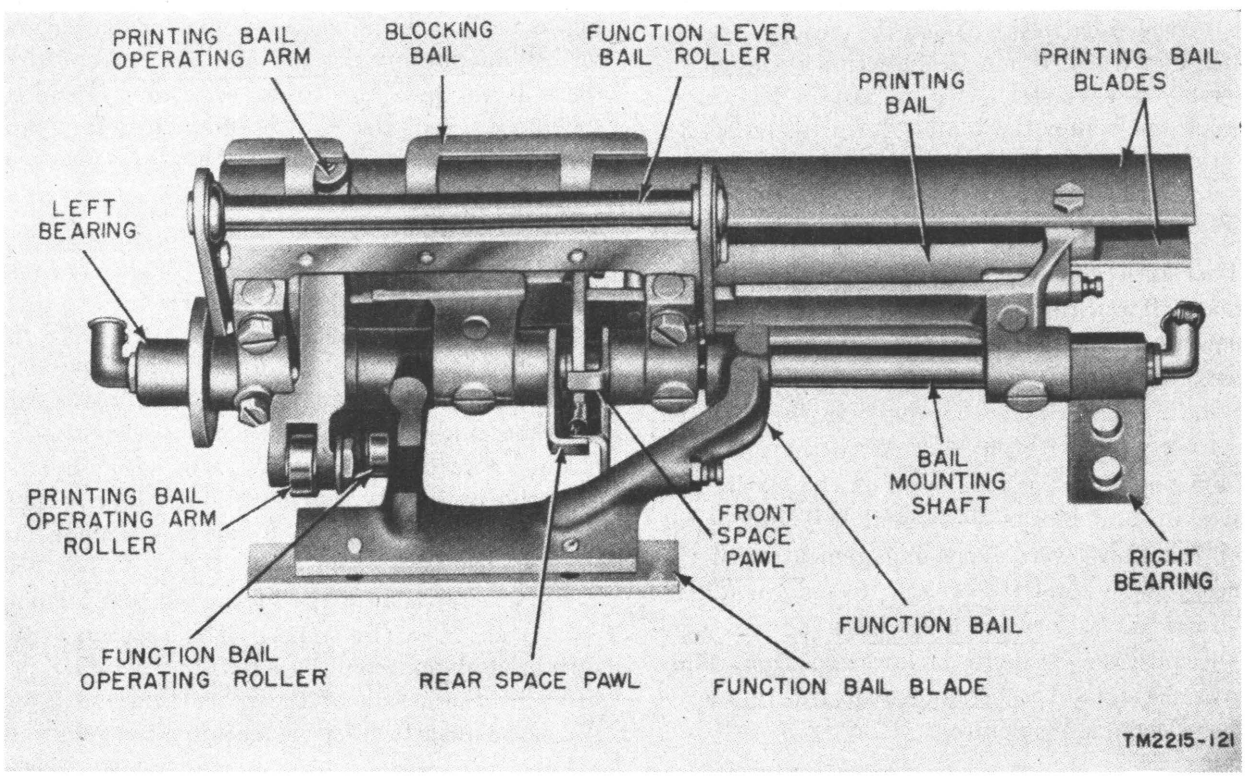


Figure 112. Printing and function bail assembly.

bail and thus pulls the line feed vertical link downward. This action rotates the line feed lever, which in turn moves the line feed pawl back and into engagement with the ratchet, and thus rotates the platen one line space (the check lever also is operated to prevent more than one space). When the line feed function lever is returned to its normal position by the function lever bail, the upper extension of this function lever moves the line feed push bar off the function bail blade. The push bar spring holds the bar out of the path of the blade.

(2) After each line feeding operation, a roller on the detent lever (figs. 96 and 107) locates itself between two teeth on the detent ratchet, regulates the space between lines, and holds the platen firmly in position during the printing of each line. A sequence chart of the line feed operation is shown in figure 113.

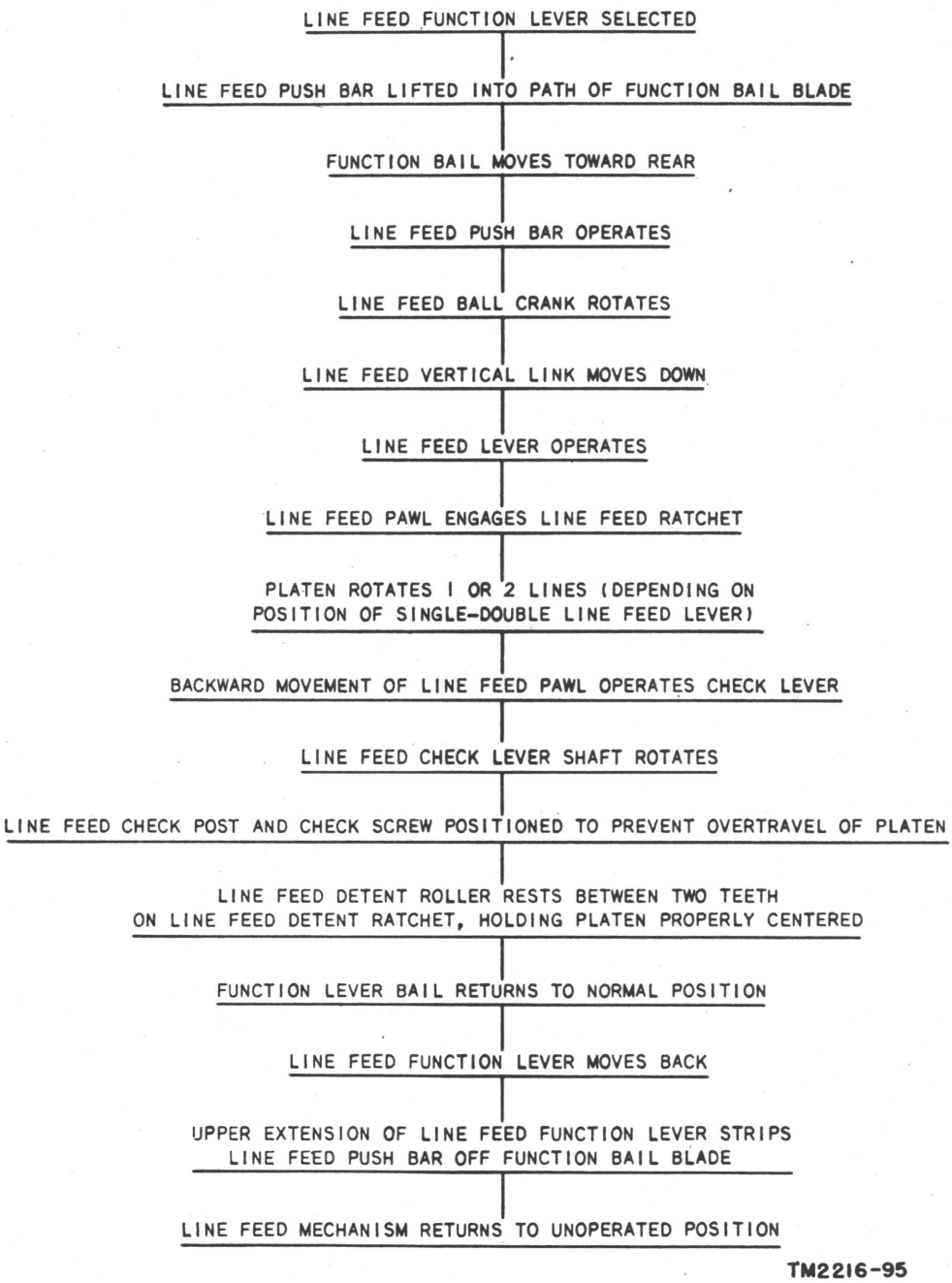


Figure 113. Line feed sequence chart.

123. Single-Double Line Feed

The distance that the paper is moved during each line feed operation normally is two spaces. An adjustment is provided whereby the teletypewriter can feed single space if required.

a. Description and Purpose. The line feed ratchet is attached to the left-hand end of the platen (fig. 110) and is designed for either double or single line feeding. The saw tooth notches on the ratchet receive the adjustable line feed pawl.

b. Operation. In its lower position, the single-double line feed lever allows the line feed pawl to skip the first and engage the second tooth. This results in rotation of the platen for a double space. When the single-double line feed lever is in its upper position, the line feed pawl engages only one tooth on the line feed ratchet. This enables rotation of the platen for only a single space.

125. Signal Bell

a. Description and Purpose. The signal bell, mounted horizontally at the rear of the typing unit (fig. 100), provides an audible means with which to signal the operator. It is connected to its function lever by means of a hammer arm, an operating lever, a latch bar, and a reset bar. The bell hammer strikes the signal bell once each time the BELL key is pressed on any teletypewriter keyboard in the circuit.

b. Operation.

(1) When the bell function lever is selected, its extension (fig. 114) raises the bell latch bar. This releases the bell operating lever, which is rotated by the spring connected to it. The bell operating lever strikes the bell hammer arm extension and causes it to throw the bull hammer against the bell.

(2) The bell reset bar and bell latch bar, both pivoting on the bell operating lever screw, are reset by the function bail as it moves to its rear position. A sequence chart of the signal bell function is shown in figure 115.

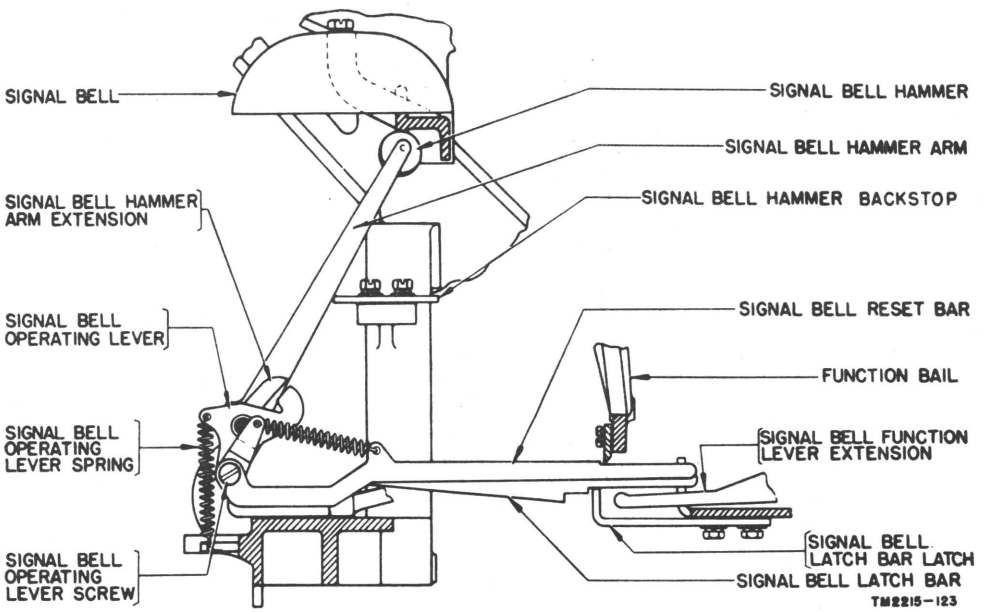


Figure 114. Signal bell mechanism.

124. Paper Feeding

To facilitate paper feeding, a paper straightener rod and a series of pressure rollers are used (fig. 61). The straightener rod guides the paper as it unwinds from the roll in response to the line feed function. The rod yields under pressure and prevents rapid acceleration of the paper roll. The pressure rollers hold the paper against the platen and prevent slippage.

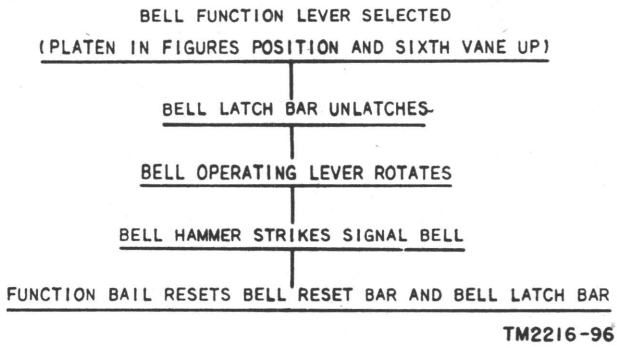


Figure 115. Signal bell sequence chart.

126. Mechanical Motor Stop

This feature is included in Teletypewriter TT–7/FG and operates when the FIGS and then H keys are pressed. This feature is not included in Teletypewriter TT–8/FG.

a. Description and Function. The mechanical motor stop is a function operation. The motor stop function lever (fig. 117) is selected when the STOP key is pressed. Paragraph 112 describes the function lever. The stop function stops the motor at the transmitting teletypewriter and all motor units of teletypewriters connected in the same signal circuit. All motors in the same circuit can be restarted by operating the SEND-REC-BREAK mechanism to BREAK or otherwise opening the line circuit momentarily.

b. Motor Stop Operation.

(1) When the motor stop function lever is selected, its forward motion causes its lower rear extension to raise the motor stop lever (fig. 116). This latches the inner motor stop pawl onto the thicker part of its latch on the armature extension (fig. 117).

(2) Simultaneously, the front extension of the motor stop function lever closes the left-hand motor stop contact. As the rear extension of the motor stop contact lever moves up, the front extension moves down against its spring. This opens the right-hand motor stop contact.

(3) Since both contacts are wired in multiple, the motor will not stop until the motor stop function lever is returned to its normal position and the left-hand contact is open again. This contact holds the motor circuit closed until the receiving selector cam sleeve comes to rest.

c. Motor Start Operation.

(1) To start the motors, the signal line must be opened momentarily by operating the SEND-REC-BREAK mechanism to BREAK (fig. 120). This moves the upper contact lever extension against the

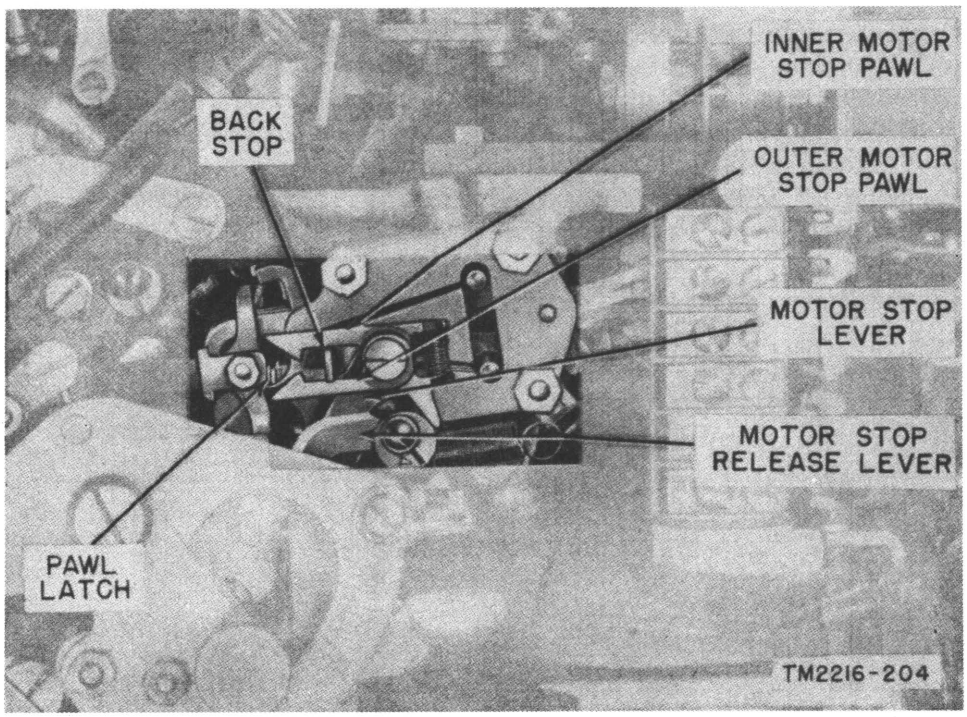


Figure 116. Mechanical motor stop.

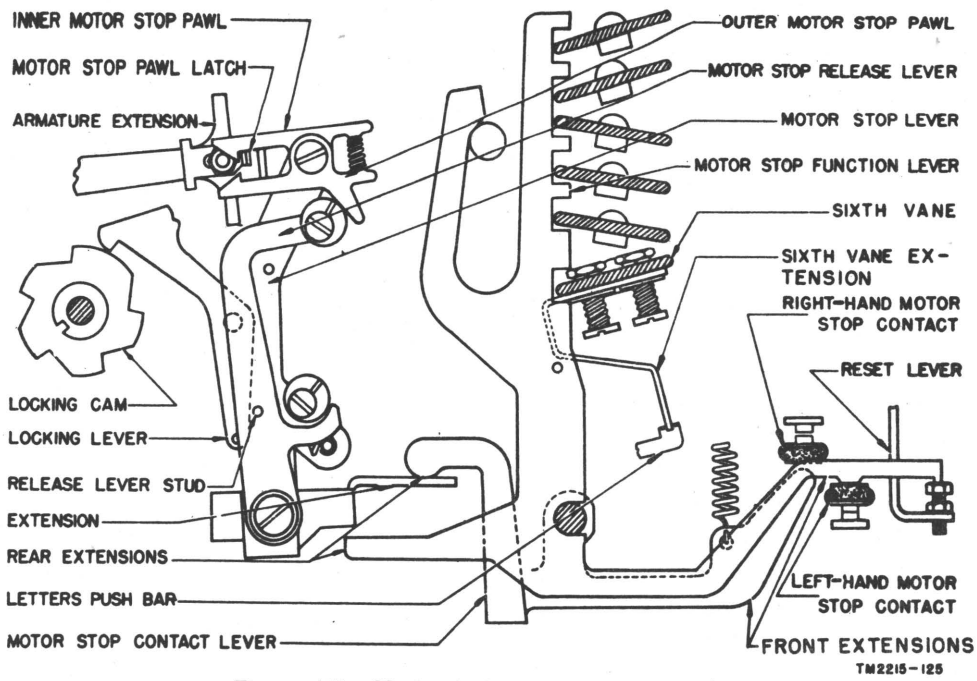


Figure 117. Mechanical motor stop mechanism.

line contact insulator. The line is opened, the selector armature extension is moved down by the armature spring, and the upper end of the motor stop lever (having traveled forward a short distance) is stopped again when its outer pawl engages the cut-away portions of the motor stop pawl latch.

(2) When the signal line is closed again the armature moves to its operated position, the outer motor stop pawl unlatches the armature extension, and the motor stop lever returns to its normal position. The extension on the lower portion of the motor stop lever, which has been holding the motor stop contact lever away from the right-hand stop contacts, now will permit the spring to move the front extension of the motor stop contact lever upward and close the motor stop contacts.

d. Keyboard Locking Operation. When the motor control function is operated, the forward end of the motor stop function lever moves down against the lower screw on the reset lever and closes the keyboard control contacts. This locks out keyboard transmission. The reset lever, in turn, moves the contact operating lever as described in paragraph 128*b*(5) and figure 118.

e. Motor Stop Release Lever. The motor

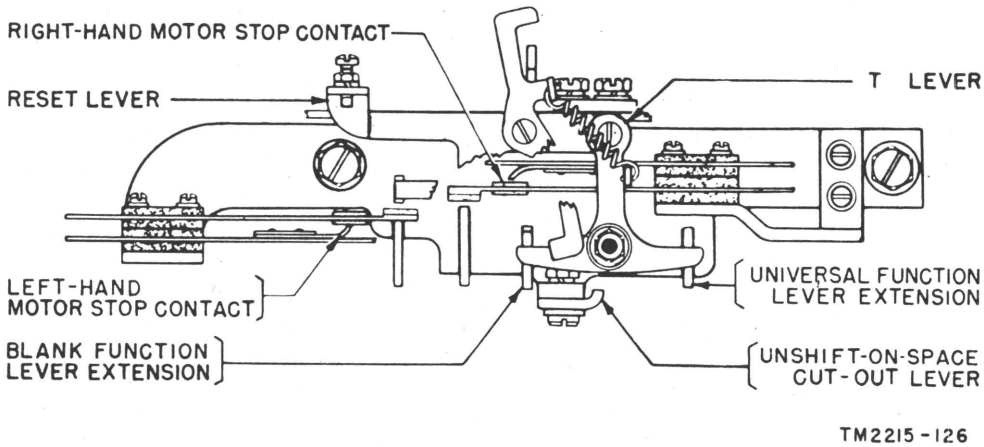


Figure 118. Mechanical motor stop contacts (front of typing unit).

stop release lever eliminates the possibility of the selector cam sleeve coming to rest with the armature locking lever riding the low part of the cam (fig. 117). For example, immediately after the STOP key has been operated, and before the motor comes to a stop, if the line opens accidently (thus releasing the selector magnet armature) the selector cam sleeve can rotate beyond the stopping point. It is possible that the armature locking lever may come to rest in an indent of its cam. With the cam stopped in this position, the armature extension is not free to respond to the next open line interval; this makes it impossible to operate the mechanical motor control. To avoid this condition, a mechanical arrangement is provided so that when the locking lever is in an indent of the locking cam, the motor stop lever is not permitted to engage the armature extension latch. This is done by means of the motor stop release lever. When the locking lever is in an indent, it comes in contact with the release lever stud. This holds the eccentric at the upper end of the motor stop pawl and prevents the pawl from engaging the motor stop pawl latch. Thus, the motor stop feature cannot function; the motor continues to revolve until the selector cam is stopped by the stop lever, and the locking lever is riding the long high part of the cam. A sequence chart for the remote motor control function is shown in figure 119.

127. SEND—REC—BREAK Mechanism
(figs. 120 and 121)

a. Description and Purpose. The SEND—REC—BREAK mechanism, mounted on the front left-hand corner of the base, extends through an opening in the cover, and its two levers control three pairs of contacts. With the SEND—REC lever operated to its SEND position, all contacts are closed except the keyboard short-circuiting contacts to arrange the equipment for transmission. Reception also is possible with the lever at the SEND position. With the lever at the REC position, only reception is possible. The BREAK lever is used when break signals are sent to a distant operator, or for starting teletypewriters in the same circuit by opening momentarily the signal line to operate the remote motor control mechanism.

b. Manual Operation. The SEND—REC lever can be moved to the SEND or REC position by moving it up or down. A latch on the stop lever stops the SEND—REC lever in the REC position when it is being moved downward. To send a break signal, the BREAK lever must be operated to release the stop lever and permit both the SEND—REC lever and the BREAK lever to be moved to BREAK. If both levers are held at BREAK and then released, they will return to the REC position and permit the break contacts to close.

c. Mechanical Operation. On Teletypewriter TT-7/FG, the SEND—REC lever moves to the REC position by the blank function mechanism when the blank key of the keyboard is struck twice in succession in either the FIGS or LTRS position (par. 128). On Teletypewriter TT-8/FG only, the blank key causes a dash to be printed for each operation of the key in the FIGS position. When the blank key is used in the LTRS position, an idle operating cycle results. While there is no difference in the operation of the BREAK lever on the two types of equipment, the SEND—REC lever must be operated manually to cut out the keyboard on Teletypewriter TT-8/FG.

128. Blank Function Operation of SEND—REC Lever

a. The SEND—REC lever may be operated manually or by that part of the SEND—REC—BREAK mechanism located on the TT-7/FG typing unit (fig. 122). The SEND—REC—BREAK mechanism, when operated to BREAK manually, or to REC by two successive operations of the blank key on the keyboard of any TT-7/FG. opens the lower contacts and closes the keyboard short-circuiting contacts to short-circuit the sending contacts of all TT-7/FG teletypewriters in a circuit. With its SEND—REC lever in the REC position, a teletypewriter cannot send until its key is restored manually to SEND. The procedure outlined above also serves as a break-in feature that permits any receiving operator to stop transmission from a remote station in the same circuit, whether the transmitting equipment is sending from tape or manually from a keyboard. A tape transmitter (transmitter distributor), if used, may be controlled from the lower contacts of the SEND—REC—BREAK mechanism on the base. These lower contacts open as the keyboard short-circuiting contacts close (fig. 268).

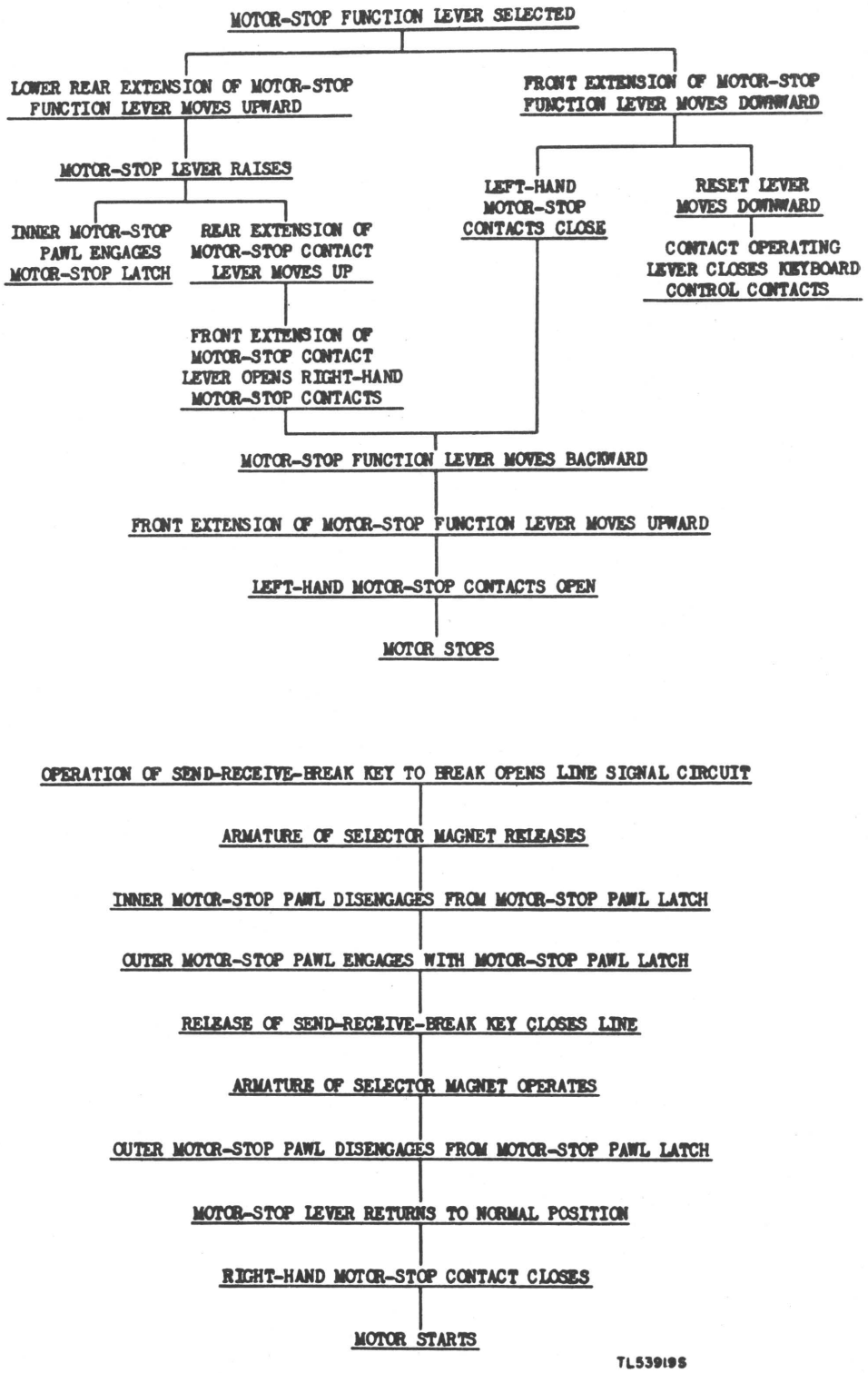


Figure 119. Sequence chart for remote motor control.

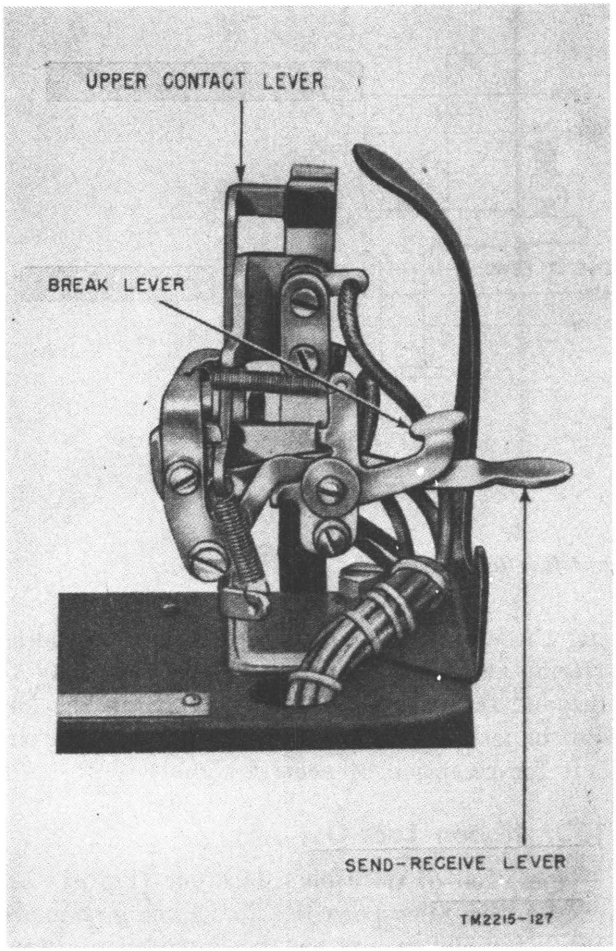


Figure 120. SEND—REC—BREAK mechanism on base unit.

b. MECHANICAL OPERATION.

(1) As the blank function lever moves forward its extension moves downward, carrying with it the left arm of the T lever (fig. 122).

(2) The left arm of the T-lever is moved down and moves the reset lever and the intermediate lever to the left. This positions the lower end of the intermediate lever against the side of the blank function lever extension where it is held by a spring.

(3) The blank function lever extension moves upward when the function lever bail returns to its normal position. The toe of the intermediate lever thereby is moved under the blank function extension by the tension of the intermediate lever spring.

(4) The blank key, when pressed the second time, causes the blank function lever to move downward again. The function lever carries the intermediate lever with it.

(5) As the intermediate lever moves downward, it depresses the reset lever. The adjustable screw in the left end of the reset lever depresses the right arm of the upper contact lever and rotates the verti-

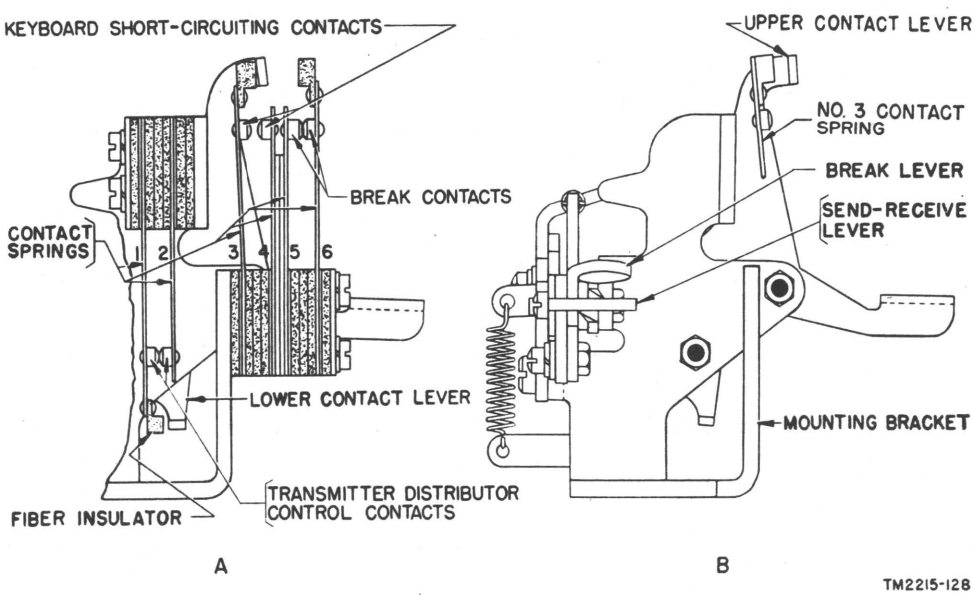


Figure 121. SEND—REC—BREAK mechanism parts on base.

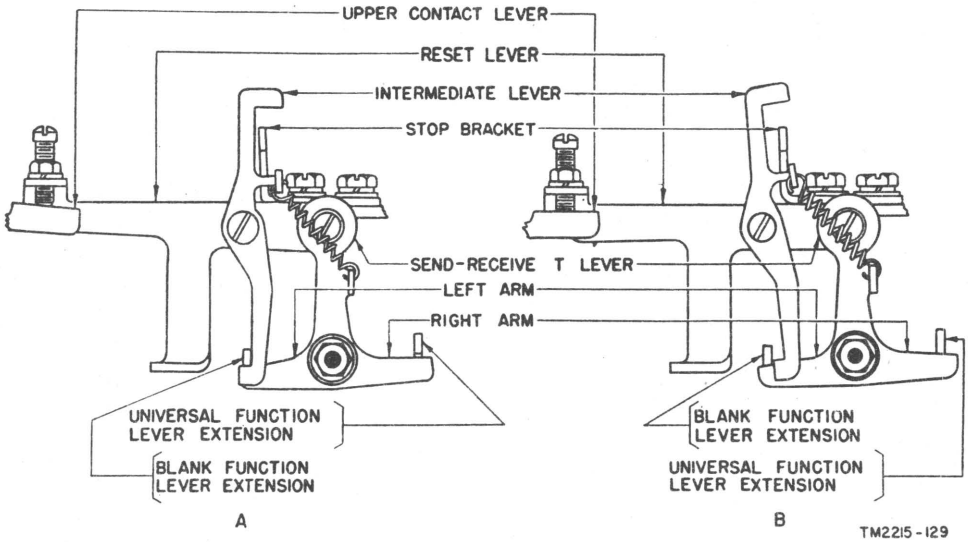


Figure 122. SEND—REC—BREAK mechanism and function on the TT-7/FG typing unit.

cal extension of the upper contact lever to the right.

(6) The clockwise rotation of the upper contact lever to the right releases a keyboard short-circuiting contact spring and permits the contacts to close under tension of the contact springs. At the same time, the left arm of the upper contact lever rotates upward and releases the SEND—REC lever which then rotates under its spring tension to the REC position.

(7) As the printing bail operating arm roller rides the high portion of the printing bail cam, the function lever bail moves upward. This causes the function lever bail roller to engage the cam surface of the rear arm of the blank function lever and move it out of engagement with the vanes. The blank function lever is returned to its normal position, and operation of the blank function is completed. A sequence chart illustrating the above operations is shown in figure 123.

129. Polar-neutral Key

a. Description and Purpose. The polar-neutral key is a two-position key mounted on top of the keyboard of the perforator transmitter as shown in figure 124. Its use enables the teletypewriter to respond to either polar or neutral signals.

b. Operation. Refer to figures 124 and 125. Pushing the polar-neutral key in results in opening the circuit through the relay bias winding (terminals 2 and 7) and permits the relay to respond to polar-type signals. Pulling the key out connects the bias winding into the rectifier circuit for reception of neutral signals.

130. Ribbon Lock-Out

Operation of the ribbon lock-out (fig. 97) arranges the teletypewriter for cutting stencils. When the ribbon lock-out bar is moved in, it engages the ribbon oscillator extension and the oscillator assembly is held below the printing line, permitting the type bar pallets to strike the stencil without striking the ribbon.

131. Electrical Circuits (General)

The electrical circuits of Teletypewriters TT-7/FG and TT-8/FG, are considered in three main groups: power circuits, signal circuits, and local circuits. Power circuits consist of the wiring at the table and in the operating components by which a-c is applied to the rectifier power unit and the motors. Signal circuits are those which carry the signal impulses. Local circuits are those by which d-c is applied to the selector magnets, perforator, character counter magnets, relay bias winding, and line test circuits. In the following paragraphs, the electrical circuits are traced from the terminal or connection points at the table to the electrical assemblies in the operating components. The rectifier is discussed in paragraph 139.

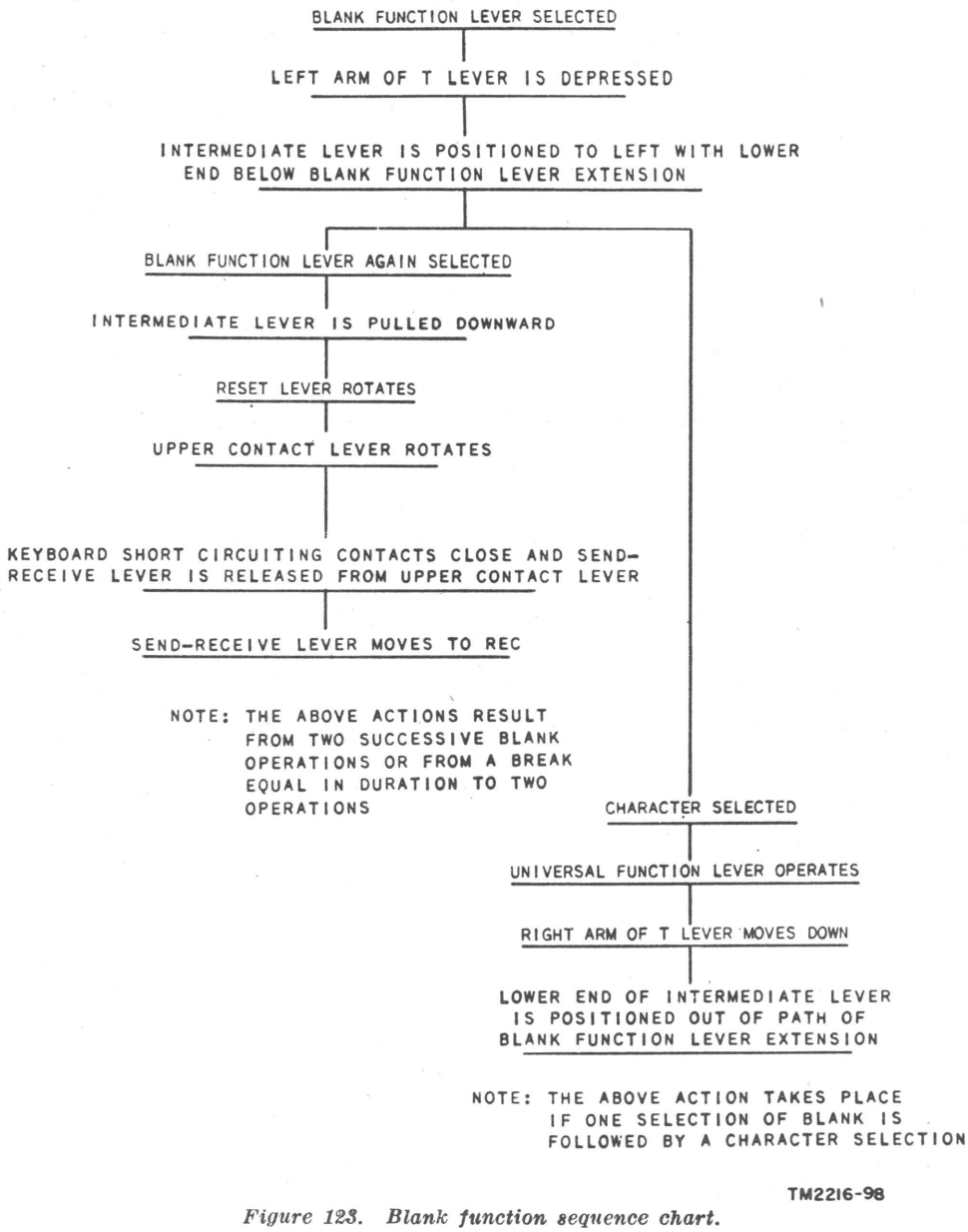


Figure 123. Blank function sequence chart.

132. Table

a. General. The table is wired so that a-c may be connected to the rectifier, d-c distributed from the rectifier to the various local circuits, and signal lines connected to the transmitter contacts and relay line winding through appropriate terminal boards. In the following subparagraphs, the a-c, d-c, and signal circuits are discussed separately.

b. Power Circuits. Refer to figures 268 to 276 (schematic and wiring diagrams). The power terminal boards, identified as E601 and E602, are made of insulating material and contain 26 screw-type terminals, numbered 21 through 46 on each board. From these terminal boards, wiring is arranged to connect each receptacle at the back of the table to its appropriate circuit. The signal circuits are completed through the screw terminals on line terminal boards E603, E604, and E605. The various receptacles arranged in the table are:

(1) J610, a convenience receptacle.
(2) XF601, the motor fuse receptacle for the transmitter distributor.
(3) XF602, the motor fuse receptacle for the reperforator power circuit.
(4) J605, a two-contact (polarized-type) receptacle for connection of the a-c input power cord to the rectifier.

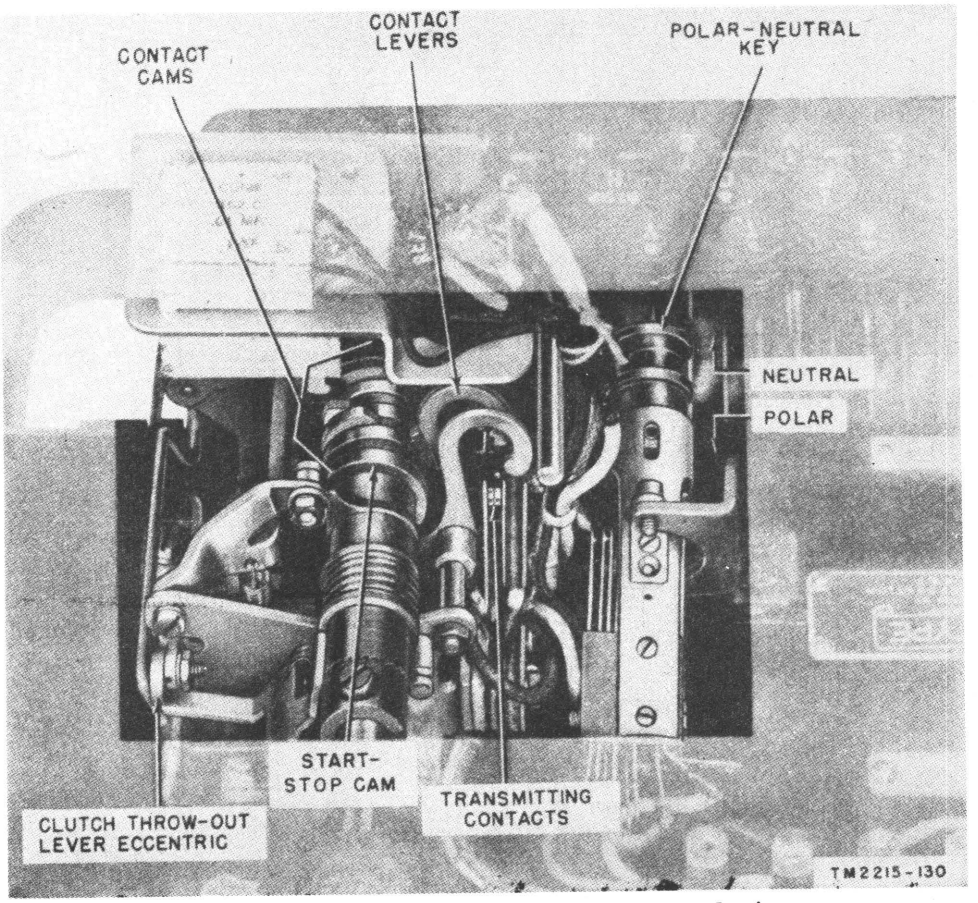


Figure 124. Polar-neutral key and transmitter mechanisms.

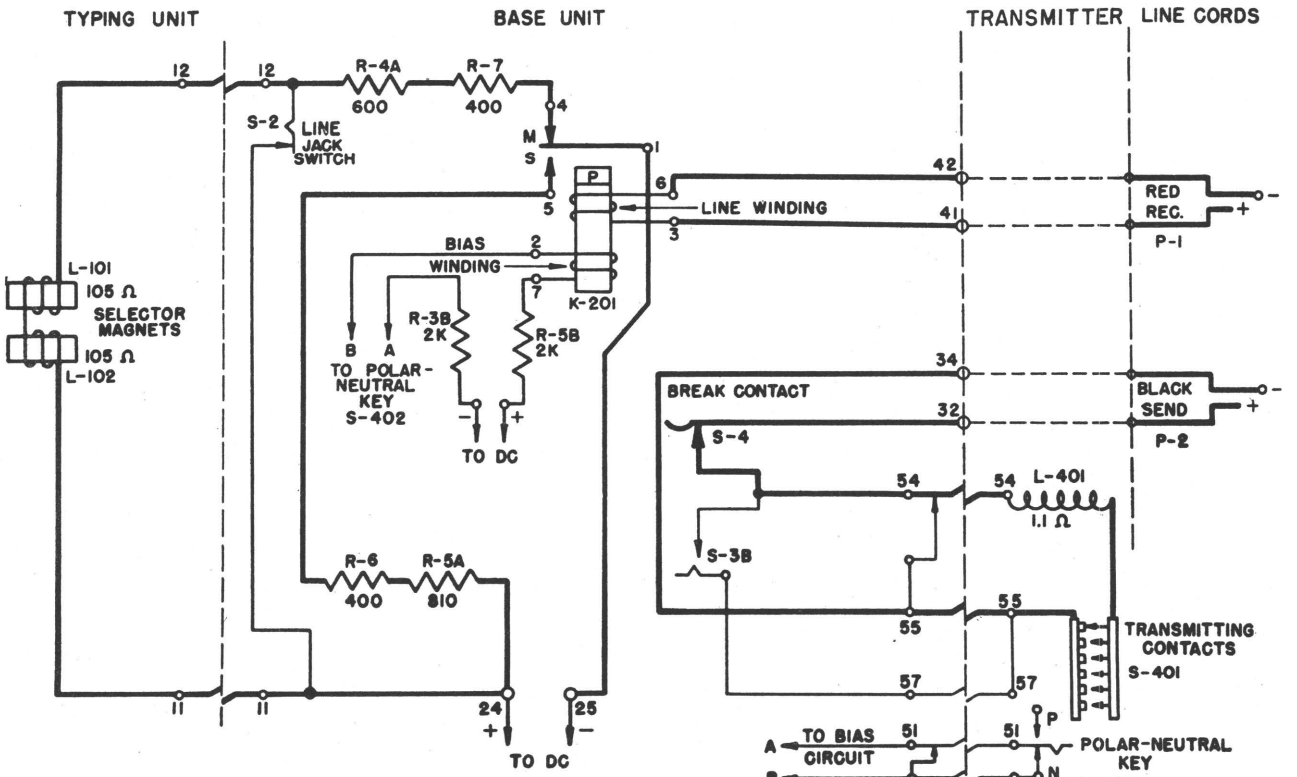


Figure 125. Teletypewriter transmitting and receiving circuit, simplified schematic.

(5) J607, a four-contact receptacle for connection of the a-c cord to the base.
(6) J606, a three-contact receptacle for connection of the d-c cord to the base.
(7) J603, a three-prong receptacle for connection of the d-c output of the rectifier.
(8) J611, a three-contact receptacle for connection of the d-c cord to a reperforator.
(9) J612, a four-contact receptacle for connection of the a-c cord to the reperforator motor.
(10) S605, a four-pole, double-throw switch (the a-c, d-c switch).
(11) J604, a four-prong receptacle for adjusted motor terminal a-c voltage.
(12) S603, a double-pole, double-throw switch in the a-c input circuit to the rectifier.
(13) S604, a single-pole, double-throw switch in the a-c input circuit to the transmitter distributor motor.

c. A-C Circuits. Incoming a-c power conductors are connected to terminals 21 and 22 on power terminal board E601. The ac is connected to the rectifier from a-c outlet J605. The rectifier, in addition to supplying dc, also is used to adjust the incoming a-c line voltage to the proper value required by the motor units. This adjusted a-c motor terminal voltage is delivered to receptacle J604. The adjusted a-c motor terminal voltage is connected to the motor units of the transmitter distributor and the teletypewriter (and the reperforator, if one is used) by a four-pole, double-throw switch S605. The diagram shows the circuit in which the motor units are connected, as well as the respective receptacle for each motor circuit. The motors are connected in parallel and each motor circuit has a switch and fuse.

d. D-C Circuits. Filtered d-c supplied by the rectifier is connected to terminals 24 and 25 of terminal board E2 of the teletypewriter base. The conductors of the d-c power cord from the rectifier terminate in a plug that is inserted into power receptacle J603 of the table. From J603, the d-c signal circuit may be traced to the transmitting contacts of the perforator transmitter and transmitter distributor, and to the relay line winding (in special cases the selector magnets) of the receiving components. In addition, local dc also is supplied to the relay bias winding through relay block E6 and slip contacts 52 and 53 of the base. The d-c from the local rectifier also can be supplied to the signal lines, if required, and to the local test circuit of the table. The necessary connections to the d-c source, when line current is supplied, are given in paragraph 18. The three 2,500-ohm resistors (R602, R603, and R601) are provided to adjust the loop current of the test circuit and two signal circuits, respectively.

e. Signal Circuits. Figures 28 and 30 show the conductors of the signal circuits connected to line terminal boards E603, E604, and E605. The signal circuits then are brought to the jacks into which the cords from the send and receive terminal boards of the base are plugged. On the base, the send terminal board usually is designated E3 and the receive terminal board, E4. The signal circuit for a reperforator is completed through the jacks at the lower rear of the table. The transmitter distributor receives its power from and is connected to the signal line through spring contacts in its mounting.

f. Line Switching Key. Line switching key S601 is provided so that either of two signal lines can be connected to the operating components; this depends on the method of operation required. Several arrangements are given in paragraph 18. It also can be set to arrange the teletypewriter for local test operation.

g. Tape-Out Key. This key, S602, is shown in figures 274 and 275, where its relation to the signal circuit is indicated. Its function is to cause the emission of extra tape at the end of a reperforated message from a reperforator and permit the tape to be torn off without damage to the message.

133. Base

a. General. The base has four terminal boards arranged as shown in figure 269. Three of these terminal boards are located at the right front corner of the base; the fourth is near the relay mounting at the left rear corner. The terminal boards are identified by the numbers of the terminals they contain. Terminal board E2, numbered 21 to 26, is called the 20 board and is used to connect the power conductors to the base. Terminal board E3, numbered 31 to 36, is used to connect the conductors from the transmitter contacts of the perforator transmitter. Terminal board E4 is numbered 41 to 46. The conductors from the line winding of the polar relay and the selector magnet usually are connected to this board. Terminal

board E6 is numbered 61 to 66, and the conductors from the polar relay are connected to this board. In the subparagraphs below, the circuits are traced from each of the terminal boards mentioned above.

b. Terminal Board E2. Conductors from the a-c power cord (which is plugged into receptacle J607 of the table) are connected to terminals 21 and 23. The wires of the d-c cord (plugged into receptacle J606 of the table) are connected to terminals 24 and 25.

(1) *A-c connections.* A convenience receptacle is connected between terminals 21 and 23, and the power circuit to the motor is completed through slip contacts 13, 14, 15, and 16 of the motor unit mounting. Motor switch S1 connects the motor control contacts, in series with the fuse and the parallel combination of two 300-ohm resistors in the lead from terminal 22, to slip contact 14 of the motor unit mounting. The 5-ohm resistor R1 and the 1-uf capacitor C1 connected between the switch and the midpoint of the two 300-ohm resistors are used to reduce sparking at the switch and contacts in the motor circuit. Figures 268 and 274 show the motor circuit and the electrical relation of the circuit elements.

(2) *D-c connections.* The d-c leads from terminals 24 and 25 are connected to slip contacts 52 and 53 of connection board E5 of the perforator transmitter and to terminals 62 and 63 of terminal board E6. From terminal 62, a lead is connected to terminal 46 to which a lead from the selector magnet also is connected. Another lead from the selector magnet is connected to terminal 45 of terminal board E4, from which a connection is made to terminal 65 of terminal board E6. The selector magnet circuit is shown in figure 268. The dc from terminals 24 and 25 of terminal board E2 energizes the selector magnet circuit. Figure 268 shows the selector magnet and relay circuits.

c. Terminal Board E3. Signal line conductors are connected to terminals 32 and 34 of terminal board E3. Figures 268 and 270 show the transmitter circuit. Connections from terminals 33, 34, 35, and 36 of terminal board E3 lead to terminals 69, 70, 68, and 67 on the resistor block, respectively. The flat-type resistors may be connected into a loop to adjust loop current. Normally, the flat resistors will not be used, and line current will be adjusted at the station supplying it or at the slide-wire line resistors located behind the line jacks of the table.

d. Terminal Board E4. Signal line conductors are connected to terminals 41 and 42 at terminal board E4. These terminals are wired to terminals 61 and 66, respectively, on terminal board E6. Conductors from the selector magnets are connected to terminals 45 and 46 of terminal board E4. From here, the circuit is completed as described in subparagraph *b* (2) above.

e. Terminal Board E6. This board is located at the left rear corner of the base. As indicated in figure 268, various relay circuits are connected to terminal board E6. Figure 57 shows the bias circuit, the selector magnet circuit, the space (rectifier load on space) circuit, and the relation of the relay line (or operating) winding to the signal circuit. Figure 56 shows the transmitting circuit and keyboard shunt circuits.

134. Polar Relay and Transmitting Contacts

a. General. The typing unit includes the selecting mechanism from the selector magnet to the code bars. The transmitter contacts of the perforator transmitter usually will be connected in series with the signal line and with the line winding of the RY–30 polar relay (fig. 126), which is located on the base, to obtain local copy of all transmitted messages. The mechanical sequence of operation of the perforator and transmitter mechanism is contained in paragraph 95. The electrical operation of the perforator transmitter mechanism is described in paragraphs 82, 131, and 138 and includes the electrical operation of the transmitting and receiving components, the line relay, and the motor unit. Circuits of these teletypewriters may be divided into separate related circuits:

(1) Bias circuit of relay RY–30.
(2) Line or signal circuit.
(3) Selector magnet circuit.
(4) Selector magnet shunt circuit (rectifier load on space circuit).
(5) Motor circuit.

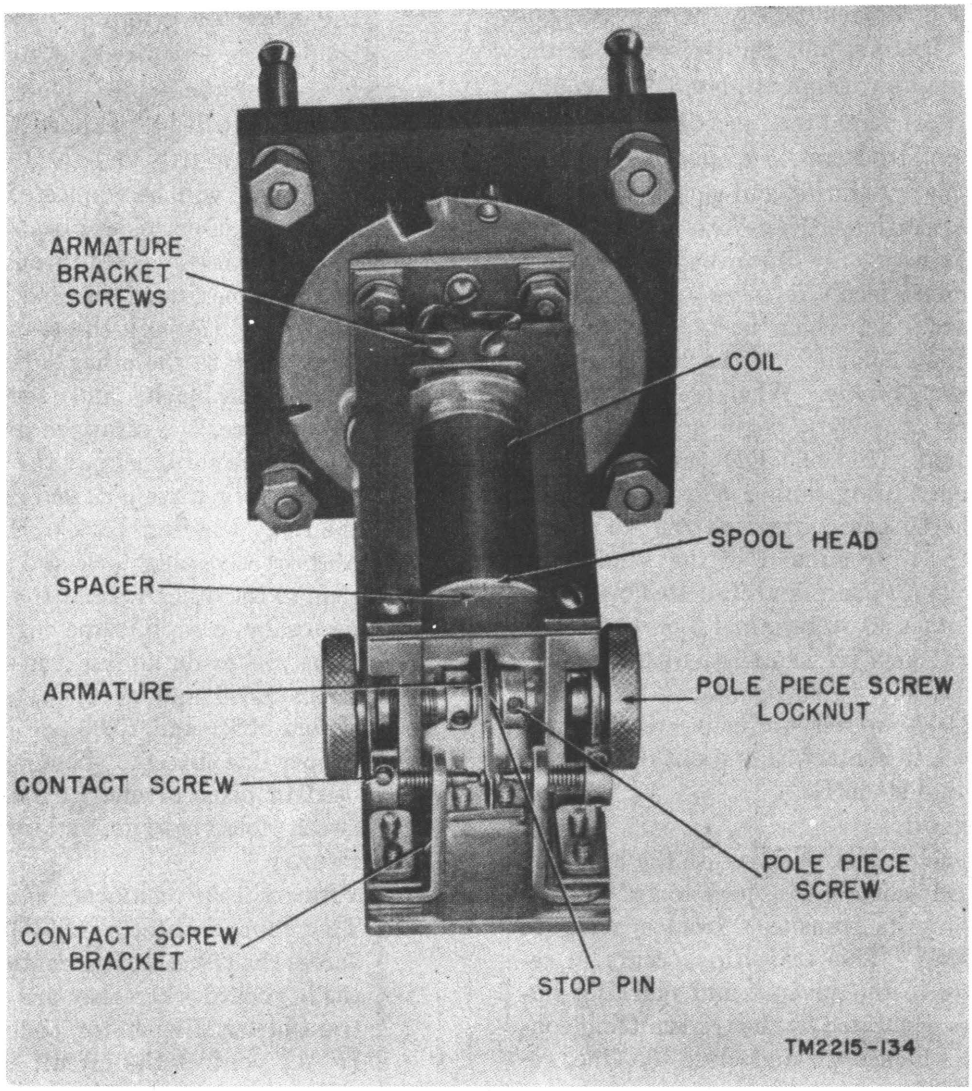


Figure 126. RY–30 line relay.

b. **RY–30 Relay For TT–7/FG and TT–8/FG** (fig. 126)

Number of windings	2.
Resistance per winding, ohms	136.
Signaling current, ma (neutral signals).	60 or 20.
Biasing current, ma	30 or 10.
Contact metals:	
Armature (No. 4)	Extra heavy.
Contact-screws (tungsten).	Extra heavy.

(1) The RY–30 relay is equipped with knurled tension knobs for increased convenience in adjusting the pole-piece screws.

(2) Efficient operation of the RY–30 relay in teletypewriter circuits depends on a periodical routine of inspection, cleaning, and adjustment. The adjustments are interrelated so that it is essential for each adjustment to be made in the given sequence. If any adjustment is changed, it will be necessary to check all subsequent adjustment (par. 476).

c. **Relay Bias Circuit.**

(1) *Purpose.* The purpose of the bias circuit is to attract the line relay armature to the spacing contact, magnetically, when a neutral (no-current) spacing impulse is received from the line.

(2) *Elements.* The bias circuit of the line relay is a simple series circuit composed of the relay bias winding (fig. 57), two 2,000-ohm resistors, and contacts 2 and 3

of the polar-neutral key. The two 2,000-ohm resistors, plus the resistance of the bias winding (approximately 136 ohms), limit the current to approximately 30 ma. The polar-neutral key opens the circuit for polar operation and closes it for neutral operation. Therefore, the bias circuit is used only for neutral operation. The bias circuit requires approximately 115 volts dc, which is applied through terminals 24 and 25 of the 20 board.

(3) *Circuit Tracing.* When tracing the bias circuit (fig. 268), begin at the positive terminal (24 on E2) and continue through spring contact 52 to terminal 62 on the 60 board, through the 2,000-ohm resistor to terminal 7 of the winding of the relay, to terminal 2 of that winding, to contact 56, to terminal 3 on the polar-neutral key (if neutral), to terminal 2 of that key, to slip contact 51, through the 2,000-ohm resistor connected to terminal 63, to contact 53 and out to negative terminal 25 on E2.

d. LINE CIRCUIT.

(1) *Purpose.* The purpose of the line circuit is to control the operation of the line relay in its transition from spacing to marking. This transition occurs in response to the spacing and marking impulses generated by the transmitting contacts which open and close the line, respectively.

(2) *Elements.* The line circuit includes the operating or line winding of the relay, the transmitting contacts, the SEND—REC—BREAK mechanism and the line resistance (the slide-wire or flat-type line resistors may be used). For simple neutral operation without a table, the signal line is connected to terminal 32 of the send block and terminal 42 of the receive block; terminals 34 and 41 are connected by a suitable strap or jumper. In an emergency, when flat-type line resistors are required, terminals 33 and 36 are strapped and the connecting strap between terminals 34 and 41 is transferred from terminal 34 to terminal 35. Teletypewriters TT–7/FG and TT–8/FG normally will be arranged with the transmitter contacts connected in series with the relay line winding by effecting the connections required at line terminal boards of the table. One of the send terminals will be strapped to one of the receive terminals and the two terminals remaining will be connected to the line (fig. 30). For this application, one wire of the line is connected through a line terminal to one side of the send jack, and the send plug, through the transmitter contacts, back to the other side of the send plug, send jack, and send terminal. From there, it is strapped over to one of the receive terminals of the table to one side of the receive jack and plug, through the relay winding, back to the other side of the receive plug, jack, and terminal and then to the other wire of the line. When necessary to supply line current, connections are made at line battery terminal strips E606 and/or E607, and line resistors R601 and R603 are adjusted for proper line current. The ground may be used in place of one wire of a pair between teletypewriter stations (ground return).

(3) *Transmitting contacts, shunt circuits.* The shunt contacts (S3B) are wired across the transmitting contacts and *lock* the keyboard when they are closed. The transmitter distributor control contacts (S3A) control the circuit between terminals 26 and 43, and may be used to stop the transmitter distributor when a remote operator breaks in on the circuit or when the SEND—REC—BREAK key is operated to REC position.

(4) *Circuit tracing.* The circuit may be traced for simple neutral operation (figs. 30, 268, and 270) from terminal 32 to the break contacts, through these contacts to slip contact 54, through the transmitter filter unit coil to the transmitter contacts, through slip contact 55, to terminal 34, through table or strap to terminal 41, terminal 61, through terminals 3 and 6 of the line winding of the relay to terminal 66, and finally to terminal 42. Figures 127 and 168 show switch S6A for closing the line and selector circuits when the relay is removed from the base.

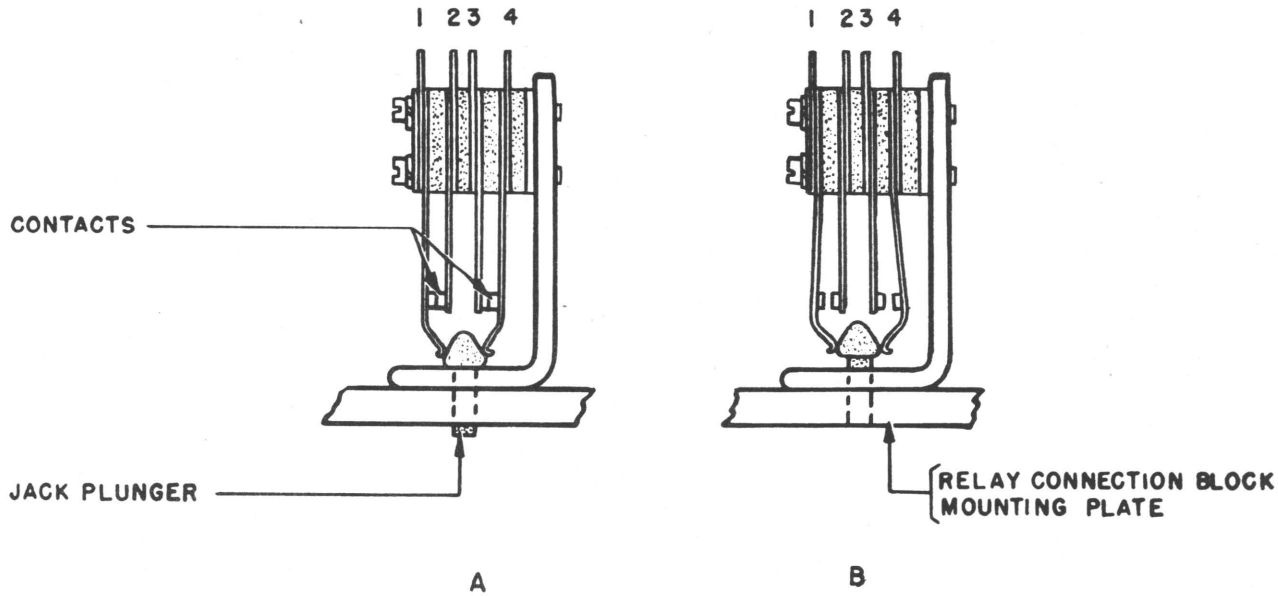


Figure 127. Switch for closing line and selector circuits when relay is removed from base mounting block.

e. SELECTOR MAGNET CIRCUIT.

(1) *Purpose.* The purpose of the selector magnet circuit is to receive the marking and spacing impulses from the polar line relay, and to control the electromechanical transitions of the marking and spacing combinations. The selector magnet circuit requires approximately 60 ma of current at 110 volts dc for satisfactory operation.

(2) *Elements.* The selector magnet circuit (fig. 268) consists essentially of the armature and the marking contacts of the relay, a 400-ohm resistor (part of the filter), two 600-ohm resistors, and the two selector magnet coils (105 ohms each) in series, with the line jack (S2) connected across the selector magnet coils. The line jack serves to close the circuit (when the selector magnets are disconnected at slip connections 11 and 12) when the typing unit is removed from the base. A projection on the typing unit holds the line jack open when the typing unit is mounted on the base.

(3) *Circuit tracing.* Trace the selector magnet circuit from positive terminal 24 to slip contact 52, terminal 62, terminal 46, to slip contact 11 (one side of the line jack), through the selector magnet coils to slip contact 12 (the other side of the jack); to terminals 45, and 65 through the 600-ohm resistor R4A, through the 400-ohm resistor R7 (part of the filter) to terminal 4 of the line relay, to the marking contact, through the armature (1) of the line relay, through the 600-ohm resistor, to terminal 63, to terminal 53, and finally to negative terminal 25.

f. SELECTOR MAGNET SHUNT CIRCUIT.

(1) *Purpose.* The purpose of the selector magnet shunt circuit (figs. 57 and 125) (load on space) is to keep the rectifier output constant across terminals 24 and 25 when dc is connected to the equipment. This serves as a protection for the old style vacuum-tube rectifier by equalizing the load on the power source, whether the armature is at marking or at spacing. The selector magnet shunt circuit, at approximately 110 volts dc, carries 60 ma of current.

(2) *Elements.* The shunt circuit consists of a 600-ohm resistor and the line relay armature (these are common with the selector magnet circuit, subpar. d above), a 400-ohm resistor (part of the filter), an 810-ohm resistor, all in series, and finally terminates at power terminals 24 and 25, which are the same terminals through which power is supplied to the selector magnet circuit. The total re-

sistance in the shunt circuit when the armature spacing contacts are closed is approximately 1,810 ohms.

(3) *Circuit tracing.* When tracing this circuit, begin at positive terminal 24, proceed to slip contact 52, to terminal 62, through the 819-ohm resistor R5A, the 400-ohm resistor R6, to terminal 5 of the line relay, to the spacing contact, to the armature (1), through the 600-ohm resistor R3A, to terminal 63, to slip contact 53, and to negative terminal 25.

135. Motor Circuit

(fig. 268)

a. PURPOSE. The purpose of the motor circuit is to furnish correct power from 110-volt, 60-cycle ac to the teletypewriter motor.

b. ELEMENTS. The motor circuit consists of two 300-ohm resistors, a power switch, a 1-μf capacitor, a 5-ohm resistor, a 1.6-ampere fuse (mechanical motor-stop contacts on Teletypewriter TT–7/FG only), and the motor. The two 300-ohm resistors are used in parallel. The 1-μf capacitor and the 5-ohm resistor constitute a filter which is used to reduce excessive sparking across the switches and contacts of the motor circuit. A target lamp and switch (slip contacts 13 and 15) are included in the circuit.

c. CIRCUIT TRACING. The circuit is traced from terminal 21, continuing to plug fuse F1, to power switch S1, to slip contact 10 (through the right pair of motor-stop contacts, except on Teletypewriter TT–8/FG), to slip contact 9, to terminal 22, to the 300-ohm resistor block (R8 and R9), to slip contact 15 (strapped to slip contact 14, and connects the two 300-ohm resistors in parallel), to one side of the 300-ohm resistors, through the motor unit filter coil (through the governor contacts, if closed), to terminal 16, through the field winding of the motor, through the motor armature, to slip contact 13, and finally to terminal 23. When the motor turns too rapidly, causing the governor contacts to open, the short circuit across the resistance is opened. Current then flows from slip contacts 14 and 15 through the two parallel resistors to slip contact 16, to the field winding of the motor, to the armature, to slip contact 13, and finally to terminal 23. The reduction in current caused by the increase in resistance slows down the motor sufficiently to allow the governor contacts to close and restore the short circuit across the resistance.

136. Control Relay

(figs. 128 and 268)

The motor on a teletypewriter can be started and stopped by solenoid control relay K1 on the base if it is connected into the motor circuit and then actuated from a remote, manually operated switch. This relay controls the operation of contacts, which in turn may be used to start and stop the motor. Refer to figure 268.

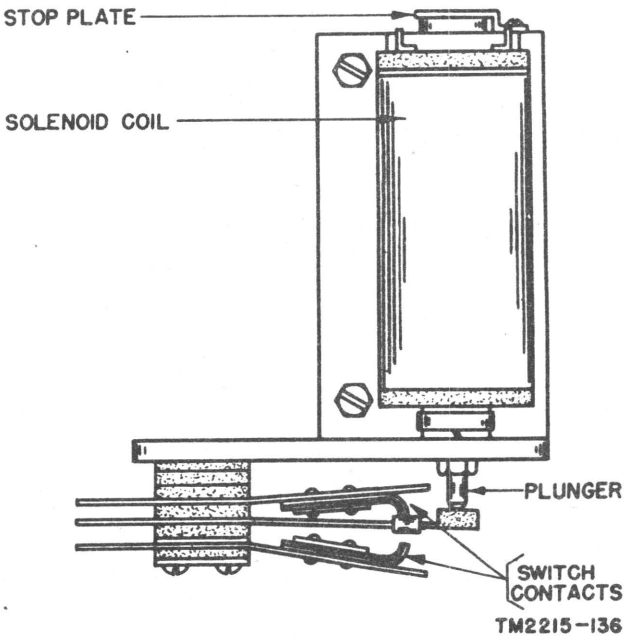


Figure 128. Control relay.

137. Miscellaneous Circuits

a. LINE RELAY FILTER. A filter cuts down the r-f induction that is due to the contact operation of the polar relay. Some protection for the relay contacts is assured through minimizing the tendency of the shunt capacities of the filter to cause contact arcing. Since the circuit conditions in which the line relay contacts operate permit the use of series resistances, a satisfactory suppressor unit, using a 400-ohm resistor as the series element and 1-μf capacitors C3 and C4 as shunt elements, is used. A .01-μf capacitor C6 provides a bypass to ground, which in this case is the frame of the teletypewriter.

b. Spark-Killing Circuits.

(1) *Purpose.* The purpose of the spark-killing circuits across the M (marking) and S (spacing) contacts of the line relay is to prevent overheating and burning of the contacts caused by arcing when the contacts open or close.

(2) *Spacing.* Trace the circuit from one side of the ¼-μf capacitor C2 (fig. 268), through terminal 64, through the 2,000-ohm resistor R4B, the 600-ohm resistor R4A to terminal 65, to terminal 45, through the selector magnets to terminal 46, to terminal 62, through the 810-ohm resistor R5A, the 400-ohm resistor R6, to terminal 5 of the relay, to the spacing contact, the relay armature, through terminal 1 of the line relay, past the 600-ohm resistor R3A to the other side of the ¼-μf capacitor C2.

(3) *Marking* (fig. 268). Trace the circuit from one side of the ¼-μf capacitor C2 to terminal 64, through the 2,000-ohm resistor R4B, through the 400-ohm resistor R7 to terminal 4 of the relay, to the marking contact, the relay armature, terminal 1 of the relay, past the 600-ohm resistor R3A to the other side of the ¼-μf capacitor C2.

c. Transmitting Contacts Filter Unit (fig. 270). Filter unit Z401 usually consists of a retardation coil L401 as the series element and a shunt capacitor C401 in addition to capacitor C402 used as a bypass to the teletypewriter frame. This filter performs the same function across the transmitting contacts as the line relay filter performs across the relay contacts.

d. Remote Motor Control (Mechanical Motor Stop). This feature (figs. 116 through 118) is found in Teletypewriter TT–7/FG only.

(1) *General.* The remote motor control feature is arranged to start the teletypewriter motor when the motor circuit is closed after an open signal. Two motor stop pawls, which latch on the armature extension, keep the motor circuit open when the machine is stopped. When the signal circuit is open, one of the pawls unlatches. When the signal circuit is closed again, the other pawl unlatches and permits the motor stop release lever to move and close the power circuit.

(2) *Electrical features.* As part of the remote motor control arrangement, two sets of contacts, S101 and S102, are provided. These are wired in parallel in the motor unit power circuit (figs. 118 and 268). The right-hand set of contacts S101 (as seen from the front of the teletypewriter) completes the circuit to the motor. The left-hand set of contacts S102 normally is open during operation of the machine. When the stop function lever is selected, the left-hand contacts close immediately, while an instant later the right-hand contacts open. The motor will continue to run because the power circuit to it is closed through the left-hand contacts. The left-hand contacts will not open until the locking lever rides the high part of the cam long enough to allow the motor stop pawls to latch on the armature extension.

138. Perforator Transmitter Circuits (fig. 270)

a. General. There are two separate circuits in the perforator transmitter. One is the line circuit. To this is added the perforator and character counter circuit. A typical teletypewriter set without a perforator mechanism is Teletypewriter TT–5/FG (or Teletypewriter TT–6/FG), described in TM 11–2215. The signal circuit is described in paragraph 134; therefore, only the additional circuits for the perforator and character counter mechanisms are discussed here.

b. Signal Lamp Circuit. The end-of-line warning signal lamp I–401 circuit consists of a lamp in series with a pair of contacts S406 which are closed by the counter mechanism when a predetermined number of characters are perforated in the tape. Connection with the battery (dc) circuit is made through slip contacts 52 and 53.

c. Perforator Magnet Circuit. The perforator magnet circuit is completed when the keyboard control operating lever is in either its middle or lower position (KBD & TAPE or TAPE). When the control lever is in the upper (KEYBOARD) position, all of the perforator contacts S404 are open and only the keyboard functions. Connec-

tion of this circuit into the d-c circuit is completed through slip contacts 52 and 53 of the base unit. The control lever is in the lower position for TAPE only. The circuit is completed to the d-c circuit through the punch magnets L404, punch contacts S405, perforator control contacts S404, and slip contacts 52 and 53. The cam pulsing contacts S407 do not operate, and are held open, when the operating lever is set at TAPE only.

d. Character Counter Control Circuit. The character counter control circuit consists of punch contacts S405, counter control contacts S403 and S403B, counter magnets L406 and L407, and release magnets L408 and L409. This circuit functions only when the operating control lever is set at TAPE only. Each closing of the universal selector bar (punch) contacts S405 sends a pulse of current through the character counter magnet coils and, in turn, causes the character counter indicator to advance one unit forward. When the left pair of character counter control contacts are opened by the character counter control selector bar (when any function key lever except CAR RET is pressed) no current flows in either the character counter or release magnet coils, and the counter indicator does not move. When the CAR RET key is pressed, the character counter control selector bar causes the left pair of character control contacts to open and the right pair to close. This energizes the character counter release magnets and allows the character counter indicator to return to its zero position.

e. Filter Circuits. The perforator transmitter contains three filter networks which are used to reduce the effects of sparking at switches and contacts. One filter is associated with the transmitter contacts and is described in paragraph 133. Another filter, Z403, is shown at the u-bar (punch) contacts. In this filter, a coil L403 is used as the series element with a .01-uf capacitor C406 connected between it and ground. The shunt element is a .1-uf capacitor C407 connected across the filter coil. A 350-ohm resistor R403, in series with 21-uf capacitors C405 and C408, is used for the signal lamp contact and counter control contact filter. Another filter network Z402, composed of a filter coil L402 connected to ground through a .01-uf capacitor C403 and bypassed by a .1-uf capacitor C404, is used at the cam pulsing contacts.

139. Rectifier

(fig. 272)

a. General. The rectifier power unit can supply dc for operation of the local circuits of the teletypewriter and for line current. Also, it provides connections through the autotransformer for a-c voltage of the required value to operate the motor units. Figure 28 shows the rectifier power unit, and figures 272 and 273 including schematic and wiring diagrams of the unit. The a-c, d-c, and voltage-regulator circuits of the rectifier power unit are discussed in the following subparagraphs.

(1) *A-c input.* The rectifier power unit is connected to the a-c supply by a cord that fits into receptacle J605 above the rear shelf of the table. Power is connected by a double-pole, double-throw switch S501 in the a-c line. One side of the input circuit is then completed through a choke coil L504B to the low side of the autotransformer. The other side of the input circuit includes a choke coil L504A but, in addition, has a 10-ampere fusetron F501 and terminates at the appropriate tap on the autotransformer for the voltage applied. A flexible lead at the tap and fuse panel must be connected to the terminal for the proper voltage input (marked vertically on the left side of the panel).

(2) *A-c output.* The rectifier power unit can supply a-c required by the motor units. The adjusted a-c motor terminal voltages required by the motor units are connected, by means of plug J604, at the rear of the table and a-c output cord P502 of the rectifier power unit. Terminal 13 of plug P502 is connected to the low side of autotransformer T501 through time-delay relay K501 armature. The other side of plug P502 (terminal 14) is connected by a flexible lead to the tap on the autotransformer market with the frequency closest to that of the input source used. It is possible to use the 60-cycle motors with 25-, 40-, 50-, or 60-cycle a-c. The motor units of Teletypewriter TT-7/FG and TT-8/FG are a-c series-governed units that require 60-cycle, 110–220, volts a-c or adjusted equivalent. The flexible

lead on the right side of the tape and fuse panel (marked "MOTOR CYCLES") is connected to the terminal representing the frequency nearest to that of the source.

(3) *Internal circuits.* The 230-volt tap of the autotransformer is connected to the high side of the primary of plate transformer T503. This circuit is completed to the low side of the autotransformer after the time-delay relay has closed. The high side of the primary of heater transformer T502 is connected to the 105-volt tap on the autotransformer and the low side then is completed through the time-delay switch contacts to the low side of the autotransformer when the time-delay relay armature is in its open or unoperated position.

c. D-C Circuits. The negative side of the d-c output circuit is traced from the plates of the rectifier tubes, the choke coils L503A and L503B in each side, through the center tap of the secondary of the plate transformer and the filter choke L501, to the d-c output plug. The positive side of the d-c output circuit is derived from the center tap of the secondary of the rectifier tube filament winding. This circuit is traced from the center tap, through choke L502 to the positive side of the d-c output plug. Two 500-uf filter capacitors C501 and C502 are connected across the d-c output line. These capacitors are connected at the cord panel at which the leads from the a-c input, d-c output, and motor-voltage cords are connected.

d. Voltage Regulator Circuit. The amplifier tube, neon tube, and the potentiometer in the grid circuit of the amplifier tube regulate the d-c output voltage. This regulation is accomplished by controlling the bias of the rectifier tube grids. The plate of amplifier tube V503 is connected through a 1,000-ohm load resistor R504 to the positive side of the d-c output. The neon tube, which is in series with the cathode of the amplifier tube, is connected in series with the negative side of the d-c output. The voltage regulating action of this circuit is as follows:

(1) The neon tube VR501 voltage remains constant over a fairly wide variation of the current through it. The voltage of the cathode of the amplifier tube, therefore, is held at a constant positive value by the neon tube with respect to the negative output terminal. The grid potential of the amplifier tube is selected by adjustment of the 10,000-ohm potentiometer R508, adjusted so that the grid voltage is less positive than the cathode by an amount (the bias) which causes the amplifier tube to pass a certain plate current. This plate current flows through the 1,000-ohm plate load resistor R504 and causes a drop across it. The magnitude of the voltage across the plate load resistor is the bias of the rectifier tubes. Adjustment of the potentiometer establishes the normal plate resistance of the rectifier tubes and is used to set the load voltage which the regulator should maintain.

(2) If the load voltage tends to rise, whether from a decrease in load current or from an increase in output voltage, the grid voltage of the amplifier tube tends to rise, or becomes less negative, while the cathode voltage is held practically constant by the neon tube. The amplifier tube then passes more current because the bias is smaller. A greater current flows through the plate load resistor and causes a greater voltage drop across that resistor. This voltage, which is the bias voltage of the rectifier tubes, causes the current through those tubes to decrease. Less current will flow through the load resistors and the voltage across these resistors consequently falls and offsets the original rise.

(3) In a similar manner, if the load voltage tends to fall, the circuit raises it again.

(4) As previously stated, the output voltage of the rectifier is adjusted by varying the potentiometer since this varies the grid bias of the amplifier tube.

(5) To increase the output, move the potentiometer arm toward the low-resistance (or negative) side of this device (fig. 272). Adjustment of the potentiometer for increase or decrease of output is described in paragraph 490.

e. Operation. Closing the a-c input switch S501 applies current to the autotransformer and causes the tube filaments to light and the bimetal switch to warm up. When the bimetal is heated sufficiently it will close the time-delay relay armature and connect the primary of the plate transformer into the a-c circuit. In addition, the plug for adjusted motor voltage (P502) is connected

into the circuit through the time-delay relay armature. When the rectifier tubes begin to operate, the resultant filtered d-c energizes the holding magnet of the time-delay relay and holds the armature in operated position, closes the a-c circuits and holds them closed while d-c is available. When the a-c input switch is opened, disconnecting a-c from the rectifier power unit, the holding magnet is released and the time-delay relay armature opens, opening the a-c circuits to the plate transformer and plug P502. Adjustment of the time-delay relay is described in paragraph 490.

Section III. TEST AND REPAIR EQUIPMENT AND TOOLS

140. Test Sets

Volt-ohm-milliammeters are satisfactory for testing the current flow, continuity, insulation, and resistance of the electrical circuits in the teletypewriter. Paragraphs 142 through 145 give brief descriptions and the purposes of the test sets most frequently used by teletypewriter repairmen.

141. Multimeter TS–297/U

Multimeter TS–297/U is designed to measure resistance, ac, dc, and voltage over a wide range of values. See TM 11–5500 for a complete description of this unit.

142. Test Set TS–2/TG

Test Set TS–2/TG is a portable, motor-driven unit arranged to transmit normal or distorted signals for testing teletypewriter circuits and for checking the efficiency of start-stop selector units on teletypewriters. It sets up two types of distortion: marking or spacing bias, and marking or spacing end distortion. For a detailed description of this test set, refer to TM 11–2208.

143. Distortion Test Set TS–383/GG

Distortion Test Set TS–383/GG is a motor-driven unit normally used in base repair shops. It transmits the Y, T, O, M, V, and LTRS characters and functions. These transmissions are sent either undistorted or with a controlled degree of distortion up to approximately 100 percent. Distortion Test Set TS–383/GG also is designed to receive and analyze distortion in the transmitting circuit of a teletypewriter. Refer to TM 11–2217 for a complete description of this test set.

144. Test Set I–193–A

Test Set I–193–A is a compact, portable unit for testing and adjusting polar relays. It provides a source of opens and closures at frequencies of either 10 or 20 cycles per second for alining circuits. The test set provides a space for four spare polar relays. Refer to TM 11–2513 for complete instructions for using Test Set I–193–A. Refer to paragraph 480 for polar relay adjustment without a test set.

145. Test Set I–181

Test Set I–181 is a current-flow type relay adjusting set. The primary purpose of the current-flow test set is to measure and control the amount of current flow through the winding of a relay or similar electromagnetic apparatus which is tested or adjusted. Test Set I–181 also may be used as a d-c milliammeter over three meter scale ranges: 0 to 15 ma, 0 to 75 ma, and 0 to 150 ma. For a detailed description of Test Set I–181, see TM 11–2036.

146. Power Supply

The model REC–30 rectifier can provide the filtered dc suitable for making operating tests of signal circuits and to provide the proper a-c voltage for operation of series-governed motors, when the rectifier is connected to a-c sources of various voltages and frequencies. Refer to paragraph 18 for description data and to paragraph 490 for information on adjustments of the power unit. If the rectifier power unit is available, a-c of the values indicated on the tap and fuse panel of this device can be applied to it. If the rectifier power unit is not available, the motor units can be operated directly from a source of 110 to 115 volts, 60-cycle ac. To use dc to operate the local or signal circuits of the teletypewriters, a means of adjusting the current to 60 ma must be provided. The table that is part of these teletypewriters has a local test circuit which includes resistors for adjusting loop current. If the table is not available, erect a local test circuit at the

workbench by simulating the test circuit constants and connecting facilities shown in the schematic diagram (fig. 274) of the table. To operate the perforator transmitter and typing unit, install these units upon the base with the motor unit in place. Make connections for the a-c and d-c circuits to the power block of the base as described in paragraph 133.

Section IV. INSPECTING, STRIPPING, AND CLEANING

147. General

a. Before any major overhaul of the teletypewriter, the unit should be inspected to determine: first, the general condition of the equipment and whether its condition warrants repairing or turning the equipment in for salvage; second, the extent of repairs required. Consider two factors when inspecting to determine whether overhauling is warranted: The extent of repairs necessary and the urgency for returning the equipment to service. If the repairs require the replacement and rework of parts to an extent equivalent to rebuilding, it may not be economical to make the repair. The urgent need for the unit in an emergency, however, may justify such extensive repairs. If the equipment is not to be repaired, turn it in for salvage after stripping all usable parts and placing them in stock for re-use.

b. The nature and extent of repairs required may be determined more easily after disassembling the teletypewriter. Any required repairs will be more apparent after cleaning is completed. Make the inspecting procedure part of the routine after all parts have been cleaned.

(1) Inspect all items listed in the preventive maintenance checklist (par. 64).
(2) Inspect the wearing surfaces of all gears, cams, cam followers, levers, bearings, and springs.
(3) Check all ball bearings to see that they turn freely.
(4) Check tension of all springs.
(5) Make a thorough inspection of all castings and supporting parts to determine that no breaks or cracks exist.
(6) Inspect all wiring, insulation, terminal blocks, and other electrical parts.

148. Indexing of Repair and Replacement Procedures

Refer to the general index of this technical manual to find the applicable paragraphs that contain detailed repair and replacement instructions. Paragraphs are grouped by related topics under the general heading for each of the principal assemblies.

149. Operation of Equipment During Overhaul

During major overhaul or repair of Teletypewriters TT–7/FG and TT–8/FG, it will be necessary to operate these equipments under power to observe over-all operation or to check certain assemblies or parts. A source of power should be available at the workbench for this purpose. The power requirements are 110 to 115 volts, 60-cycle ac (for motor), and 120 volts dc (for signal test circuit).

150. Inspection Procedure for Major Repairs

a. General. Inspection procedure for a major overhaul includes all the items listed in the preventive maintenance checklist (par. 64), and additional items inspected while the teletypewriter is disassembled. Inspection determines which parts can be re-used, which require repair, and which must be replaced. If a teletypewriter is damaged during shipment, it may be necessary to disassemble and inspect only one of the principal parts and give the remainder a general preventive maintenance inspection.

b. Frequency of Major Overhauls. Wide variations in age and general physical condition of a teletypewriter and the experience of organizational maintenance personnel who perform preventive maintenance work dictate the need for overhauling equipment. Differences in the climatic conditions under which the equipment is operated also will affect the frequencies between major overhauls. Do not disassemble teletypewriters completely until regular preventive maintenance inspection shows that wearing of parts requires disassembly to permit a detailed inspection. Teletypewriters operating 8 to 12 hours per day ordinarily will not require a complete overhaul by field or base repair shops more often than at 6- to 8-

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month intervals. Teletypewriters operating less than 8 hours per day may be maintained in such condition that a complete overhaul is unnecessary even after a year of service. Very old or worn equipments may require a major overhaul every third or fourth month if they are operated in tropical regions. Thoroughness of the preventive maintenance work performed by organizational personnel is the principal factor in determining how frequently the teletypewriter must be taken out of service and returned to field or base shops for overhaul.

c. PROCEDURE.

(1) Make the inspection, incidental to repairs, after all parts have been cleaned thoroughly. Include all related items listed in the preventive maintenance checklist (par. 64).

(2) In addition to the preventive maintenance inspection, include a thorough inspection of the wearing surfaces of gears, cams, levers, springs, and bearings which can be inspected only after the equipments are disassembled.

(3) When parts are disassembled, make a thorough inspection of the surfaces of all castings and supporting parts to determine whether breaks or cracks exist.

(4) Inspect the condition of all wiring, insulating strips, and terminal boards.

(5) Check the surface condition of all clutches, commutators, and contacts, and the end play of bearings as instructed in paragraphs 155 through 197.

151. Preparation for Disassembly

a. PREPARATORY. Cover the top of the workbench with clean heavy paper or other suitable material to protect the mechanism of the equipment and to catch small parts or hardware that may drop. Prepare several small boxes or other suitable containers, appropriately labelled, so that small parts may be kept together for each assembly. This prevents loss of small parts or mixing together of parts of different mechanisms. Arrange tools and materials so that they are accessible during the work. See that containers in which special cleaning operations are performed are positioned so that they will not be overturned. Protect the equipment against dust and dirt.

b. DISASSEMBLY.

(1) Remove paper, tape, and ribbon.

(2) Clean excess grease or oil and dirt from nuts or screws that must be loosened or removed, so that tools will fit them properly.

(3) Disassemble the equipment in the following sequence:

(*a*) Typing unit cover.

(*b*) Perforator transmitter.

(*c*) Transmitter distributor.

(*d*) Typing unit.

(*e*) Motor unit.

(*f*) Base (including relay).

(*g*) Rectifier power unit.

(*h*) Table. (Disassembly of the table is described in paragraph 194 and chapter 5.)

(*i*) Dismantling. The term *dismantling* is used here to indicate the removal of various major assemblies or subassemblies. The term disassembly is used to indicate the actual taking apart of the various linkages, or mechanisms, within each assembly or subassembly.

(*j*) Proceed to disassemble the various parts and assemblies with the tools designed for each particular item. *Do not disassemble assemblies beyond the point necessary to inspect and clean the entire mechanism thoroughly; repair or replace any defective part.*

(*k*) Place small parts in an appropriate container marked to identify their origin.

(*l*) Refer to appendix II, for illustrations showing the location of parts and part numbers.

(*m*) The sequence in which the work is completed may be varied to speed up the repair process without sacrificing quality. Experienced mechanics frequently prefer to complete cleaning, washing, and drying, of as many parts as possible before starting to repair, adjust, or lubricate the various units. This allows an early and accurate appraisal of the number of parts requiring attention or replacement and the amount of time required to complete the work.

152. Instructions for Special Cleaning Procedures

Equipment that has been disassembled for major overhaul can be cleaned thoroughly by immersing and brushing the parts in containers of the appropriate cleaning fluids. *Do not immerse equipment wiring, resistors, the motor armature, or motor windings.*

a. Use of Special Cleaning Materials. The following cleaning fluids, normally available through supply channels, are satisfactory for the purposes described below.

(1) Soap and water solution to remove nonoily dirt from nonelectrical rubber and cellulose (plastic) parts.

(2) Cleaning compound, Signal Corps stock No. 6G236, to remove oil, grease, and gummy deposits. Soak for 10 to 15 minutes and then flush with very hot water.

(3) Use solvent (SD) to remove oil, grease, gummy dirt, and paper lint.

(4) Carbon tetrachloride *only* for cleaning electrical contacts.

(5) Diacetone alcohol to remove ditto ink or hectograph ribbon stains from metal, rubber, or cellulose parts.

Note. Be careful to use a very small amount of diacetone alcohol on cellulose or similar plastic materials. Such materials are dissolved readily in this chemical; therefore, never use diacetone alcohol full strength and never allow it to remain on a cellulose surface any longer than is absolutely necessary. *Do not* open a container of this fluid in the presence of a flame; *do not* breathe its fumes.

b. Drying.

(1) *Wiping.* Individual parts can be dried with a clean dry cloth. Be careful to dry the cleaning fluid from all crevices.

(2) *Oven drying.* Dry the parts in an oven adjusted to maintain a temperature of about 160° F. Such an oven can be improvised by using electric lamps or heater coils and a metal box. Use appropriate current control resistors or rheostats to adjust the temperature of the oven. Leave the parts to be dried in the oven from 1 to 2 hours.

Section V. TROUBLE LOCATION

153. Preliminary Tests

a. Process of Elimination. By determining which of the transmitting, receiving, and common functions of a teletypewriter are operating properly and which are not, the trouble-shooter will save considerable time and effort. The trouble analysis chart, listing commonly observed faults, is of considerable assistance in determining the best sequence and testing procedure for a particular condition. By sending to and/or receiving from a teletypewriter or transmitter distributor known to be in good condition, the trouble can be proved to be in either the transmitting, receiving, or common functions. The local or dummy testing circuit in the table can be used when a second teletypewriter is not readily available. When a definite observed fault has been found, refer to paragraph 79 for the related list of indicated conditions; first select the items that logically would be the cause of the fault.

b. Localizing Trouble. When it has been determined, by observation or testing, which of the units or functions are causing the trouble, isolate or localize the trouble in a particular electrical circuit or mechanical element. The trouble analysis charts (par. 79) provide reference data for both electrical and mechanical failures. Information on the best procedures for locating the more common troubles is contained in paragraphs 70 through 78. Binding may be detected by sound and/or turning the motor and various parts by hand. Check the motor pinion and the main shaft gear adjustment by turning the flywheel of the motor by hand. The proper adjustment is achieved when the amount of backlash is just barely perceptible.

c. Localizing Electrical Troubles. Electrical circuits in the teletypewriter are provided with connecting terminals at points where it is necessary to connect or disconnect circuits or units. (Check the circuits against correct wiring and schematic diagrams.) Do not disturb the wiring any more than is necessary during testing and inspection. The majority of electrical troubles are found at contacts in switches and jacks or where the insulation on wires or between metal parts has been damaged. The repairman must be

familiar with the use of schematic and wiring diagrams (figs. 268–276) and must use them while making point-to-point checks of teletypewriter circuits until the fault has been located. Schematic wiring diagrams of external equipment to which the teletypewriter is connected furnish information which helps the repairman in setting up circuits for testing and localizing trouble. Detaile procedure for localizing electrical trouble is furnished in paragraph 68.

d. Testing Procedure. Actual procedures for locating electrical troubles vary, depending on whether the work is being done by organizational repair personnel using Multimeter TS–297/U or Test Unit I–236. The basic principles remain the same for any given trouble, but certain troubles, such as part of a shorted-out resistor or small variations in voltage cannot be measured accurately with Test Unit I–236. All of the more common troubles can be located with this test unit; the data in paragraphs 67 through 69 are arranged to start with the use of Test Unit I–236. The data also give information for use of field or base repair personnel who may be responsible for major overhauls of the equipment. Use a milliammeter or a voltohmmeter to locate electrical trouble.

154. Preliminary Connections

Stations at which theses equipments are operated must have good grounding facilities. One or more grounds are required to provide protection against damage from lightning or other high-voltage sources, to reduce cross-fire interference, and to complete ground-return paths for d-c telegraph circuits. Each item of equipment must be connected to a low-resistance ground. The grounding point should be as conveniently close to the equipment as possible. The procedure for establishing grounding facilities for protection is the same as that required to establish a ground-return connection. Refer to TM 11–676, paragraph 18, for complete connection data. With the usual wiring arrangements, it is possible to connect the equipment in series with the local test (dummy loop) circuit, as suggested in paragraph 153*a*, by operating the line switching key to test position.

Section VI. FITS AND TOLERANCES

155. General Repairs and Replacements

a. Outline of Repair and Adjustment Procedure. Service failures can be kept to a minimum by careful handling of equipment during installation, by completing preventive maintenance as specified in chapter 3, and by thoroughly investigating and correcting all troubles encountered. When service faults are discovered, a definite plan of corrective maintenance procedure will reduce both the time the equipment is inoperative and the amount of work required to complete repairs.

b. Detailed Functioning of Equipment. Paragraphs 82 through 139 include a complete explanation of the purpose and operation of the various parts and circuits. An understanding of how the various mechanisms function will assist greatly in determining when the equipment is operating correctly, when it requires repairs, and, when servicing is required, whether it will be more practical to replace a part, to make the repair, or to adjust it.

c. Tools and Test Equipment. Paragraphs 39, 40, 140, and 145 describe the tools and test equipment normally required to check accurately all of the clearances, spring tensions, speed of rotation, and other adjustments to determine that the entire teletypewriter is functioning properly.

d. Trouble Shooting. Paragraphs 65 through 79 describe methods of isolating and locating different troubles and provide step-by-step analysis procedures in the form of trouble analysis charts.

e. Repair and Replacement. This section furnishes recommended procedures for the repair and replacement of parts and units which experience the most wear.

f. Requirements and Adjustments. Paragraphs 207 through 490 furnish all the test requirements and adjustment values required to make a complete check and adjustment of the entire teletypewriter mechanism.

g. General Repair Information. This section deals with repairing and replacing defective teletypewriter parts but does not duplicate information on preventive maintenance procedure. The repair instructions are not a complete shop guide which lists every possible operation that may be necessary in large-scale dismantling and repair of salvaged teletypewriters.

h. Normal Procedures. Because of variations in service needs and in the repair and supply facilities available, definite rules cannot be given al-

ways that specify which parts, assemblies, or units should be repaired and which should be replaced. As only a limited number of the many small teletypewriter parts can be repaired satisfactorily, the repair instructions consist primarily of detailed disassembly, cleaning, replacement, reassembly, adjustment and lubrication instructions. These procedures are to be followed in overhauling a complete teletypewriter or when repairing a single unit or assembly. Most actual repair instructions included are for the parts and assemblies which can be repaired satisfactorily under normal conditions.

i. MAJOR OVERHAULS. Major overhauls and replacements must be accomplished through the use of experience and good mechanical judgment in making adjustments and in replacing those parts which are in doubt or do not meet the adjustment requirements (pars. 207 through 490). When determining methods of approach to repair and replacement operations, keep the following factors in mind:

(1) Skilled maintenance service must be applied to obtain efficient, dependable service.

(2) There is, generally, no adequate substitute for the conscientious efforts of skilled personnel. To obtain the best service possible without the aid of highly skilled personnel (emergency conditions only), use only new or thoroughly rebuilt equipment with stand-by spares ready to be substituted into service.

(3) Replace, if possible, any part that shows signs of wear or damage or does not meet the adjustment requirements. Where there is a close relationship and interdependency of overlapping functional parts, it is impossible for even the most experienced personnel to estimate accurately the life expectancy of a part.

(4) A slight decrease in the quality of major repair work contributes toward an accumulation of troubles and greatly increases the requirements for skilled labor and/or extra equipment necessary to maintain service.

j. SKILLED PERSONNEL. Except in cases of extreme emergency, all repairs to teletypewriters should be made by personnel who are trained thoroughly in teletypewriter maintenance. *It is important to know what not to do, as well as what to do, when making teletypewriter repairs.* Equipment operating with minor faults may fail completely as a result of efforts of inexperienced personnel.

k. REFERENCES. Inspecting, cleaning, and lubricating, completed while repairs are made, should be performed in accordance with procedures described in chapter 3 and with the additional instructions contained in this chapter. All adjustments should be completed in accordance with detailed requirements and adjustments (pars. 207–490). Weatherproofing information is contained in paragraph 47.

1. SUBSTITUTION OF COMPLETE UNITS. General instructions given in paragraphs 207 through 209 are intended for use when a complete unit is removed and another installed. These instructions do not include disassembly, cleaning, repair, replacement and reassembly information which applies only to the repairing and replacement of individual parts.

m. MAINTENANCE INFORMATION. Use the index to locate detailed maintenance, repair, and replacement instructions for individual parts and assemblies. The grouping of the paragraphs in the index are arranged according to the related topic for each of the related assemblies. In case of doubt, or where more information is desired, refer to sections on theory, service upon receipt of equipment, operating under usual conditions, lubrication, fits and tolerances, test equipment, trouble shooting, apparatus adjustments, requirements, diagrams and charts, preventive maintenance, final testing, or parts required.

156. General Reassembly Procedures

Reassemble all parts, subassemblies, and units in accordance with the following provisions:

a. Replace all worn or broken parts that cause maladjustment of the teletypewriter, and adjust them in accordance with directions in the appropriate paragraph in this chapter. While the equipment is disassembled for checking or repair, replace any parts that are so worn that they are likely to cause trouble before the next complete overhaul of the teletypewriter.

b. Assemble replaced and associated parts securely. Tighten all screws, nuts, and bolts carefully.

c. Readjust all parts that were replaced or disturbed during repair. Make the necessary readjustments during or immediately after reassembly.

d. When dented or flattened areas prevent proper turning or adjusting, remove the faulty part and repair or replace it.

e. Restore bent or distorted parts to shape. Such parts may be re-used if repairs have not resulted in cracks or softening of hardened surfaces which may cause future service failure.

f. If the locking edges of lockwashers removed during repairs are rounded, replace the lockwashers; new lockwashers are always better.

g. Replace all stripped screws or nuts and those with damaged heads.

h. When screws, nuts, or other parts are secured in place with locknuts, do not remove or loosen these parts without first loosening the locknuts; otherwise threads may be damaged.

i. Remove slivers and sharp burrs.

157. Replacing Principal Teletypewriter Units

Each component of Teletypewriters TT–7/FG and TT–8/FG may be removed from the equipment by following the disassembly instructions in chapter 5 or the assembly instructions in chapter 2 in reverse order. To replace some components, certain items must be removed before the item to be replaced is reached. Refer to the sequences listed in paragraphs 151 and 157. For example: To remove or replace the motor unit, remove the typing unit cover, the perforator transmitter, and the typing unit. The motor unit now can be removed readily or replaced without further disturbing the equipment. To replace parts and assemblies of a transmitter distributor, refer to TM 11–2222. To replace parts of reperforators that can be used with these teletypewriters, refer to TM 11–2223. Major assemblies of these teletypewriters are removed or replaced as follows:

a. Removal and Replacement of Type Bar Carriage. Remove the typing unit before removing the type bar carriage from, or restoring it to, the typing unit. To remove the type bar carriage proceed as follows:

(1) *Removal.*

(*a*) After the platen crank and typing unit cover are removed, loosen the two captive screws that hold the perforator transmitter in place and remove it. Loosen the three large, flat, knurled screws that hold the typing unit to the base and carefully lift it off. Set the typing unit on the workbench so that it is supported by the three hexagonal studs on the bottom of the unit.

(*b*) Operate the carriage return lock bar (fig. 129) and move the type bar carriage to the extreme right. Operate the dash pot level and lock the carriage in its extreme right position.

(*c*) Remove the draw strap by grasping the carriage return spring drum in one hand to remove the spring tension from the draw strap. With the other hand, remove the strap from its retaining pin on the carriage and hook the eyelet at its end, on the margin bell hammer spring post.

(*d*) Operate the right margin adjusting screw to the rear of the machine.

(*e*) Operate the carriage return lock bar again, and the carriage will slide off to the right (fig. 129).

(2) *Replacement.*

(*a*) Shift the platen to the FIGS position and rotate the main shaft until the printing bail is in its rearmost position.

(*b*) Move the right margin adjusting screw arm on the carriage to the rear so that it is approximately 45° from vertical.

(*c*) Hold the carriage in the right hand and rest the *left* front support roller on the *right* end of the front carriage track. Make sure that the carriage guide screw engages the slot in the front carriage track.

(*d*) Move the carriage slowly to the left until the rear carriage support roller rests on the rear track.

(*e*) Operate the carriage return lock bar and move the pull bar bail to its rearmost position by pushing the right pull bar bail roller with the right thumb.

(*f*) Move the carriage farther to the left. See that the bell cranks engage their respective vanes. Also make sure that the *right* front carriage support roller and guide screw engage the *front* carriage track properly and that the pull bar bail plunger roller is between the printing bail blades.

(*g*) When the carriage has been moved far enough to the left to permit the right margin adjusting screw to clear

the spacing stop lever, *restore* the right margin adjusting screw to its normal vertical position. Shift the carriage to its extreme right position and lock it in place by operating the dash pot lever.

(*h*) Hold the carriage return spring drum to prevent the spring from unwinding.

(*i*) Unhook the eyelet of the draw strap from the margin bell hammer spring post and hook it over its mounting post on the carriage.

(*j*) Operate the carriage return lock bar to permit the carriage to return to its extreme left position.

b. Removal and Replacement of Motor Unit.

(1) *Removal.* Unscrew the three motor mounting screws that hold the motor unit to the base. Remove the motor unit.

(2) *Replacement.* After repairs to the motor unit are completed, or if it is necessary to install a new motor unit, proceed as follows:

(*a*) Set the motor unit on the base and push it back against the spring contacts.

(*b*) Insert the three mounting screws in the mounting holes in the base plate.

(*c*) Tighten the two front screws and then back them off about ¼-turn. Do not tighten the rear mounting screw until the typing unit is in place. Adjust and tighten.

c. Removal and Replacement of Typing Unit.

(1) *Removal.* Remove the typing unit as described in *a*(1) above.

(2) *Replacement.* After necessary repairs and adjustment of the typing unit are completed, replace it as follows:

(*a*) Lower the typing unit in place on the base and be careful that this operation is performed without damage to the gears or contact springs.

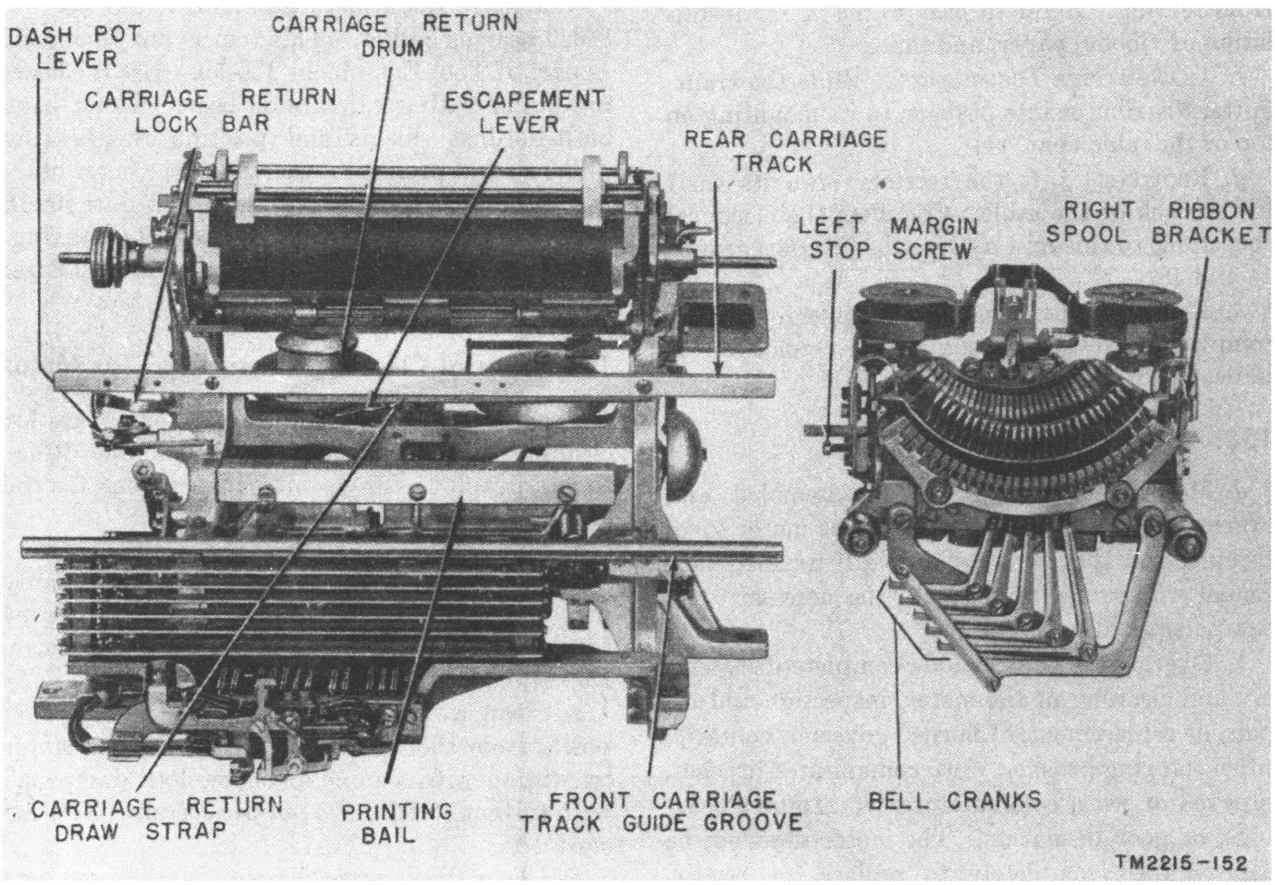


Figure 129. Removal or replacement of type bar carriage.

(*b*) While lowering the typing unit in place, turn the motor by hand to insure that the gears will mesh properly (par. 367). Tighten the rear motor mounting screw after proper adjustments have been made.

(*c*) Insert and tighten the thumbscrews that secure the typing unit to the base.

d. Removal and Replacement of Perforator Transmitter.

(1) *Removal.* Refer to *a*(1) above.

(2) *Replacement.* Slide the perforator transmitter into the opening in front of the typing unit and base. Be careful not to place undue strain upon it that could distort the mechanical linkages or throw them out of adjustment. Refer to paragraph 14 for installation procedure for the perforator transmitter.

e. Typing Unit Cover and Copyholder. Place the typing unit cover over the typing unit and perforator mechanism. Ease it down gently to prevent the padding with which the cover is lined from tearing. Refer to paragraph 14 for installation of ribbon, paper, and tape.

f. Transmitter Distributor. Slide the transmitter distributor into position in its mounting on top of the table (par. 14).

g. Rectifier. Lift the rectifier onto its shelf in the back of the table. Complete the electrical conections to this unit as described in paragraphs 14 and 18.

h. Reperforator. Install the reperforator by completing power and signal line connection as indicated in figure 274.

158. Repair of Motor Units

a. Motor units should be disassembled and overhauled completely *only* when the motor gives trouble, and then only by specially trained personnel who are equipped with the necessary test equipment and proper tools.

b. Overhaul should include complete disassembly and cleaning of the motor, inspection and repair, or replacement, of burned governor contacts, worn end ring brushes, worn commutator brushes, grooved or worn commutators, worn motor bearings, or poor insulation. The motor need not be disassembled completely to replace, or repair, brushes or governor parts; these may require repairs or replacement more frequently than once every 6 months.

159. Disassembly of Motor for Major Repairs

Disassemble the motor for repairs in the following sequence:

a. Remove the motor unit from the base unit (par. 157*b*). Remove the brush holder caps and the brushes. Remove the governor brush bracket assembly and the motor connection block.

b. Remove the motor unit from the motor base unit by removing the four mounting screws. Remove the motor pinion and governor. Be careful not to lose any of the shims that may be on the armature shaft between the governor hub and the end frame casting of the motor.

c. Remove the external bearing retainer screws.

d. Remove the motor frame bolts or screws and separate the parts by prying gently with the blade of a screw driver. Lift out the armature. Be careful not to drop the armature or damage the windings. Do not lose any of the parts, such as bearing retainers and spring washers.

e. Remove the armature bearings; use the No. 84020 bearing puller. This tool is not furnished as part of Tool Equipment TE–50. Use the bearing puller with great care on bearings that have built-in dust shields and position the bearing puller so that pressure is exerted on the outer bearing race *only*. Pressure applied to the dust shield will crush the shield and destroy the bearing. *Never attempt to pry the bearings off with a screw driver.*

160. Special Cleaning Instructions for Motor

The instructions given in this paragraph are for cleaning the internal parts of the motor. Refer to paragraph 55 for cleaning instructions for the external parts of the motor.

a. Disassemble the motor (par. 159).

b. Clean away all dust, paper lint, and nonoily dirt from the armature and stator windings by brushing carefully with a clean, dry sash brush. *Do not damage the windings.*

c. Clean away all oil, grease, or gummy deposits from the face of the armature and stator by wiping with a piece of cheesecloth dampened with solvent (SD). *Do not use solvent (SD) excessively.*

d. Clean the bearings, motor pinion, and any other metal parts by immersing them in a con-

tainer of appropriate cleaning fluid (pars. 148–152). Be sure to dry and lubricate the parts as directed for each of the cleaning materials. Use a sash brush to remove dirt, grease, or gummy deposits.

e. Clean all dust, dirt, oil, grease, gummy deposits, or other foreign matter from the commutator by rubbing with a piece of cheesecloth dampened with carbon tetrachloride. Be careful not to damage the windings. The copper segments of the commutator may become quite dark and discolored because of the inbedding of particles of carbon (from the brushes) in the copper. This greatly increases the life of the commutator segments. Do not polish the commutator to remove the discoloration unless the commutator has become grooved deeply or causes excessive sparking at the brushes. Refer to paragraph 162 for information on resurfacing the commutator.

161. General Instructions for Replacement or Repair of Motor Armature

a. After long periods of operation, commutators of series wound motors become worn and grooved by brush wear and require resurfacing (par. 162). If the surface of the commutator is not grooved deeply and has an even, smooth grayish coating of oxide, resurfacing is not required unless there is excessive sparking at the brushes when the motor is under load.

b. If there is excessive sparking of brushes on a commutator that is not grooved or pitted, clean it with a cloth moistened with carbon tetrachloride; turn the shaft over by hand after the brushes are removed (par. 163).

c. If there is still excessive sparking, remove the armature from the motor and clean the commutator by lightly applying No. 0000 sandpaper. Wrap a piece of sandpaper around the commutator and rotate the armature in a lathe, or between other fixed centers; hold the sandpaper against the rotating commutator very lightly.

d. Inspect the commutator carefully to determine if it is necessary to undercut the separating insulators between the segments. The top of the insulating material must be below the level of the commutator bars on either side to prevent small carbon particles from lodging in the separators and building up to a point where the adjoining commutator segments, or bars, will be short-circuited.

e. Organizational maintenance personnel should replace the motor when the commutator requires resurfacing. Field repair personnel should complete repairs, or replace the motor, in accordance with local instructions.

162. Resurfacing Motor Commutators

When authorized by local instructions, the commutator may be resurfaced by experienced personnel, as follows:

a. Refinishing Commutator Surface.

(1) Mount the motor armature between centers on a lathe so that the armature shaft does not run out of line more than .0005 inch. Place a sharp cutting tool in the tool rest and set the tool rest so that only light cuts are taken. Take a series of light cuts across the entire width of the commutator by moving the tool rest up and down the length of the lathe. Generally, movement of the tool rest will be controlled automatically by a worm gear on the lathe. Be very careful not to make deep cuts in the commutator. Continue to cut away metal until the grooves and rough spots on the surface of the commutator are eliminated. *Do not remove any more metal from the commutator than is absolutely necessary.*

(2) Polish the commutator with a strip of fine sandpaper (No. 000 or No. 0000) held in flat contact with the commutator as the armature revolves in the lathe. Never attempt to smooth a rough commutator with sandpaper unless this work is done in a lathe or between similar fixed centers. Never use emery cloth or carborundum paper. Loose particles from such abrasives cause trouble in electrical circuits and wearing surfaces.

b. Undercutting Commutator Bar Separators (Insulators).

(1) Tool equipment available at larger repair shops may include any one of several types of undercutting tools. Do not attempt to use such tools until the directions furnished with them have been studied carefully.

(2) If no standard undercutting tool is available, improvise a substitute from a piece of hacksaw blade, as follows:

(*a*) Grind the sides of the cutting edge of the hacksaw blade until the total width of the teeth is a little less than the width of the slot between the commutator segments.

(*b*) Fit a wooden handle to the unground portion of the blade to serve as a protection against injury to the fingers.

(3) Hold the improvised tool at an angle so that only one or two teeth are in contact with the separator material (usually mica). Draw the tool in a direction away from the windings and cut away a portion of the separator. Repeat the process until the surface of the separator material is one sixty-fourth to one thirty-second inch below the surface of the adjacent metal commutator segment bars, uniformly, along the entire slot. Repeat for all the separator slots in the commutator. Make sure that there are no slivers of metal remaining in the slots after the cutting process. Such slivers short-circuit the commutator segments and burn out the windings when the motor is started.

163. General Instructions for Replacing Motor Brushes

a. When removing the brushes, mark the upper surface so that the brush may be replaced in its holder with the same side uppermost. If the brush has a number stamped on the upper side of the carbon, this number may be used as a guide.

b. Inspect the brushes as follows:

(1) Check to see that at least five-eighths inch of brush material remains.

(2) Check to be sure that at least one-third of the brush face bears upon the commutator surface.

(3) Check to see that the brushes make contact across at least 75 percent of the long dimension of the brush face.

c. If the above requirements are not met, substitute a new brush which will seat properly.

164. Surfacing and Installing Motor Brushes

To shape the contact face of the brush to the curvature of the commutator proceed as follows:

a. Wrap a piece of No. 0000 sandpaper around a broom handle or similar round object.

b. Hold the brush so that it bears against the sandpaper under the approximate normal pressure of the brush spring.

c. Rotate the broom handle back and forth so that the sandpaper will wear a surface of proper curvature in the contact face of the brush. The last rotation should be in the direction in which the armature turns during operation of the motor.

d. After the proper curvature has been cut in the brush face, level the edges slightly; use sandpaper.

e. Wipe the brush with a cloth moistened with carbon tetrachloride.

f. Examine the brush spring to see that it is in good condition. See that the pigtail within the brush spring is intact and free of kinks, and that it will permit the spring to extend properly.
cloth moistened with carbon tetrachloride wrapp

g. Clean out the brush holder. Use a piece of cloth moistened with carbon tetrachloride wrapped around a stick or an appropriately shaped tool such as a screw driver. Be careful not to score the side of the brush holder and do not attempt to clean the brush holder unless the armature has been removed from the motor.

h. Reinsert the old brushes in the brush holders from which they were removed for resurfacing. See that a brush is restored in the same position that it occupied before removal, with the numbered or marked side uppermost.

i. Always insert a new brush that has just been resurfaced, with the numbered side uppermost.

j. See that the brush moves freely in the brush holder. Check the pressure of the brush springs and see that they meet the specified requirements.

165. Replacing Armature Bearings

a. General. Install new bearings, if the old ones are burned, cracked, worn badly, or damaged in any way. Handle the bearings carefully. See that no dirt gets into the bearing races. Lubricate all bearings, including used bearings that are found to be in good condition when cleaned and inspected. Apply grease to new bearings before they are installed on the shaft. The grease prevents dirt from entering the bearings, while they are out of the motor. Place a paper washer over the exposed side of the bearing as a further preventive against entrance of dirt or dust.

b. Installation of Bearings.

(1) *General.* Bearings fit tightly upon the armature shaft; therefore, they must be pressed onto the shaft with an arbor press, vise, or similar tool. Such tools are normally available at field repair shops. See that the bearings are pressed onto each end of the shaft very carefully, so that the pressure exerted by the press or vise will not bend the armature shaft or force the bearing on the shaft at an angle to the axis of the shaft. The procedure below outlines a typical method of installing bearings on the armature shaft.

(2) *Preparatory.* Prepare two blocks of hardwood, equal in length and about 1 inch longer than the armature shaft extension. Shape one end of each of these blocks so that it will not bear against the ball bearing or outer race of the bearing. Prepare another block (fig. 130) large enough to be used against the rear jaw of the press or vise. Slip a bearing onto each shaft extension as far as it will go (fingertight). Be careful to see that the bearings are at right angles to the axis of the armature shaft.

(3) *Installation.*

(*a*) If the bearings have dust covers, see that the dust cover of each bearing is nearest the winding. Place the two wooden blocks of equal length at either side of the armature shaft extension. Place the other wooden block against the rear jaw of the press or vise, as shown in figure 130. See that the armature is set in the press or vise so that each end of the armature shaft is near the center of the face of each jaw. Tighten the tool very slowly until there is even pressure applied to *both* sides of the bearings. Be very careful not to bend the armature shaft. Continue to tighten the tool slowly until the bearing is pressed onto the shaft and is against the armature shaft shoulder. Repeat the procedure to mount the bearing on the opposite end of the shaft. Some types of bearings can be taken apart. If possible, disassemble and assemble this type of bearing on the shaft. Then the inner race can be removed and replaced on the shaft with less danger of damage to the other parts of the bearing.

(*b*) When a suitable press or vise is not available, bearings can be installed on the armature shaft, when authorized as a field expedient, by the following method:

1. Slide the bearings on the armature shaft as described in (2) above.

2. Prepare a piece of copper or brass pipe 1 inch longer than the shaft extension (fig. 131) and with an inside diameter slightly larger than the diameter of the armature shaft. If copper or brass pipe is not available, an iron pipe can be substituted if a brass washer is used to protect the

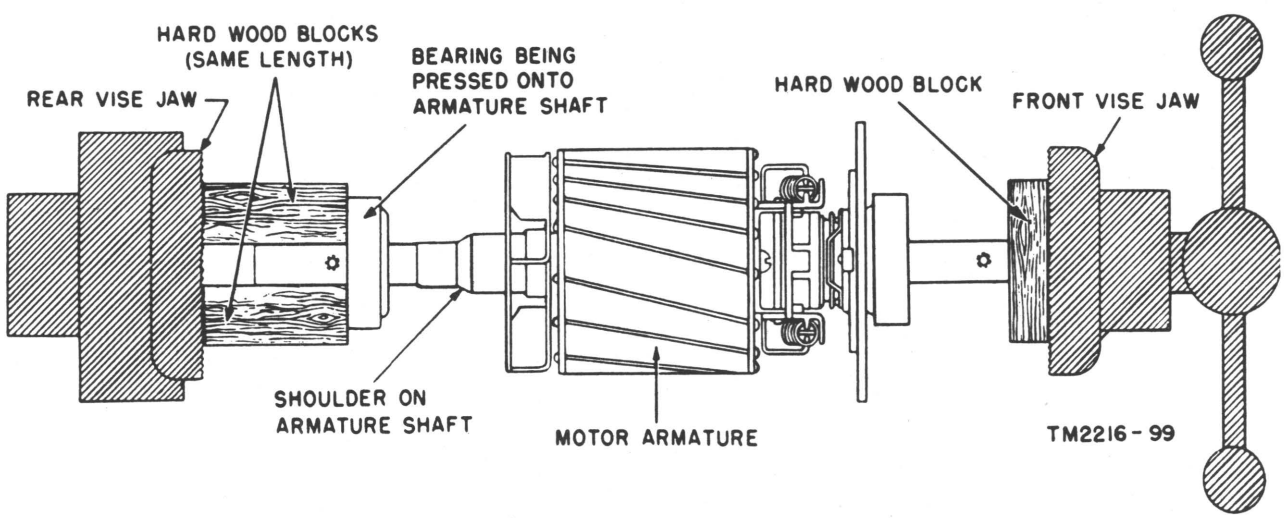


Figure 130. Pressing armature bearing onto its shaft by use of a vise.

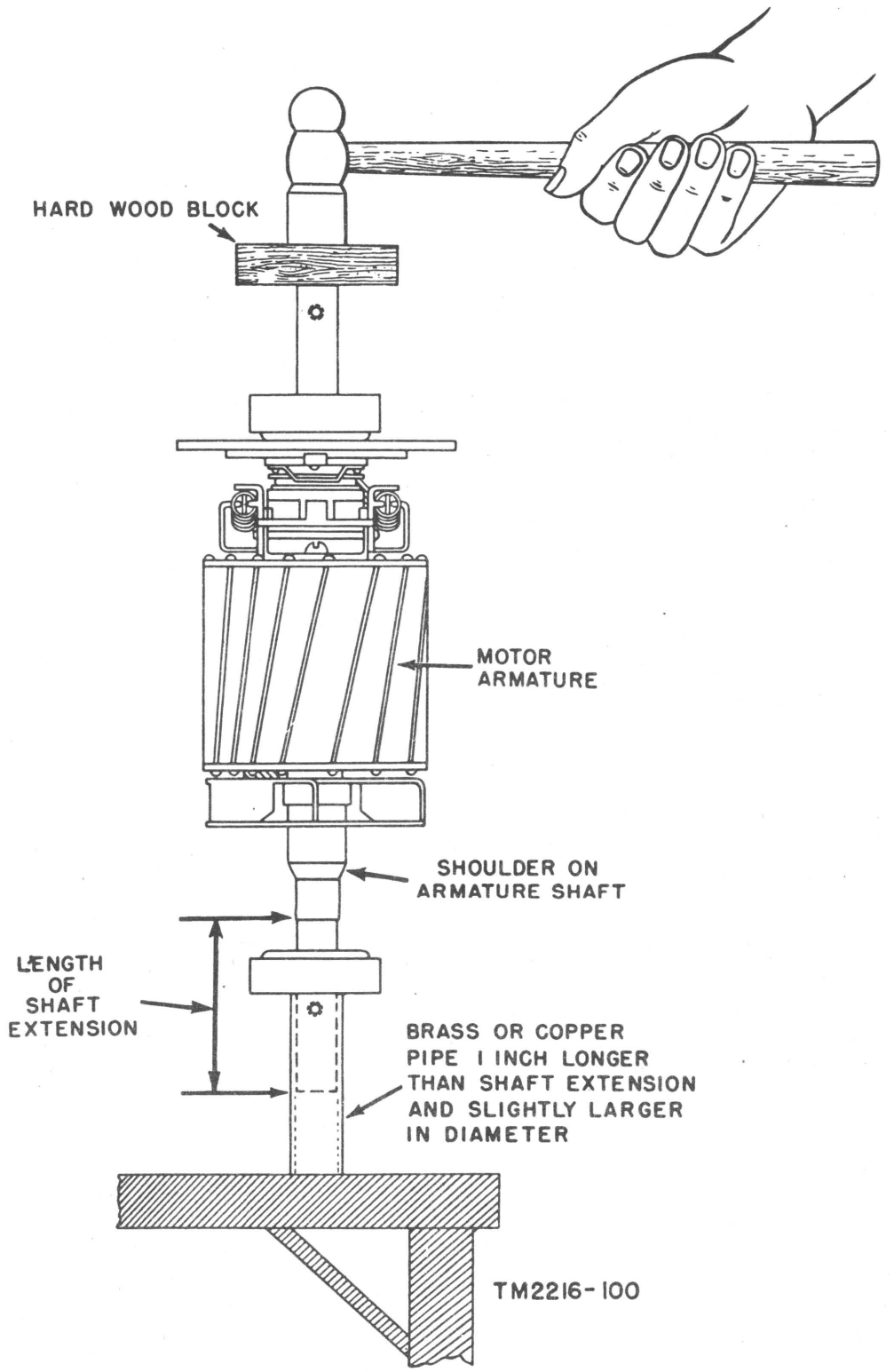


Figure 131. Mounting bearings on the armature shaft by use of hammer and soft metal pipe.

inner race of the bearing against the iron pipe. Slip the copper or brass pipe onto the shaft so that it bears against the inner bearing race.

3. Stand the armature on end with the pipe resting on the bench or work table.

4. Place a block of hardwood over the other end of the armature shaft. Drive the armature shaft down by pounding the upper end of the armature shaft (protected by the hardwood block) with a hammer. Use steady, even strokes of the hammer until the bearing is forced firmly against the shoulder of the shaft. Be careful that the pipe bears against the inner bearing race. Also, do not bend or otherwise damage the armature shaft.

166. Reassembly of Motor

a. PREPARATION. Thoroughly clean and dry the motor before reassembling. Examine the bearings and parts which should be free from dirt before beginning to reassemble the motor.

b. STEP-BY-STEP REASSEMBLY.

(1) Position the bearing retainer so that the holes match the positions of the retainer screws.

(2) Insert the armature into the stator so that the bearing on the shaft, opposite to the commutator end, enters the end frame. Do not use force because the bearing should fit into the end frame easily.

(3) Remove the brushes from the end frame that fit over the commutator. Place the end frame on the commutator end of the shaft. Gently tap the end frames into position.

(4) Insert the motor frame bolts. Tighten the opposite ends at the same time to be sure that the end frames are mounted and seated correctly in the motor frame.

(5) Use at toothpick, a piece of wire, or other convenient means to move the bearing retainer ring into position so that the bearing retainer screws can be started. Tighten both retainer screws at the same time.

(6) Replace the motor pinion and pilot screw. Replace all the shims that were found when the governor was removed; then replace the governor and pilot screw.

167. Governor Repairs

a. GENERAL. Governor contacts cause considerable trouble when they are not in good condition. All governor contacts in good condition have an over-all grayish appearance. When the contacts have become pitted, or the grayish color does not cover 75 percent of the contact surface area, replace *both* contacts with new ones (pars. 169 and 170). Always replace governor contacts in pairs. Never touch the contacting surface with the fingers because even minute deposits of moisture or dirt will cause arcing and pitting.

b. CONTACTS IN SATISFACTORY CONDITION. The ideal condition for governor contacts is where both contact surfaces are exactly parallel and the area of contact is a maximum (fig. 135). Contacts may be satisfactory under the condition where one contact has build-ups and the other has corresponding craters, provided that the craters will accept the build-ups (A, fig. 134); this maintains contact over an acceptable area. Contacts in this condition are considered to be good and need not be replaced unless trouble is experienced in obtaining and maintaining proper motor speed.

c. COMMON CAUSES OF CONTACT TROUBLE.

(1) Trouble due to poor contact surface frequently is the result of a previous attempt to burnish or file contacts to produce better surfaces. In such cases, the build-ups are removed, as shown in B, figure 134, with the result that the craters that still remain do not meet the renewed surface and reduce the amount of effective contact surface.

(2) If the contacts are rotated or shifted in position, as shown in C, figure 134, the build-ups and craters do not match. This condition results in extremely erratic motor speed because practically all of the contacting surface is lost.

168. Disassembly of Governor

To completely disassemble the governor brush assembly, proceed as follows:

a. Remove the screw holding the governor adjusting bracket to the brush spring plate bracket.

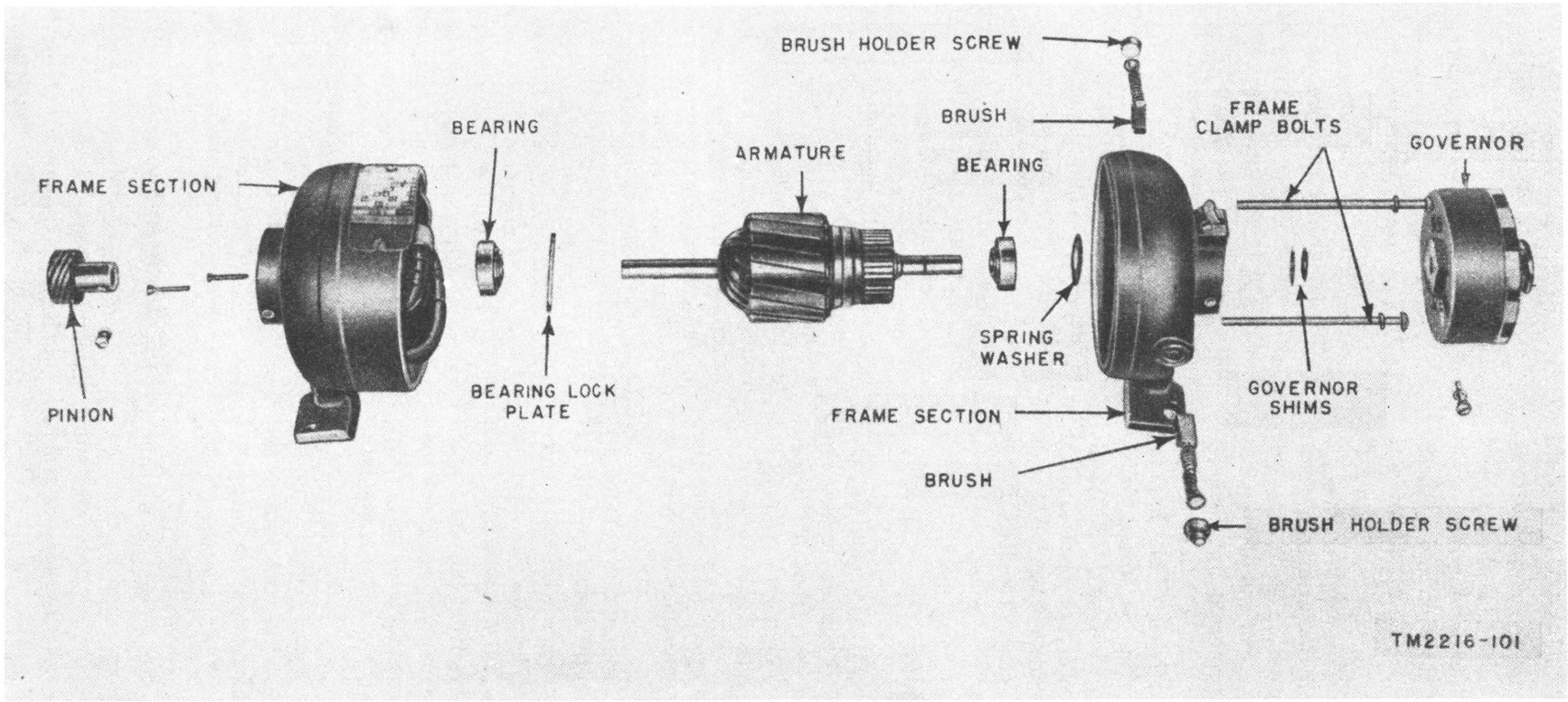


Figure 132. Disassembly of motor.

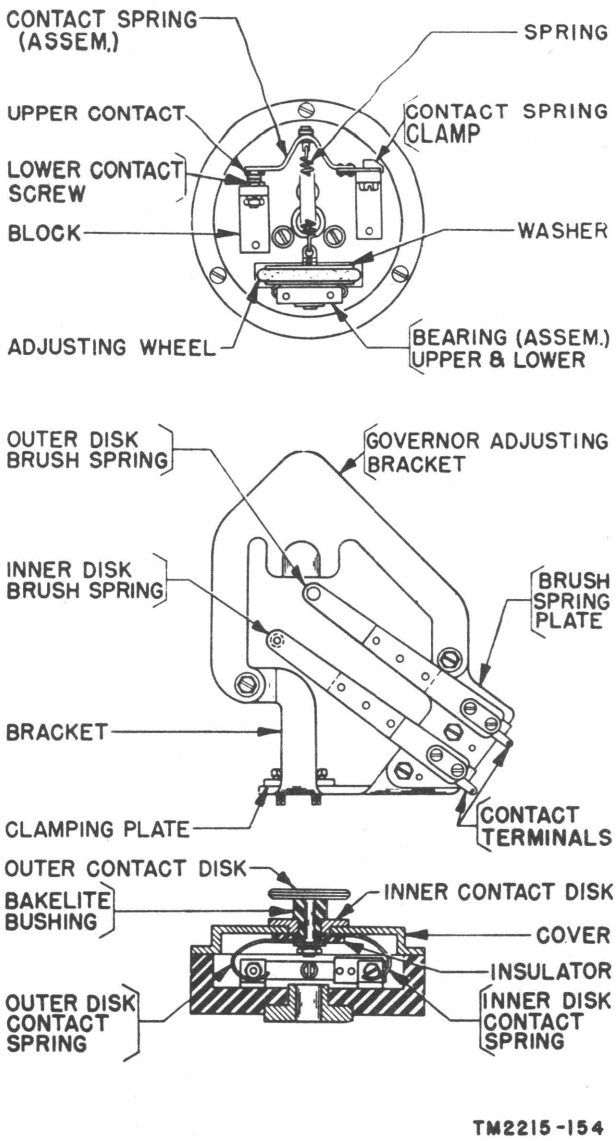


Figure 133. Motor governor parts.

b. Remove the screw that holds the governor adjusting bracket to the brush spring plate and remove the adjusting bracket. When the governor brush assembly does not require repair, merely loosen the screw (*a* above) and raise the left end of the governor adjusting bracket so that it pivots (on the loose screw) to the right of the governor.

c. Loosen the screws holding the brush springs in place. Remove the brush springs.

d. Loosen the screw that holds the governor to the end of the armature shaft. Slip the governor from the shaft.

e. Remove the screws that secure the target and governor cover. Remove the target and cover.

f. Unhook the governor contact spring (fig. 135).

g. Loosen the screw by which the feather spring is clamped to the end of the contact spring (fig. 135). Lift the contact spring out of the governor shell.

h. Remove the nut and lockwasher on the contact screw (fig. 135). Lift out the contact screw.

169. Replacing Governor Contact Points

a. Contact points are made of tungsten and are welded to the contact spring (upper contact) and to the contact screw (lower contact). When removing the old contact points, replace both the upper and lower points at the same time to avoid difficulties in seating them.

b. Replace the new points with their associated contact springs and contact screws. The new lower point with the contact screw is alined properly when the contact surface of the new point is perpendicular (or at right angles) to a line through the axis of the contact screw (fig. 135). The new upper point and contact spring is alined properly when there is no appreciable gap between any part of the contacting surface of the new point and a straight edge, when tried as shown in figure 135. Old style contact springs had contact points that screwed into the springs and were bonded in position by a drop of solder on the springs or were

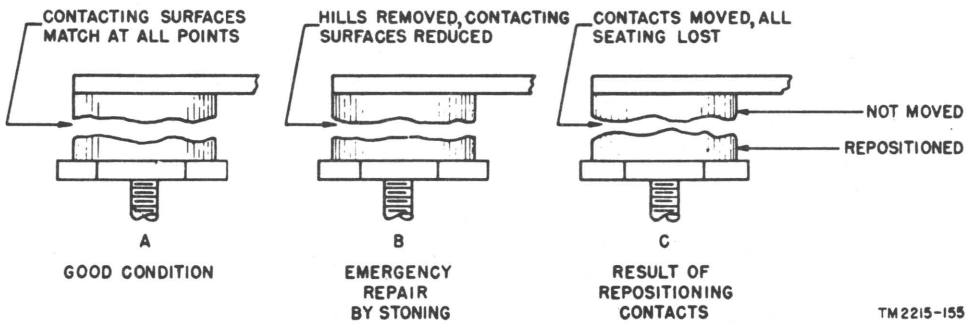


Figure 134. Enlarged diagrams of governor contact surfaces.

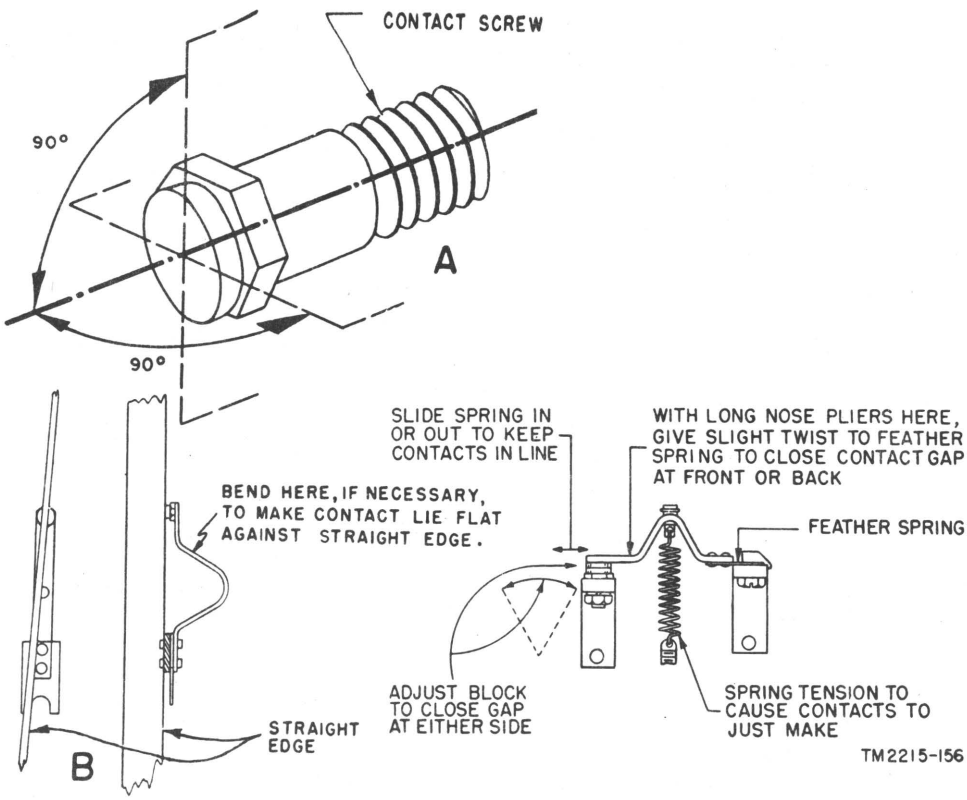


Figure 135. Alinement of new governor contact points.

soldered directly to the contact springs. New style contacts are welded and require replacement of an upper spring and lower screw with the contacts.

170. Repair of Contact Points

In emergencies, when trouble is due to build-ups or pitting and new contact points are not available, remove the points and dress them with a fine carborundum stone. Such a stone is part of Tool Equipment TE–50(*). It may be necessary to remove a particularly large build-up by knocking it off with a screw driver and then dressing the contact surface with the stone. When resurfacing a point with the stone, see that the stone is clean and has a level surface. Hold the point as flat as possible against the surface of the stone. To be sure that the entire face of the point is dressed level, use a rotary motion when dressing the contact point. Do not use too much pressure. Examine the point at frequent intervals. Stop when the faces of the points meet the requirements mentioned in paragraphs 167*b* and 169*b*. Clean the dressed points with carbon tetrachloride. *Replace both points as soon as possible. This is necessary to avoid trouble from build-ups and pitting, which form quickly on resurfaced contacts.*

171. Reassembly of Governor

a. Insert the contact screw in the hole in its mounting block. Place the lockwasher and nut on the end of the contact screw. Tighten the nut securely.

b. Insert the feather spring of the contact spring assembly (fig. 135) under the clamp on its mounting block and tighten the clamp screw until the contact spring is held friction-tight. The contact should remain separated slightly (approximately .005 inch).

c. Hook the spring onto the contact spring. Turn the adjusting wheel until all tension is released. Contacts should return to the slightly separated position indicated in *b* above.

d. Insert a piece of white paper behind the contacts.

e. Turn the adjusting wheel until the contacts just touch. Use a flashlight or other small bright light to illuminate the contacts during this adjustment.

f. Slide the contact spring to the right or left, until the sides of the upper and lower contact are

alined vertically. If a gap can be seen on either side of the contacts, loosen the contact mounting block retaining screw and move the top of the block to the right or left. At the same time, shift the contact spring to keep the contact points in line (fig. 135). Tighten both the contact spring clamp screw and the contact mounting block retaining screw.

g. If a gap at the front or back of the contacts is observed, twist the feather spring on the end of the contact spring with a pair of long-nosed pliers (fig. 135), until the contacts are correctly positioned.

h. Turn the adjusting wheel so that the tension of the spring is near the midpoint of its range.

i. Clean the points with carbon tetrachloride applied with a toothpick or orange stick. Reassemble the govenor cover and target to the governor, and remount the governor on the motor.

172. Inspection, Cleaning, and Repair of Governor Contact Disks

a. Clean the governor contact disks with a piece of cloth moistened with carbon tetrachloride. A smooth, even gray coating of oxide on the disks is desirable, and the contact disks should not be disturbed unless there is excessive sparking at the brushes.

b. Never touch the contact surface of the contact disks with the fingers. Minute deposits of moisture or foreign matter can cause arcing and pitting. Flush the contacts with carbon tetrachloride immediately after they have been sanded. This is done by applying the fluid to the contact with a toothpick or orange stick repeatedly, to flush away all foreign matter. Prevent the carbon tetrachloride from coming into contact with wire insulation or plastic parts.

173. Repair and Replacement of Center Contact Governor Brushes

a. Replace the No. 78403 carbon brushes on the tips of the inner and outer governor disk contact springs when the brushes are worn down to one-eighth inch. Replace the individual brushes, as described below.

b. Unsolder the old brush from the spring. Clean away solder that remains in the mounting hole in the spring from which the brush is removed. Insert a new brush in the mounting hole and solder it securely in place. Clean the brush with carbon tetrachloride applied with an orange stick, toothpick, or a similar tool.

c. Restore the governor brush assembly to its proper position and tighten the mounting screws.

174. Testing Repaired Governor

a. After the governor is reassembled completely, seat the new contacts by running the motor on test for at least an hour. Check the speed every 15 minutes and investigate any sudden change in the motor speed immediately.

b. If the motor speed is erratic and the trouble cannot be traced to other parts of the motor, disassemble the governor and check the contacts for build-ups and alinement. If build-ups are found, replace the contacts. After the contacts have been realined properly, reassemble the governor and run the motor again for an hour.

c. Proper operation of the governor is indicated if the motor speed does not change appreciably during the hour test run.

175. Introduction to Perforator Transmitter Repairs

a. Complete the inspection, cleaning, repairing, replacement, and adjustment of perforator transmitter parts with the perforator transmitter removed from the teletypewriter.

b. No special disassembly of the perforator transmitter is required for general cleaning or inspection purposes because most of the parts are exposed when the unit is removed from the teletypewriter.

176. Replacement of Transmitting Shaft Driven Gear

a. Replace the driven gear if any of the teeth are missing, or if the gear is worn.

b. To replace the gear, remove the gear pilot screw. Slide the gear from the transmitting shaft. Slide the new gear into place. Replace the pilot screw.

177. Replacing Keytops

a. Replace all illegible and missing keytops.

b. To remove the keytops from the key levers turn the tops one-quarter turn in a clockwise direction, and lift them up. To replace the keytops, set them in the normal position and press them

down on the key lever, while supporting the key lever from underneath.

178. Replacement of Transmitting Shaft, Cam Sleeve, and Clutches

a. Replace the transmitting shaft if it is scored or worn. Replace the clutches if the teeth are broken or worn badly. Replace worn cam shafts, and cams that have scored bearings, or if there is excessive play between the shaft and the cam sleeve.

b. To replace transmitting shaft parts, remove the keyboard control contact shield and the transmitting shaft driven gear. Remove the rear bushing bracket mounting screws and the rear bushing bracket with its bushing. Do not lose any of the shims between the bracket and the keyboard casting. Remove the transmitting shaft with its parts. Remove the transmitter cam sleeve, clutch spring, and transmitter clutch driven member.

c. Install the new parts in the reverse order in which the old parts are removed. Figure 136 shows the correct arrangement.

d. Adjust the transmitting shaft as directed in paragraph 381.

179. Repair or Replacement of Transmitter Contacts

a. Do not clean or burnish transmitter contacts that are working properly. Clean contacts that are out of adjustment, or that are causing trouble. Use carbon tetrachloride for cleaning transmitter contacts. Remove build-ups with a contact file and adjust the contacts as instructed in paragraph 397. Refer to TM 11–4302 for maintenance and repair data applicable to electrical contacts.

b. Replace burned transmitter contacts and those with broken springs.

c. Whenever possible, replace the entire transmitter contact assembly as a complete unit.

d. Dismount the contact assembly by removing the two screws that fasten it to the frame.

e. Remove the wiring to the contact by unsoldering the connection at the terminals. Clean the wires of excess solder, attach new contacts, and resolder the connections. Do not change the electrical connections to the transmitter contacts.

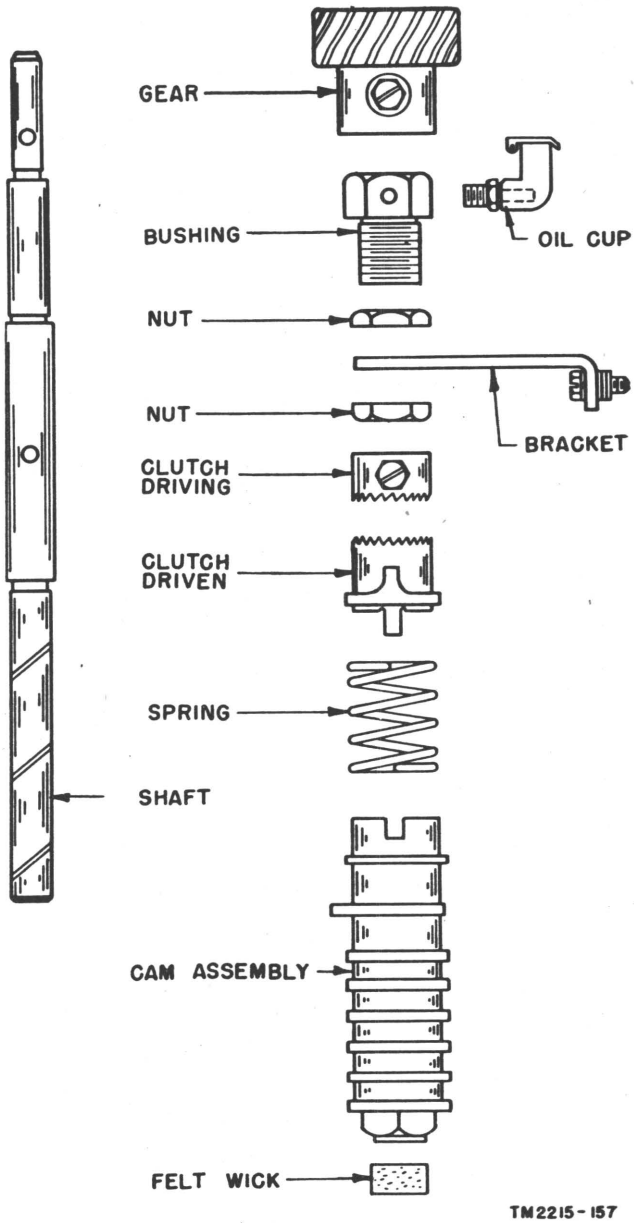


Figure 136. Transmitting shaft assembly.

180. Repair or Replacement of Other Electrical Contacts on Perforator Transmitter

a. General. The electrical contacts of the perforator transmitter, except the transmitter contacts, are contained in the polar-neutral key, the perforator, and counter circuits (fig. 270).

b. Repair or Replacement. Repair of the electrical contacts normally will consist of cleaning and burnishing the contact points, and adjusting the contact springs, in accordance with paragraphs 207 through 490. Refer also to TM 11–4302 which contains valuable data on the re-

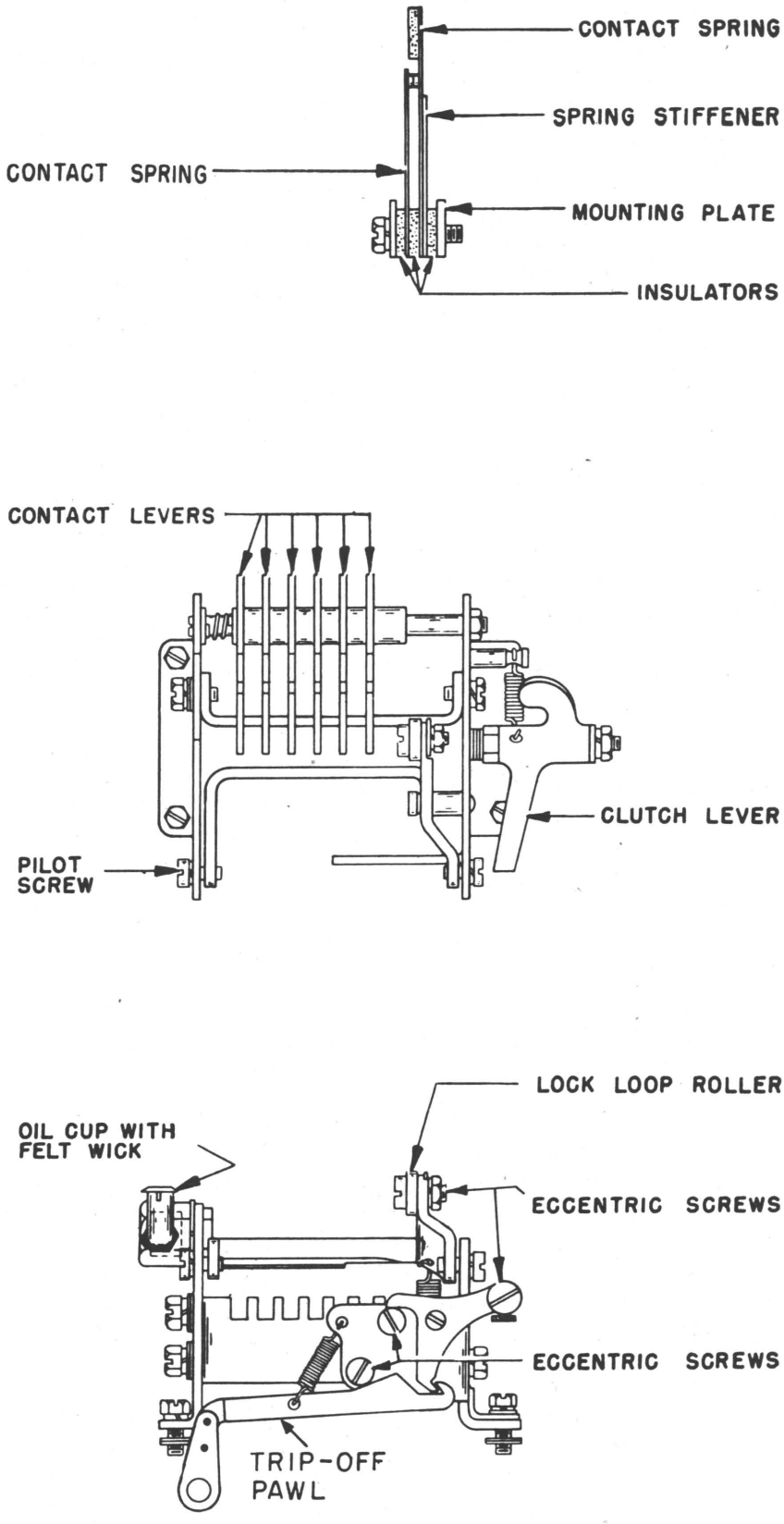


Figure 137. Transmitter contact and clutch throw-out lever assembly.

pair and adjustment of spring contacts. When replacement of any of these electrical devices is necessary, the procedure will include unsoldering of all electrical conductors from the various terminal points and the removal of the mounting screws or other hardware. Always tag the conductors as they are removed to avoid confusion when they are replaced. Save and re-use any lockwashers associated with the mounting hardware. If insulating materials used in spring-type electrical contacts are broken or damaged badly, replace the entire assembly rather than attempt to replace only the insulators.

181. Repair or Replacement of Perforator

a. Items of the perforator that require repair or replacement most frequently are the punch block (par. 182), and the punch contacts. The character counter is part of the perforator mechanism and its repair or replacement depends on the extent of the adjustment required, or the injury or damage sustained. Normally, replacement of the mechanical linkages or other mechanical parts necessitates complete disassembly of the perforator mechanism. Replacement of magnets or magnet coils in either the perforator mechanism or the character counter will require entire disassembly of the perforator assembly. It may be more expedient to replace the entire perforator assembly than to replace or repair any mechanical element.

b. To replace the perforator assembly, remove the screws that hold it to the keyboard casting. Unsolder and tag the electrical conductors. The mechanical linkages that connect the key levers and associated mechanism to the punch selector fingers now may be unlinked. The new perforator mechanism then can be installed in place of the defective unit. After the new or replacement perforator assembly is connected and all mechanical linkages to the keyboard are restored, adjust the unit to conform to requirements listed in paragraphs 380 through 460.

182. Repair and Replacement of Punch Block

a. Causes of Trouble. Items listed below are the most frequent causes of trouble in the punch block. Never remove the punch block until it is obvious that preventive maintenance measures will not remedy the trouble.

(1) Tape jammed in the block so that it will not feed through the feed roll.
(2) Tape feeds normally but perforations are incomplete or faulty.
(3) Tape cannot be threaded into the block.
(4) Punch selector fingers are jammed or stuck.
(5) Bunch block filled with dust or grit.
(6) Feed hole punch broken or damaged.
(7) Dull die plate which causes improper perforation of tape.
(8) Improper threading of the tape through the punch block by the operator. This condition is caused when the operator, although threading the tape through the block and feed roll properly, places excessive tension on the tape to pull it through the block while the perforator

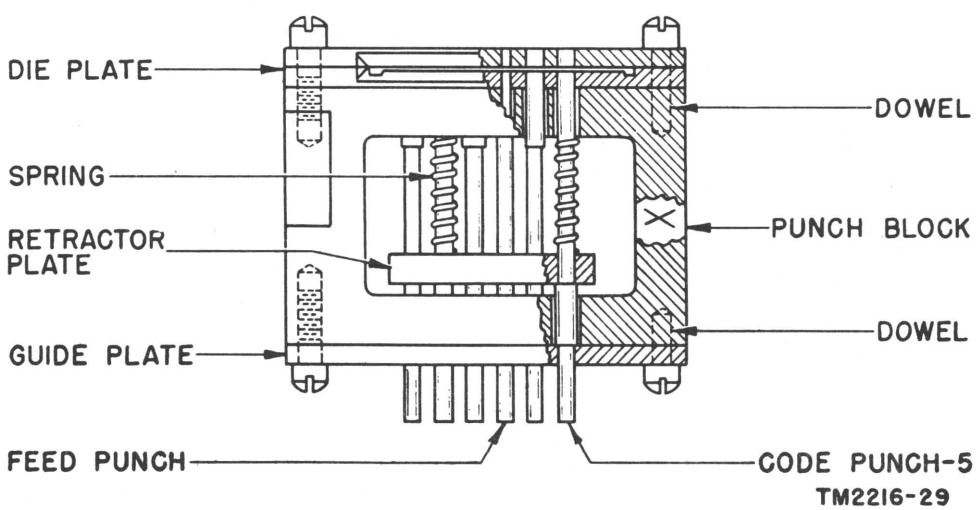


Figure 138. Punch block assembly.

mechanism is operating. This causes mutilation of the tape and uneven spacing.

b. REPAIRS. Minor repairs, such as the removal of small bits of mutilated tape that have become stuck in the punch block may be made without removing the punch block for complete overhaul. When bits of tape are stuck in the punch block, remove them as follows:

(1) Set the operating control lever at TAPE.
(2) Operate the blank key so that the punches are clear of the punch selector fingers.
(3) Gently insert the .002-inch gage, from the left side, into the tape slot.
(4) Push the gage, *carefully*, betwen the die plate and the stripper plate. If this does not clear the punch block of mutilated tape, remove the unit and perform a complete overhaul of the punch block.

c. To replace the punch block, proceed as follows:

(1) With the perforator transmitter assembly removed from the teletypewriter, remove the chad chute by removing the two small screws that hold it to the top of the punch block.
(2) Remove the two screws that hold the tape shield and the two that hold the tape knife, and remove these items.
(3) Remove the two screws that hold the key pressure adjustment screw bracket. Remove the adjustment screw from the key presser adjustment lever.
(4) Remove the right-hand screw that holds the punch block. The tape feed pawl adjusting screw and bracket are fastened to the punch block by the right-hand punch block mounting screw. Remove the feed pawl adjusting screw and bracket.
(5) Remove the left-hand punch block mounting screw and the punch block.

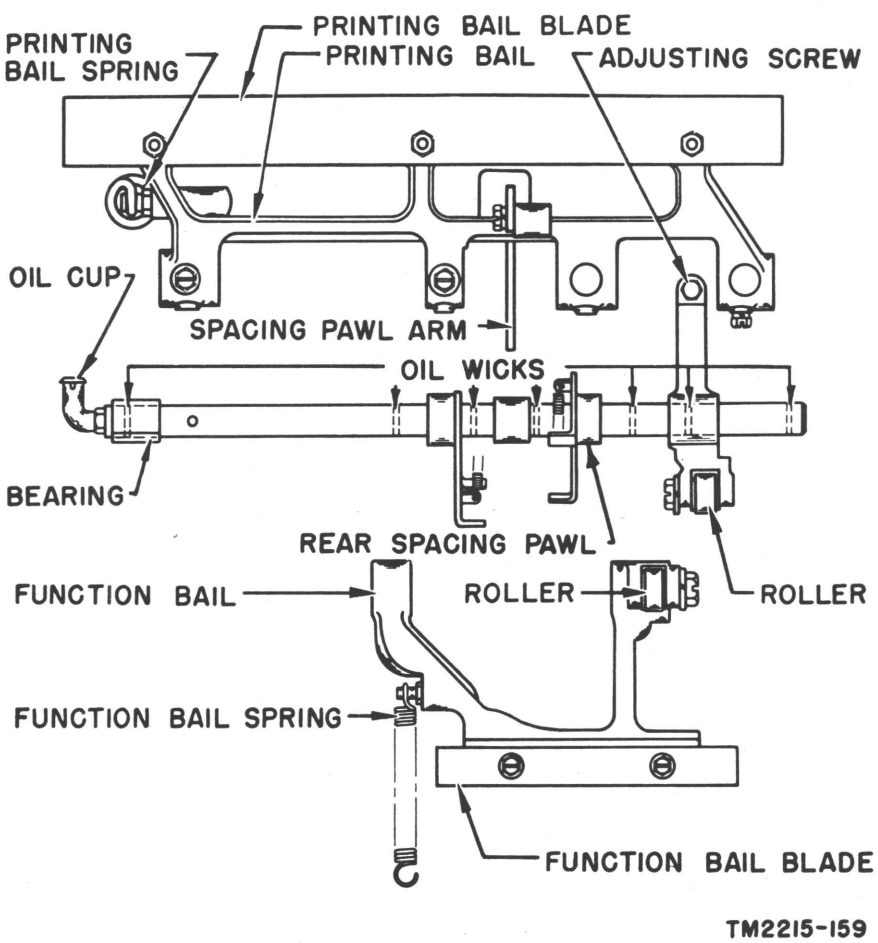


Figure 139. Disassembled printing bail.

(6) Install the replacement punch block and fasten it in place. Restore the mounting screws and other mechanical elements of the assembly in a sequence the reverse of that given in (1) through (5) above.

183. Introduction to Typing Unit Repairs

a. Instructions required for a major overhaul of the typing unit follow. These instructions are arranged by principal assemblies and subassemblies for easy reference when repairs to a single item are necessary. Instructions for repair of the type bar carriage are contained in paragraphs 189 and 190.

b. Dismantle the various assemblies only to the extent necessary to complete the work involved. Complete disassembly of the typing unit is warranted only when the unit is subjected to sand, grit, or some corrosive element.

184. Removal and Disassembly of Typing Unit Subassemblies

a. Rangefinder Assembly.

(1) Remove the two screws that mount the rangefinder on the selector assembly.

(2) Remove the bell crank screw and remove the bell crank. Remove the trip latch screw, and remove the trip latch and spring. Remove the stop lever screw locknut and the stop lever screw. Remove the stop lever spring and stop lever.

b. Motor Stop Bracket Assembly. Unhook the motor stop lever spring from its spring brackets. Remove the two motor stop lever bracket mounting screws. Cut any lacing from the motor stop bracket. Remove the motor stop lever bracket assembly (fig. 141).

c. Removal of Selector Assembly. Remove the selector cam sleeve by removing the friction disks, the friction washer, and the selector cam sleeve from the left end of the main shaft. Disconnect the two leads from the selector magnets. Remove the three screws that mount the selector assembly to the typing unit frame. Carefully remove the selector assembly. It is necessary to separate the T levers from the vanes and the main shaft cutch throw-out lever from its left pivot screw to free the assembly. Handle the selector assembly carefully to avoid damage to any of the small parts (fig. 140).

(1) *Removal of selector magnets.* The selector magnets are removed from the selector assembly, either before or after the selector assembly is removed from the typing unit. Remove the two screws that hold the magnet bracket to the selector assembly. Remove the magnets and bracket as a unit.

(2) *Removal of selector armature.* The selector armature may be removed either before or after the selector unit has been removed from the typing unit. Loosen the outside selector armature pivot screw locknut, and remove the pivot screw. Remove the selector armature carefully by moving the armature in the direction of the removed pivot screw, until the armature is clear of the opposite pivot screw. Withdraw the armature.

(3) *Removal of selector levers, swords, and T levers.* Remove the selector lever springs and the locking lever spring. Remove the five nuts and washers that clamp the separator plates together. Remove the separator plates, swords, T levers, selector levers, and locking lever.

d. Removal of Main Shaft. The main shaft is removed independently of other subassemblies or disassembly procedures. Details for removal of the main shaft are contained in paragraph 185.

e. Removal of Printing Bail Assembly. The type bar carriage must be removed before the printing bail assembly can be removed. Proceed as follows:

(1) Remove the printing of bail and the function bail springs.

(2) Remove the two nuts and washers that fasten the function lever bail to the printing bail.

(3) Remove the two screws and lockwashers that fasten the right-hand printing bail bearing to the typing unit frame.

(4) Slide the bail assembly to the right, until the left end of the bail shaft clears the left bail bearing; then remove the assembly.

f. Removal of Spacing Shaft. Remove the nut and screw that fasten the carriage return lock bar to the carriage return bell crank. Remove the two horizontal screws that fasten the upper bearing block to the typing unit frame. Remove

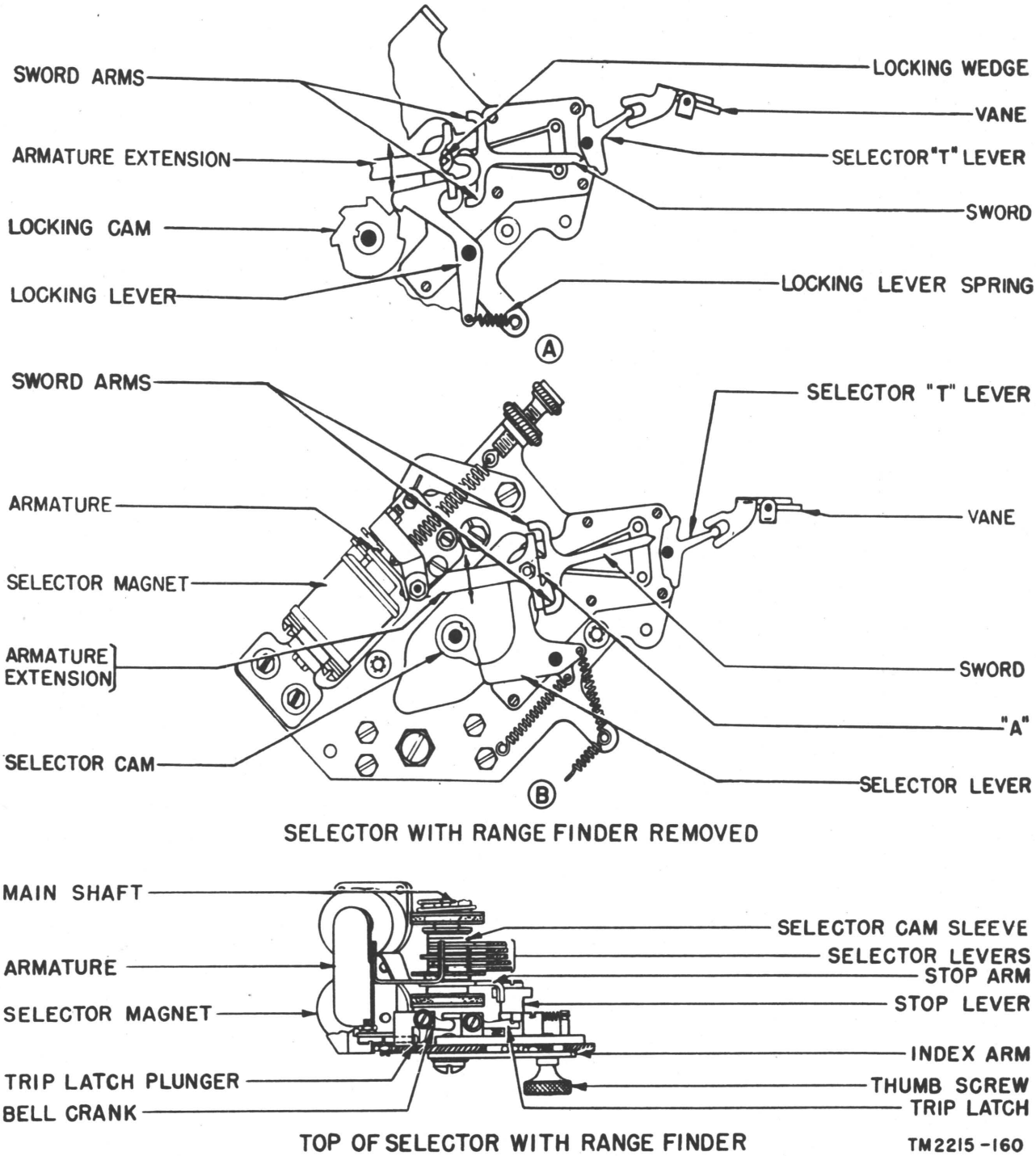


Figure 140. Selector with and without rangefinder.

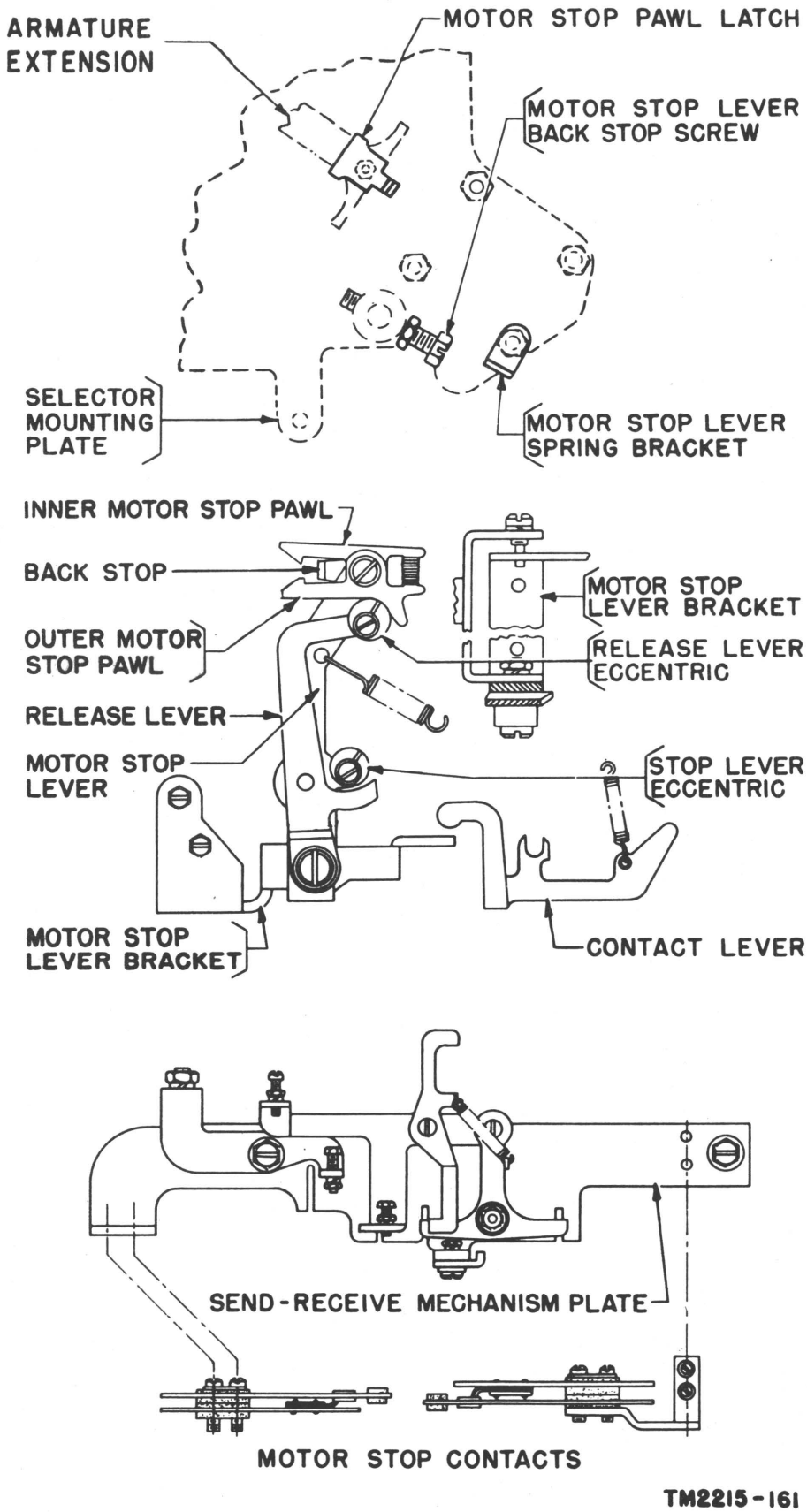


Figure 141. Motor stop locking assembly.

the two screws that hold the carriage return bracket against the typing unit frame. Remove the shaft by moving the shaft upward and out. Remove the carriage return bracket and the attached parts.

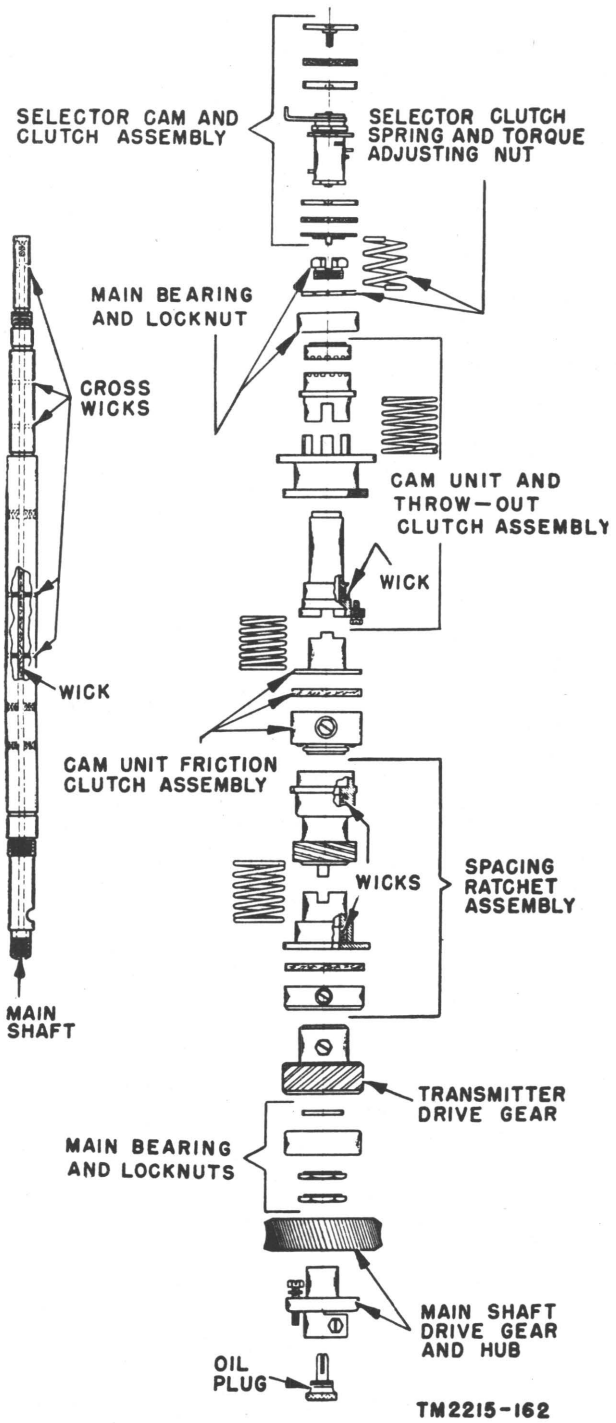


Figure 142. Main shaft parts in sequence of removal.

185. Removal of Main Shaft

a. General. Most repairs to main shaft parts are made by replacing rather than repairing a part. Parts of the main shaft that are between the main bearing locknuts and the nearest shaft end can be replaced without removing the shaft from the typing unit (fig. 142). When the main shaft is removed to reach a part that must be serviced or replaced, completely disassemble, clean, inspect, and lubricate the shaft before restoring it to its operating position.

b. Removal of Main Shaft From Typing Unit.

(1) Remove the typing unit from the teletypewriter base. Set the typing unit on a workbench so that it rests on its right side.

(2) Remove the two screws that hold the rangefinder to the selector assembly and remove the rangefinder.

(3) Remove the outer selector cam friction clutch plate (retaining disk) by turning the plate clockwise; use a large screw driver for this purpose, and remove the selector cam.

(4) Place the typing unit so that it rests on its back, and remove the four screws that hold the main bearing caps in place.

(5) Hold the main shaft clutch throw-out lever away from the main shaft and remove the main shaft from the right end.

c. Removal of Main Shaft Parts (fig. 143).

(1) *Removal of selector cam.* The selector cam can be removed from the main shaft without removing the shaft from the typing unit.

(2) *Removal of bail cam unit.* After the selector cam sleeve has been removed, remove the selector unit friction spring. Grasp the main shaft drive gear in one hand and remove the main shaft bearing locknuts by turning them clockwise from the selector cam end. Remove the main shaft clutch plates, the main shaft clutch spring, and the bail cam unit. Remove the bail cam friction spring, friction disk, and washer.

(3) *Removal of spacing escapement ratchet.* Remove these parts from the main shaft drive gear end. Remove the oil plug. Remove the main shaft gear clamping

screw and main shaft gear. Remove the main shaft bearing locknuts, by turning the nuts counterclockwise from the main shaft gear end. Remove the main shaft bearing. Remove the transmitting shaft driving gear mounting screw and remove the gear. Remove the friction clutch, stop sleeve, and clutch spring. Hold the shaft vertical and lift off the spacing escapement ratchet and gear. Remove the thrust bearing race mounting screw. Slide the bearing race off the shaft carefully so as not to lose the ball bearings.

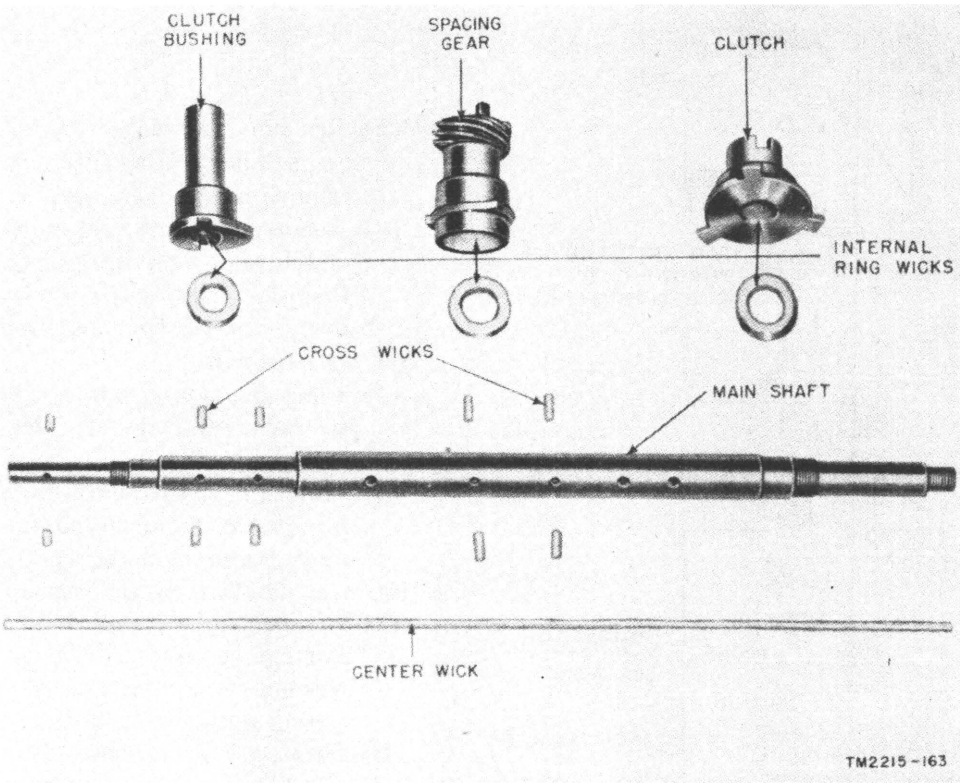


Figure 143. Main shaft oil wick locations

(4) *Removal of main shaft for replacement.* The preparation of the main shaft for replacement is explained in (1), (2), and (3) above. Figure 143 shows the locations of oil wicks in the main shaft.

186. Repair and Replacement of Main Shaft

a. Inspection and Repair Procedure.

(1) *Gummy friction washers.* Friction washers that have become gummy usually can be cleaned with solvent (SD). Dry the washers thoroughly and lubricate them with the specified lubricant before reassembly. Replace any washers that have hardened surfaces or that have lost their absorbent qualities.

(2) *Selector cam sleeve.* Replace the cam sleeve if it is so worn that it cannot be adjusted to the requirements given in section IX of this chapter.

(3) *Drive gear.* The main shaft drive gear can be replaced without removing the main shaft (par 185). Replace the gear when it becomes badly worn, when it cannot be adjusted to the requirements of paragraph 367, or if any of the teeth are worn or missing. If the new or replacement gear is supplied without a hub, disassemble the old gear unit by removing the three hub mounting screws and lockwashers, and use the old hub with the new gear.

b. Main Shaft Replacement.

(1) Remove the typing unit from the teletypewriter and set it upon its back. The main shaft can be replaced with the selec-

tor unit in place but the rangefinder must be removed as described in paragraph 184.

(2) Remove the selector cam sleeve from the main shaft, and slide the main shaft into place from the right side.

(3) Move the clutch throw-out lever until the main shaft will slide past it and into normal position.

(4) Place the bearing caps on the main bearings and tighten the screws just enough to prevent the shaft from shifting. Place the bearing caps so that the beveled corner is on the same side as that on which the casting is beveled.

(5) Place the selector cam sleeve and associated parts on the end of the shaft. The friction clutch plates must face the right direction, and the selector cam sleeve ends must fit into the slots of the driven clutch plates. After the driving clutch plate, on the end of the shaft, is tightened, check to see if the selector cam sleeve can be turned by hand without difficulty.

(6) For complete instructions for the adjustment of the main shaft and rangefinder, which must be completed before the teletypewriter can be operated, refer to section IX of this chapter.

187. Repair of the Platen Assembly

a. General. Replace the platen if the following conditions exist: if the platen cannot be repaired locally; if the paper will not feed; if the surface has become sticky; or if the platen has split. Keep the platen free of oils or cleaning solvents. Perform all repair work with the platen removed from the teletypewriter.

b. Removal of Platen.

(1) Remove the three set screws that hold the detent ratchet to the shaft. The ratchet is located at the right side of the platen.

(2) Remove the platen shaft by sliding it and the friction clutch out to the left.

(3) Remove the platen. Be careful not to get dirt, oil, or grease on it.

c. Cleaning the Platen. Clean metal parts of the platen with a cloth dampened with solvent (SD). Clean the rubber parts with soap and water. Wipe with a damp cloth and dry with a clean dry cloth.

d. Pressure Rollers. Release the pressure roller springs, back out the shoulder screws, and remove the pressure rollers. *Do not wash the pressure rollers.*

e. Removal of Rough or Shiny Surfaces. Place the platen in a lathe and cut a new surface by holding No. 0000 sandpaper, supported by a flat block, against the platen surface. Cut away only as much of the surface as is necessary to remove rough or shiny parts. In the case of smooth platens, remove sufficient platen material so that the platen feeds paper. Never attempt to remove deep cuts or breaks in the platen, by the sanding method outlined above.

f. Reassembly of Platen. Restore the platen to its operating position in the teletypewriter by following the disassmbly procedure, described in *b* above, in a reverse sequence. See that the platen is inserted in its proper position before inserting the set screws. Use a flashlight, or other small light, and look down a set screw hole of the platen detent ratchet, while turning the shaft. Stop turning when an indentation in the shaft is seen. Insert a set screw and tighten it. Move the shaft to determine whether the set screw is centered; retighten the screw. Repeat the process until the screw no longer will turn. Insert and tighten the other two set screws.

188. Reassembly of Typing Unit Subassemblies

a. General. Generally, all subassemblies are reassembled in the reverse order of that in which they are disassembled. If parts have been cleaned and surfaces are free from oil, relubricate them as they are reassembled. Pay particular attention to all parts or mechanical elements which are not reached easily once they are reassembled.

b. Rangefinder Assembly Replacement. The rangefinder may be removed and replaced without the readjustment of the trip-off eccentric screw. After the mounting screws are tightened, back them off at least one-half turn. Take up any resultant play by exerting pressure to the right and up. Tighten the mounting screws.

c. Adjustments. Any adjustments disturbed during the disassembling, cleaning, repairing, replacement, or reassembling process must be completely readjusted in accordance with the applicable instructions.

189. Disassembly of Type Bar Carriage

a. Removal of Code Bars. Remove the two screws that hold the bell crank bracket to the frame of the type bar carriage and remove the bracket. Remove the four nuts and washers from the two studs that secure the code bars to the pull bar guide. Hold the code bars together and slide the bars and spacer washers out from the studs. Be careful not to lose washers or shims that may adhere to the outside of the code bar and fall off as the code bars are lifted (fig. 144).

d. Removal of Ribbon Oscillator Mechanism. Remove the two screws that hold the ribbon oscillator mounting bracket to the carriage frame. Remove the assembly including the margin bell pawl, the ribbon oscillator, and the ribbon oscillator springs and levers (fig. 145).

e. Removal of Ribbon Feed Ratchet Mechanism. Remove the two nuts that hold the ratchet bearing cap. Remove the ratchet friction spring screw and remove the ratchet shaft. Remove the screw that holds the ribbon feed operating lever

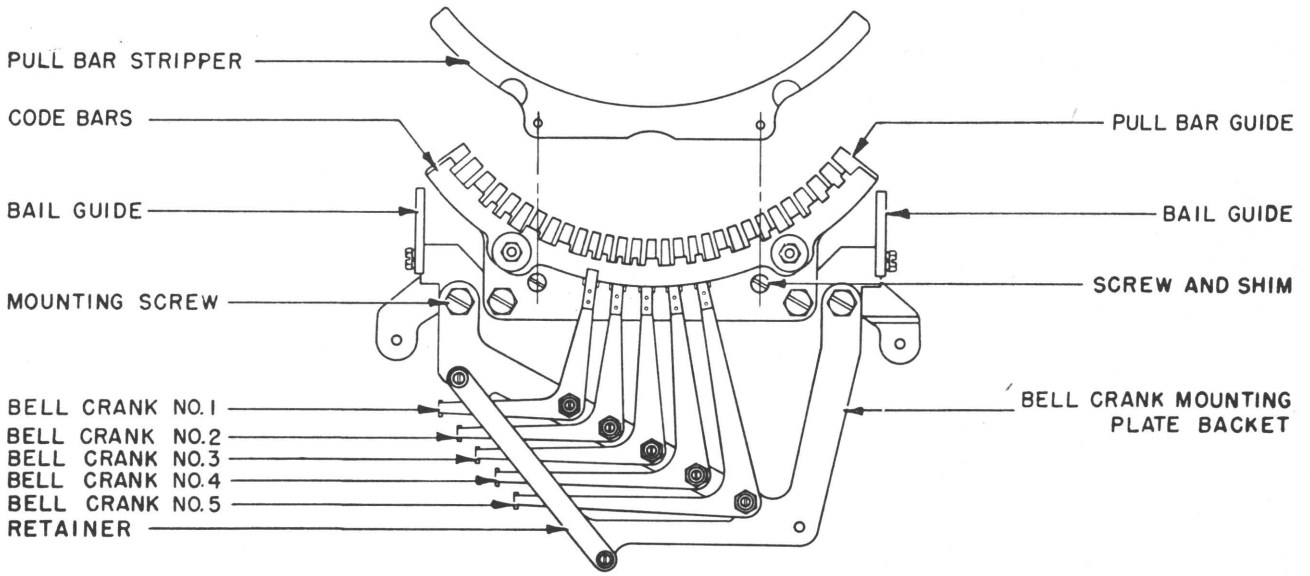


Figure 144. Code bar and bell crank assembly.

b. Removal of Pull Bars and Type Bars (fig. 145). Remove the two fulcrum rod pilot screws. Slide the fulcrum rod out endwise. Remove the type bars. Remove the pull bar springs and pull bars. See paragraph 190 for instructions covering replacement procedure for type bars and pull bars.

c. Removal of Pull Bar Bail Plunger. Remove the bell crank bracket. Remove the two screws that secure the pull bar guide to the carriage frame, and remove the pull bar guide. Remove the bail guide screws and remove the bail guides. Remove the two screws that hold the roller bracket, and remove the roller bracket. Remove the two screws and springs that fasten the pull bar bail to the plunger. Move the bail to the front and remove the plunger to the rear (fig. 146).

to the carriage, remove the ratchet pawl spring, and remove the ratchet pawl and lever.

190. Repair and Replacement of Type Bars or Pull Bars

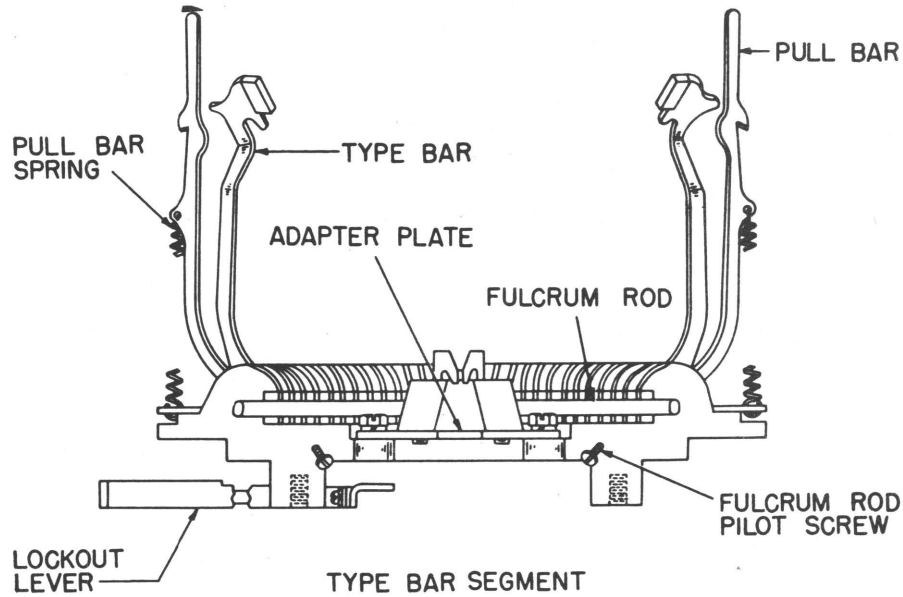
a. General. The decision to repair or replace faulty type bars should be made in accordance with authorized organization instructions.

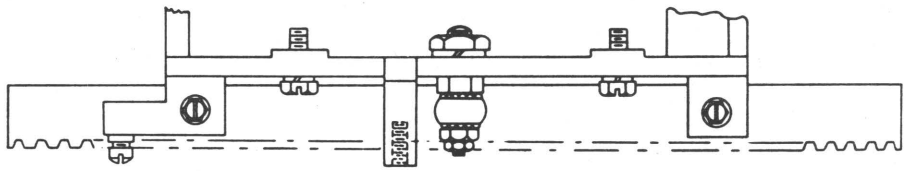
b. Replacing Type Bars or Pull Bars.

(1) Remove the type bar carriage, the ribbon, and the two screws and lockwashers that secure the type bar guide to the adapter plate. Unhook the ribbon carrier from the oscillator lever and remove the type bar guide. Also unhook the pull bar spring if the pull bar is to be replaced.

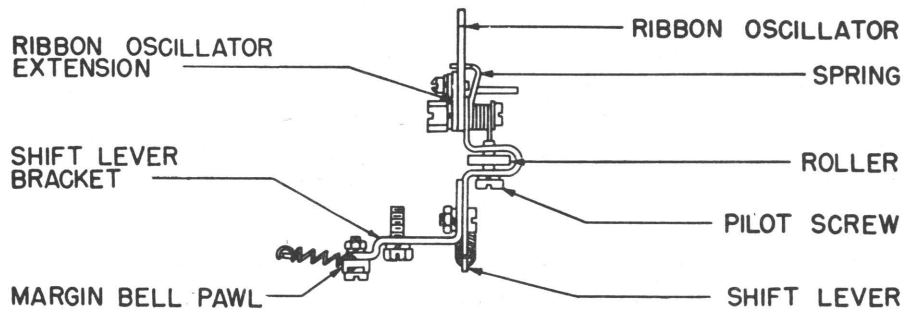
(2) Raise the type bar and move it beyond its top operating position. Hold the pull bar and lift out the type bar.

(3) Place the new type bar in the type bar segment, and engage the pull bar so that it is even with the other bars, when the type bar is in rest position. If the new type bars are oversized, they should be stoned down with a carborundum stone. The type bar should not bind. Side play clearance when the type bar is against the back stop should be not more than .003 inch and not more than .002 inch when in the typing position. Be sure to clean the type bar after stoning, to remove all abrasive material that may have adhered to it.





SPACING RACK AND ROLLER PARTS



RIBBON OSCILLATOR

TM2215-165

Figure 145. Upper carriage mechanism.

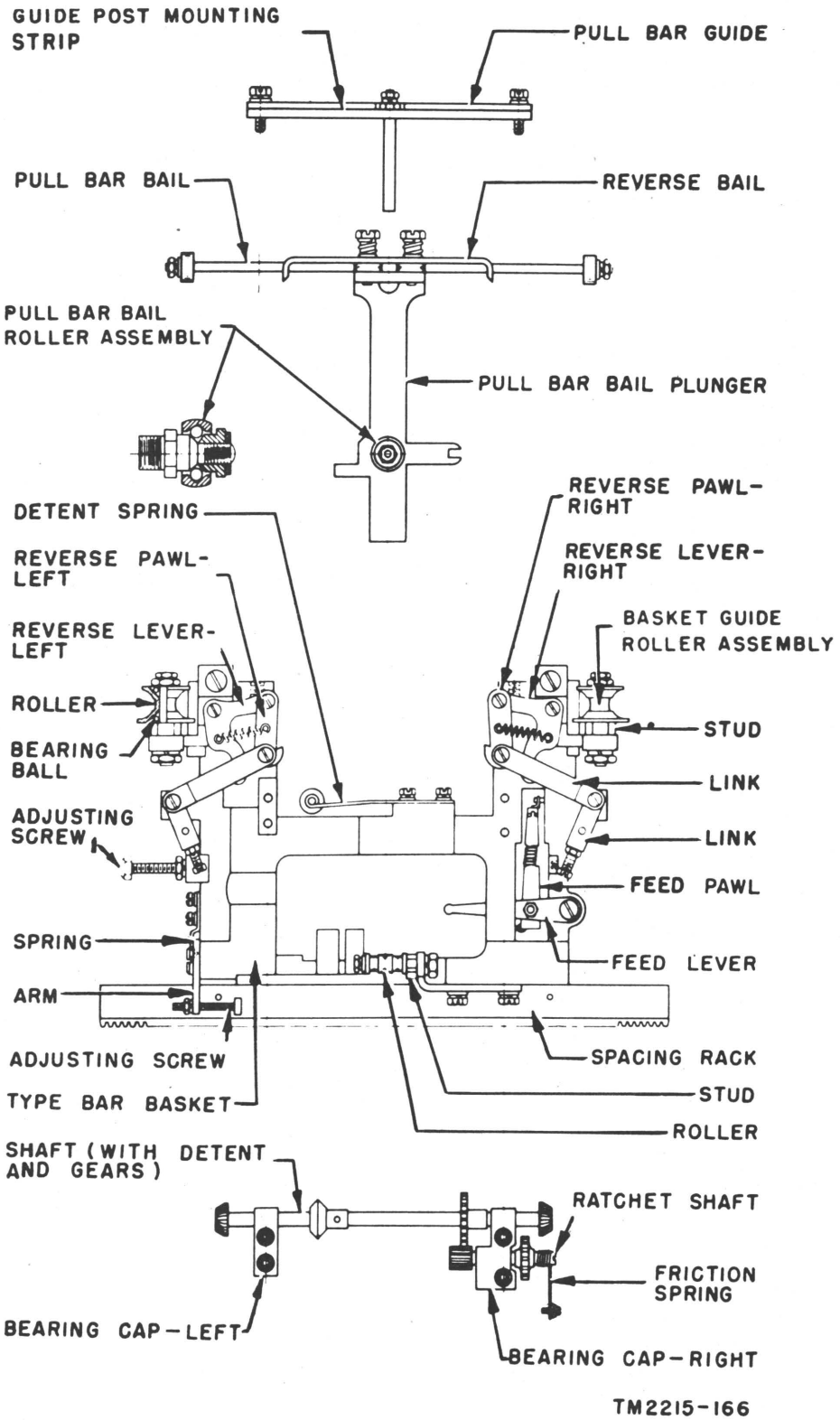


Figure 146. Lower carriage mechanism.

(4) Reassemble the type bar guide and ribbon carrier, and connect the oscillator lever to the ribbon carrier.

(5) Replace the type bar carriage in the typing unit (par. 156).

c. Repair of Type Bar Pallets.

(1) Use the special type bar toe straightening tools to straighten type bar toes.

(2) If necessary, reposition the 74294 adapter plate (fig. 145). Loosen the two mounting screws in the adapter plate, adjust to the required position, and retighten the screws. This plate is positioned at the factory when alining the type. Its disturbance may necessitate considerable work in realining the type.

(3) Adjust the horizontal alinement of the type pallet by heating with a soldering tool and moving the pallet, thus loosened, by tapping up or down (fig. 147).

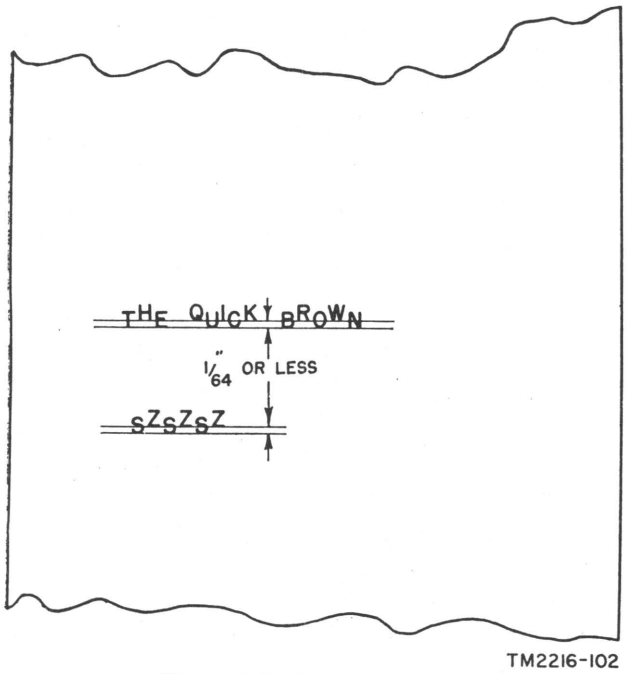


Figure 147. Type alinement.

(4) Straighten pallets by gripping the type bar firmly with the short-nosed pliers just below the pallet and bending the end of the type bar.

191. Reassembling Type Bar Carriage Parts

Generally, all parts are reassembled in the reverse order of that in which they were disassembled. If the parts have been cleaned, relubricate them as they are reassembled. Give particular attention to parts not easily reached after they are reassembled. Examine and reconcile any adjustments altered during the repair or maintenance work.

192. Instructions for Base Unit Repairs

a. General. After the keyboard, typing unit, and motor unit are removed from the base, the base can be lifted off the table for adjustment, or repairs that are found necessary. The base is not secured to the top of the table but sits on a protective pad. If necessary to inspect thoroughly or service the undersurface of the base, remove the steel plate from the bottom.

b. Mechanical Repairs. Repairs to the base are governed by the extent of damage or breakage. Normally the base requires little more than preventive maintenance. All mounting screws and similar fastenings should be examined and replaced if necessary. Examine the electromechanical devices such as the relay and fusetron mountings, terminal strips, line jack, and similar contacts and adjust them in accordance with instructions contained in section IX of this chapter.

c. Electrical Repairs. Repair or replace electrical devices promptly. Examine all wiring, and if faulty wiring is found, tape or replace it as soon as possible. Clean electrical contacts associated with the line jack and relay and adjust them as directed in section IX and applicable portions of TM 11-4302. Inspect, clean, and adjust the slip contacts and replace them if they are broken or bent too badly to be restored to normal condition.

d. Weatherproofing and Lubrication. Examine closely the weatherproofing protective coating of the wires associated with the base. Similarly, inspect carefully for rust or corrosion. When necessary, renew the protective coating and clean away all old grease or oil and replace it with clean lubricant as directed in paragraphs 41 through 47.

193. Repair of Cover

a. Repairs of the various parts of the cover are limited to cleaning as described in preventive maintenance instructions, straightening of bent or dented parts and replacement of glass, etc., as described in paragraph 197.

b. When any of the screws are broken and cannot be replaced, or if the threads within the hole

for a particular fastening screw are stripped, drill out the hole and retap it to accommodate a new flathead screw.

c. Replace or trim frayed padding or facing on the inside of the cover, to prevent it from dropping into the mechanism of the teletypewriter.

d. Replace broken lid stop arm and bracket, if necessary.

194. Table

Repairs or adjustment of the table normally will be confined to replacing electrical or mechanical parts that have become damaged or unusable. Electrical continuity checks of various signal and power circuits of the table usually reveal when wiring should be replaced or repaired. Similarly, examination of the line and power terminal devices and switches will determine when these should be repaired or replaced. Examine the line switching key, tape out switch, and the two power switches at the front of the table regularly and replace or repair them as necessary. The tape out switch and line switching key are of the spring contact type and should be adjusted for good electrical contact (as similarly instructed in paragraphs 488 and 489, and in TM 11–4302). Replace the pad on the top of the table, if required, and inspect the mounting for the transmitter distributor (par. 31). Examine the chad box and clean all chads. Finally, examine the table for broken metal or missing screws, and repair as necessary, before painting or refinishing. Apply weatherproofing coating to wiring and other surfaces as directed in paragraph 47.

195. Repair of Rectifier

a. General. Disconnect all power to the power unit, remove it from the rear shelf of the table, and set it upon a workbench to repair it. Repair of the rectifier power unit normally will include performance of all preventive maintenance procedures (par. 59). Such repair includes service and adjustment of the cover, tightening terminals and replacement of tubes, fuses, resistors or capacitors, if required. Replacement of major circuit components such as the time-delay relay, choke coils, tube sockets, transformers, etc., should include replacement of worn wiring, defective mounting screws, and brackets.

b. Mechanical. Broken or damaged parts revealed during inspection should be replaced promptly. Always use lockwashers and insulating washers wherever these items are used originally. Replace cracked or broken terminal panels, if possible. When any cricuit component is removed always tag, or otherwise identify, the conductors and the terminal from which it is removed. Then replacement can be made without confusion. If the color code can be recognized, it will identify the connection of the various wires and conductors. If the color has faded or the insulation is worn, replace the wiring.

c. Electrical. With a voltohmmeter (or other suitable continuity tester), and by use of the diagrams (figs. 268 through 276) as guides, test the various circuits to locate trouble. When trouble has been located, refer to the actual wiring diagram of the rectifier power unit (fig. 273) to locate the circuit component that requires replacement. If 323A grid-controlled rectifier tubes must be replaced, use tubes 323B as replacements. These tubes are completely interchangeable but tube 323B is the preferred type.

d. Adjustments for Output Voltage (pars. 18 and 490). Apply no power to the rectifier during the following adjustments.

(1) Connect the flexible lead on the left-hand top side of the tap and fuse panel to the terminal with a marking which most nearly corresponds to the available a-c voltage supply.

(2) Connect the flexible lead on the right-hand side of the tap and fuse panel to the terminal marked with the frequency that most nearly corresponds to the frequency of the a-c input to the rectifier (marked MOTOR CYCLES).

(3) Connect a 60-watt, 115-volt lamp in series with a suitable ammeter across the d-c output terminals of the unit, and connect a suitable voltmeter across the a-c output terminals.

(4) Connect power to the rectifier power unit. Operate the power switch to ON. It is necessary to connect a-c to the unit for approximately 20 seconds before d-c is available. This time delay is necessary for protection of the grid-controlled rectifier tubes.

(5) Take the reading of the adjusted motor voltage output of the rectifier power unit. The reading should be that on which the motor units of the operating compo-

nents of the teletypewriter will work—110 volts (nominal).

(6) The correct current reading on an ammeter connected across the d-c output ((3) above) is .5 ampere. This value may be achieved by adjusting the potentiometer with the slotted shaft (located in the center of the tap and fuse panel) with a suitable screw driver.

e. Adjustment of Time-delay Relay.

(1) The time-delay relay is located under a metal cover at the top of the door opening (when the rectifier power unit cover is in place). Adjust the time-delay relay by loosening one screw and sliding the cover off to the right; then use the adjusting screw and locknut located on the tie bar between the two bimetal strips. If d-c output fails to become available within approximately 1 minute after the power switch is turned on, check the following:

(*a*) The input fuse (lower cartridge type fuse on the tap and fuse panel). If it is burned out, replace it with a 10-ampere fusetron.

(*b*) The plate transformer fuse (lower fuse on the tape and fuse panel). If it is operated, replace it with a 3-ampere fuse.

(*c*) The filaments of both the 323A (or B) grid-controlled rectifier tubes. See that they are lighted.

(2) The front make contacts of the relay (the contacts nearest the door of the unit) should be closed.

(3) The bimetal should pull the relay armature down.

(*a*) If the bimetal does not pull the armature down, check the back contacts of the relay. These contacts normally are closed. The contacts in multiple are in series with the primary winding of the heater transformer. If the bimetal is inoperative and these contacts are *making*, it is an indication that the heater transformer is defective. Start the unit manually by depressing the relay armature with a stick or other nonconductive material. Once closed, the relay coil holds the armature in its operated position.

(*b*) If the d-c output rises considerably, or if the rectifier output does not regulate properly (*d*(6) above), either the neon glow lamp (LP3) or the amplifier tube (6F6G), or both, may be defective.

(*c*) If a high enough d-c output voltage cannot be obtained, one or both of the 323A (or B) tubes need replacing. If the line voltage drops considerably below the a-c input line voltage setting (on the tap and fuse panel) the d-c output voltage also will drop. In such a case, move the a-c input line connection to the next lower tap on the tape and fuse panel to match more nearly the actual line voltage.

(4) If the time-delay relay coil fails to hold the armature down magnetically, and the bimetal remains hot (a condition that can affect both the a-c and d-c outputs), proceed as follows:

(*a*) Check the relay magnet.

(*b*) Check the 1,500-ohm resistor (No. 1 on the resistor panel (fig. 272)).

(*c*) Replace as necessary. Usually it will be more practicable to replace the entire time-delay relay rather than the magnet coil alone. However, the bimetal strip can be replaced.

196. Emergency Repairs

a. General. Under *emergency conditions* normal requirements for new replacement parts are set aside and any available parts, assemblies, or units are used to restore service. Use locally constructed, or temporarily repaired, parts and nonstandard items, or adjustments, to restore service *only* upon proper authority; replace or readjust them at the earliest opportunity.

b. Repairs to Castings. Frames of cast-iron or steel sometimes may be repaired by brazing. Figure 148 shows a break repaired by this method. Be careful when setting up broken castings for brazing, especially when small errors in positioning cannot be corrected by adjustment.

c. Stripped Threads.

(1) When threads are stripped they sometimes can be repaired. Use the next larger size tap that has the same number of threads per inch, and use the next

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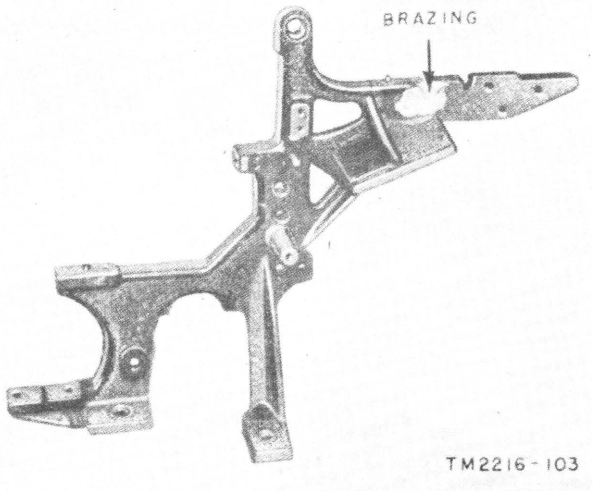


Figure 148. Repair by brazing (side frame).

larger size screw. For example, a No. 6–32 thread that is stripped can be re-tapped to take a No. 8–32 screw and the larger size screw can be used to complete the repair.

(2) When the above method cannot be used, necessary repairs sometimes may be made by drilling a clearance hole for the screw, soldering a steel hexagonal nut over the hole on the side away from the screw, and using a screw of appropriate size and thread.

d. Repairs by Soldering. Solder is used when joining metals that can be tinned. Such metals are copper, brass, and steel. Repairs must be made in such a way that there will be little strain on the solder. Figure 149 shows a repair by soldering a steel bar and a piece of metal bent to a **U**-shaped section to take the mechanical strain. Both the sheet metal (out of which the **U** section is formed) and the repaired part must be tinned with an acid flux. A large area of solder holds each side of the broken part to the sheet metal **U**; the sheet metal brace gives it joint strength. When acid flux is used, parts must be cleaned thoroughly in hot water to remove all traces of acid left after soldering.

e. Tempered Metal Parts.

(1) Parts such as small springs that are broken near one of the ends sometimes can be re-used after a new loop is formed by turning the broken end with a pair of pliers.

(2) Large springs and tools that are broken near the ends sometimes can be heated and bent into shape. Certain metals can be heated, re-formed, hardened, tempered, and resharpened to restore their usefulness.

197. Recover and Repair Requirements

a. General. Listed in this paragraph are examples of requirements for reconditioning the teletypewriter. In addition to requirements given in this section, all parts must meet the adjustment requirements of section IX of this chapter and the final test operating requirements of paragraphs 205 and 206.

b. Corrective Steps.

(1) Replace steel springs which are rusted beyond the stage of surface discoloration.

(2) Replace bearings with pits or discoloration that cannot be removed with solvent (SD).

(3) Free all interior surfaces of loose dirt, lint, chips, flaky rust, corrosion (formation of salts), dirty oil, and any other foreign matter.

(4) Replace faulty parts when adjustment requirements cannot be met.

c. Mechanical Features.

(1) Screws and nuts should not be stripped and, except those used for adjusting purposes, must be set tightly. Adjusting screws equipped with locknuts must be held tightly in place by the locknuts.

(2) Screwhead slots must not be so burred as to interfere with engagement and

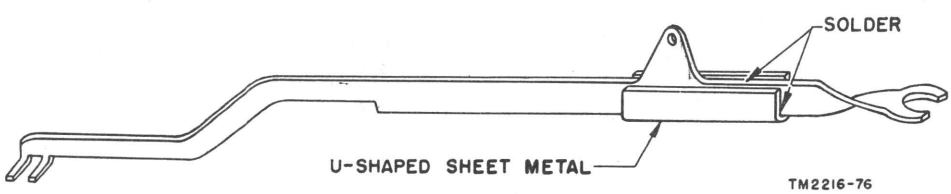


Figure 149. Repair by soldering.

turning with a screw driver. Nuts and heads of bolts may be burred slightly provided they can be engaged properly and turned with an open-end or socket wrench.

(3) All parts should be free from slivers, splinters, sharp burrs, and sharp edges, which may cause personal injury.

(4) Lockwashers removed in the course of repair operations should be replaced if locking edges are rounded.

(5) If parts are loosened or readjusted, the contact points should fall within the circumference of the opposing contact points, except where contacts have the same diameter; then the contact centers should not be out of alinement more than 25 percent of the diameter.

d. Electrical Features.

(1) Insulation on wiring must not be worn, loose, or frayed. Varnished cambric tubing should not be torn. Defective wires are replaced with #18 art silk-covered, single-conductor Deltabeston fixture wire, of the same color, sewed into cable. Slightly worn insulation must be repaired with friction tape or shellac varnish.

(2) The location of cables should not interfere with moving parts.

(3) Insulation between insulated metal parts and between metal parts and wiring should be capable of withstanding a standard a-c insulation break-down test of 500 volts (frequency, 15 to 65 cycles) for at least one-quarter second.

(4) Coils, capacitors, and resistors should show no signs of having been burned, overheated, or otherwise damaged. Capacitors with cracked compound and capacitor cans and coil coverings which are torn must be considered damaged and should be discarded and replaced.

e. Marking. The serial number should be sufficiently legible to be identified under ordinary lighting conditions. If the serial number is missing or illegible, it often is possible to obtain the correct number from the records. If not, arrange to assign a substitute number for identification purposes.

f. Typing Unit. Refer to paragraphs 183 through 191.

(1) Castings should not be cracked or broken. If the platen unit casting is cracked or broken, replace it. If any other casting is broken, replace the typing unit; then repair the defective unit by replacing the broken casting and making all necessary adjustments.

(2) Shafts must be free of bind and have no broken springs, hard or glazed felt washers, or obviously worn gears, bearings, or clutch parts, the replacement of which will require removal of the shafts. Replace or repair typing units that do not conform.

(3) Spacing and escapement pawls should not be worn more than .010 inch at the point of engagement with the main shaft spacing ratchet. This may be judged by eye. Replace or repair typing units that do not conform.

(4) Hard or glazed friction clutch felt washers, or those removed in the course of repair, and felt lubricating wicks should be replaced by new washers or wicks which are saturated thoroughly with oil.

(5) Printing and function bail shaft bearings should not have more radial play than .015 inch when the printing and function bail springs are unhooked and the printing bail roller is on the low part of its cam. Judge by eye and feel. Replace or repair typing units which do not conform.

(6) Printing and function bail roller assemblies should have no more radial play than .015 inch when the printing and function bail springs are unhooked and the rollers are on the low part of their cams. Judge by eye. Replace worn roller assemblies.

(7) Function bail blade and the associated push bars or reset bars should not be worn at the points of engagement more than .010 inch deep. Judge by eye.

(8) Printing bail blades, carriage tracks, and the platen slide bar should not have worn spots more than .010 inch deep. Printing bail blades may be reversed to present unworn surfaces to the pull bar bail plunger roller.

(9) The function lever roller should rotate freely and should have no more than

.008-inch and .015-inch radial end play, respectively, when not in contact with the function levers. Replace worn parts.

(10) The type bar backstop should not be worn more than halfway through the leather. Replace nonconforming *leather* strips.

(11) Type pallets may be replaced or moved on type bars by heating solder first. Pallets should be soldered in position with nonacid flux.

(12) The carriage draw strap must not be frayed. Replace worn straps.

(13) Platen surface should be smooth and not cracked, swollen, worn, or pitted by type. Rubber should be tight on the metal core.

(*a*) The platen may be smoothed after removal from the typing unit by rubbing with No. 0000 or finer sandpaper placed around the platen.

(*b*) Replace the platen if rubber is loose, cracked, swollen, or worn.

(14) The selector cam sleeve should not have more than just barely perceptible radial play with the retaining disk removed and spring tension released.

(*a*) Replace the selector cam sleeve if it is loose or if any affected adjustments cannot be met.

(*b*) If it is still loose, replace the main shaft.

(15) The locking lever must not be worn at point of contact with its cam on the selector cam sleeve. Replace worn locking levers.

(16) The locking lever and the locking wedge should have no more than .005-inch wear at points where they engage each other.

(17) Armature extensions should be free of grooves at points of engagement with swords. Replace worn armature extensions.

(18) There should be no obvious wear in the following parts: clutch teeth; throw-out lever; vanes; bell cranks; code bars; T levers; pull bars; rangefinder mechanism; and all rollers. No perceptible wear should be permitted in the trip latch or the stop lever. Replace worn parts and make adjustments as directed in section IX of this chapter.

(19) Replace the stop nut and screwhead of the pulling magnet selector if they show a worn ridge at the point of engagement with the armature.

(20) Radial play in the selector armature bearing should not be more than barely perceptible when the end play has been adjusted to a minimum. Replace worn armature or pivot screws or both.

(21) Selector swords and lever posts shall be equipped with a nut and lockwasher on the under side of the selector mounting plate.

(22) The paper insulator, 74946, should be between the terminal board on the rear crossbar and the crossbar (fig. 150).

(23) New black ribbons should be supplied with repaired typing units.

(24) The main shaft drive gear and other fiber gears should not be worn or have any broken teeth.

g. Perforator Transmitter.

(1) Keytop characters should be clean and distinguished easily under average lighting conditions.

(2) Transmitter contacts should not be worn more than .025 inch thick and must have no build-ups, pits, or broken springs.

(*a*) Contacts may be filed flat with contact file 91117, and then burnished with burnisher 88993.

(*b*) The various contacts should have the thickness listed below:

Contacts	*Minimum thickness*
Punch magnet	.040″
Signal Lamp	.040″
Cam pulsing	.040″
Transmitting	.025″
Perforator control	.040″ Top and next-to-bottom springs (other springs, .045″).
Counter control	.008″ (old style, .045″)

(*c*) The insulators adjacent to the contact springs should be cleaned free of metal filings and dirt.

(3) The cam sleeve end (bushing or nut) should project beyond the front end of the cam at least five-thirty-seconds inch or .156 inch, so that contact levers are centered approximately on their respective cams.

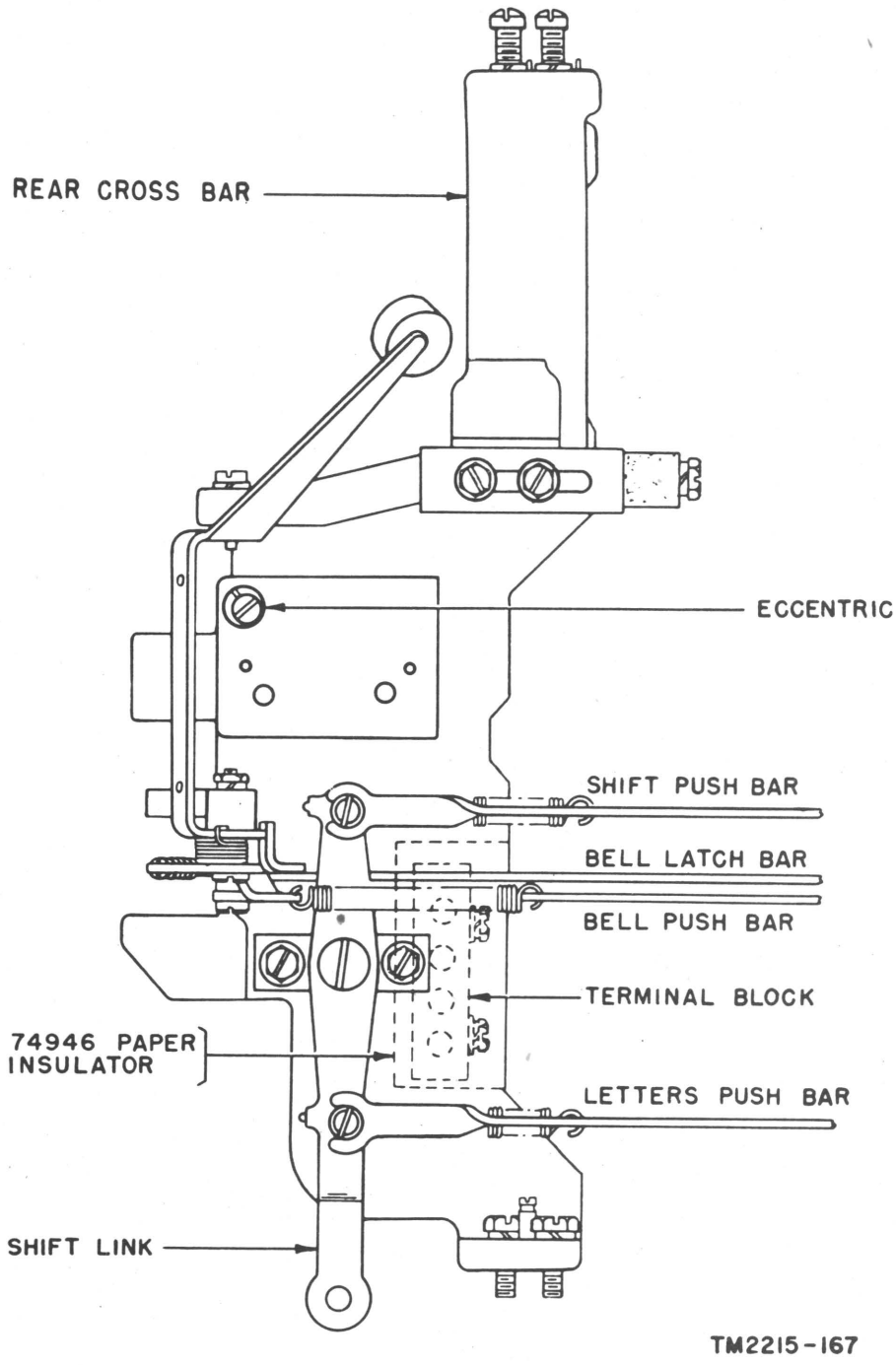


Figure 150. Typing unit contacts and rear crossbar parts.

(4) If requirements are not met, replace the cam sleeve assembly and oil wicks. Place the oil wick in the rear shaft bearing so it projects into the bearing (approximately one-sixteenth inch) and place a felt button, 90438, in the closed end of front shaft bearing oiler 7383.

(5) The transmitter shaft should not be scored or worn.

(6) The transmitter shaft driving gear should not be worn or have any chipped teeth.

(7) Front shaft bearing and cam sleeve wear, measured by the movement of the

contact on the long front transmitting contact spring, should not exceed .002 inch when the front contact lever is on the high part of its cam and the front cam is pressed downward by hand.

(8) Capacitors should show no evidence of flow of the sealing compound.

(9) Punch selector fingers, except the feed punch finger, should have high spots and burrs stoned down to clear their retainers. This applies only to units with a two-piece armature and a follow-through feature.

(10) The nonmagnetic plate on the counter armature should lie flat against the armature and within .004 inch.

(11) A punch block so worn that satisfactory punchings cannot be obtained by readjusting the punch travel should have the worn parts replaced. Alinement of guide and die plates so that punch pins line up accurately with their holes in these plates may be accomplished by tapping the plates into alinement after tightening the plate mounting screws friction-tight.

h. MOTOR UNIT. (pars. 157 through 174).

(1) Motor bearings should turn freely and not contain any grit. Replace bearings which cannot be cleaned, or are coated with a yellowish varnishlike substance after cleaning. Refer to paragraph 159 before removing the bearings. Bearings may be flushed with high-grade kerosene, mineral spirits, or noncorrosive cleaning fluid if all cleaning fluid is removed from the bearings and they are packed with grease before reassembly on the shaft.

(2) Motors should be equipped with ball oilers in good condition on each bearing. Normally, grease is applied to the ball bearings through the ball oilers when it is not necessary to dismantle the motor.

(3) Surfaces of commutators and governor contact disks should be free from burns, scores, pits, or other deformation of surface or structure, except slight scoring caused by normal wear. Commutators must not have high, low, or loose segments or flat spots. Remove slight defects by sanding surfaces with No. 0000 or finer sandpaper. Remove deep grooves by machining, provided bearings are removed from rotor shaft and care is taken to remove all chips from space between commutator segments before reassembling bearings on shaft.

(4) Contact surfaces should be bright, smooth, and the equivalent of those on new contacts in these respects:

(*a*) Should be flat and free from pits.

(*b*) Should be parallel to the under side of the contact screwhead.

(*c*) Should not be worn less than .015 inch thick.

(*d*) Tungsten contact screws (old style) should be clean, and threads should not be damaged. If the contact point is replaced, the new contact should be screwed into the contact arm and soft solder applied to the threaded end. Later style contacts lack screw threads and are welded to contact spring (par. 169). *Always replace contacts in pairs.*

(5) Motor brushes must be free to move in holders without excessive play.

(6) Motor brushes should be at least five-eighths inch long exclusive of their springs. Brush ends should be shaped so that at least one-third of their area, over 75 percent of their length, bears on the commutator. Flexible shunt wire should not be broken, kinked, or loose in the brush.

(7) Carbon governor brushes on the center contacting governors must be at least one-eighth inch long.

(8) Target illuminating assemblies, which require repair or replacement other than replacement of the lamp, should have the entire assembly removed and the wires to the lamp taped, unless directed otherwise by proper authority.

(9) The governor adjusting wheel leather rim should project beyond its metal washers at least one-thirty-second inch.

(10) Shims 91617 should be added on the rotor shaft between the governor and the end frame of the motor so that the governor adjusting wheel clears the wearing strip appreciably when the adjusting lever is in its normal position and the governor is pushed against the tension of the motor end play spring as far as possible.

(11) Insulation on wiring should not be worn, loose, or frayed. Insulation may be repaired with friction tape or shellac varnish. Replace defective wire with black #18 art silk-covered single-conductor Deltabeston fixture wire.

(12) Motor control cable 74789 should be fastened with lock stitch cord to the rear crossbar casting behind the right end of the clutch throw-out lever bracket.

(13) The character of sparking observed at motor commutator and governor contacts should not differ from that usually encountered on new apparatus. Refer to paragraphs 41 through 47 for lubrication and paragraphs 207 through 490 for adjustments.

i. Base Unit (par. 192).

(1) Fuse blocks may have small chips without impairing efficiency, but may not have broken porcelain. When fuse blocks are broken, they should be replaced and mounted with felt washers 90752 between block and casting and without lockwashers.

(2) Fiber insulating sheets above the keyboard and the typing unit slip connections in the resistance mounting and adjacent to the capacitors should not be broken or chipped to permit insulated parts being short-circuited.

(3) Line relay and resistance mounting and contacting springs must not be broken or bent to prevent these parts from holding the relay or resistance mounting securely or providing good electrical contact.

(4) SEND—REC—BREAK mechanism wire guard 74744 should have a properly shaped long vertical flange sufficiently high to protect the wiring to the upper terminals.

j. Line Relay.

(1) Line relay contacts should not be worn, rough, or pitted; windings should show no evidence of being burned, overheated, or otherwise damaged.

(2) Replace line relays which do not conform with the above requirements and adjust in accordance with paragraphs 476 through 481.

(3) If only the contacts are defective, replace the armature with its contacts and antichatter springs.

(4) Clean or replace the line relay and selector circuit closing jack contacts as required.

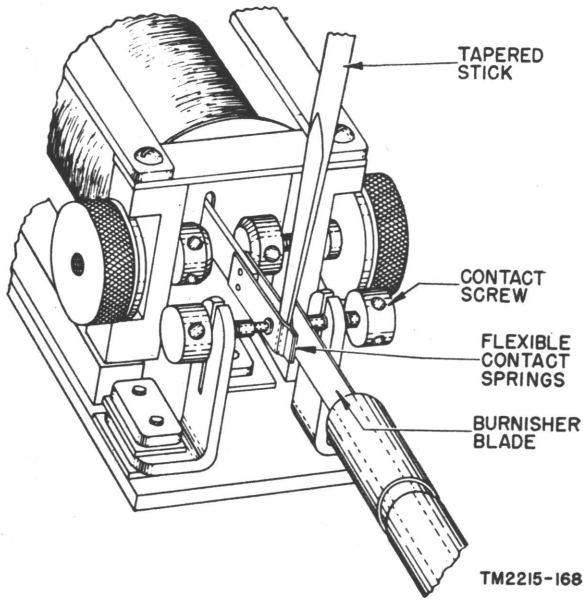


Figure 151. Burnishing line relay contacts.

k. Covers (par. 193).

(1) Cover doors should operate freely on their hinges, and detent knobs should engage the detent springs to hold the doors closed firmly.

(2) Cover windows are clamped firmly in covers and should not be cracked or chipped on the bearing edges to expose any sharp edges which may cause personal injury; three forty-second inch felt may be glued to the inside surface of the ear which forms the lower support for the glass.

(3) The copyholder message line guide should operate freely and not be blurred or have sharp edges which may damage the finish. Sharp edges on the under surface of the guide may be removed with No. 0000 sandpaper or finer abrasive cloth.

(4) Cover pads should fit snugly against the inside of the cover. Tears more than 1 inch long may be repaired by sewing.

l. Table.

(1) The table should not have broken screws or metal, frayed or broken wiring, or insulation.

(2) The one-piece pad and associated metal channels should be in good condition on the top of the table. Use diagrams (figs. 268 through 276) to check resistance and continuity if circuit trouble is indicated.

m. RECTIFIER (pars. 18, 139, and 490).

(1) Fuses, tubes, and all contact surfaces should be clean and in good condition.

(2) The hinged cover must fit and close properly.

(3) Terminals and terminal panels should not be broken or cracked.

(4) Rectifier wiring should not be cracked, brittle, frayed, broken, or faded beyond the point of recognition of the color code. Use the diagram in figure 272 when checking circuits.

Section VII. CIRCUIT DATA

198. General Circuit Features

Electrical circuits for the various components listed in the following six paragraphs are explained in detail in other sections of the book and are illustrated in figures 268 through 276. Use the table of contents and the index to obtain circuit information on the individual units listed below. Refer to paragraphs 19, 55, 83, 158, 210, and 211 for motor information.

199. Table Circuit

a. Electrical circuits of the table include wiring, terminal boards, plugs, receptacles, slip connections, jacks, and switches for connecting a-c to the rectifier, for distributing d-c from the rectifier to the various local circuits, and for connecting the signal loop or loops to the local transmitting and receiving components. The table also contains variable resistors for regulation of current in two loops and the local test circuit from the local rectifier.

b. For further details, refer to paragraphs 8, 9, 10, 16, 18, 21, 31, 53, 66, 132, 194, 489, 494, and appendix II.

200. Base Circuit

a. The base has four terminal strips, a line relay mounting bracket with filter resistors and capacitors, the SEND—REC—BREAK key, slip or spring contacts for mounting the perforator transmitter, the typing unit and the motor, a solenoid type of motor control relay, a motor switch and fuse, a convenience receptacle, a-c, d-c, and signal loop connector plugs with cords, motor circuit resistors, and switches for closing the loop when the relay, typing unit, or perforator transmitter is removed from the base.

b. For more complete information refer to paragraphs 54, 83, 133, 192, 488, 494 and to the additional references in paragraph 199.

201. Line Relay Circuit

a. The line relay circuit consists essentially of a low-inductance line winding and a bias winding which control the movement of an armature having two contacts (one on either side). These contacts, in turn, actuate the selector magnets from the local d-c power supply. The bias winding is supplied with current from the local power supply and is connected into the circuit by the polar-neutral key when neutral signals are received. This winding pulls the armature contact against the spacing contact for the spacing impulses received.

b. For more detailed information refer to paragraphs 9, 71, 74, 192, and 476 through 481 and to figures 268, 269, and 276.

202. Typing Unit Circuit

a. The typing unit circuits include the selector magnets, part of the send-receive-break mechanism with keyboard shunt (lock-out with key in REC position) contacts, the mechanical motor stop contacts if the typing unit is in a TT–7/FG teletypewriter; and a set of terminal board contacts to make contact with the other components when set in place on top of the base.

b. For further details, refer to paragraphs 5, 7, 14, 15, 16, 32, 56, 71, 77, 97, 126, 134, 183, 271, 280, 285, 363, and 364 and to figures 268 and 269.

203. Keyboard (Perforator Transmitter) Circuit

The perforator transmitter includes, essentially, the following:

a. Slip connections to make contact with the base, loop, and other components.

b. Transmitting contacts with filter, polar-neutral key, and perforator and keyboard control contacts operated by keyboard control lever.

c. Perforator mechanism consisting of punch contacts with a filter and two resistors, and the cam pulsing contacts with a filter.

d. Character counter with counter control contacts, counter magnets, signal lamp, and release magnets (fig. 270).

204. Rectifier Circuit

a. The power circuit consists essentially of an autotransformer, necessary control and filament windings for the operation of the grid control rectifier network, an insulating type plate transformer, suitable radio interference filters on both a-c input and d-c output circuits, d-c output filter consisting of a choke and two capacitors, resistor network, two grid-controlled rectifier tubes, a voltage standard tube, and an amplifier tube. These parts are secured to a metal base which has metal feet for shelf mounting.

b. The main terminal panel, which is located directly behind the hinged door in the cover, contains terminals for a-c input taps, a-c output taps, fuses, and a potentiometer. The a-c input taps for the line voltages of 95, 105, 115, 125, 190, 210, 230, and 250 volts are located on the top and left-hand side of the panel. The a-c output taps to adjust voltage properly for operating series-governed motors on frequencies of 25, 40, 50, or 60 cycles are located on the right-hand side of the panel.

Section VIII. FINAL TESTING

205. Preparation

Make adjustments as directed in section IX, paragraphs 207 through 490. Lubricate teletypewriters according to the instructions given in paragraphs 41 through 47. Refer to paragraph 206 for tests on assembled teletypewriters.

206. Final Tests and Adjustments

For the following tests, connect the teletypewriter to a suitable power supply. Place the SEND—REC—BREAK key in the SEND position unless otherwise specified.

a. The motor should start and rotate without excessive sparking at the commutator and at the governor brushes.

(1) The motor speed and position should conform to provisions of paragraphs 211 and 367.

(2) If contacts are not bright, smooth, flat, free from pits, more than .015 inch thick, and parallel to the under side of the governor contact screwhead, replace the governor.

b. The selector clutch torque should conform to the requirements of paragraph 377 (14 to 18 ounces after running for 10 minutes).

c. The type bar carriage should move one character space to the right each time a character key or the space bar is depressed and should repeat space to the end of the line when the space bar is held depressed.

(1) Carriage rollers should rotate freely and guide screws should not bind in the groove in the front carriage track.

(2) Selector vanes should be straight.

(3) Spacing mechanism and carriage return spring adjustments on the typing unit should conform to section IX of this chapter.

(4) Adjustments of the repeat space mechanism on the keyboard should conform to section IX of this chapter.

d. Paper should feed correctly, one or two lines per line feed operation, depending on the position of the single-double line feed lever, when the LINE FEED key is depressed.

(1) The pressure roller release shaft arm should be in the forward position.

(2) The platen shaft should be free of bind.

(3) The line feed function lever should be free of bind.

(4) Adjustments of the line feed, platen roll, and paper mechanisms should conform to section IX of this chapter.

e. The type bar carriage should return to the left side of the typing unit from any point of its travel without bounce within the time allotted for one carriage return and one line feed operation when the CAR RET, the LINE FEED, or

any character key is depressed, in turn, as rapidly as permitted.

(1) The carriage rollers should rotate freely without bind.
(2) The selector vanes should be straight.
(3) The carriage return function lever should be free of bind.
(4) The carriage return linkage should not have more than 3/32-inch play measured on the lock bar. Judge by eye.
(5) Adjustments of the carriage return mechanism and dash pot should conform to section IX of this chapter.

f. The platen should shift and unshift when FIGS and LTRS keys are depressed alternately and, unless otherwise specified, when the FIGS key and the space bar are depressed alternately.

(1) The platen assembly should be free of bind.
(2) The shift linkages should be correct.
(3) FIGS, LTRS, and space function levers should be free of bind.
(4) The unshift-on-space, cut-out lever adjustment should conform to section IX of this chapter.
(5) The shift mechanism and the sixth vane adjustments should conform to section IX of this chapter.

g. The signal bell should ring when the platen is in FIGS position and the BELL (upper case S) key is depressed.

(1) The bell hammer and its operating lever should be free of bind.
(2) The bell function lever should be free of bind.
(3) Adjustment of the signal bell mechanism should conform to section IX of this chapter.

h. The motors should stop when FIGS and STOP (upper case H) keys are depressed in turn.

(1) The pawls, lever, release lever, and function contact lever of the motor stop mechanism should be free of bind.
(2) Adjustment of the motor stop mechanism should conform to section IX of this chapter.

i. Motors previously stopped by the remote motor control mechanism should start when the BREAK lever of the SEND—REC—BREAK mechanism is depressed to the BREAK position momentarily, when the line circuit to the magnet is opened momentarily, or when the line circuit to the magnet is opened momentarily.

(1) Adjustments of the SEND—REC—BREAK contacts should conform to section IX of this chapter.
(2) Check (8) (*a*) and (*b*) above.

j. SEND—REC lever on sending-receiving teletypewriters should move from the SEND to the REC position when the line circuit is opened for a period of at least the length of two blank signals. Adjustments of the SEND—REC—BREAK mechanism should conform to section IX of this chapter.

k. The teletypewriter should receive undistorted miscellaneous matter signals, such as the *test paragraph* (fig. 152). It should type all characters without error, with uniform impression, even spacing, and even left margin. The excess characters at the end of a line should overtype partially the last character of the line.

(1) If characters are incorrect or omitted, check the following requirements in the order given. When satisfactory operation is obtained, discontinue these checks.
(*a*) The rangefinder arm should be set at the optimum setting for distorted signals.
(*b*) The type bars should not bind in the type bar segment or guide slots.
(*c*) The pull bars should be free of bind.
(*d*) Code bars, bell cranks, selector vanes, T levers, and selector levers should be free of bind.
(*e*) The pull bar and operating lever rollers should turn freely without bind.
(*f*) The armature extension of the selector mechanism should be free of grooves at points of engagement with the swords.
(*g*) The locking wedge should not be worn more than .005 inch (judged by eye), at points of engagement with the locking lever.
(*h*) The stop nut should be tight on the stop screw of the pull magnet selectors, and neither the screw head nor the nut should show a worn ridge at the point of engagement with the armature.
(*i*) Adjustments of the selector mechanism, rangefinder, vanes, code bars, and typing mechanism should conform to section IX of this chapter.

(2) If typed copy does not have a uniform impression, check the following requirements in the order given.

(*a*) The ribbon should not be dry or show signs of wear.

(*b*) The type bars should not bind in type bar segment or guide slots.

(*c*) The pull bars should be free of bind.

(*d*) The ribbon mechanism, typing mechanism, type bar guide, and type bar backstop adjustments should conform to section IX of this chapter.

(*e*) If the left margin is uneven, check the left margin adjusting screws, dash pot, and the carriage return mechanism.

(*f*) If the character spacing is uneven, check the type alignment and spacing mechanism adjustment.

(*g*) If the excess characters do not partially overtype the last character of the line, check the right margin adjustment.

l. The teletypewriter should receive and type, without error, miscellaneous matter signals, such as the *test sentence*, sent from a transmitter distributor at 61 wpm and distorted in turn with 40 percent marking and spacing bias when the rangefinder arm is at the *optimum setting for bias.* If the teletypewriter is being adjusted for special 75 wpm service, test it on signals sent at 75 wpm instead of 61 wpm. If the teletypewriter fails, check the following points in the order given and when satisfactory operation is obtained, discontinue these checks.

(1) The armature spring tension and magnet bracket adjustments should be at fixed values within the limits specified.

(2) The main shaft clutch teeth and the main shaft clutch throw-out lever should not be obviously worn, or have bind or excessive end play.

(3) Selecting vanes, bell cranks, code bars, and T levers should not bind or be obviously worn.

(4) The armature extension should not be obviously worn at points of engagement with sword arms.

(5) The rangefinder mechanism should not bind, should not be obviously worn (check

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TM2215-169

Figure 152. Test paragraph.

especially wearing edges of trip latch and stop lever), and its adjustment should conform to section IX of this chapter.

(6) The selecting mechanism, vane and code bar mechanism, and pull bars should not be obviously worn.

m. The teletypewriter should type and punch in tape, without error, miscellaneous matter signals such as the test paragraph or the test sentence with the keyboard control operating lever in KBD & TAPE position. With the keyboard control operating lever in TAPE position, only the perforator will operate to punch tape and the character counter will count the perforated characters. For adjustment data, refer to section IX of this chapter.

n. Signals sent by the keyboard of a sending-receiving teletypewriter should be such that the upper and lower limits of orientation range are within 5 points of the upper and lower limits of the range obtained when undistorted signals sent by a transmitter distributor adjusted to send at the same speed as the teletypewriter are received. If characters are incorrect or omitted, check the following requirements in the order given. When satisfactory operation is obtained, discontinue these checks.

(1) Key levers should move freely in their guide slots and rest against their upstop.

(2) The selector bars and rollers should be free of bind.

(3) The contact and locking levers should be free of bind.

(4) The transmitting shaft and cam sleeve should be free of bind.

(5) The clutch teeth shall disengage fully when any key is held depressed.

(6) Adjustment of the keyboard (perforator transmitter) shall conform to section IX of this chapter.

(7) The teletypewriter should receive and type undistorted miscellaneous matter signals, such as the *test paragraph*, without error in at least 5 copies of the test paragraph.

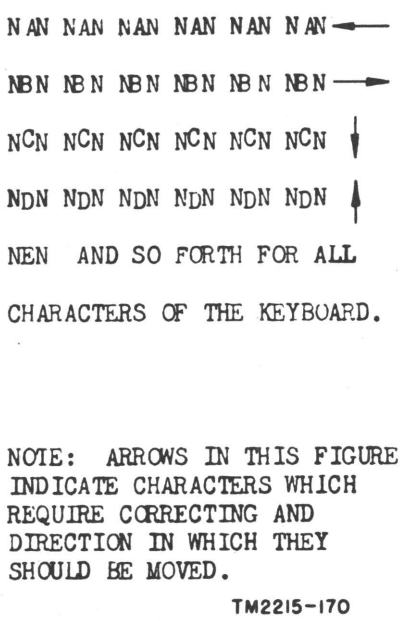


Figure 153. Type alinement and corrections.

Section IX. APPARATUS ADJUSTMENTS AND REQUIREMENTS

207. Apparatus Tests and Adjustments

a. General. Data in this section includes all test requirements and adjustments for Teletypewriters TT–7/FG and TT–8/FG. The information is arranged in the sequence normally to be followed when test and adjustment of a complete teletypewriter is undertaken.

b. Index. When a complete test and adjustment is not involved, refer to the index to locate the information desired. Always remember that a change in any one adjustment requires checking of all related adjustments.

208. Details of Requirements and Procedures

The information in the following paragraphs is arranged under three headings: preparation, requirements, and adjustments.

a. Preparation. Instructions for arranging the unit for testing or adjusting are furnished under this heading.

b. Requirements. Measurements, spring tensions, settings, clearances, etc., that have been found by experience to give the best restults are furnished under this heading. Some requirements

have a very small working margin or tolerance; others have a relatively large tolerance. Because of slight differences in various machines of the same model, some teletypewriters function better when clearances are adjusted to the minimum values recommended; other teletypewriters give better results when clearances are adjusted to maximum values. The same is true of spring tensions and air gaps. The specifications given for clearances and spring tensions, should be applied as necessary to give the best results and operation.

c. Adjustments. Each adjustment is described in the text and frequently is shown in accompanying illustrations. Adjustments vary in type, including the replacing of an old spring with a new one, bending a leaf type spring with a spring bending tool, emergency cutting and forming of new loops on coil springs, repositioning eccentric screws, and inserting shims between certain parts. When making adjustments, set the clearances, midway between the minimum and maximum values until it can be determined if more critical adjustment is required. Before adjustment of each mechanical unit, determine the rangefinder upper and lower scale readings (par. 212). After the adjustment of the components, again check the rangefinder upper and lower scale readings. A range of 80 between the upper and lower scale readings indicates the teletypewriter is in satisfactory operating condition. Maintenance of a range of 80 usually indicates that most of the major components of the unit that directly affect transmission and reception are properly adjusted.

209. Preparation for Checking and Adjusting

a. General. Teletypewriter adjustments are made on the basis of various units and assemblies. To facilitate checking and adjusting, or to set up certain functions, remove some of the units and assemblies.

b. Setting Up Certain Characters or Functions. When the instructions specify setting up of certain characters or functions, rotate the main shaft until the printing bail is in its extreme rear position. Hold the front edges of the vanes down to correspond to the marking impulses and up to correspond to spacing impulses of the code combination to be set up (fig. 59). Then rotate the main shaft as directed in the particular adjustment.

c. Spring Tension. Spring tension values given are derived from requirements made with spring scales. To obtain the proper spring tension readings, use the spring scales included in the teletypewriter tool kit (Tool Equipment TE–50 or TE–50–A).

d. Fixed Pivot Points. Fixed pivots are indicated in the illustrations by solid black circles.

e. Shim Pile-Ups. Before starting to adjust any part, read the procedure of the adjustment carefully. After the adjustment is completed, be sure to tighten any screws or nuts which may have been loosened. If a part that is mounted on shims is to be dismantled, the number of shims used at each of its mounting screws should be noted so that the same shim pile-ups can be replaced when the part is remounted.

Caution: Be careful when removing or installing the cover to avoid damaging parts in close proximity. As a precaution, raise or lower the cover slowly with a vertical movement.

210. Reassembly after Repairs and Adjustment

When a teletypewriter, disassembled for repair and adjustment, has been completely overhauled and is ready for reassembly, follow the directions given in paragraph 14. Be careful when lifting and moving any of the components so as not to put any part under undue stress and thereby disturb critical adjustments. When setting the typing unit on the base, hold the unit so that, when the left-hand side is resting on the base, the main shaft gear is just ready to mesh with the motor pinion. Rotate the motor shaft slowly while carefully lowering the right-hand side of the unit so as to secure proper engagement between the main shaft gear and the motor pinion. Be sure that the typing unit is placed properly on the locating studs of the base. Figure 154 shows the motor pinion and main shaft gear alinement.

211. Adjusting Motor Speed
(figs. 66 and 256)

Synchronous motors do not require governors because they are constant speed motors. The speed of a governed motor is checked by viewing the target on the motor governor through the vibrating shutters of a speed indicator (tuning fork) provided for this purpose. With the motor running and the target well illuminated, tap the speed indicator lightly to make it vibrate and hold it so that the shutters are close to the eye. If

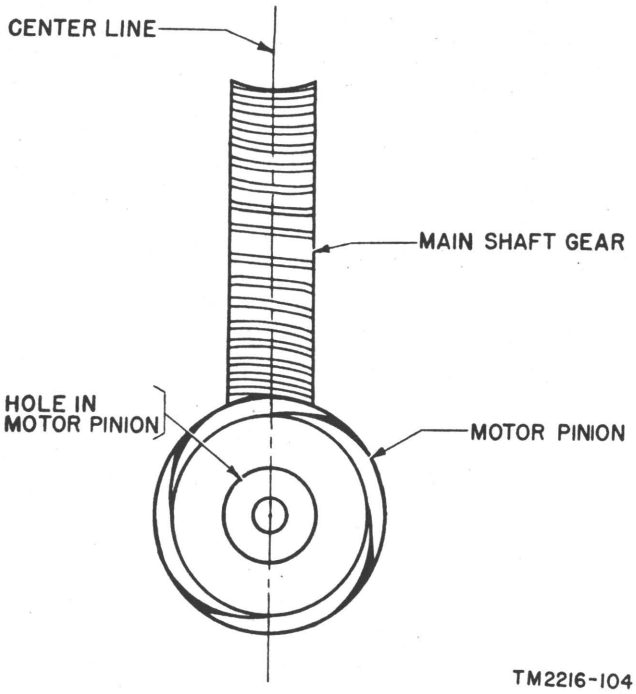


Figure 154. Alinement of motor pinion and main shaft gear.

the motor is running at the correct speed, the target will appear stationary. If the motor speed is too fast, the target will appear to be moving in the direction of rotation; if the motor speed is too slow, the target will appear to be moving in the opposite direction. Refer to paragraph 19. There is a possibility of setting the speed incorrectly, because of getting a speed multiple; for example, the speed could be one-half or two-thirds of the desired speed (or some other multiple) even though the spots appear to be stationary when viewed through the speed indicator shutters. When increasing or decreasing the motor speed, depress the governor adjusting lever or the governor adjusting bracket momentarily. Refer to figure 66 for the location of parts.

212. Measuring Receiving Range

(fig. 155)

a. Mounted on the left end of the typing unit is the rangefinder assembly which is used for the purpose of orientating the selector mechanism to the incoming signals.

b. Before proceeding to measure the receiving range on a unit, turn the selector armature spring adjusting screw to a position where it will require 6 to 6⅜ ounces to stretch the armature spring to its position length. Then alternately transmit RY to the teletypewriter continually while the receiving range is being determined. The range may be taken as described in subparagraph *c* below.

c. While RY is being received, loosen the index arm thumbscrew and shift the index arm of the rangefinder toward 0 until errors appear in the copy. Then move the arm back slowly until errors no longer appear; at least 72 characters should be received without error. This position indicates one limit of the orientation range. Note the position of the index arm on the scale. Determine the opposite end of the receiving range by repeating the foregoing procedure with the index arm near the opposite end of the scale. After the two limits of the receiving range are found, set the index arm of the range scale midway between these two points. If facilities for transmitting biased test signals to the receiving unit are available, set the index arm at the optimum setting for the reception of biased signals.

d. Instructions in this subparagraph for emergency and test operation apply only to units equipped with pulling magnet selectors connected directly (no line relay) into a line circuit with biased signals. Turn the armature spring adjusting screw in a clockwise direction until errors appear in the copy; then, from this point, count the number of turns that can be made in a counterclockwise direction before errors again appear in the copy. Turn the adjusting screw backward (clockwise), half this number of turns, to a point midway between the two failing points or the middle of the armature spring range, and lock the adjusting screw with its locknut. If no errors appear in the copy throughout the entire range of the spring, set the spring tension at 6 to 6⅜ ounces, and lock the adjusting screw. Recheck the orientation range after the armature spring range is determined.

213. Plunger Guide Roller Bracket Adjustment

(fig. 156)

a. Preparation. Remove the type bar carriage (par. 157).

b. Requirements. There should be not more than .010-inch clearance between either the right or left end of the pull bar bail and the stripper plate, when the bail is moved to its extreme forward position. The flanged guide roller should

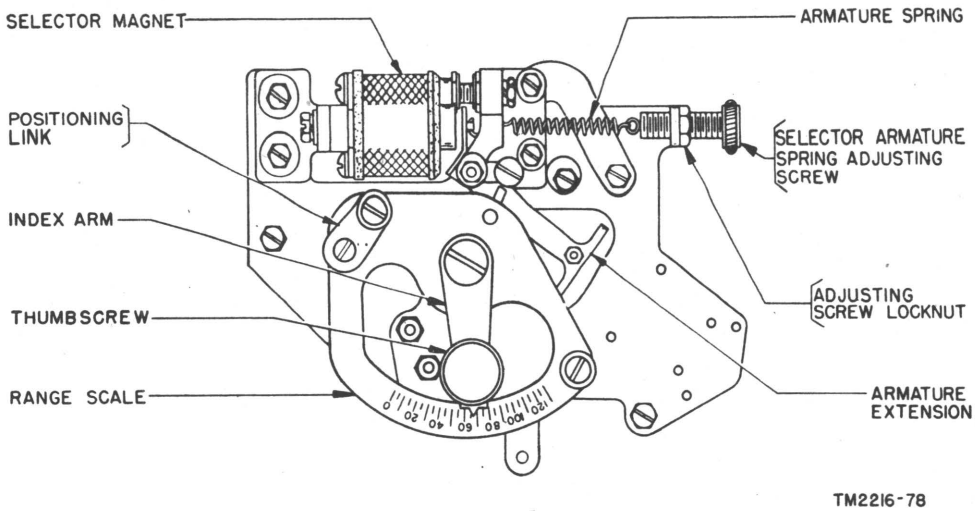


Figure 155. Rangefinder mechanism.

be parallel, or within .002 inch of being parallel, to the surface of the plunger, and both guide rollers should rotate freely.

c. ADJUSTMENT.

(1) To adjust the position of the pull bar bail with relation to the stripper plate, loosen the plunger guide roller bracket mounting screws and move the bracket to the right or left.

(2) To adjust the flanged roller with relation to the plunger, move the roller end of the bracket up or down with the mounting screws friction-tight. Tighten the mounting screws.

214. Plunger Roller Eccentric Mounting Stud

(fig. 156)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENT. The amount of play between the pull bar bail plunger and the rollers should not exceed .004 inch. Check for this amount of play throughout the entire travel of the plunger.

c. ADJUSTMENT. Adjust the position of the eccentric mounting stud to obtain the desired requirement.

215. Pull Bar Spring

(fig. 157)

a. PREPARATION. Remove the type bar carriage and the type bar segment assembly as follows:

(1) Remove the type bar backstop (fig. 161).

(2) Unhook the ribbon carrier from the ribbon oscillator lever (fig. 166).

(3) Remove the type bar segment mounting screws.

(4) Hold the pull bars out of engagement with the code bar mounting plate. As an aid, use a piece of string or wire under the pull bars.

(5) Slide the assembly forward.

b. REQUIREMENTS. With any spring unhooked from its pull bar, and an 8-ounce scale hooked in the spring eye, a vertical pull of 2½ to 3½ ounces is required to pull the spring to its position length.

c. ADJUSTMENT. Replace with a new spring.

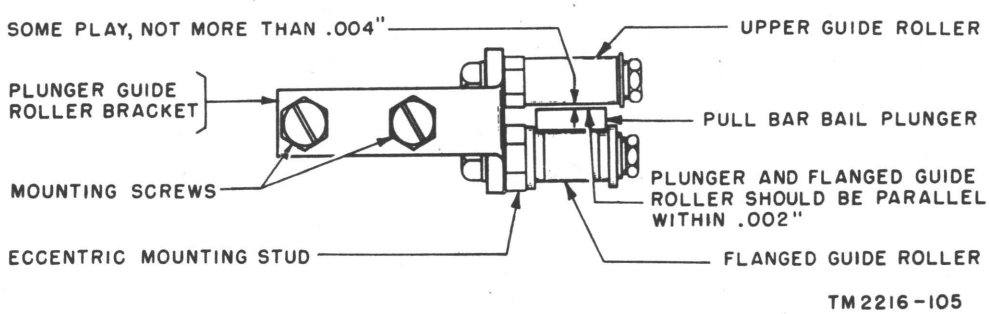


Figure 156. Plunger guide roller bracket.

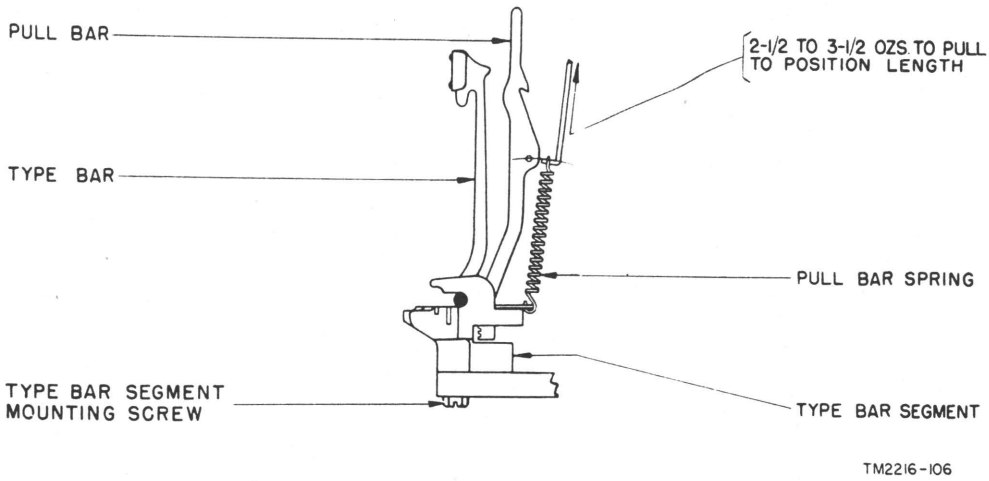


Figure 157. Pull bar spring.

216. Ribbon Feed Pawl Spring

(fig. 158)

a. PREPARATION. Remove the type bar carriage and the type bar segment assembly.

b. REQUIREMENTS. With the pull bar bail in its extreme rear position and the carriage held in its normal position, unhook the ribbon feed pawl spring from its post. With an 8-ounce scale held in a horizontal position and hooked in the spring eye, a pull of 2¼ to 3¼ ounces should be required to pull the spring to its position length.

c. ADJUSTMENT. Replace with a new spring. Rehook the spring and remount the type bar segment assembly, the type bar backstop and the ribbon carrier. Be careful to place the ribbon lockout bar and detent spring (fig. 168) and the ribbon oscillator lever (fig. 166) in their right slots.

217. Pull Bar Guide

(fig. 178)

a. PREPARATION. The type bar carriage must be on the typing unit.

b. REQUIREMENTS. With the pull bar bail in its extreme rear position, move the code bars to the right. Then move the pull bar bail opposite the pull bar humps. There should be a clearance of .008 inch to .020 inch between the humps on all the pull bars (except the blank function pull bar of TT–8/FG) and the pull bar bail. With the code bars moved to the left, there should be a like clearance between the blank pull bar hump and the pull bar bail on TT–8/FG.

c. ADJUSTMENT. When checking this adjustment, all the play of the pull bar bail should be taken up in a direction to make the clearance a

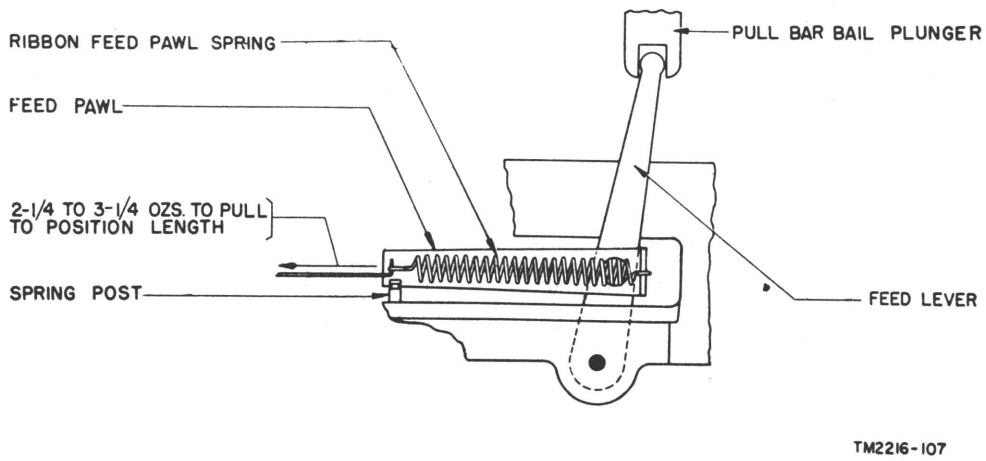


Figure 158. Ribbon feed pawl spring.

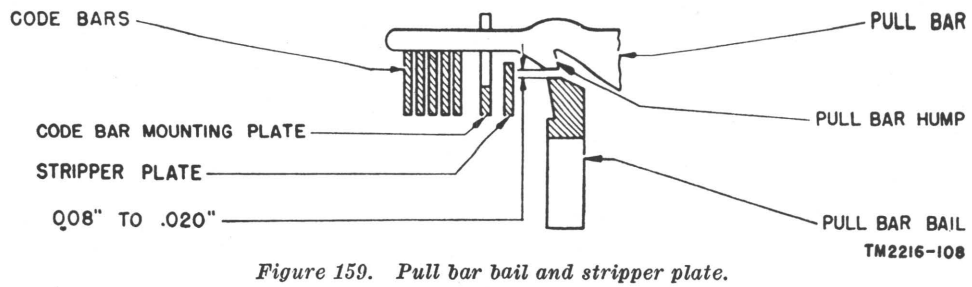


Figure 159. Pull bar bail and stripper plate.

minimum. To adjust, remove the bell crank mounting plate assembly (fig. 89) from the type bar carriage assembly. Be careful not to bend the bell crank retainers. Position the pull bar guide by means of the elongated mounting holes to secure the specified clearance.

218. Ribbon Feed Shaft Bearing Plates

(figs. 160 and 161)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS.

(1) The left end of the ribbon feed shaft should be flush with or extend not more than .015 inch over the inner end of the left vertical feed shaft bevel gear teeth, when the ribbon feed shaft is in its left position and the left vertical feed shaft bevel gear is engaged with the ribbon feed shaft gear.

(2) A like condition should exist when the ribbon feed shaft is in its right position, and the right vertical feed shaft bevel gear is held in engagement with the right ribbon feed shaft gear.

c. ADJUSTMENT. Loosen the mounting screws of both the right and left ribbon spool brackets and move the brackets upward as far as the elongated mounting holes permit. Tighten the mounting screws with the brackets vertical and at right angles to the casting. Adjust the right bearing plate, by using its clamping nuts, to meet the first requirement. Similarly, adjust the left bearing plate with the ribbon feed shaft in its right position to meet the second requirement. Check the lateral movement of the ribbon feed shaft (movement from one detent position to the other); it should measure at least three-sixteenths inch. If necessary, refine the ribbon feed shaft bearing plates adjustment.

219. Ribbon Feed Shaft Detent Spring

(fig. 160)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS.

(1) The center of the ribbon feed shaft detent roller should be at the same height as the center of the ribbon feed shaft, and the shaft detent should travel equally, on either side of the detent roller, when the shaft is moved from its extreme left to its extreme right position (or from its extreme right to its extreme left position).

(2) With the ribbon feed shaft in its extreme left position, hook a 32-ounce scale over the detent roller hub and pull horizon-

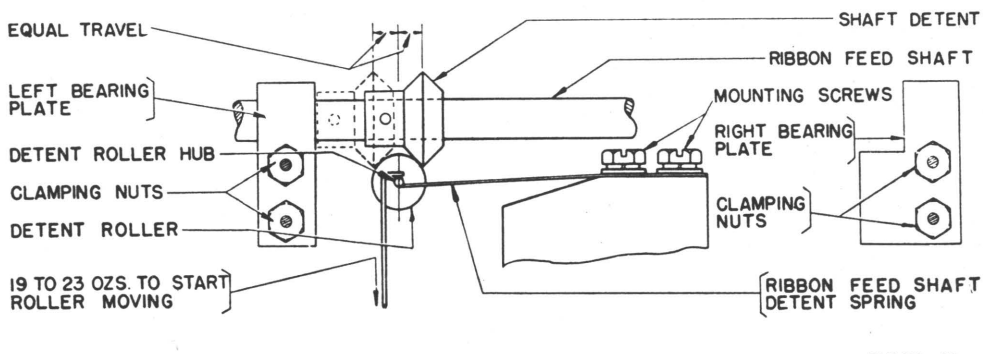


Figure 160. Ribbon feed shaft detent.

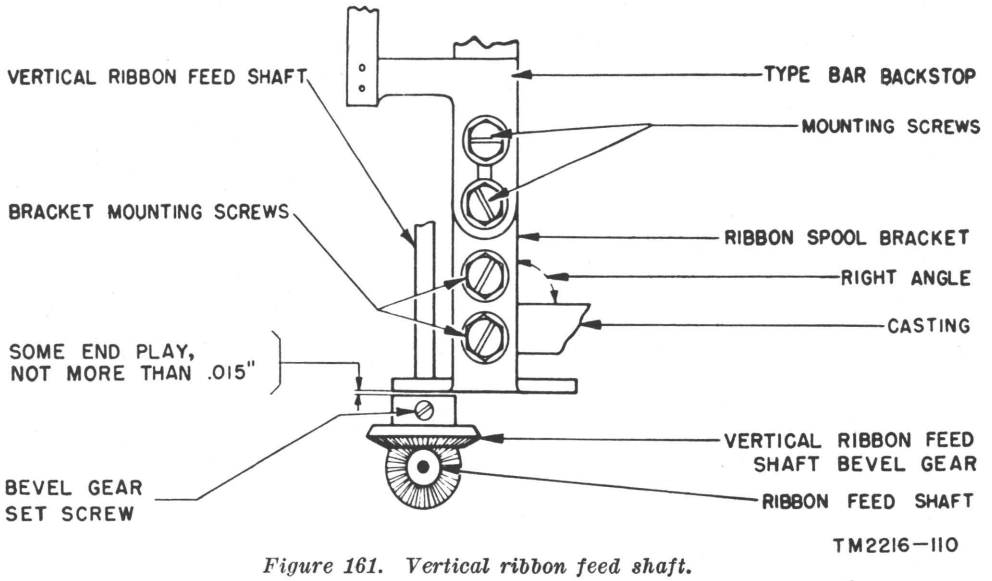


Figure 161. Vertical ribbon feed shaft.

tally toward the rear of the type bar carriage. It should require a pull of 19 to 23 ounces to start the roller moving away from the detent. Check this spring pressure with the shaft in its extreme right position. The two springs pressure scale readings should be within two ounces of being equal.

c. ADJUSTMENT. Loosen the mounting screws of the ribbon feed shaft detent spring, and position the spring. To increase or decrease the spring pressure, remove the spring and bend it. To equalize the pressure, position the spring to the right or left.

220. Vertical Ribbon Feed Shafts
(fig. 161)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. The lower ends of the right and left vertical ribbon feed shafts should be flush with the outside edges of their respective bevel gears.

c. ADJUSTMENTS. Loosen the bevel gear set screws. Move the bevel gears, then tighten the screws. When the set screws are tight, be sure that they bear against the flat surfaces on the shafts.

221. Ribbon Spool Brackets
(fig. 161)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the ribbon feed shaft in its left position, the left vertical ribbon feed shaft should have some end play during 1 revolution of the vertical ribbon shaft bevel gear. This end play should be not more than .015 inch. The right vertical ribbon feed shaft should have the same amount of end play, when the ribbon feed shaft is in its right position. When checking the vertical feed shafts for end play, take up the bearing play of the ribbon feed shaft in a direction so as to make the end play of the vertical shaft maximum.

c. ADJUSTMENT. Adjust both the right and left ribbon spool brackets, by using their elongated mounting holes, to meet this requirement. Be sure that the brackets are vertical and at right angles to the casting.

222. Ribbon Spool Shaft Spur Gears
(fig. 162)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. The ribbon spool shafts should have not more than .006-inch end play.

c. ADJUSTMENT. Loosen the set screws of the vertical ribbon feed shaft spur gears. Move the gears out of engagement with their respective ribbon spool shaft spur gears. Position the ribbon spool shaft spur gears by using their set screws. When tightening the set screws, be sure that they bear against the flat surfaces on the shafts.

223. Vertical Ribbon Feed Shaft Spur Gears
(fig. 162)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. Both the right and left vertical ribbon feed shaft spur gears should line up

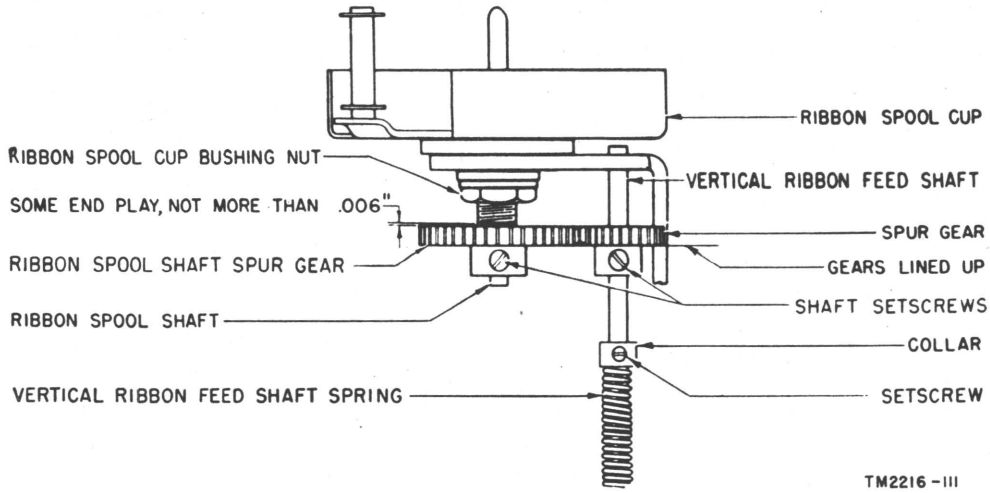


Figure 162. Ribbon spool shaft spur gears.

with their respective ribbon spool shaft spur gears.

c. ADJUSTMENT. Position the vertical ribbon feed shaft spur gears by using their set screws and be sure that the set screws bear against the flat surfaces on the shafts.

224. Ribbon Spool Cups
(fig. 163)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. The centers of the ribbon rollers should be three-fourths to seven-eighths inch in front of a line through the centers of the ribbon spool shafts. The ribbon spool shaft spur gears and the vertical ribbon feed shaft spur gears should not bind at any point of their engagement.

c. ADJUSTMENT. Position each ribbon spool cup by using the nut on its ribbon spool cup bushing. When tightening the nut, take up the play between the ribbon spool cup bushing and the bracket in a direction that results in maximum play between the spur gears. This adjustment applies only to units not equipped with the ribbon reverse yield mechanism.

225. Vertical Ribbon Feed Shaft Spring
(fig. 163)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. Move the ribbon feed shaft to the right. This disengages the ribbon feed shaft gear from the gear on the left vertical feed shaft. Hook an 8-ounce scale onto the pin on the left ribbon spool shaft and pull in a horizontal direction. A pull of 2 to 4½ ounces should be required to start the shaft turning. Move the ribbon feed shaft to the left and, in the same way, check the spring tension of the right vertical ribbon feed shaft.

c. ADJUSTMENT. To get the proper tension, loosen the set screws and move the collars on the vertical feed shaft (fig. 162). Tighten the set screws.

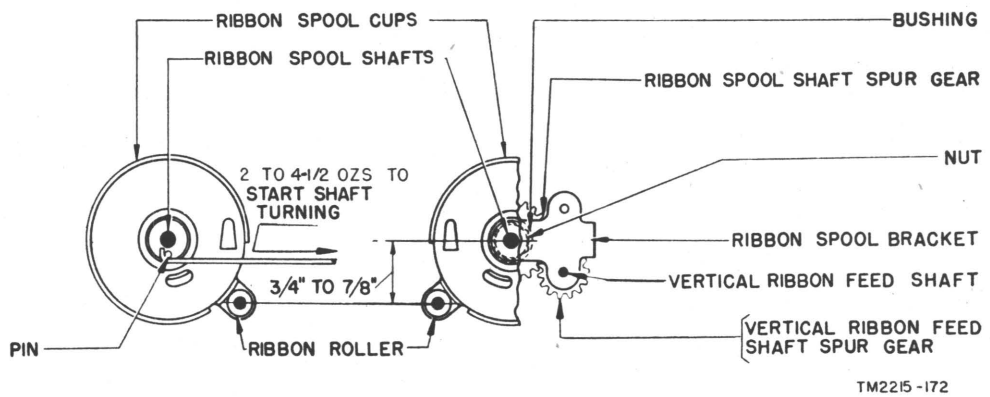


Figure 163. Ribbon spool cups.

226. Ribbon Reverse Shaft
(fig. 164)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. There should be a clearance of .040 inch to .060 inch between the bottoms of the ribbon spool cups and the upper ends of the ribbon reverse shafts, when the ribbon reverse arms are held against the ribbon spool brackets.

c. ADJUSTMENTS.

(1) To adjust typing units that are not equipped with ribbon yield mechanism (old style), loosen the set screw of the left ribbon reverse arm and, if necessary, the set screws of the collars and the link of the left ribbon reverse shaft. Position the shaft, while holding the ribbon reverse arm up against the ribbon spool bracket, and then tighten the ribbon reverse arm set screw. Adjust the right ribbon reverse shaft in the same manner.

(2) To adjust typing units that are equipped with the ribbon yield mechanism, loosen the set screw of the spring block on the left ribbon reverse shaft and, if necessary, the set screws of the ribbon reverse shaft collar and link. Position the shaft while holding the ribbon reverse arm against the ribbon spool bracket and the spring block up against the reverse arm. Then tighten the spring block set screw. Adjust the right ribbon reverse shaft in the same manner (fig. 164).

227. Ribbon Reverse Shaft Collar

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. The ribbon reverse shafts should have some end play, not to exceed .008 inch. The ribbon reverse shaft collars should be positioned so that there is one-fourth to three-eighths inch between the centers of the set screws and the edges of their respective ribbon spool brackets.

c. ADJUSTMENTS. Position the collars by using their set screws while holding both ribbon reverse arms forward against their stops.

228. Ribbon Reverse Shaft Link
(fig. 165)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. The ribbon reverse bail should clear both the left and the right ribbon reverse pawls by .015 to .040 inch when the pull bar bail is in its extreme rear position and both the left and the right ribbon reverse arms are held forward against their stops. When checking the .015-inch clearance between either ribbon reverse

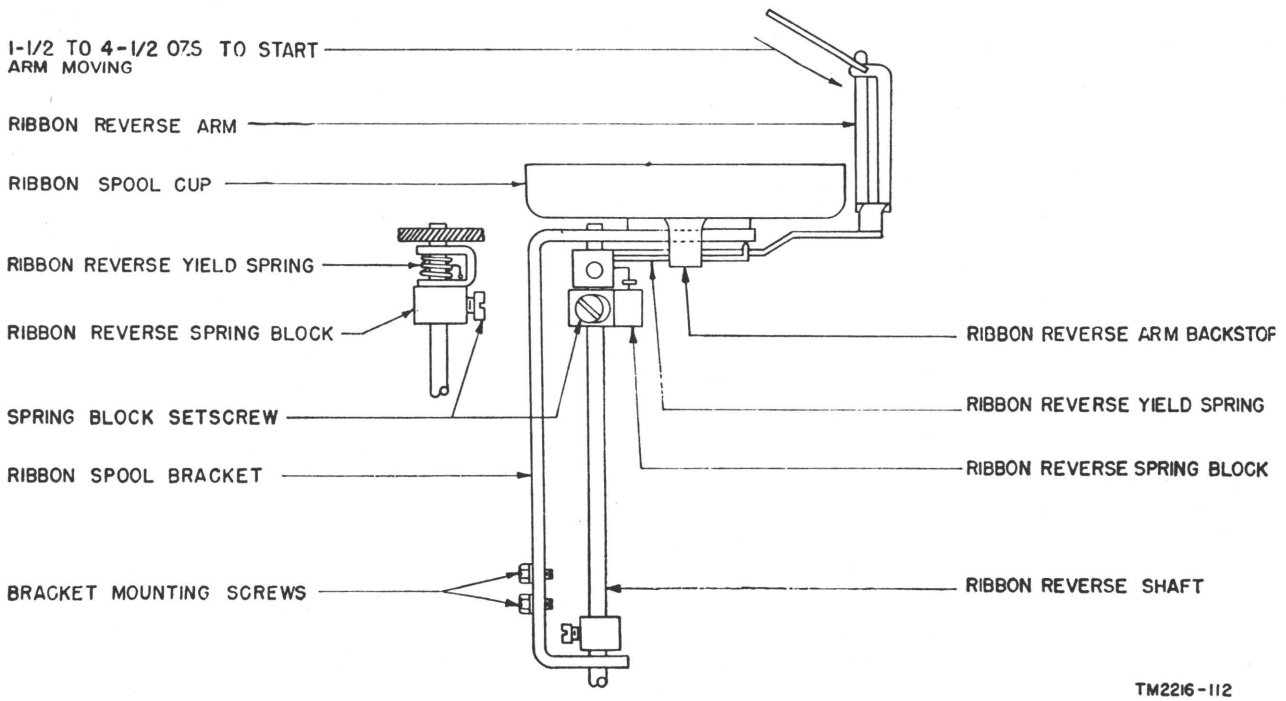


Figure 164. Ribbon reverse shaft.

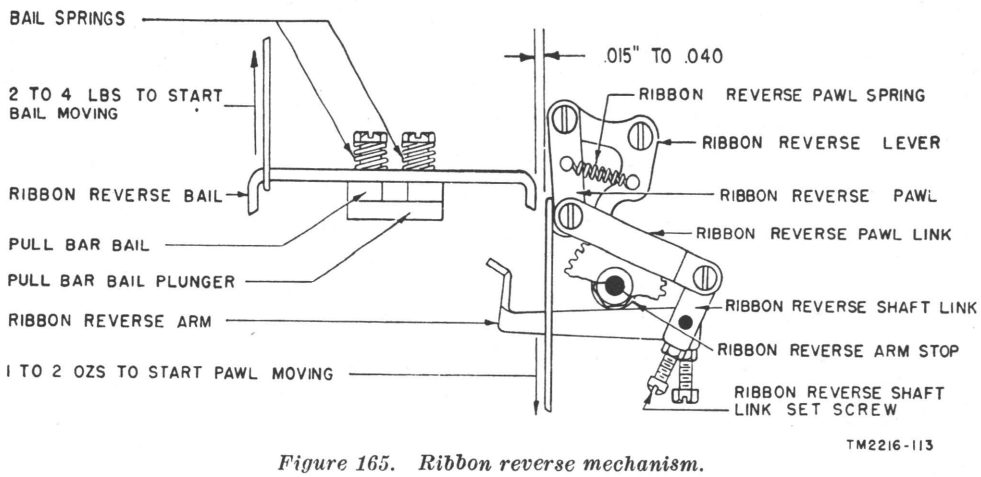


Figure 165. Ribbon reverse mechanism.

pawl and ribbon reverse bail, take up the play in a direction that will make the clearance minimum. When checking for the .040-inch clearance, take up the play in a direction that will make the clearance maximum.

c. Adjustments. Position the ribbon reverse shaft links by means of their set screws. At the same time make sure that the ribbon reverse pawl links do not bind at their shoulder screws, and that the right ribbon reverse shaft link clamping screw does not interfere with the screw that anchors the ribbon feed ratchet friction spring to the carriage casting.

229. Ribbon Spool Cups and Ribbon Reverse Arm Backstops

(fig. 164)

a. Preparation. Remove the type bar carriage.

b. Requirements. The centers of the ribbon rollers should be three-fourths to seventh-eighths inch in front of a line through the centers of the ribbon spools, with the rear of the carriage toward the operator (fig. 163). With the ribbon reverse arms held against their backstops, approximately three-fourths of the tooth on each ribbon reverse pawl should be in a position to be engaged by the ribbon reverse bail. There should be no bind between the ribbon spool shaft spur gears and the vertical ribbon feed shaft spur gears at any point in their engagement.

c. Adjustment. To adjust, position each ribbon spool cup and ribbon reverse arm backstop with the nut on the ribbon spool cup bushing. When tightening the nut, take up the play between the ribbon spool cup bushing and the ribbon spool bracket in a direction to make the play between the spur gears maximum. This adjustment applies only to units equipped with the ribbon reverse yield mechanism.

230. Ribbon Reverse Arms Yield Spring Tension

(fig. 164)

a. Preparation. Remove the type bar carriage. Position the ribbon reverse bail so that it will block the full travel of the ribbon reverse arm.

b. Requirements. With the ribbon reverse pawl resting against the ribbon reverse bail, apply the push end of an 8-ounce scale to each ribbon reverse arm at the center where the ribbon is threaded; hold the scale at right angles to the ribbon reverse arm. A push of 1½ to 4½ ounces should be required to start the ribbon reverse arm moving.

c. Adjustment. To increase or decrease the tension, remove the ribbon reverse arm yield spring and bend the spring. Replace the ribbon on the type bar carriage.

231. Ribbon Reverse Arm Yield Spring and Backstop Feature

(fig. 164)

The adjustment procedure for the ribbon reverse arm yield spring and backstop feature varies as follows: Omit the ribbon spool cups adjustment (par. 224). Perform the vertical ribbon feed shafts spring tension adjustment (par. 225), the ribbon reverse shafts adjustment (par. 226), the ribbon reverse shafts collars adjustment, ribbon reverse shafts links adjustment (pars. 227 and 228), the ribbon spool cups and ribbon reverse

arm backstops adjustments, ribbon reverse arm yield spring tension (pars. 229 and 230), the ribbon reverse pawl spring tension, and ribbon reverse bail spring compression adjustments (pars. 232 and 233).

232. Ribbon Reverse Pawl Springs
(fiig. 165)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the ribbon feed shaft in its left position and the pull bar bail in its extreme forward position, hold the carriage so that the ribbon spool cups are at their lowest position. Hook an 8-ounce scale in the notch of the left reverse pawl and pull horizontally toward the rear of the carriage. A pull of 1 to 2 ounces should be required to start the pawl moving. Move the ribbon feed shaft to its right position and, in the same manner, check the tension of the right ribbon reverse pawl spring.

c. ADJUSTMENT. Install new springs.

233. Ribbon Reverse Bail Springs
(fig. 165)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the type bar carriage held so that the ribbon spool cups are at their lowest position, and the pull bar bail plunger is in its extreme forward position, hook a 12-pound scale in the corner at the left end of the ribbon reverse bail and pull horizontally toward the front of the carriage. A pull of 2 to 4 pounds should be required to just start the ribbon reverse bail moving. Measure the right spring compression at the right end of the ribbon reverse bail, for this requirement, in the same manner.

c. ADJUSTMENT. Replace with new springs.

234. Type Bar Backstop
(fig. 161)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the pull bar bail in its extreme rear position, there should be not less than .010-inch clearance between the type bar backstop and the pull bars when the type bars are held in the type bar guide. Make this check on the two end pull bars and the middle pull bar.

c. ADJUSTMENT. To adjust, set the up and down position of the type bar backstop by using its elongated mounting holes to meet this requirement. (Refer to figure 161 for location of parts). When meeting the clearance requirement between the backstop and the pull bars, position the backstop low enough to eliminate any interference between adjacent type bar assemblies at the pallet ends, which would probably cause *light* printing. It is preferable that the end type bars rest against the backstop buffer strip along its entire width; however, a clearance of not more than .010-inch between the front edge of the buffer strip and the type bars may be allowed.

235. Ribbon Shift Lever Bracket
(figs. 166 and 167)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. The ribbon oscillator lever should move freely in its slot when its spring is unhooked and the ribbon carrier is located and approximately centered, with respect to the type bar guide.

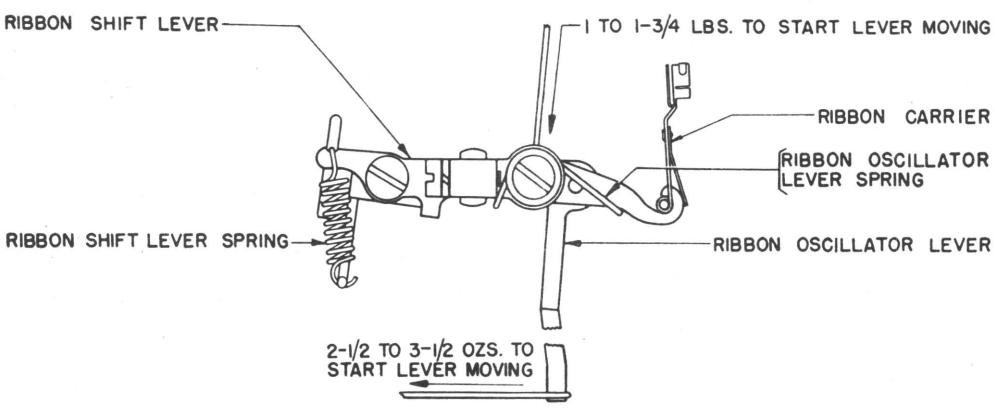


Figure 166. Ribbon shift and ribbon oscillator levers.

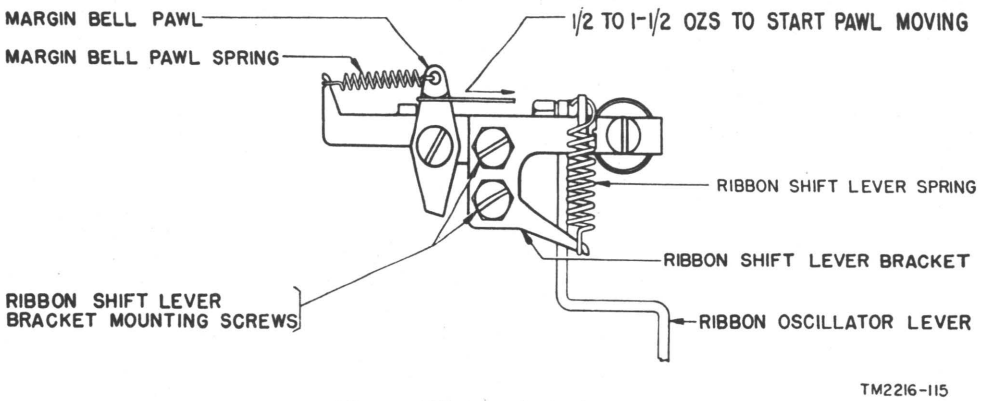


Figure 167. Margin bell pawl.

c. ADJUSTMENT. Position the ribbon shift lever bracket by means of its enlarged mounting holes. Replace the ribbon oscillator lever spring.

236. Ribbon Oscillator Lever Spring
(fig. 166)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the ribbon shift lever spring removed, hook an 8-ounce scale over the lower end of the ribbon oscillator lever and pull horizontally toward the rear of the type bar carriage. It should require a pull of 2½ to 3½ ounces to start the oscillator lever spring moving.

c. ADJUSTMENT. Install a new ribbon shift lever spring.

237. Ribbon Shift Lever Spring
(fig. 166)

a. PREPARATION. Remove type bar carriage.

b. REQUIREMENTS. With the ribbon oscillator lever spring unhooked from the oscillator lever, apply the push end of a 12-pound scale, held in a vertical position, to the ribbon shift lever at the point where the ribbon oscillator lever spring is mounted. It should require a force of 1 to 1¾ pounds to start the shift lever moving.

c. ADJUSTMENT. Replace with a new ribbon shift lever spring.

238. Margin Bell Pawl Spring
(fig. 167)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. Hook an 8-ounce scale, held in its unoperated position (extreme right) and just above the stop. A pull of ½ to 1½ ounces in line with the spring should be required to start the pawl moving.

c. ADJUSTMENT. Replace with a new spring.

239. Adjustable Ribbon Lock-out Bar Detent Spring
(fig. 168)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the ribbon lock-out bar in its unoperated position (exereme right) and with the push end of a 12-pound scale bearing against the ribbon lock-out bar in a direction in line with the bar, it should require 1¼ to 2¼

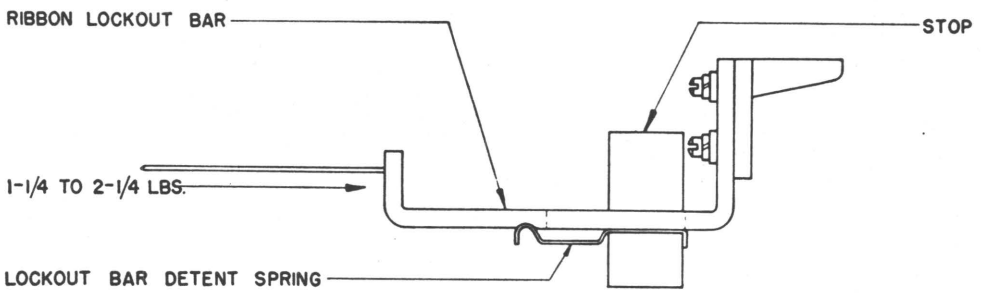


Figure 168. Adjustable ribbon lock-out bar detent spring.

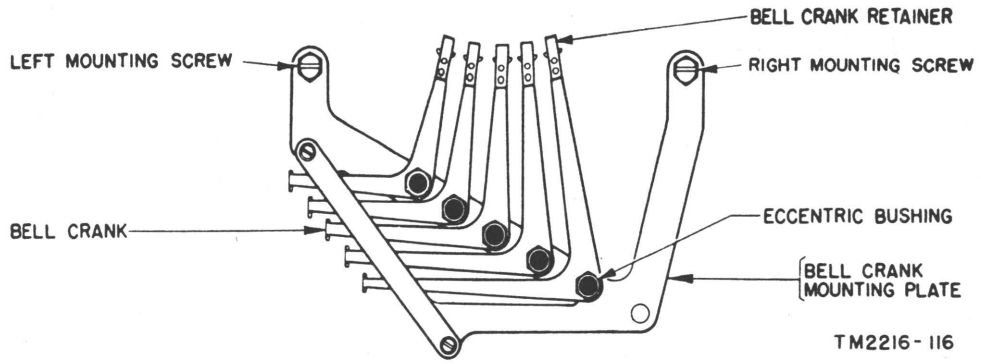


Figure 169. Bell crank assembly.

pounds to disengage the ribbon lock-out bar detent spring from its notch in the lock-out bar.

c. ADJUSTMENT. Replace with a new spring.

240. Mounting of Bell Crank Assembly

(fig. 169)

a. PREPARATION. Remove the type bar carriage.

b. ADJUSTMENT. Place the bell cranks in their lowest position, with respect to the code bars, by means of the bell crank eccentric bushings. Then mount the bell crank assembly as follows:

(1) Mount the right end of the bell crank assembly with one of its mounting screws so that it is friction-tight.

(2) Rotate the assembly in a clockwise direction and engage the five bell cranks with their respective code bars.

(3) Remove the left mounting screw and tighten both the left and right screws.

241. Right Pull Bar Spring Bracket

(fig. 170)

This paragraph applies only to typing units equipped with a three-section pull bar bracket.

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the pull bar bail in its extreme rear position, the right end pull bar and the fourth pull bar from the right end should have some play, not more than .004 inch, between the right spring bracket and the type bar when the type bar is in its guide.

c. ADJUSTMENT. Loosen the mounting screw of the right pull bar spring bracket and position the bracket. Tighten the screw. If the second or third pull bar from the end binds against the spring bracket when type bars are moved to the type bar guide manually, readjust the spring bracket so that all four pull bars are free and the end pull bar and at least one of the other three pull bars have not more than .004-inch clearance between the type bars and the spring bracket when their type bars are in the type bar guide.

242. Left Pull Bar Spring Bracket

(fig. 170)

This paragraph applies only to typing units equipped with a three-section pull bar bracket.

a. PREPARATION. With the pull bar bail in its extreme position, the left end pull bar and the third pull bar from the left end should have some play, but not more than .004 inch, between the left spring bracket and the type bar when the type bar is in the type bar guide.

b. ADJUSTMENT. Loosen the mounting screw of the left pull bar spring bracket and position the bracket. Tighten the screw. If the second pull bar from the left binds against the bracket, readjust the spring bracket so that the end pull bar and the second pull bar from the left end have a

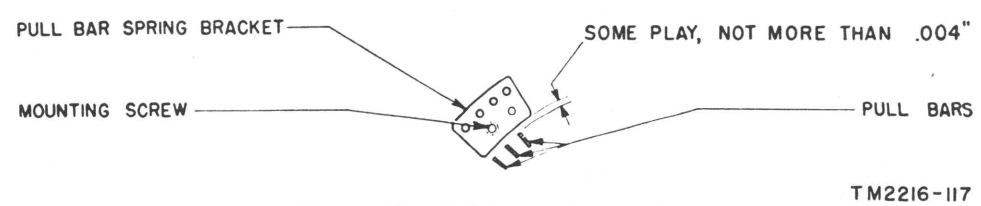


Figure 170. Pull bar spring bracket.

clearance of not more than .004-inch between the left spring bracket and the type bar when the type bar is in the type bar guide.

243. Margin Adjusting Screw Arm Spring
(fig. 171)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. With the notch in the right margin adjusting screw arm engaged with the detent spring, hook a 4-pound scale over the adjusting screw and pull at right angles to the arm toward the rear of the type bar carriage. It should require a pull of 2 to 4 pounds to disengage the arm from the detent spring.

c. ADJUSTMENT. Replace with a new spring.

244. Carriage Support and Pull Bar Bail Plunger Rollers
(figs. 93 and 178)

a. PREPARATION. Remove the type bar carriage.

b. REQUIREMENTS. The three carriage support rollers and the pull bar bail plunger roller should turn freely with a barely perceptible amount of end play.

c. ADJUSTMENT. Loosen the locknuts and adjust the cone nuts. The rollers should turn freely without end play after the locknuts are tightened.

245. Instructions for Replacing Type Bar

The type bar guide adapter plate, located between the type bar guide and the type bar segment, is positioned at the factory for type alinement and should not be disturbed as it may affect the alinement seriously. Remove the type bar carriage, the ribbon, the two screws and lockwashers mounting the type bar guide to the adapter plate, and the ribbon carrier after disengaging it from the hook on the ribbon oscillator lever; lift the type bar guide off its dowels; raise the type bar until it passes the ribbon oscillator lever; then raise the selected pull bar until it is disengaged from the type bar and remove the type bar from its slot in the type bar segment. Insert the new type bar in the slot just vacated, engaging the teeth on the pull bar so that the top of the pull bar is even with that of the other pull bars when the type bar is resting against its backstop. New type bars are usually oversized, and the section that fits in the segment probably will have to be stoned down to permit it to operate freely. Do not remove more metal than is necessary for freedom of movement. Reassemble the type bar guide on the adapter plant; use the two screws and lockwashers previously removed. Reassemble the ribbon carrier on the type bar guide; engage the lower end of the ribbon carrier in the ribbon oscillator lever hook. Place the type bar carriage on the typing unit.

246. Type Bar Guide Adapter Plate
(fig. 172)

a. PREPARATION. Place the type bar carriage on the typing unit and then place the typing unit on the base.

b. REQUIREMENTS. Characters in any printed line must line up with each other within one-sixty-fourth inch. To test for this requirement, type a test line. With the base of the lowest letter as the reference point, draw a line parallel to the type line of letters. From the line which represents the base of the lowest character, measure to the base of the highest character. The difference should be no more than one-sixty-fourth inch (fig. 147).

c. ADJUSTMENT. Loosen the type bar guide

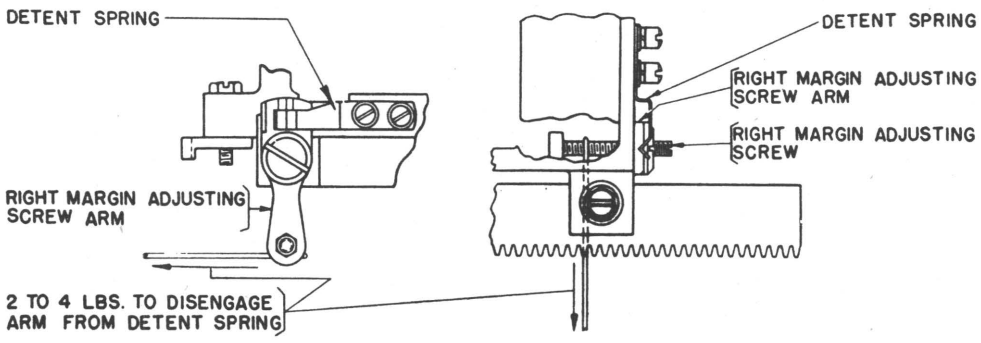


Figure 171. Right margin adjusting screw and detent spring.

adapter plate mounting screws until they are friction-tight, and move the top of the type bar guide to the left or right as required. When the adjustment is made correctly, the extreme right and left characters (S and Z) and the center character (N) all should aline.

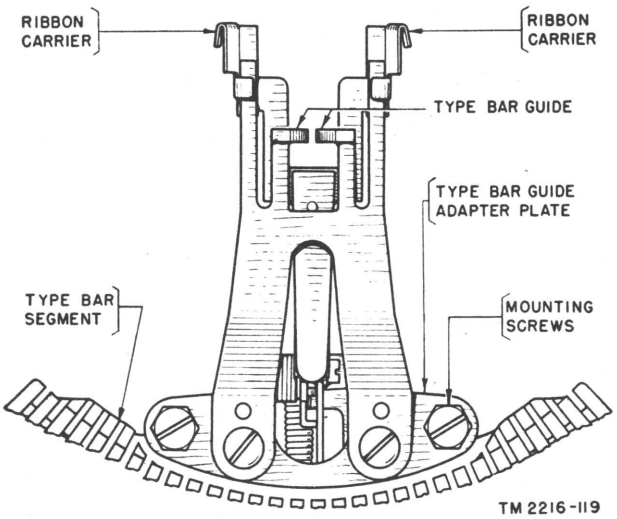


Figure 172. Type bar guide adapter plate.

247. Main Shaft (Selector Cams)
(fig. 173)

a. PREPARATION. Remove the typing unit from the base and rest the typing unit on its right side.

b. REQUIREMENTS. When the main shaft is rotated, the selector cams on the selector cam sleeve should line up with their respective selector levers.

c. ADJUSTMENT. Loosen the four screws that hold the main shaft bearing caps, and position the main shaft. Tighten the bearing cap mounting screws.

248. Main Shaft Clutch Throw-out Lever
(fig. 174)

a. PREPARATION. Remove the typing unit from the base.

b. REQUIREMENTS. With the clutch driven member fully cammed out of engagement with the driving member by the clutch throw-out lever, there should be .010- to .020-inch clearance between the ends of the clutch teeth. The clutch throw-out lever should be free and should have no perceptible end play.

c. ADJUSTMENTS. Reposition the clutch throw-out lever by use of its pilot screws.

249. Main Shaft Clutch Throw-out Lever Spring
(fig. 174)

a. PREPARATION. Remove the typing unit from the base, remove the type bar carriage from the typing unit, and rest the typing unit on its right side. Rotate the main shaft until the clutch teeth are engaged fully.

b. REQUIREMENTS. Hook an 8-ounce scale, held in a horizontal position, over the clutch throw-out lever at the spring hole and pull at a right angle to the throw-out lever. It should require 2½ to 4 ounces to start the lever moving.

c. ADJUSTMENT. Replace with a new spring.

250. Main Shaft Clutch Spring
(fig. 175)

a. PREPARATION. Remove the typing unit from the base, remove the type bar carriage, and rest the typing unit on its right side. Rotate the main

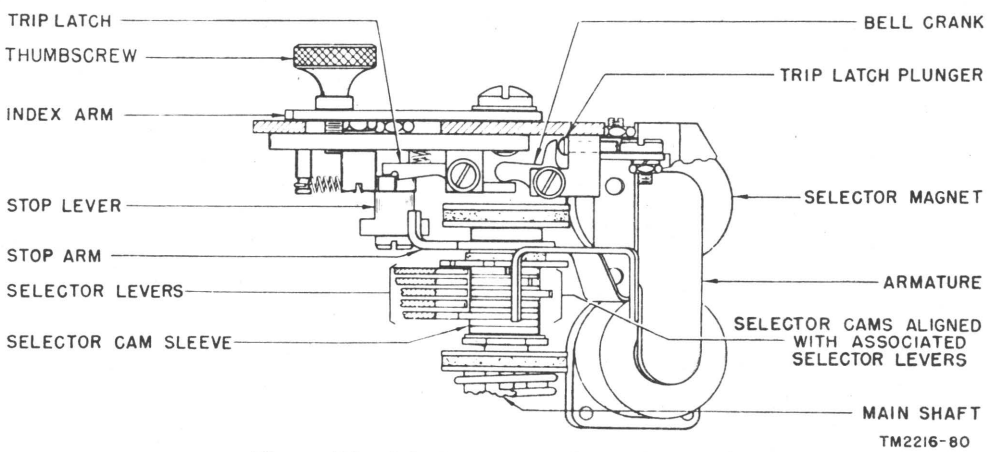


Figure 173. Selector cam and lever alinement.

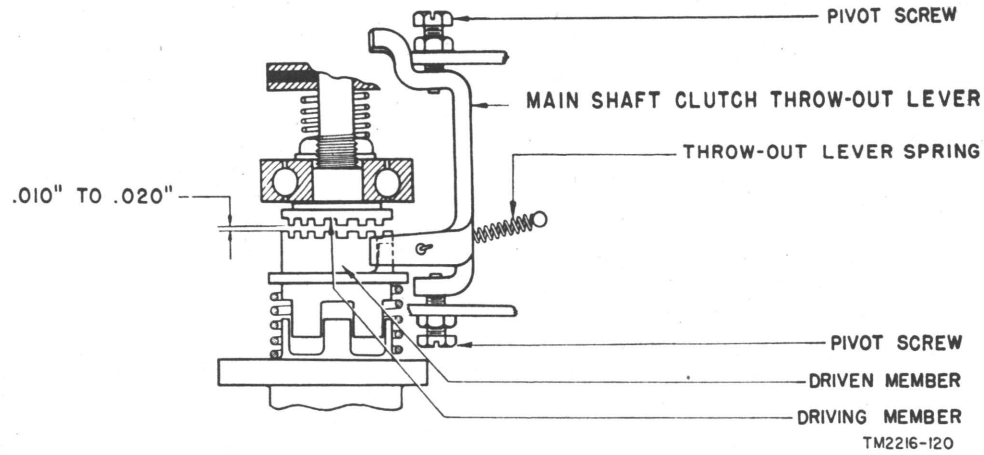


Figure 174. Main shaft clutch.

shaft until the low part of the printing bail cam is toward the bottom of the typing unit.

b. REQUIREMENTS. With the teeth of the clutch driven member resting against the teeth of the driving member, not engaged, hook a 32-ounce scale on the driven member in line with the low part of the printing bail cam and pull vertically, downward. It should require a pull of 22 to 30 ounces to separate the clutch teeth. After checking the 22- to 30-ounce pull with the positive clutch teeth still separated, gradually reduce the spring tension (exerted by the scale) on the driven clutch member. The clutch teeth should engage, top to top, before the scale reading drops to 10 ounces.

c. ADJUSTMENT. Replace with a new spring.

251. Spacing Shaft Lower Bearing Bracket

a. PREPARATION. Remove the typing unit from the base.

b. REQUIREMENTS. Hold the spacing escapement pawl away from the ratchet and rotate the main shaft spacing gear. There should be a minimum amount of play, without binding at any point of engagement, between the spacing shaft gear and the main shaft spacing gear during 1 complete revolution of the spacing shaft gear.

c. ADJUSTMENTS. Set the typing unit in its normal upright position, unhook the carriage return operating lever spring from the spring post, move the eccentric away from the bearing bracket, and position the bracket in its elongated mounting holes. Replace the carriage return operating level spring and reposition the eccentric against the bearing bracket.

252. Printing Bail Shaft Right Bearing (fig. 177)

a. PREPARATION. Remove the typing unit from the base and the type bar carriage from the typing unit.

b. REQUIREMENT. The printing bail should have some end play, not more than .015 inch.

c. ADJUSTMENTS. Remove the printing bail spring and position the right bearing in its elongated mounting holes. Replace the printing bail spring.

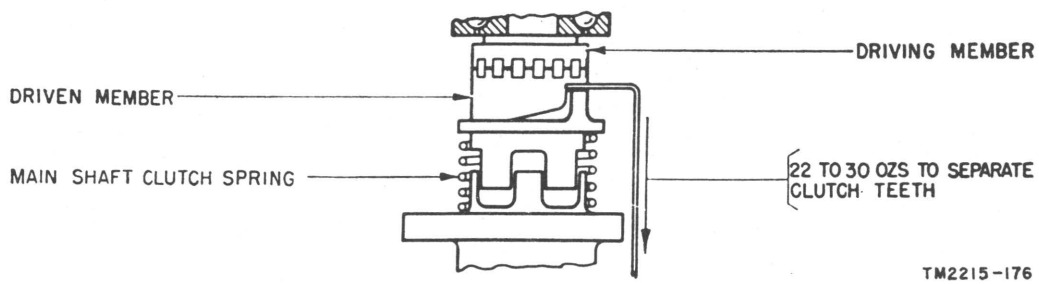


Figure 175. Main shaft clutch spring.

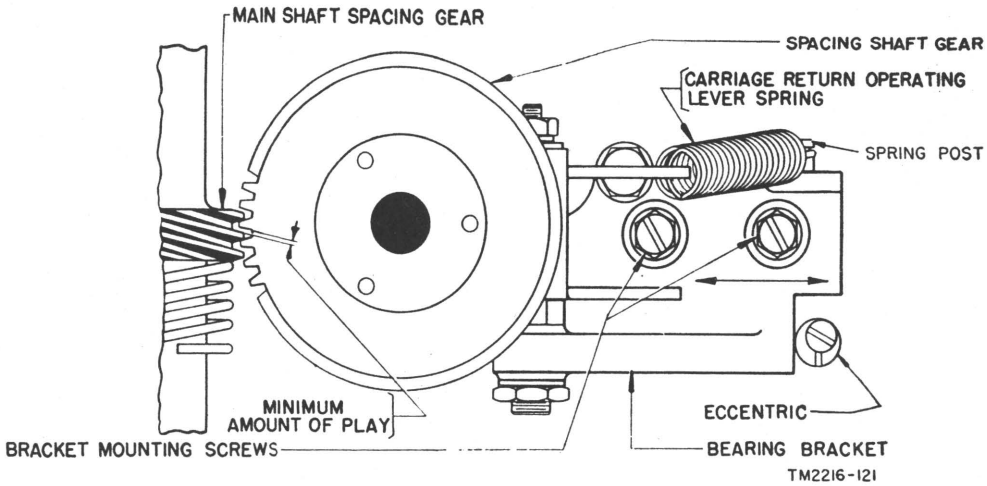


Figure 176. Spacing shaft gear and lower bearing bracket.

253. Replacing Type Bar Carriage

Shift the platen to the FIGS position and rotate the main shaft until the printing bail is in its rear position. Then move the right margin adjusting screw arm on the carriage to the rear so that it is approximately 45° from vertical. Hold the carriage in the right hand and rest the left front carriage support roller on the right end of the front carriage track; be sure that the carriage guide screw engages the slot in the carriage track. Move the carriage slowly to the left until the rear carriage support roller rests on the upper track. Operate the carriage return lock bar and move the pull bar bail to its rearmost position by pushing on the right pull bar bail roller with the right thumb. Move the carriage further to the left; be sure that the bell cranks engage their respective vanes, that the right front carriage support roller and guide screw properly engage the front carriage track, and that the pull bar bail plunger roller is between the printing bail blades. When the carriage is moved far enough to the left to permit the right margin adjusting screw to clear the spacing stop lever, restore the right margin adjusting screw to its vertical position.

254. Printing Bail
(fig. 178)

a. Preparation. Remove the typing unit from the base.

b. Requirements. The pull bars should clear the code bars by .010 to .050 inch when the main shaft is rotated until the printing bail is in its extreme rear position. Check this adjustment with the type bar carriage in both its extreme right and left positions and with the play in the pull bars taken up in a direction to make the clearance a minimum.

c. Adjustments. Position the printing bail by use of its adjusting screw and locknut which are located on the printing bail operating arm. If the clearance at one side is so unequal to the clearance

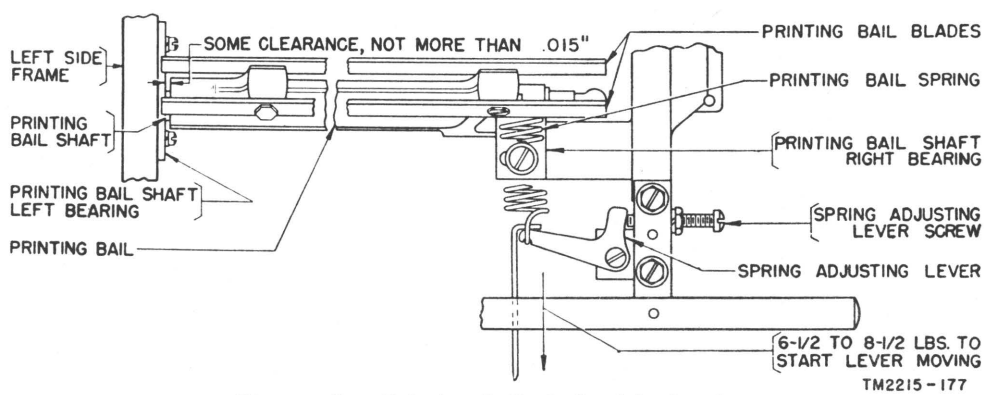


Figure 177. Printing bail shaft right bearing.

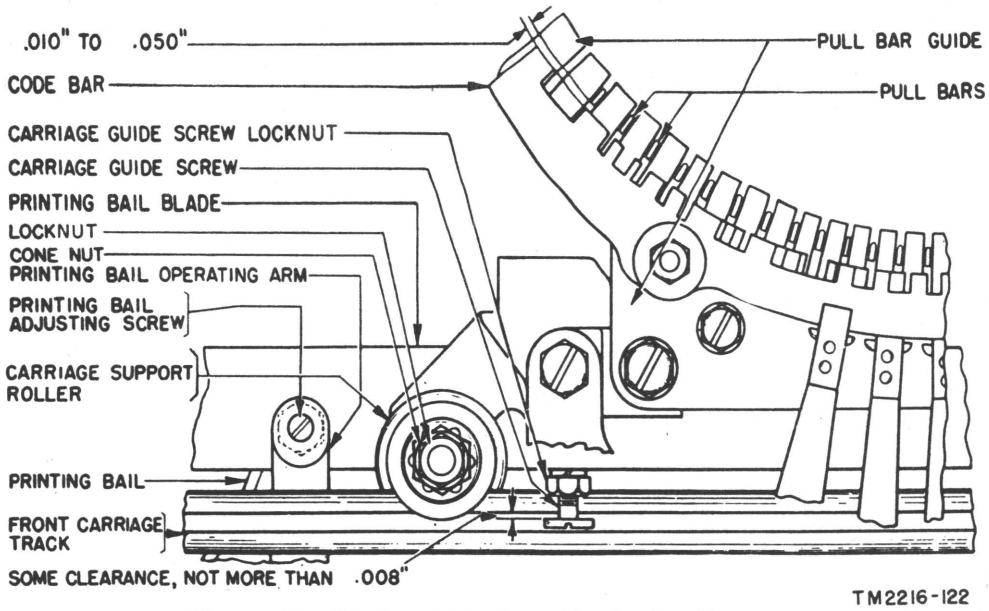


Figure 178. Printing bail and carriage track guide screw.

at the other side that the .010- to .050-inch clearance cannot be obtained, refine the pull bar guide adjustment (par. 217). Reduce the clearance between the pull bar bail and the pull bar humps, at the side that has the least clearance, to a minimum, and increase the clearance at the side that has the most clearance, toward a maximum.

255. Function Lever Bail (Two-piece)

(fig. 179)

a. PREPARATION. Remove the typing unit from the base and the type bar carriage from the typing unit.

b. REQUIREMENTS. When the main shaft is rotated until the printing bail is in its rearmost position and vane 1 is midway between the marking and spacing positions, there should be a clearance of .040 to .060 inch between the rear edge of vane 1 and the front edges of the function levers (except the universal function lever) (fig. 181).

c. ADJUSTMENT. Position the function lever bail; use the elongated mounting holes.

268. Armature Stops

(fig. 179)

a. PREPARATION. Remove the typing unit from the base and the type bar carriage from the typing unit.

b. REQUIREMENTS.

(1) With the CAR RET combination selected, the line feed push bar removed, and the main shaft rotated until the carriage return function lever is drawn completely into selection with the vanes, the travel of the function lever bail should be blocked by the selected function lever. Also, the front edge of the right projection of the function lever bail should be flush (within .005 inch) with the top front edge of the rear prong of the carriage return function lever.

(2) With the LINE FEED combination selected, the line feed push bar removed, and the main shaft rotated until the line

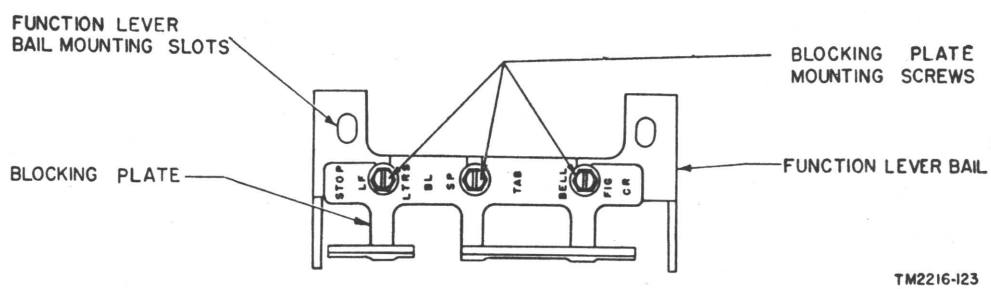


Figure 179. Two-piece function lever bail.

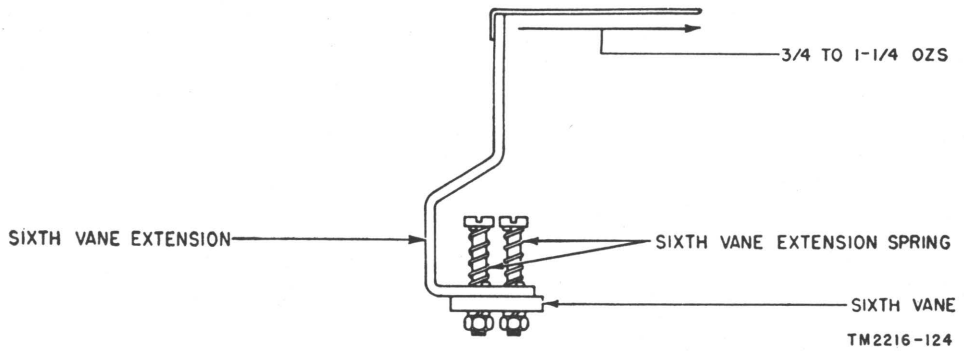


Figure 180. Sixth vane extension and springs.

feed function lever is drawn completely into selection with the vanes, the travel of the function lever bail should be blocked by the line feed function lever. The front edge of the left projection of the function lever bail should be flush (within .005 inch) with the front edge of the rear prong of the line feed function lever.

c. ADJUSTMENTS. Position the blocking plate in the slotted holes to meet the requirements given in *b* (1) and (2) above. Replace the line feed push bar.

257. Sixth Vane Extension Springs

(fig. 180)

This paragraph applies to those typing units which have the new style sixth vane extension. This extension is a formed piece of steel mounted on the sixth vane by shoulder screws and compression springs.

a. PREPARATION. Remove the typing unit from the base and the type bar carriage from the typing unit.

b. REQUIREMENTS. Loosen the left pilot screw and remove the sixth vane from the typing unit. With the vane held in a horizontal position and with the vane extension upward, hook an 8-ounce scale over the upper end of the extension. Pull at a right angle to and toward the front of the vane; a pull of 3/4 to 1 1/4 ounces is required to start the extension moving away from the vane. Check this spring compression in the opposite direction by hooking the scale over the end of the extension and pulling toward the rear edge of the vane.

c. ADJUSTMENT. Replace the sixth vane extension springs.

258. Sixth Vane

(fig. 181)

a. PREPARATION. Remove the typing unit from

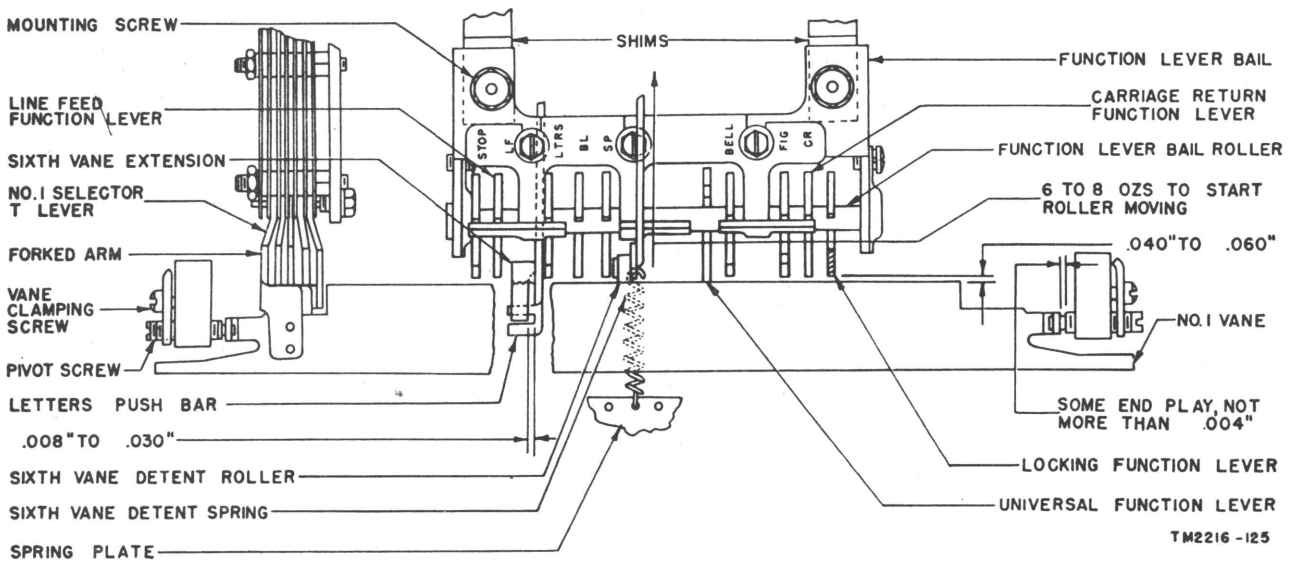


Figure 181. Associated function lever bail parts.

the base and the type bar carriage from the typing unit.

b. Requirements. There should be a clearance of .008- to .030-inch between the right edge of the sixth vane extension and the right end of the slot in the unshift (LTRS) push bar. The vane should have some end play, not more than .004-inch.

c. Adjustments. Loosen the vane clamping screws and position the sixth vane by use of the pilot screws. Tighten the clamping screws.

259. Selector Vanes

(figs. 181 and 182)

a. Preparation. Remove the typing unit from the base and the type bar carriage from the typing unit.

b. Requirements. The forked arms of vanes 1 through 5 should line up with their respective T levers. When the printing bail is in its extreme rear position, each vane should have some end play, not more than .004 inch.

c. Adjustments. Loosen the vane clamping screws and position the vanes by means of their pilot screws. Tighten the clamping screws.

260. Function Bail Spring

(fig. 182)

a. Preparation. Remove the typing unit from the base and the type bar carriage from the typing unit.

b. Requirements. With the function bail in its extreme rear position, unhook the function bail spring from the front spring post and hook a 12-pound scale in the spring eye. A pull of 2 to 3 pounds should be required to extend the spring to its position length. Rehook the spring.

c. Adjustment. Replace with a new spring.

261. Printing Bail Spring

(fig. 177)

a. Preparation. Remove the typing unit from the base and the type bar carriage from the typing unit.

b. Requirements. Rotate the main shaft until the printing bail is in its extreme rear position. Hook a 12-pound scale over the left end of the spring adjusting lever, so that the hook on the scale engages the lever directly in the rear of the spring notch in the lever. Pull in line with the spring. It should require a pull of 6½ to 8½ pounds to start the lever moving.

c. Adjustment. Adjust the spring tension with the spring adjusting lever screw.

262. Selector Armature Bracket Link (Friction Adjustment)

(fig. 183)

a. Preparation. Remove the typing unit from the base and the type bar carriage from the typing unit. Rest the typing unit on its right side.

b. Requirements. Remove the selector armature bracket link screw. With an 8-ounce scale hooked in the link screw hole and pulled at a right angle to the link, some tension, not more than 8 ounces, should be required to start the link moving.

c. Adjustments. If necessary, remove the link and adjust the slotted end to obtain the friction specified in *b* above. Replace the link and screw.

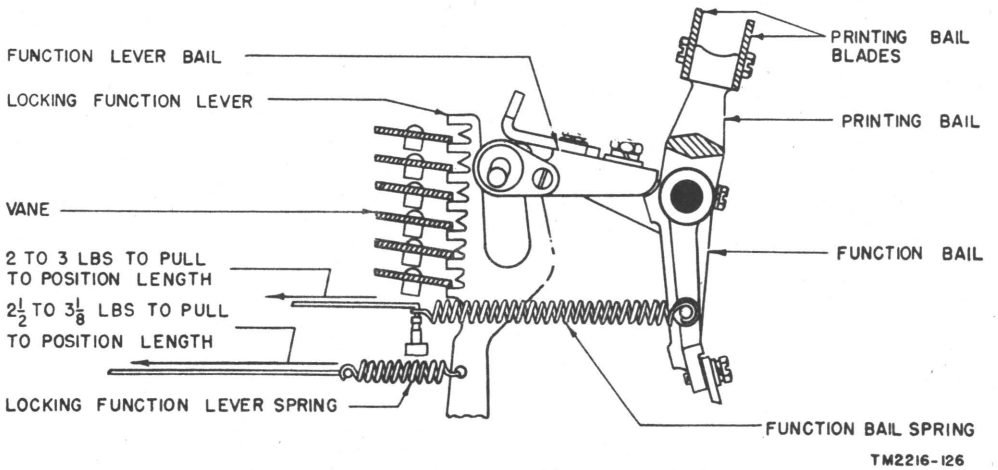


Figure 182. Function bail and locking function lever springs.

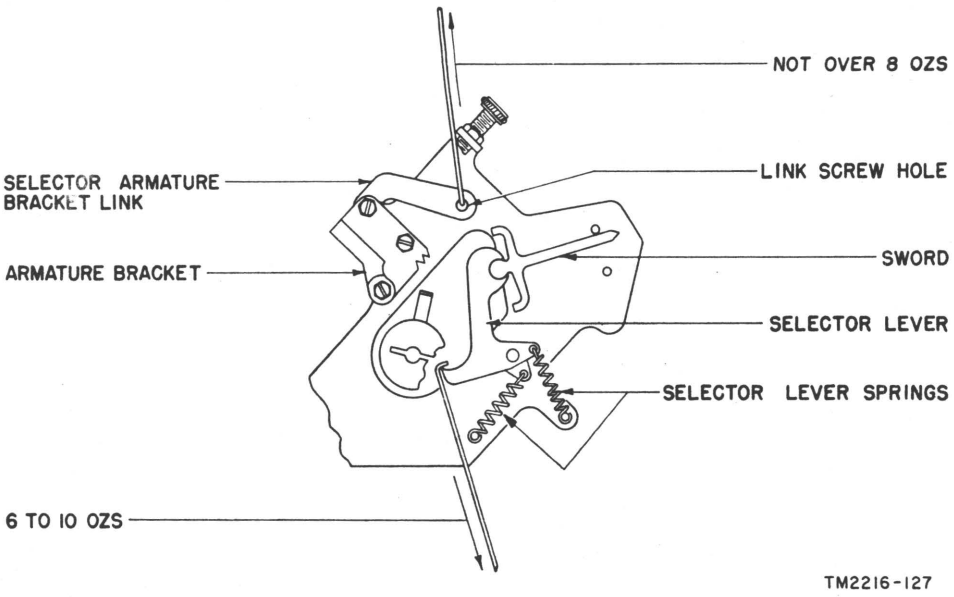


Figure 183. Selector lever springs.

263. Selector Lever Spring

(fig. 183)

a. PREPARATION. Remove the typing unit from the base and the type bar carriage from the typing unit. Set the typing unit on its right side. Remove the rangefinder assembly (par. 184).

b. REQUIREMENTS. With the code bars in marking position and the function lever bail in its extreme forward position, move the swords manually to the spacing position. Hook a 32-ounce scale over the end of each selector lever at the selector cam sleeve and pull in a line straight out from (or radial to) the main shaft. A pull of 6 to 10 ounces should be required to start each selector lever moving. When checking the tension of the selector lever springs, be sure that the selector levers are free.

c. ADJUSTMENTS. Replace with new springs.

264. Selector Separator Plates

(fig. 184)

a. PREPARATION. Remove the typing unit from the base and the type bar carriage from the typing unit. Remove the rangefinder.

b. REQUIREMENTS. The leaf springs should exert a *light* pressure against the swords.

c. ADJUSTMENTS. Bend the leaf springs at the narrow portions so that the ends of the springs are .050 to .060 inch below the undersurface of the straight portions. Separator plate leaf springs are adjusted during the initial assembly of the unit at the factory and should require attention only if the selector has been damaged or dismantled. If it is necessary to check the adjustment, be careful to guard against distorting the selector lever springs when removing or replacing them. Final adjustment of the selector will

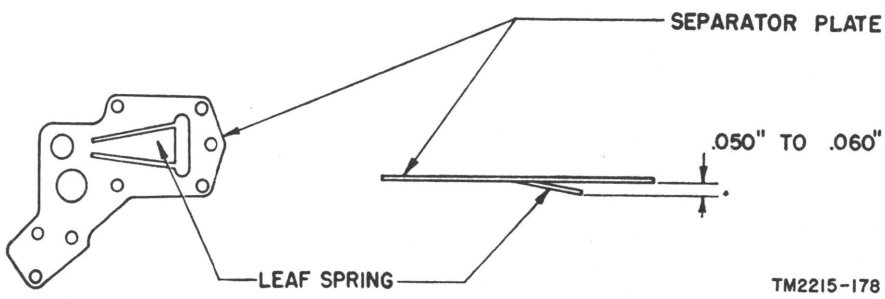


Figure 184. Selector separator plates.

be made easier if the swords and selector levers are replaced in the identical locations from which they are removed.

265. Selector Armature
(fig. 185)

a. PREPARATION. Remove the typing unit from the base and the type bar carriage from the typing unit. Rest the typing unit on its right side and remove the rangefinder assembly.

b. REQUIREMENTS. The armature should move freely on its pivot screws, with barely perceptible end play. There should be some clearance (not more than .008 inch) between the lower surface of the armature locking wedge and the No. 1 sword under the following conditions:

(1) Selector lever 1 resting on the peak of its cam.
(2) Sword 1 held against the upper separator plate without bending the plate.
(3) Armature end play taken up in a direction to reduce the clearance (not more than .008 inch) to a minimum.

c. ADJUSTMENTS.

(1) If there is no clearance between the armature locking wedge and sword 1, loosen the locknut on the upper pivot screw and adjust to obtain the desired clearance. (A one-quarter turn of the screw is equivalent to approximately .006 inch). Remove the armature bracket and adjust the lower pivot to obtain the proper armature end play. Replace the armature bracket.
(2) If there is more than .008-inch clearance, remove the armature bracket and adjust the lower pivot screw. Replace the bracket and adjust the armature end play with the upper pivot screw.

266. Selector Armature Bracket Link
(figs. 186 and 187)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder and motor stop mechanisms are removed.

b. REQUIREMENTS. When sword 1 is held midway between the stop posts by the No. 72581 gage pins, the position of the armature bracket should be such that a line through the center of sword 1 extends approximately through the centers of the armature pivot screws. This may be gaged by using a 6-inch rule.

c. ADJUSTMENT.

(1) Unhook the locking lever spring.
(2) Loosen the magnet bracket mounting screws, and move the bracket to its rearmost position.
(3) Back off the armature stops.
(4) Loosen the armature bracket mounting screws.
(5) Loosen the bracket link screws.
(6) Move the bracket eccentric out of the way so that it will not interfere with the adjustment.
(7) Rotate the main shaft until selector lever 1 rests on the peak of its cam.
(8) Hold the swords in a position midway between the two stop posts with the gage pins inserted between the stop posts and the swords. Be sure that both armature extension arms are between the arms of the swords. With the swords held in this midway position, place the No. 73370 locating gage over the end of sword 1 so that the two legs of the gage are against the ends of the sword arms.
(9) Move the armature bracket to a position where both armature extension arms are against the flat surface between the legs

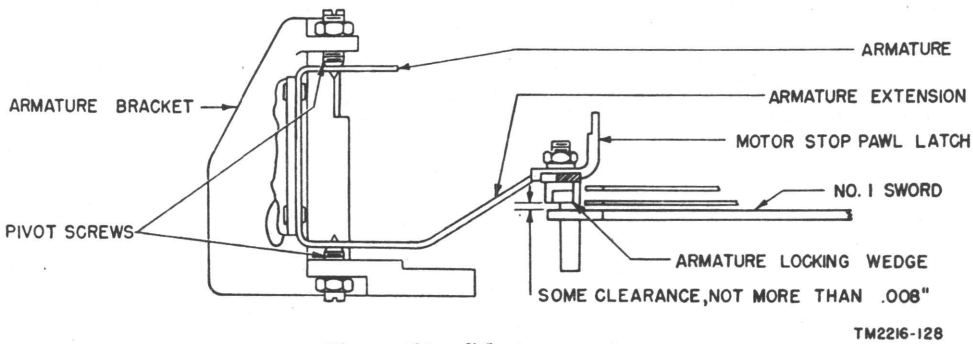


Figure 185. Selector armature.

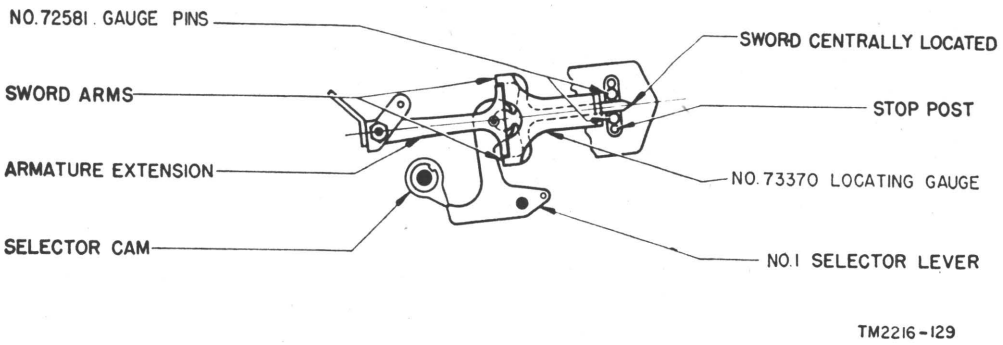


Figure 186. Use of No. 73370 locating gage.

of the gage. Use a straightedge to check that a line through the center of the armature pivot screw and a line through the center of the sword will coincide.

(10) Hold the armature bracket in this position and tighten the bracket link screw only; make the armature bracket mounting screws friction-tight.

(11) Remove the locating gage and the two gage pins.

(12) Rehook the locking lever spring.

267. Selector Armature Bracket

(fig. 187)

a. Preparation. The typing unit is resting on its right side, and the rangefinder is removed from the typing unit. The armature stops are backed off. The magnet bracket mounting screws are loosened, and the magnet is moved to its rearmost position. The armature bracket mounting screws are friction-tight. The bracket eccentric is moved out of the way. The motor stop mechanism is removed.

b. Requirements. The position of the armature bracket should be such that it provides some clearance, not more than .040-inch, between each sword and either stop post. The test for this requirement is as follows:

(1) Rotate the main shaft until selector lever 1 is resting on the peak of its cam. With the armature in its unoperated (spacing) position, move the spacing arm of the No. 1 sword against the armature ex-

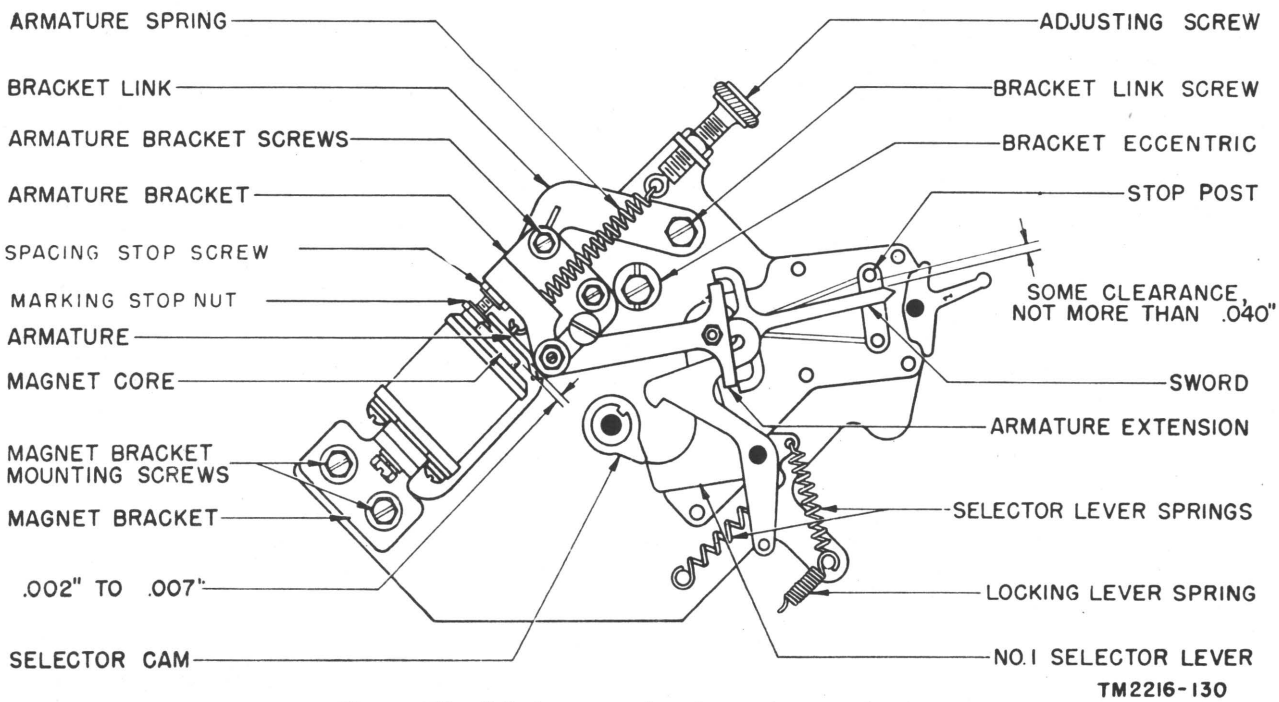


Figure 187. Selector magnet and armature mechanism.

tension. Place a .040-inch wire gage against the spacing stop post and move the armature slowly toward the marking position. The blade of the sword should strike the .040-inch gage before the armature extension leaves the spacing arm of the sword. Under these conditions the armature extension moves the sword to within not more than .040-inch of the stop post.

(2) Remove the .040-inch gage and repeat the procedure described in (1) above. The armature extension should leave the spacing arm of the sword before the blade of the sword strikes the spacing stop post. Under these conditions, there is some clearance between the sword and the stop post.

(3) Unhook the armature spring at its adjusting screw and, with the selector armature in its operated (marking) position, move the marking arm of sword 1 against the selector armature extension. Then move the armature slowly toward the spacing position until the armature extension just leaves the marking arm of sword 1. Check the clearance between sword 1 and the marking stop post in the same manner. Rehook the armature spring.

(4) With each selector lever on the peak of its cam, each associated sword should be tried for some clearance ((1) and (2)) above, between each sword and the spacing and marking stop posts, respectively.

c. Adjustments.

(1) Tighten the armature bracket mounting screws just enough to allow the bracket to be moved by tapping it lightly. The clearance between the sword and the stop posts is regulated by rotating the armature bracket on its pivot.

(*a*) If the clearance is more than .040 inch, move the bracket in a direction to bring the armature toward the sword.

(*b*) If there is no clearance, move the bracket in the opposite direction to move the armature away from the sword.

(2) Tighten both armature bracket screws.

(3) With the armature bracket set and both screws tightened, move the bracket eccentric against the bracket and tighten the screw. The eccentric and bracket link determine the position of the armature bracket. If it is necessary at any time to remove the armature bracket, do so by removing the two bracket screws. When replacing the bracket, hold the armature bracket against the eccentric while the two bracket screws are tightened.

268. Armature Stops

(figs. 187 through 189)

a. Preparation. The typing unit is resting on its right side, and the rangefinder is removed. The magnet bracket mounting screws are loosened and the magnet bracket is moved to its rearmost position. The motor stop mechanism is removed. Unhook the locking lever spring (fig. 187).

b. Requirements. Sword arms 1 (right and left) should clear the associated arms of the selector armature extension .035 to .037 inch when the front edge of the opposite sword arm is against its armature extension arm and selector lever 1 is on the high part of its cam. Rehook the locking lever spring.

c. Adjustments.

(1) To adjust the clearance of the right arm, reposition the armature stop screw (fig. 187) with the armature in its spacing position.

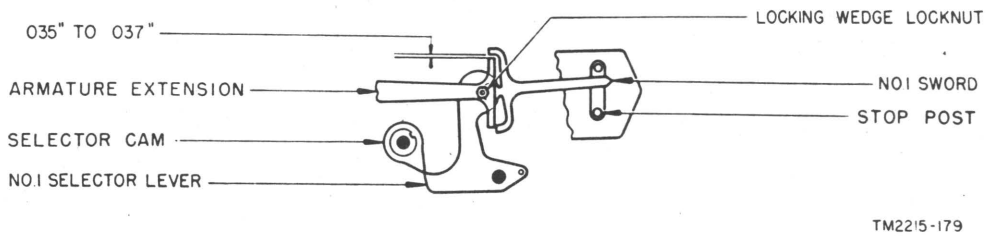


Figure 188. Sword arm clearance.

(2) To adjust the clearance of the left arm, reposition the armature stop nut with the armature in its marking position. If necessary, remove the nut and pinch the slotted portion (fig. 189) to make the nut tight on the screw. (Either the armature bracket or the magnet bracket may be removed to permit the removal of the armature stop nut. Recheck the right arm. Rehook the locking lever spring.

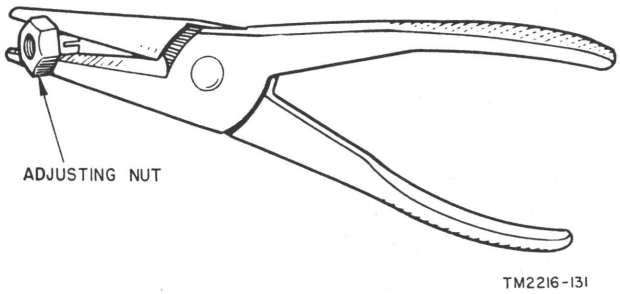


Figure 189. Pinching the armature stop nut.

269. Armature Locking Wedge
(fig. 190)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed. The magnet bracket mounting screws are loosened, and the magnet bracket is moved to its rearmost position. The motor stop mechanism is removed. Unhook the locking lever spring.

b. REQUIREMENTS. There should be .008- to .012-inch clearance between the point of the armature locking wedge and the point of the locking lever when the locking lever is on the long high part of the locking cam and the two points are in line.

c. ADJUSTMENT. Loosen the locking wedge locknut (figs. 185 and 187). Position the locking wedge forward or backward in its slot in the armature extension. Tighten the locknut. Rehook the locking lever spring. When making this adjustment on typing units equipped with a motor stop mechanism, set the motor stop pawl latch so that the shoulder of the latch is against the front face of the armature extension (fig. 185).

270. Armature Locking Lever Spring Tension
(fig. 190)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed. The magnet bracket mounting screws are loosened, and the magnet bracket is moved to its rearmost position. The motor stop mechanism is removed.

b. REQUIREMENTS. With the locking lever on the high part of the locking cam, hook a 32-ounce scale in the spring hole of the locking lever and pull in line with the spring. A pull of 10 to 14 ounces should be required to start the lever moving.

c. ADJUSTMENT. If the armature locking lever spring fails to meet requirements, replace it with a new spring.

271. Motor Stop

a. Teletypewriter TT–7/FG is equipped with a mechanical motor stop mechanism which permits the starting and stopping of the teletypewriter upon receipt of proper signals. Paragraphs 271 through 280 apply to teletypewriters equipped with the motor stop mechanism.

b. At this point in the adjustment procedure sequence, the motor stop mechanism is removed from the equipment. Replace the motor stop mechanism, as follows:

(1) Place the motor stop lever bracket in position and fasten it in place with the two motor stop lever bracket mounting screws.

(2) Rehook the motor stop lever spring.

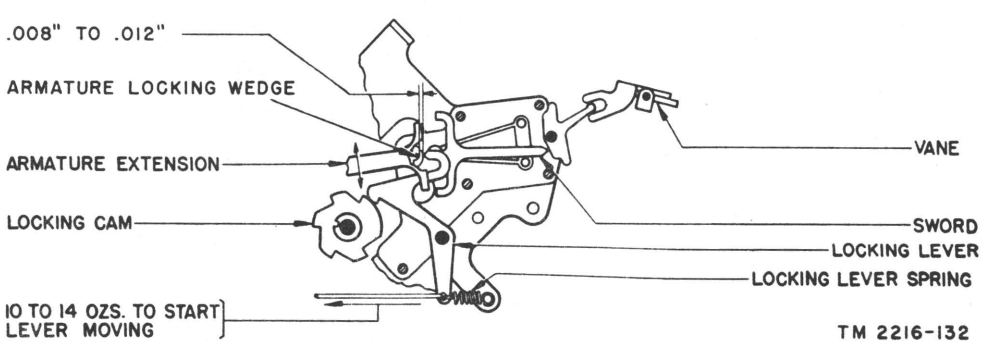


Figure 190. Armature locking wedge.

272. Motor Stop Lever Bracket
(fig. 191)

a. PREPARATION. Remove the typing unit from the base; place the typing unit on its right side. Remove the rangefinder assembly.

b. REQUIREMENTS. With the platen in the FIGS position, set up the STOP combination (uppercase H) and rotate the main shaft slowly until the motor stop function lever is selected completely. The latching surface of the inner motor stop pawl should overtravel the extreme rear surface of the motor stop pawl latch .010 to .025 inch when the armature is held in the marking position.

c. ADJUSTMENT. Position the motor stop lever bracket by use of the enlarged mounting holes. When making this adjustment, the motor stop pawl backstop should not be in contact with the inner pawl.

273. Motor Stop Lever Eccentric
(fig. 191)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed.

b. REQUIREMENTS. Rotate the main shaft until the printing bail is in its extreme rear position and the locking lever is on the high part of the locking cam. Then, with the armature in the marking position, engage the inner motor stop pawl with the motor stop pawl latch. The motor stop lever eccentric should be in contact with the lower arm of the motor stop release lever when the release lever stud touches the locking lever.

c. ADJUSTMENT. Position the motor stop lever eccentric.

274. Motor Stop Lever Backstop Screw
(fig. 191)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed.

b. REQUIREMENTS. With the platen in the LTRS position, set up the STOP combination (uppercase H) and rotate the main shaft until the printing bail is in its extreme forward position. Be sure that the motor stop pawls are released from the latch. There should be some clearance, not over .002 inch, between the rear extension of the motor stop function lever and the lower edge of the motor stop lever.

c. ADJUSTMENT. Loosen the backstop screw locknut and position the backstop screw. Tighten the locknut.

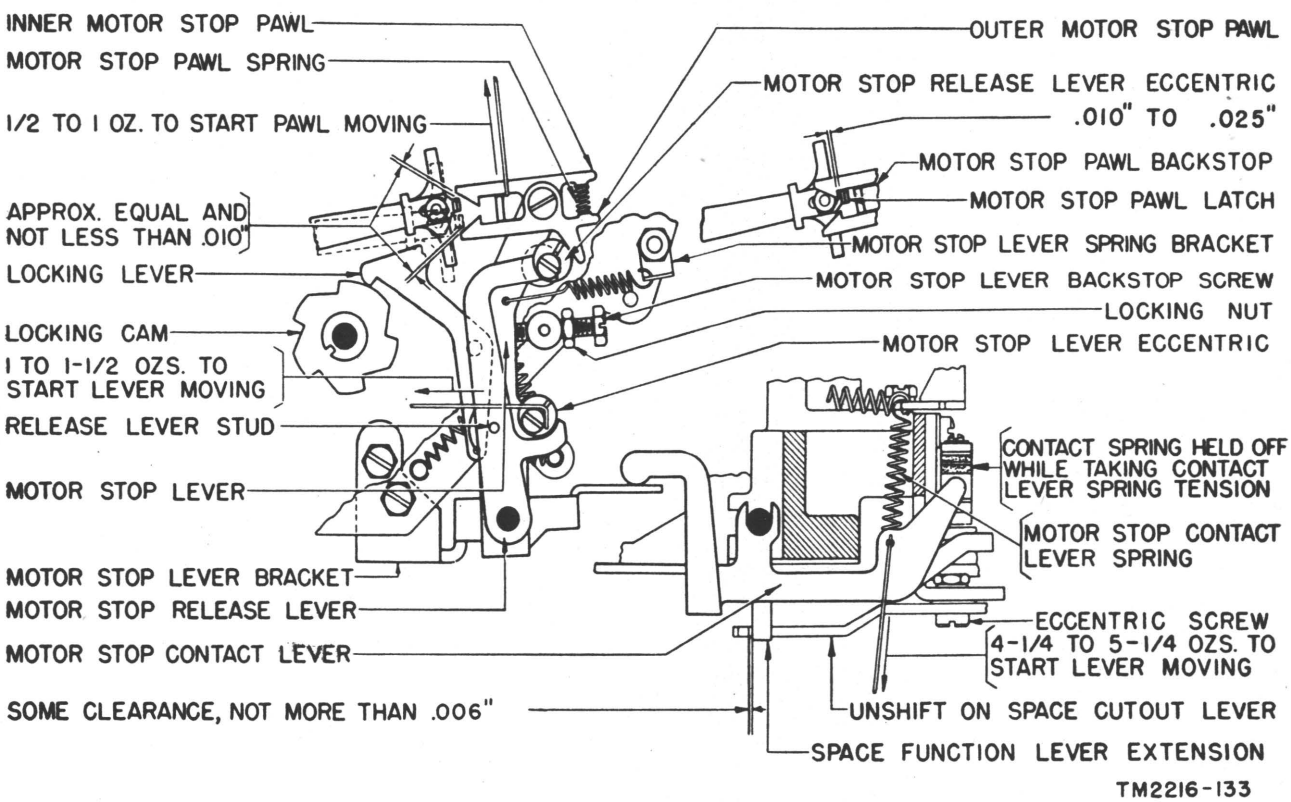


Figure 191. Mechanical motor stop mechanism.

275. Motor Stop Pawl Backstop
(fig. 191)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed.

b. REQUIREMENTS. With the printing bail in its extreme rear position and the motor stop release lever eccentric moved away from the outer stop pawl, the motor stop latch should clear both motor stop pawls by an approximately equal distance (not less than .010 inch) when the armature is moved to the marking or spacing position.

c. ADJUSTMENT. Loosen the motor stop pawl backstop mounting nut and rotate the backstop. Tighten the nut.

276. Motor Stop Release Lever Eccentric
(fig. 191)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed.

b. REQUIREMENTS. Rotate the main shaft until the printing bail is in its extreme rear position and the locking lever is on the high part of the locking cam. Then, with the armature in the marking position, engage the inner motor stop pawl with the motor stop pawl latch. The motor stop release lever eccentric should just touch the outer motor stop pawl when the lower arm of the motor stop release lever is in contact with the motor stop lever eccentric and the outer pawl is against the motor stop pawl backstop.

c. ADJUSTMENT. Loosen the motor stop release lever eccentric mounting screw. Position the motor stop release lever eccentric. Tighten the mounting screw.

277. Motor Stop Pawl Spring Compression
(fig. 191)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed.

b. REQUIREMENTS. With the printing bail in its extreme rear position, hook an 8-ounce scale, held in a horizontal position, over the inner motor stop pawl just in front of the backstop and pull at right angles to the pawl. A pull of ½ to 1 ounce should be required to start the pawl moving.

c. ADJUSTMENT. If the motor stop pawl spring fails to meet requirements, replace it with a new spring.

278. Motor Stop Lever Spring Tension
(fig. 191)

a. PREPARATION. The typing unit is resting on its right side, and the rangefinder is removed.

b. REQUIREMENTS. Unhook the motor stop contact lever spring, located toward the front of the typing unit. With the motor stop lever in the unoperated position, hook an 8-ounce scale over the head of the screw which mounts the motor stop lever eccentric, and pull toward the rear of the teletypewriter. A pull of 1 to 1½ ounces should be required to start the lever moving.

c. ADJUSTMENT.

(1) Position the motor stop lever spring bracket on the post of the selector unit. Replace the motor stop lever spring with a new spring if moving the spring bracket does not cause the old spring to meet the requirements.

(2) Rehook the motor stop contact lever spring.

279. Motor Stop Contact Lever Spring Tension
(fig. 191)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. Hold off the contact spring (located on the front of the typing unit) if it rests on the motor stop contact lever. Hook an 8-ounce scale in the contact lever spring hole and pull in line with the spring. A pull of 4¼ to 5¼ ounces should be required to start the contact lever moving.

c. ADJUSTMENT. If the motor stop contact lever spring fails to meet requirements, replace it with a new spring.

280. Motor Stop Function Lever Spring Tension
(fig. 192)

a. PREPARATION. The typing unit is removed from the base. Place the typing unit in its normal upright position.

b. REQUIREMENTS. With the motor stop function lever resting against the rear edges of the vanes, but not selected, hook a 12-pound scale under the extreme front end of the lever (located on

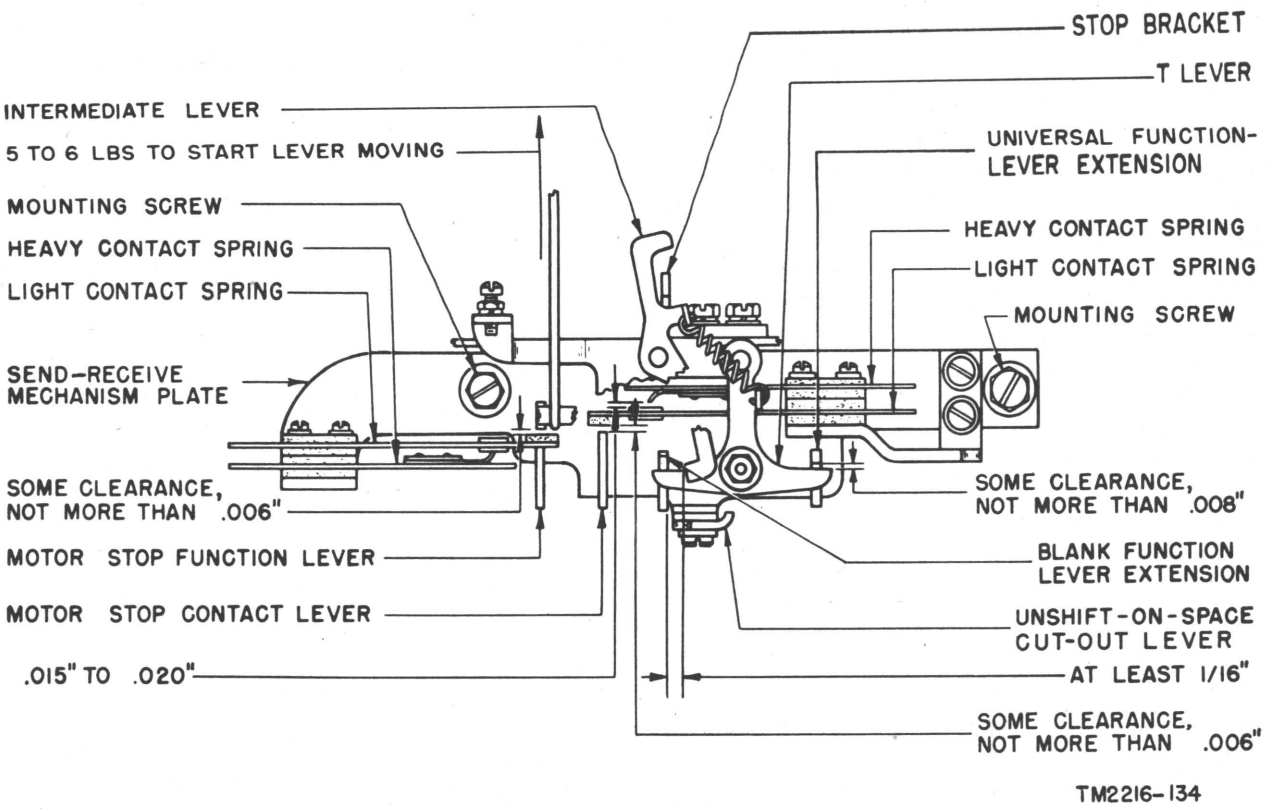


Figure 192. Mechanical motor stop contacts.

the front of the typing unit just above the right end of the motor stop contact spring assembly). Pull at right angles to the lever and toward the top of the teletypewriter. A pull of 5 to 6 pounds should be required to start the lever moving.

c. Adjustment. If the motor stop function lever spring fails to meet requirements, replace it with a new spring.

281. Stop Lever Eccentric Screw and Spring

(figs. 193 and 194)

a. Eccentric Screw.

(1) *Preparation.* The rangefinder assembly is removed from the typing unit.

(2) *Requirement.* The stop lever on the rangefinder assembly should overtravel the latching surface of the trip latch not more than .006 inch.

(3) *Adjustment.* Position the stop lever eccentric screw by loosening the locknut; be careful not to disturb the adjustment.

b. Spring Tension.

(1) *Preparation.* The rangefinder assembly is removed from the typing unit.

(2) *Requirements.* With the rangefinder assembly bottom-side up, and with the trip latch plunger held operated, hook an 8-ounce scale at the end of the stop lever on the rangefinder assembly (fig. 194). A pull of ¾ to 1¼ ounces should be required to start the lever moving.

(3) *Adjustment.* If the stop lever spring fails to meet requirements, replace with a new spring.

282. Trip Latch Spring Compression

(fig. 193)

a. Preparation. Remove the rangefinder assembly from the typing unit.

b. Requirements. Hold the rangefinder assembly in a horizontal position (fig. 193). Apply the push end of an 8-ounce scale, held in a vertical position, to the trip latch as near to the stop lever as possible. Push up; a push of 1 to 1½ ounces should be required to start the trip latch moving.

c. Adjustment. If the trip latch spring fails to meet requirements, replace with a new spring. Remount the rangefinder assembly. Be careful that the trip latch plunger does not jam against the armature trip-off eccentric screw.

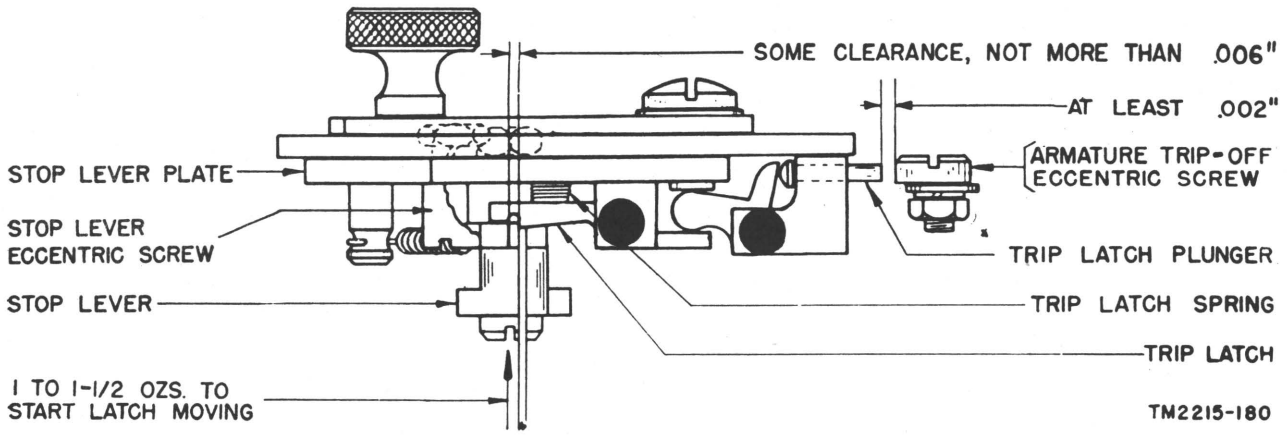


Figure 193. Rangefinder and stop lever.

283. Selector Stop Arm and Stop Lever Engagement

(figs. 155, 173, and 195)

a. PREPARATION. With the selector armature in the spacing position, rotate the selector cam sleeve until the stop arm moves the stop lever to its maximum travel beyond the step of the trip latch. Loosen the rangefinder assembly mounting screws and the positioning link mounting screw just enough to make them friction-tight (fig. 155).

b. REQUIREMENTS. The overtravel of the stop lever beyond the trip latch is at least half, but not more, than the width of the stop lever. Check this with the index arm set at 0, 60, and 120 on the range scale.

c. ADJUSTMENTS. Position the rangefinder assembly to meet the above requirements. Tighten the mounting screws and the positioning link screw.

284. Armature Trip-off Eccentric Screw

(fig. 195)

a. PREPARATION. The rangefinder assembly is on the typing unit, and the typing unit is resting on its right side. The magnet bracket mounting screws are loosened, and the magnet bracket is moved to its rearmost position. The motor stop mechanism is removed.

b. REQUIREMENTS.

(1) There should be some clearance, not more than .002 inch, between the stop lever and trip latch when the armature is in the spacing position and the main shaft is rotated until the stopping edge of the stop lever is directly below the latching surface of the trip latch.

(2) The trip latch plunger should have at least .002-inch end play (fig. 193) when the armature is in the marking position and the stop lever is clear of the latching surface of the trip latch.

c. ADJUSTMENT.

(1) To obtain correct clearance, position the armature trip-off eccentric screw by loosening the locknut and turning the screw. Tighten the locknut.

(2) The second requirement (*b* (2) above) serves as a check on the trip-off eccentric screw adjustment and also on the adjustment of the armature stops (par. 268).

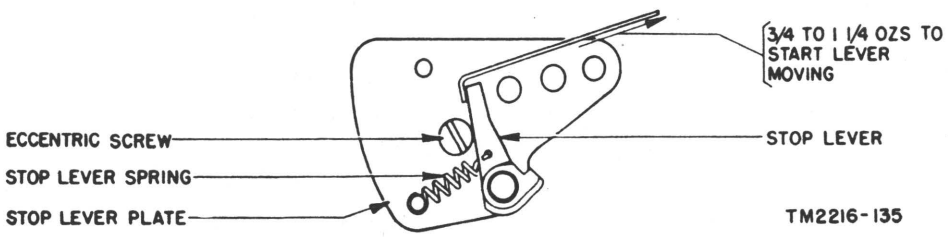


Figure 194. Stop lever spring.

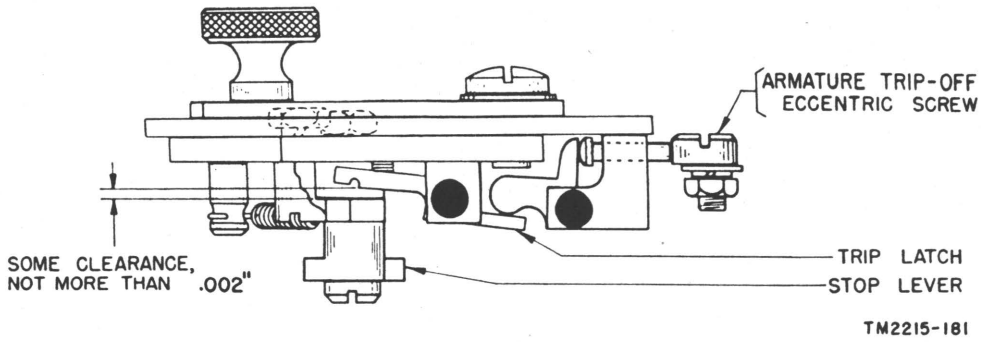


Figure 195. Armature trip-off eccentric screw.

285. Selector Magnet Coil Adjustment

(fig. 187)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENT. The left edge of the core of the left magnet coil should aline, within one-sixty-fourth inch, with the left edge of the armature.

c. ADJUSTMENT. Adjust by means of the magnet coil mounting screws.

286. Magnet Bracket

(fig. 187)

a. PREPARATION. The typing unit is resting on its right side. The magnet bracket mounting screws are loosened, and the magnet bracket is moved to its rearmost position. The motor stop mechanism is removed.

b. REQUIREMENTS. There should be .002- to .007-inch clearance between each magnet core and the armature antifreeze strip when the armature is against the marking stop nut. This clearance should be .003- to .010-inch when a chromium-plated armature is used. The faces of the cores should be parallel to the face of the armature, and the sides of the cores should aline with the edges of the armature.

c. ADJUSTMENT. Position the magnet bracket in the elongated mounting holes.

287. Armature Spring and Rangefinder Adjustments

(fig. 155)

a. PREPARATION. Place the type bar carriage on the typing unit and the typing unit on the base. Connect the teletypewriter to the proper power supply.

b. REQUIREMENTS.

(1) The selector armature spring tension should measure from 6 to 6⅜ ounces when pulled to position length (par. 212).

(2) The index arm of the rangefinder should be set midway between the upper and lower scale readings.

c. ADJUSTMENTS.

(1) Loosen the adjusting screw locknut and position the armature spring adjusting screw. Tighten the adjusting screw locknut.

(2) Adjust the rangefinder setting as follows:

(*a*) Type (or, if possible, receive from another teletypewriter) the letters R and Y.

(*b*) While RY is being printed or received, loosen the index arm thumbscrew and shift the index arm toward zero until errors begin to appear in the printed letters RY.

(*c*) Slowly move the arm back until the errors disappear. This position indicates one limit of the orientation range; note the position on the scale.

(*d*) To find the other limit, repeat the procedure described in (*b*) and (*c*) above at the opposite end of the scale.

(*e*) After the two limits (or extreme positions of perfect printing) have been found, set the index arm of the rangefinder midway between these two points.

288. Shift Mechanism

a. Tests and adjustments for the shift mechanism are described in paragraphs 289 through 302.

b. When a test or adjustment requires the removal of the shift detent spring, do not use the spring hook supplied with Tool Equipment TE–50 or TE–50–A to remove the spring, as the shift detent spring is too heavy for the spring hook and probably will break the hook.

c. Experience in making tests and adjustments indicates that the most logical and efficient sequence for making tests and adjustments of the shift mechanism is the order in which the procedures are presented in the following paragraphs. A change in any one of a chain of adjustments requires that all related adjustments be checked.

289. Platen Unit Pilot Screws
(figs. 196 and 200)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. The platen unit should be midway between the side frames and should be free on its bearings without side play.

c. ADJUSTMENT. With the typing unit in its normal upright position, disconnect the line feed and shift vertical links at the upper shoulder screws. Unhook the platen balance spring and the shift detent spring. Position the platen unit by means of its pilot screws. Then back off one pilot screw until the platen unit has some side play. Turn the pilot screw in just enough to take up the side play. Reconnect the line feed and shift vertical links; rehook the platen balance spring and the shift detent spring. Do not tighten the pilot screws to the extent that they cause a strain on the side frames.

290. Platen Shift Stop Post
(fig. 196)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. The top and bottom surfaces of the platen shift stop post should be parallel to a line through the center of the platen detent roller screw and the platen pilot screw.

c. ADJUSTMENT. Loosen the platen shift stop post nut and rotate the post. Tighten the nut.

291. Letters Stop Screw
(fig. 196)

When the LTRS combination is selected, the platen will move to the unshift (down) position. When the FIGS combination is selected, the platen will move to the shift (up) position.

a. PREPARATION. The type bar carriage should be in place on the typing unit. Remove the ribbon from the ribbon carrier.

b. REQUIREMENT. With the platen in the LTRS position and the letter N type bar held lightly against the platen, the curved surface of the letter N should fit the curved surface of the platen. The contact of the two surfaces can be seen best if a light is placed on the side of the type bar away from the operator. To check further, insert a sheet of paper with a carbon in the teletypewriter and press the letter N firmly against the paper and platen. The impression made by the carbon on the paper should be of uniform shade.

c. ADJUSTMENT. If the shading is lighter at the bottom of the character, raise the letters stop screw. If the shading is lighter at the top, lower the screw.

292. Figures Stop Screw
(fig. 196)

a. PREPARATION. The type bar carriage is in place on the typing unit. Install the ribbon in the ribbon carrier.

b. REQUIREMENT. The top of the figure 2 typed with the platen in the FIGS position should be in line with the top of the letter W typed with the platen in the LTRS position.

c. ADJUSTMENT. Raise or lower the figures stop screw.

293. Figures, Letters, and Line Feed Function Lever Spring Tensions
(fig. 197)

a. PREPARATION. Remove the type bar carriage from the typing unit. Place the typing unit on its right side.

b. REQUIREMENTS. Select the blank combination and rotate the main shaft until the printing bail is in its extreme forward position. Hook a 32-ounce scale over the rear extension of the figures, letters, and line feed function levers, in turn, just in front of the lobes which engage the push bars; pull horizontally at right angles to the respective function lever rear extension. A pull of 15 to 19 ounces should be required to start each of these function levers moving. When checking these tensions, the push bars should be held away from the function levers.

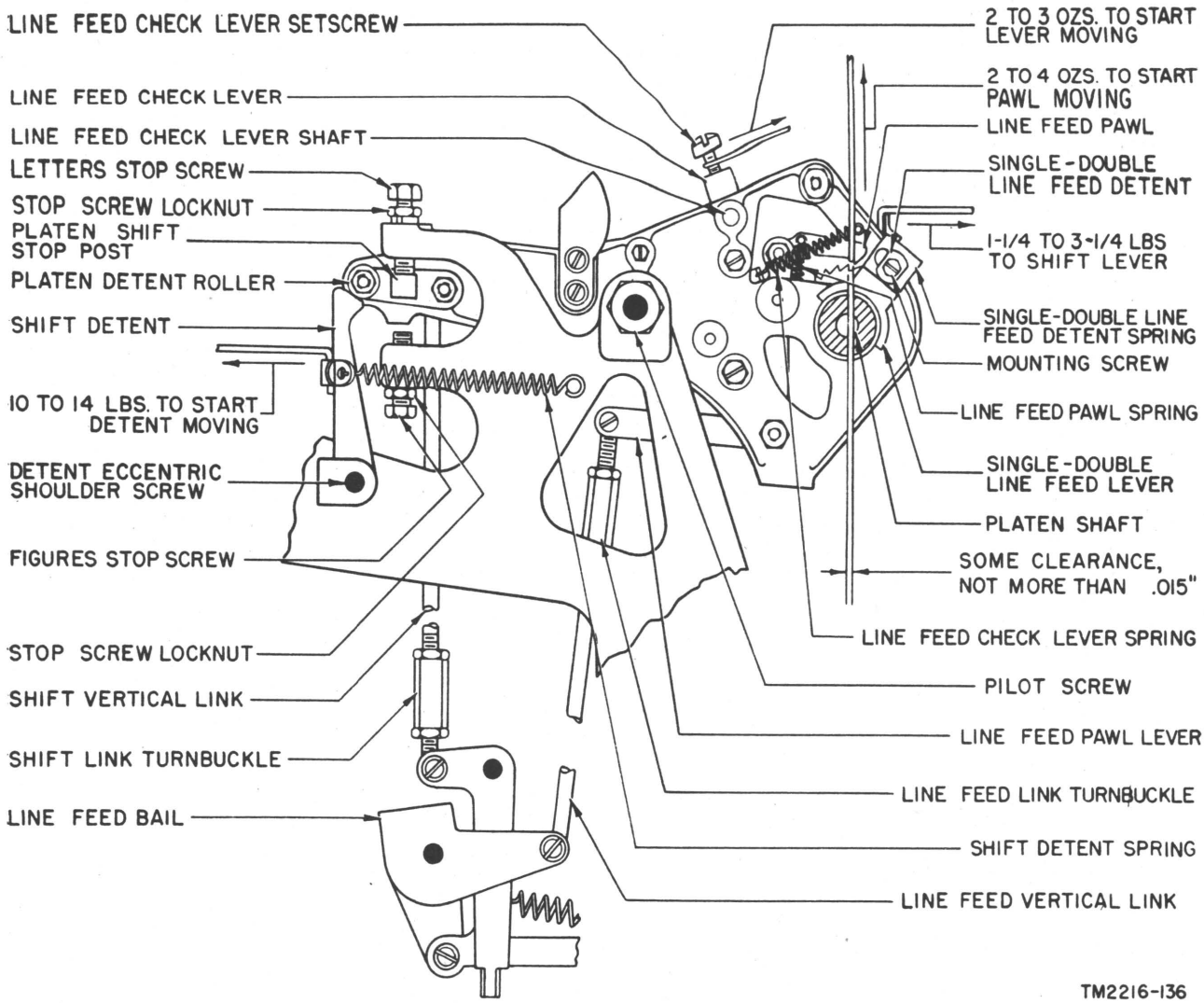


Figure 196. Platen shifting mechanism.

c. ADJUSTMENT. If any function lever spring fails to meet the requirements, replace it with a new one.

294. Space Function Lever Spring Tension (fig. 197)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. With the space function lever resting against the vanes, but not selected, hook a 32-ounce scale over the rear extension of the lever, just in front of the lobe, and pull horizontally at right angles to the rear extension. A pull of 12 to 16 ounces should be required to start the space function lever moving. When checking the tension, hold the letters push bar away from the function lever.

c. ADJUSTMENT. If the space function lever spring fails to meet requirements, replace it with a new spring.

295. Blank Printing and Spacing Cut-out Function Lever Spring Tension

This adjustment applies only to teletypewriters equipped with a special function lever to prevent printing and spacing when the blank combination is selected.

a. PREPARATION. The type bar carriage is removed from the typing unit, and the typing unit is removed from the base. Place the typing unit in its normal upright position.

b. REQUIREMENTS. Rotate the main shaft until the printing bail is in its extreme rear position. Then unhook the blank printing and spacing cut-

out function lever spring from the spring plate. Hook a 32-ounce scale in the spring eye. A pull of 22 to 30 ounces should be required to stretch the spring to its position length. Rehook the spring.

c. ADJUSTMENT. If the printing and spacing cut-out function lever spring fails to meet requirements, replace with a new spring.

296. Function Bail Blade
(fig. 199)

Note. If the letters and figures shift mechanism has not been adjusted, loosen the mounting screws of the shift bell crank operating lever bracket (shift link bracket, figure 198) and move the bracket to its extreme rear position before proceeding with the function bail blade adjustment.

a. PREPARATION. Place the typing unit on its right side.

b. REQUIREMENTS.

(1) With the figures, line feed, and letters function levers alternately selected and the main shaft rotated until the travel of the function lever bail is blocked by the selected function lever, there should be .004- to .015-inch clearance between the rear edge of vane 1 and the back of the notch in the selected function lever (fig. 199).

(2) With the unshift-on-space cut-out lever (fig. 197) released from the lower extension of the space function lever, place the platen in the FIGS position, select the space combination, and rotate the main shaft until the function lever bail roller just leaves the cam surface of the space function lever. Under this condition, the clearance between the rear edge of vane

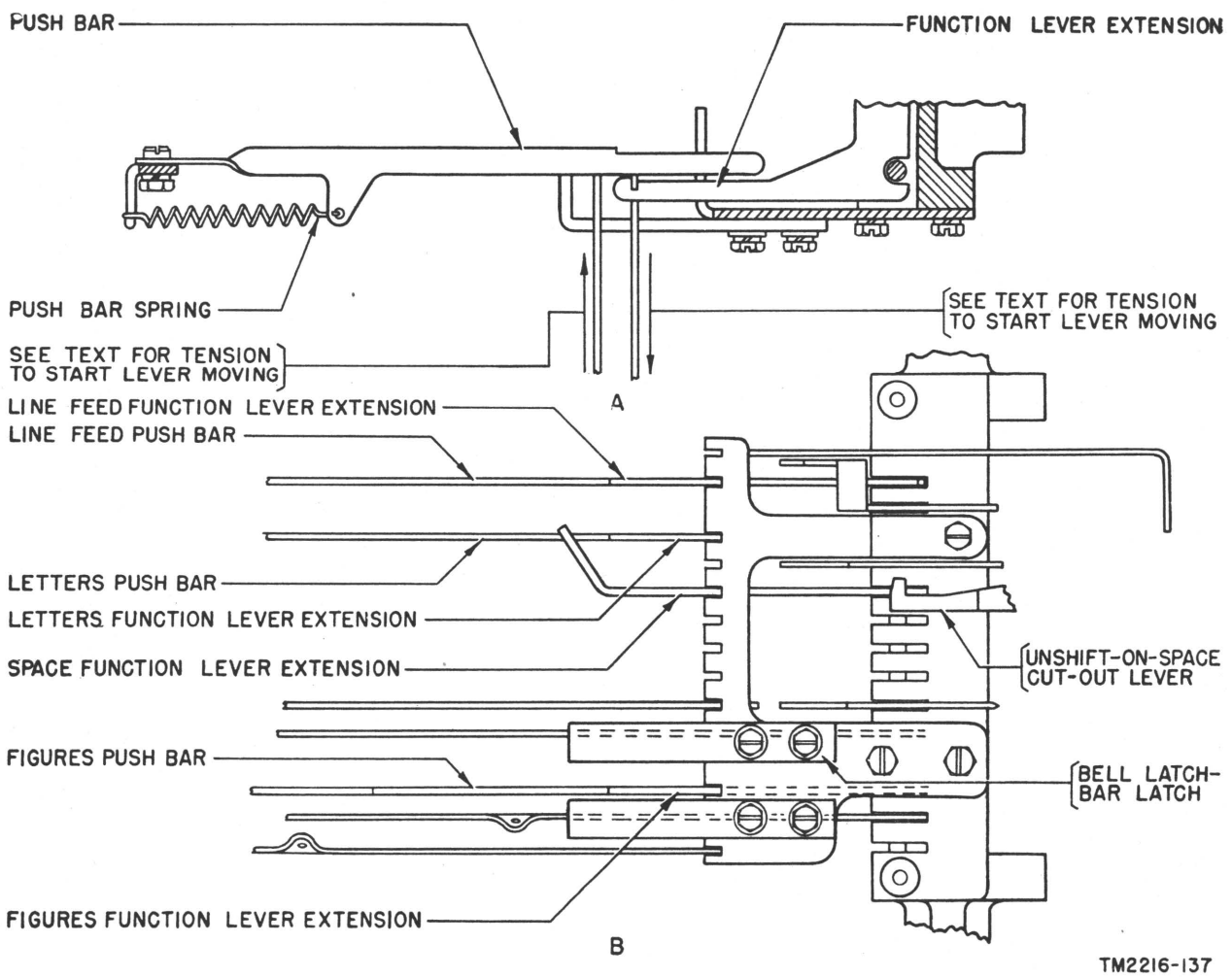


Figure 197. Function lever extensions.

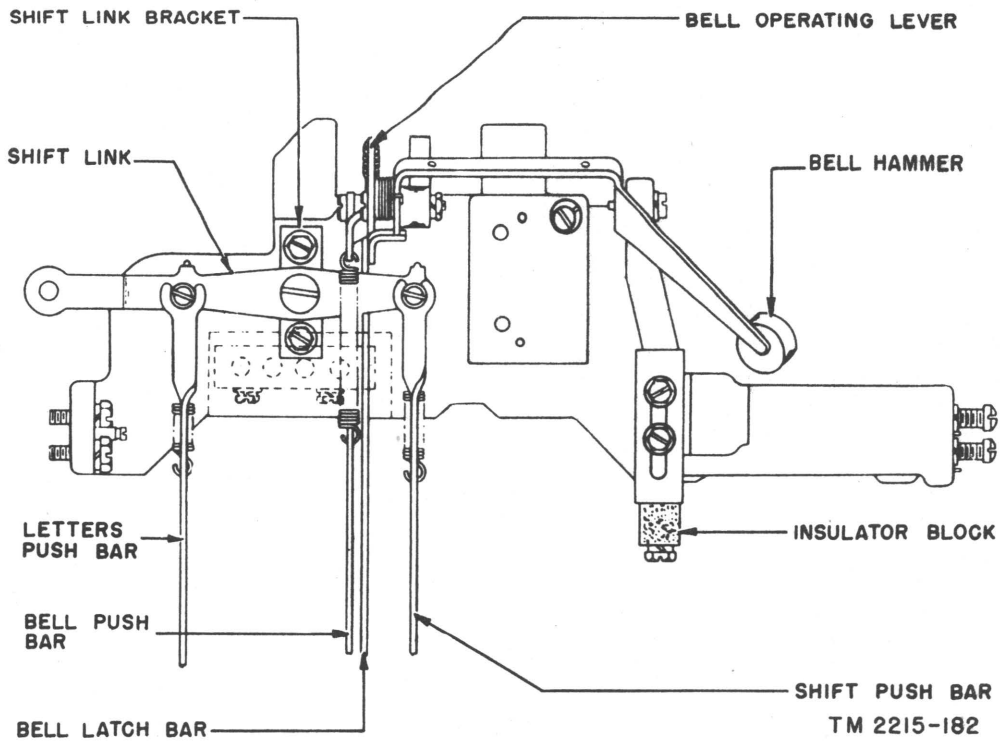


Figure 198. Shift link and bracket.

1 and the back of the notch in the space function lever should be .004 to .015 inch (fig. 199).

c. ADJUSTMENT.

(1) Select the figures function lever. Raise or lower the right (with respect to the front of the typing unit) end of the function bail blade in its mounting slots to obtain the specified clearance between the rear edge of vane 1 and the back of the notch in the figures function lever.

(2) Select the line feed function lever and adjust the left end of the function bail blade, by raising or lowering it, to obtain the specified clearance between the rear edge of the No. 1 vane and the back of the notch in the line feed function lever.

(3) If requirements are not met when the letters and space function levers are selected, it may be necessary to readjust both ends of the function bail blade to obtain specified clearances.

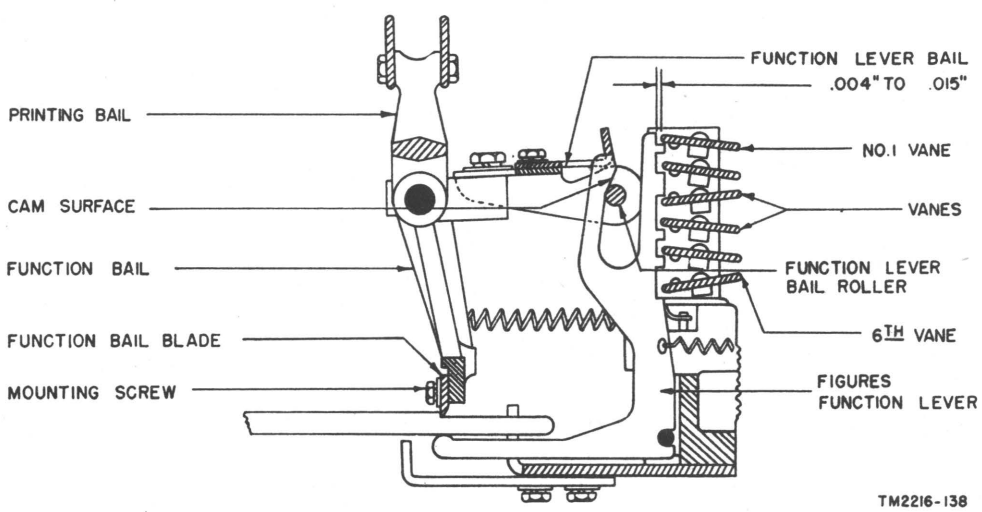


Figure 199. Function bail.

297. Unshift-on-space Cut-out Lever

(figs. 191 and 197)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS.

(1) If it is desired that the platen return to the LTRS position when the space combination is received, rotate the unship-on-space cut-out lever counterclockwise (as viewed from the bottom of the teletypewriter) against its stop. Tighten the cut-out lever eccentric screw locknut to hold the cut-out lever in this position.

(2) If it is desired that the platen should *not* return to the LTRS position when the space combination is received, rotate the unship-on-space cut-out lever clockwise (as viewed from the bottom of the teletypewriter), so that the hooked end of the cut-out lever is to the rear of the space function lever extension and the cut-out lever touches the side of the space function lever extension. There should be some clearance, not more than .006-inch, between the rear surface of the space function lever extension and the cut-out lever.

c. ADJUSTMENT. Remove the **T** lever and attached mechanism (fig. 192) from its mounting post and loosen the cut-out lever eccentric screw nut. Position the cut-out lever and the eccentric screw and then tighten the locknut. Replace the **T** lever and attached mechanism.

298. Letters and Figures Shift

(figs. 196 and 197)

a. PREPARATION. The typing unit is removed from the base. Place the typing unit in its normal upright position. Unhook the shift detent spring and the platen balance spring (figs. 196 and 200).

b. REQUIREMENTS.

(1) Place the platen in the FIGS position (up). Select the LTRS combination. Rotate the main shaft until the function bail blade moves the letters push bar to its extreme rear position. The shift stop post should move to within .010 to .025 inch of the letters stop screw.

(2) Place the platen in the LTRS position. Select the FIGS combination. Rotate the main shaft until the function bail blade moves the figures push bar to its extreme rear position. The shift stop post should move to within .010 to .025 inch of the figures stop screw.

c. ADJUSTMENT.

(1) Place the shift bell crank operating lever bracket (shift link bracket, figure 198) in the middle of the adjustment provided by the mounting slots, and tighten the mounting screws. Place the typing unit on its right side and rotate the main shaft until the function bail is in its extreme forward position. The clearance between the function bail blade and the shoulder on the letters push bar (platen in FIGS position) should be equal (within .010 inch) to the clearance between the function bail blade and the shoulder on the figures push bar (platen in LTRS position). Accomplish this adjustment by use of the turnbuckle on the shift link.

(2) Select the LTRS and FIGS combinations alternately and check for the specified clearances between the shift stop post and the letters and figures stop screws (*b* above). If either of these clearances is greater than .025 inch, move the shift bell crank operating lever bracket (shift link bracket) toward the front of the unit. If either clearance is less than .010 inch, move the shift bell crank operating lever bracket toward the rear.

(3) After adjusting the shift bell crank operating lever bracket, a slight readjustment of the shift link turnbuckle may be necessary to bring both clearances within the specified limits (*b* above).

(4) Rehook the shift detent spring and the platen balance spring.

299. Platen Balance Spring Tension

(fig. 200)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. With the platen in the LTRS position, unhook the platen balance spring from the platen unit side frame. It should require 3½ to 5 pounds to pull the spring to position length on units equipped with cast-iron platen brackets,

1¼ to 2 pounds on units equipped with aluminum platen brackets. Rehook the platen balance spring.

c. ADJUSTMENT. If the platen balance spring fails to meet the requirements, replace it with a new spring.

300. Shift Detent

(fig. 196)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. When the platen is shifted from the FIGS to the LTRS position, and vice versa, the platen detent roller should ride equally on either side of the shift detent.

c. ADJUSTMENT. Position the shift detent by loosening the locknut and turning the shift detent eccentric shoulder screw. Tighten the locknut.

301. Shift Detent Spring Tension

(fig. 196)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Hook a 25-pound scale over the extension on the shift detent and pull in line with the spring. A pull of 10 to 14 pounds should be required to start the detent moving.

c. ADJUSTMENT. If the shift detent spring fails to meet requirements, replace it with a new spring.

302. Letters and Figures Push Bars Spring Tensions

(fig. 197)

a. PREPARATION. Place the typing unit on its right side.

b. REQUIREMENTS. With the platen in the LTRS position, select any character and rotate the main shaft until the printing bail is in its extreme forward position. Place the push end of an 8-ounce scale directly beneath the notch on the letters and figures push bars, alternately, and push horizontally at a right angle to the bar. A push of 3 to 5 ounces should be required to start either push bar moving.

c. ADJUSTMENT. If either push bar spring fails to meeting requirements, replace the respective push bar spring.

303. Line Feed and Paper Feed Mechanisms

a. The line feed mechanism tests and adjust-

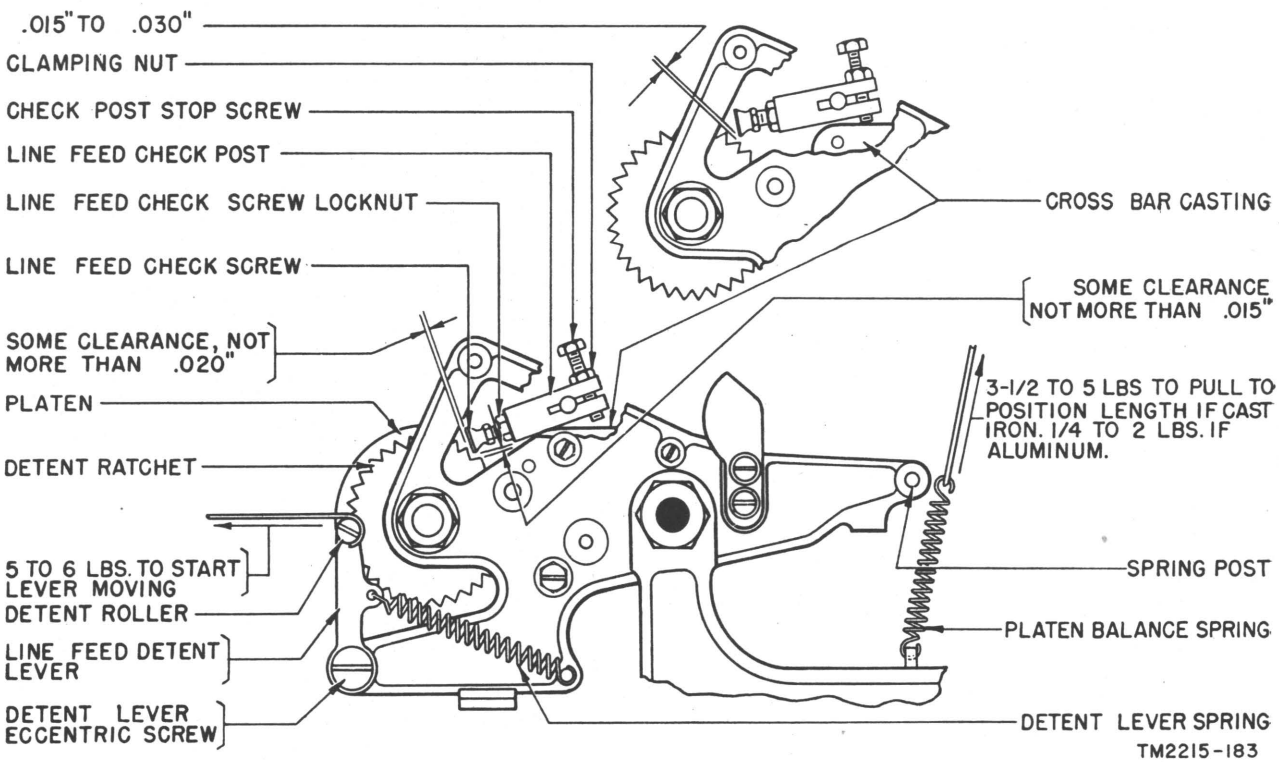


Figure 200. Line feed mechanism and platen balance spring.

ments are described in paragraphs 305 through 315. For a description of the line feed sequence of operations, see paragraph 122.

b. The paper feed mechanism tests and adjustments are described in paragraphs 316 through 326.

c. Location (right or left) directions are with respect to the front of the typing unit.

d. Experience indicates that the most logical and efficient sequence for making tests and adjustments of the line feed and paper feed mechanisms is the order in which the procedures are presented in paragraph 304 through 326.

304. Platen Shaft

(fig. 214)

Before testing the platen shaft for end play, be sure that the three screws on the right end of the platen are seated securely into the shaft.

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. The platen shaft should have some end play, not more than .004 inch.

c. ADJUSTMENT. Position the friction assembly on the platen shaft by loosening the friction assembly set screws and moving the friction assembly as required. Tighten the set screws.

305. Single-double Line Feed Detent

(fig. 196)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. When the single-double line feed lever is shifted from the single to the double line feed position, or vice versa, the hump on the detent spring should travel equally on either side of the detent.

c. ADJUSTMENT. Position the detent by loosening its mounting screw and moving the detent as required. Tighten the mounting screw.

306. Single-double Line Feed Detent Spring Pressure

(fig. 196)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the single-double line feed lever in the single line feed position (up), hook a 12-pound scale, held in a horizontal position, over the extension of the lever and pull toward the front. A pull of 1¼ to 3¼ pounds should be required to move the lever to the double line feed position.

c. ADJUSTMENT. If the single-double line feed detent spring fails to meet requirements, replace with a new spring.

307. Line Feed Detent Lever

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT (fig. 196). With the single-double line feed lever in the single line feed position (up) and the line feed bail operated by hand, the line feed pawl, when sliding off the rear edge of the single-double line feed lever, should just miss the edge of a tooth on the line feed ratchet.

c. ADJUSTMENT (fig. 200). To obtain the requirement, loosen the detent lever eccentric screw nut and turn the eccentric screw to rotate the platen by means of the detent lever. Tighten the detent lever eccentric screw nut and check the adjustment for all the teeth on the line feed ratchet. There are two positions of the detent lever eccentric screw which will provide correct adjustment. Use the position which applies the least tension to the detent lever spring and be sure that the detent roller rests in the bottom of a notch on the detent ratchet.

308. Line Feed Link Turnbuckle

(fig. 196)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the single-double line feed lever in the single line feed position, select the LINE FEED combination and rotate the main shaft until the line feed push bar is stripped from the function bail blade. Under this condition, the platen should rotate one line space, the detent roller should rest in the hollow between two ratchet teeth, and there should be some clearance, not more than .015 inch, between the line feed pawl and the front face of a tooth on the ratchet. Check each tooth on the ratchet for this clearance. When gaging clearances, the play in the line feed mechanism should be taken up in a direction to make the clearance a maximum (by pressing forward on the line feed pawl).

c. ADJUSTMENT. Place the typing unit on its right side. Adjust the length of the line feed link by means of its turnbuckle.

309. Line Feed Push Bar Spring Tension

(fig. 197)

a. PREPARATION. Place the typing unit on its right side.

b. REQUIREMENTS. With the printing bail in its extreme rear position, apply the push end of an 8-ounce scale to the line feed push bar, just to the rear of the line feed function lever extension, and push horizontally at right angles to the bar. A push of 1½ to 2½ ounces should be required to start the push bar moving.

c. ADJUSTMENTS. If the line feed push bar spring fails to meet requirements, replace it with a new spring.

310. Line Feed Detent Lever Spring Tension

(fig. 200)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the typing unit in its normal upright position, hook a 12-pound scale over the head of the detent roller mounting screw and pull at right angles to the detent lever. A pull of 5 to 6 pounds should be required to start the detent lever moving.

c. ADJUSTMENT. If the line feed detent lever spring fails to meet requirements, replace it with a new spring.

311. Line Feed Pawl Spring Tension

(fig. 196)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the single-double line feed lever in the double line feed position and the line feed pawl in its unoperated position, hook an 8-ounce scale under the line feed pawl, just to the rear of the notch, and pull straight up. A pull of 2 to 4 ounces should be required to start the pawl moving.

c. ADJUSTMENT. If the line feed pawl spring fails to meet requirements, replace it with a new spring.

312. Line Feed Check Screw

(fig. 200)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Select the LINE FEED combination and rotate the main shaft. The line feed check screw should drop in the twelfth notch from the detent roller when line feed ratchets having 33 teeth are used and in the fourteenth notch when ratchets having 37 teeth are used. When counting the notches, start with the notch just above the detent roller. When the check screw is held in the bottom of a notch on the ratchet, there should be some clearance, not more than .020 inch, between the front face of the screw and the face of the tooth, at the point of minimum clearance.

c. ADJUSTMENT. Loosen the line feed check screw locknut and position the check screw to meet requirements. Tighten the locknut. Rotate the platen roll and check the clearance in each notch of the ratchet. If necessary, loosen the clamping nut of the line feed check post stop screw and back off the stop screw before making the adjustment.

313. Line Feed Check Post Stop Screw

(fig. 200)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIRMENTS. Hold the line feed check post stop screw down against the crossbar casting. When the platen is rotated, the line feed check post stop screw should clear each detent ratchet tooth by .015 to .030 inch. Check every eighth or ninth tooth on the detent ratchet.

c. ADJUSTMENT. Loosen the check post clamping nut and position the line feed check post stop screw. Before tightening the clamping nut, make sure that the line feed check post is against the inner side of the crossbar casting and that the end of the line feed check lever shaft (fig. 196) is flush with the outer surface of the casting. Tighten the clamping nut.

314. Line Feed Check Lever

(figs. 196 and 200)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Select the LINE FEED combination and rotate the main shaft until the line feed pawl has reached its farthest travel in rotating the platen. The line feed pawl lever should be in contact with the check lever and there should be some clearance, not more than

.015-inch, between the lower edge of the line feed check screw and the bottom of any notch in the detent ratchet.

c. ADJUSTMENT. Loosen the line feed check lever set screw and position the line feed check lever. Before tightening the set screw, make sure that the shaft has some end play, not more than .008 inch. When checking the clearance between the line feed check screw and the ratchet, take up the play of the line feed check lever shaft in its right bearing to obtain the maximum clearance.

315. Line Feed Check Lever Spring Tension

(fig. 196)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMET. With the line feed pawl in the forward position, hook an 8-ounce scale under the head of the check lever set screw and pull at right angles to the set screw. A pull of 2 to 3 ounces should be required to start the lever moving.

c. ADJUSTMENT. If the line feed check lever spring fails to meet requirements, replace it with a new spring.

316. Pressure Roller Release Shaft Collars

(fig. 201)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS.

(1) The pressure roller release shaft should have some end play, not more than .004 inch.

(2) With the right collar against the casting, there should be 5/32 to 7/32-inch clearance between the platen shaft boss and the pressure roller release shaft arm when the arm is opposite the boss.

c. ADJUSTMENTS.

(1) Adjust the end play by moving the left collar.

(2) Adjust the clearance of the pressure roller release shaft arm by moving the right collar.

317. Pressure Roller Release Cams

(fig. 202)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the pressure roller release shaft in its rear (with respect to the front of the typing unit) position, the high parts of both of the pressure roller release cams should rest on the high parts of their respective pressure roller release levers.

c. ADJUSTMENT. Position the cams on the release shaft by loosening the release cam set screws and by moving the cams as required. Tighten the set screws.

318. Pressure Roller Tension Springs

(fig. 202)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the pressure roller release shaft arm in its forward position, hook a 12-pound scale over the lower end of each pressure roller tension spring adjusting lever, in turn, just

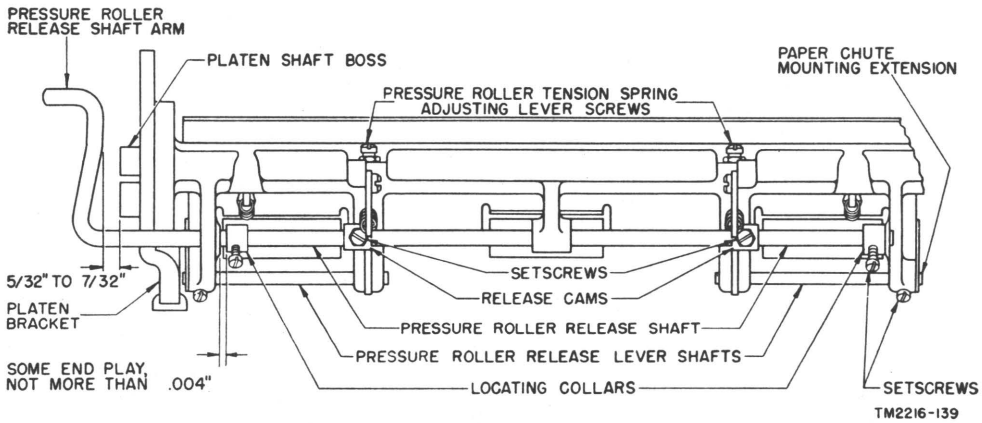


Figure 201. Pressure roller release mechanism.

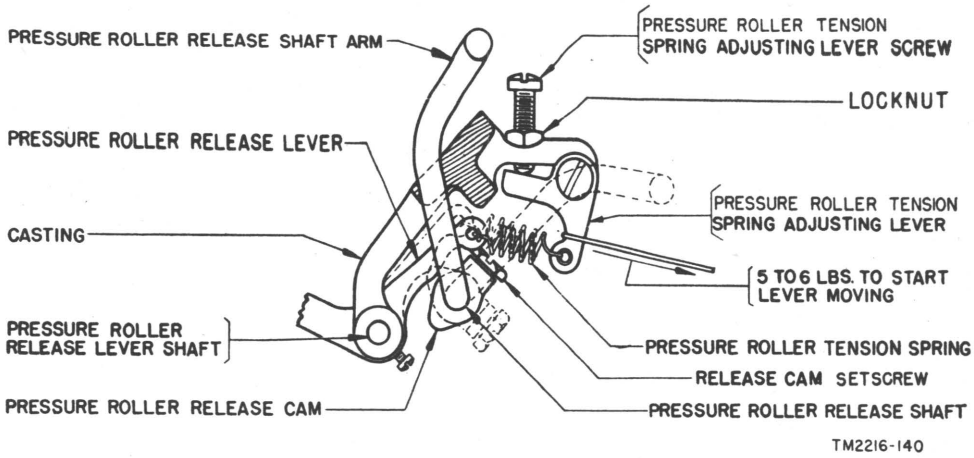


Figure 202. Pressure roller release cams and tension springs.

above the spring, and pull in line with the spring. A pull of 5 to 6 pounds should be required to start the adjusting lever moving.

c. ADJUSTMENT. Loosen the locknut and turn the pressure roller tension spring adjusting lever screw. Tighten the locknut.

319. Pressure Roller Release Lever Shafts
(fig. 201)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the inner surface of the paper chute mounting extensions against the casting, the outer ends of the release lever shafts should project beyond the outer surfaces of the paper chute mounting extensions by not more than $\frac{3}{64}$ to $\frac{3}{32}$ inch.

c. ADJUSTMENT. Position the release lever shafts by loosening their set screws and moving the shafts as required. Tighten the set screws.

320. Paper Chute Springs Tension
(fig. 203)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the pressure roller release shaft arm in its rear position, hook an 8-ounce scale over the rear edge of the paper chute, midway between the side frames, and pull at right angles to the rear flat surface. A pull of 2 to 4 ounces should be required to start the paper chute moving.

c. ADJUSTMENT. If the paper chute springs fail to meet requirements, replace with new springs.

321. Paper Chute

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With one side of the paper chute touching its associated end boss on the platen crossbar, the other side of the chute should touch or be within .004 inch of touching its associated end boss; also, when one or both sides of the paper chute are touching their associated end bosses on the platen crossbar, there should be some clearance, not more than .020 inch, between the front edge of the paper chute and the surface of the platen.

c. ADJUSTMENTS. To adjust, bend the chute manually to meet the above requirements. Rotate the platen shaft to see that the paper chute does not bind the platen.

322. Paper Fingers
(fig. 203)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With both paper fingers resting against the platen, the paper finger shaft stop arm should clear its stop post .004 to .020 inch. When paper 8½ inches wide is used, the outer edge of the lower portion of each finger should be within $\frac{3}{32}$-inch of the end of the rubber portion of the platen and should not extend beyond the end of the rubber portion.

c. ADJUSTMENT. Loosen the right paper finger set screw and position the right paper finger to provide the specified lateral clearance and the clearance between the paper finger shaft stop arm and the stop post. Tighten the set screw. Set the

left paper finger in a similar manner to provide the specified lateral clearance.

323. Paper Fingers Shaft Spring Tension
(fig. 203)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Hook a 32-ounce scale over the paper fingers shaft stop arm, just above the stop post, and pull in line with the spring. A pull of 14 to 18 ounces should be required to start the stop arm moving.

c. ADJUSTMENT. If the paper fingers shaft spring fails to meet requirements, replace it with a new spring.

324. Paper Straightener Rod Stops
(fig. 203)

a PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. When the paper straightener rod is in its extreme upward position, the clearance between the straightener rod and the blocking edge of the stops should be .030 to .050 inch.

c. ADJUSTMENT. Loosen the paper sstraightener rod stops mounting screws and position the stops by means of their slots. Tighten the mounting screws.

325. Paper Straightener Rod Springs Tension
(fig. 203)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Hook a 32-ounce scale over the ends of the paper straightener rod levers where the springs are hooked and pull in line with the springs. A pull of 8 to 12 ounces should be required to start the levers moving.

c. ADJUSTMENT. If either paper straightener rod spring fails to meet requirements, replace the defective spring.

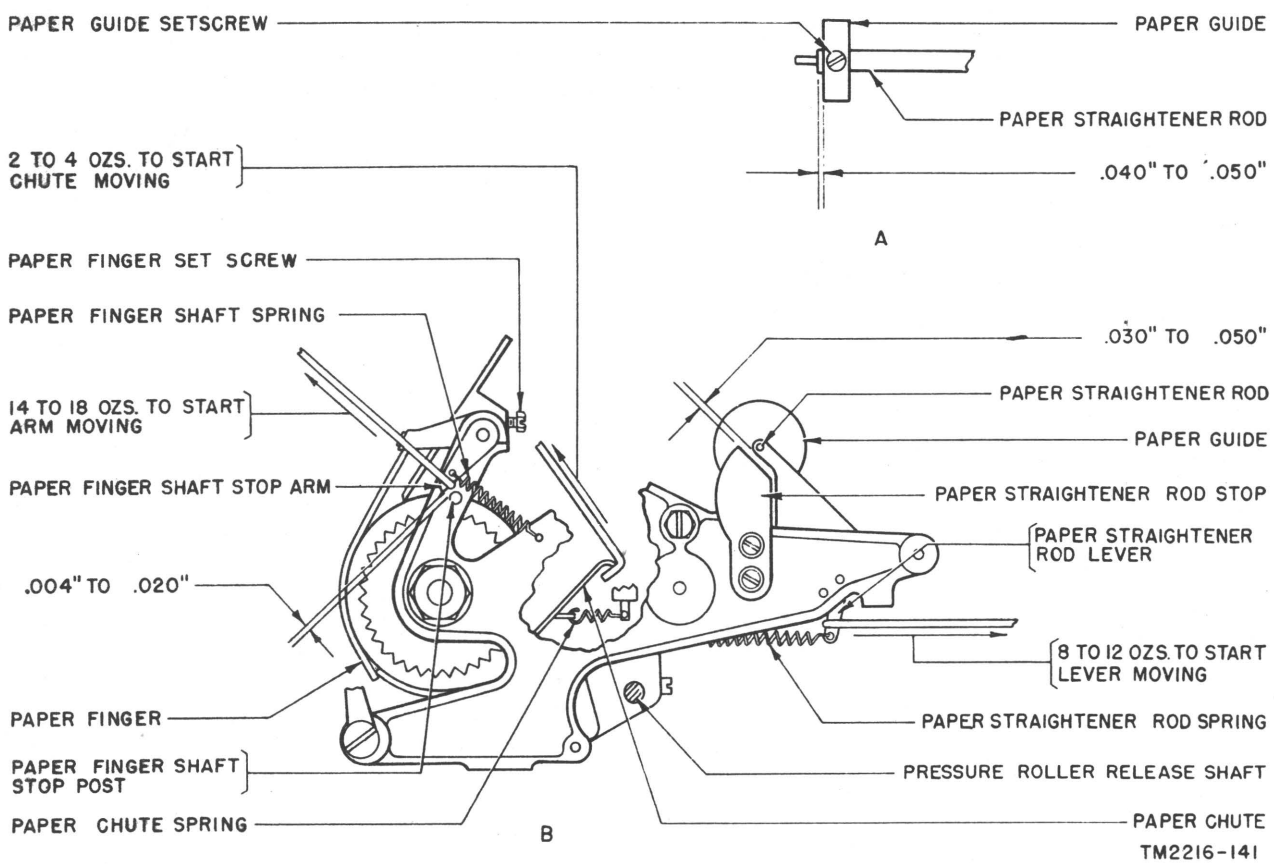


Figure 203. Paper chute, paper fingers, and paper straightener rod.

326. Paper Guides
(fig. 203)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. The outer side of each paper guide should be .040 to .050 inch from the shoulder on its end of the straightener rod.

c. ADJUSTMENT. Position the paper guides on the shaft by loosening the paper guide set screws and moving the guides as required. Tighten the set screws.

327. Spacing Escapement Pawlp Operating Arm
(fig. 204)

a. PREPARATION. Install the typing unit on the base.

b. REQUIREMENTS. Select the LINE FEED combination. Turn the governor wheel assembly counterclockwise with respect to the front of the base; this will rotate the main shaft. Rotate the main shaft until the function lever bail rests on the line feed function lever. There should be .020- to .040-inch clearance between the rear spacing escapement pawl and the low part of the spacing escapement ratchet.

c. ADJUSTMENT. Loosen the spacing escapement pawl operating arm mounting screws and position the arm. Tighten the mounting screws.

328. Spacing Escapement Pawl Spring Tension
(fig. 204)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. Rotate the main shaft until the printing bail is in its extreme rear position. Hook a 32-ounce scale under the front spacing escapement pawl at the point where the pawl rests against the escapement pawl operating arm; pull straight up. A pull of 10 to 14 ounces should be required to start the pawl moving.

c. ADJUSTMENT. If the spacing escapement pawl spring fails to meet requirements, replace it with a new spring.

329. Margin Bell Hammer
(fig. 205)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. With the bell hammer arm resting against the stop post, the clearance between the bell and the bell hammer should be .020 to .060 inch.

c. ADJUSTMENT. Bend the bell hammer arm along its entire length; avoid a sharp bend at any point.

330. Margin Bell Hammer Spring Tension
(fig. 205)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. Hook a 32-ounce scale over the bell hammer arm directly below the spring and pull in line with the spring. A pull of 10½ to 13½ ounces should be required to start the arm moving.

c. ADJUSTMENT. If the margin bell hammer spring fails to meet requirements, replace it with a new spring.

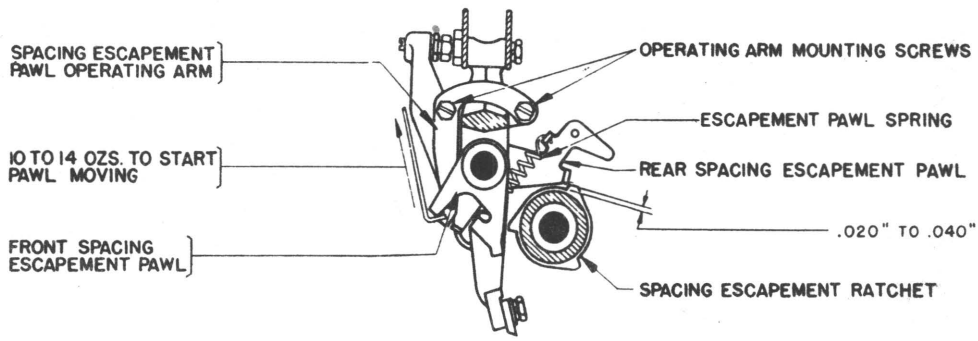


Figure 204. Spacing escapement pawls.

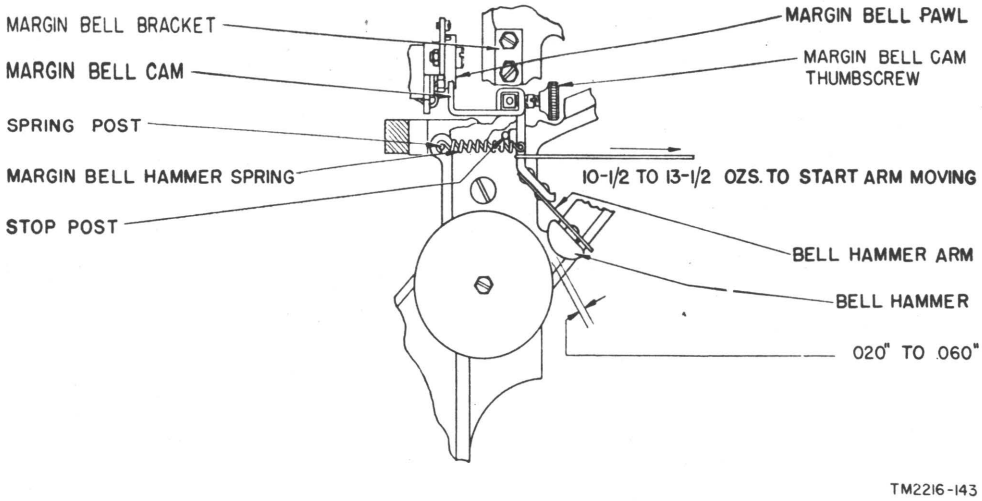


Figure 205. Margin bell hammer.

331. Signal Bell Hammer Spring Tension

(A, fig. 206)

a. Preparation. The typing unit may be on or off the base.

b. Requirements. With the bell latch bar in its latched position, hook an 8-ounce scale over the upper end of the bell hammer arm extension. Pull at right angles to the inner straight edge of the extension. A pull of 3 to 5 ounces should be required to start the bell hammer moving.

c. Adjustment. Replace with a new spring if the signal bell hammer spring fails to meet requirements.

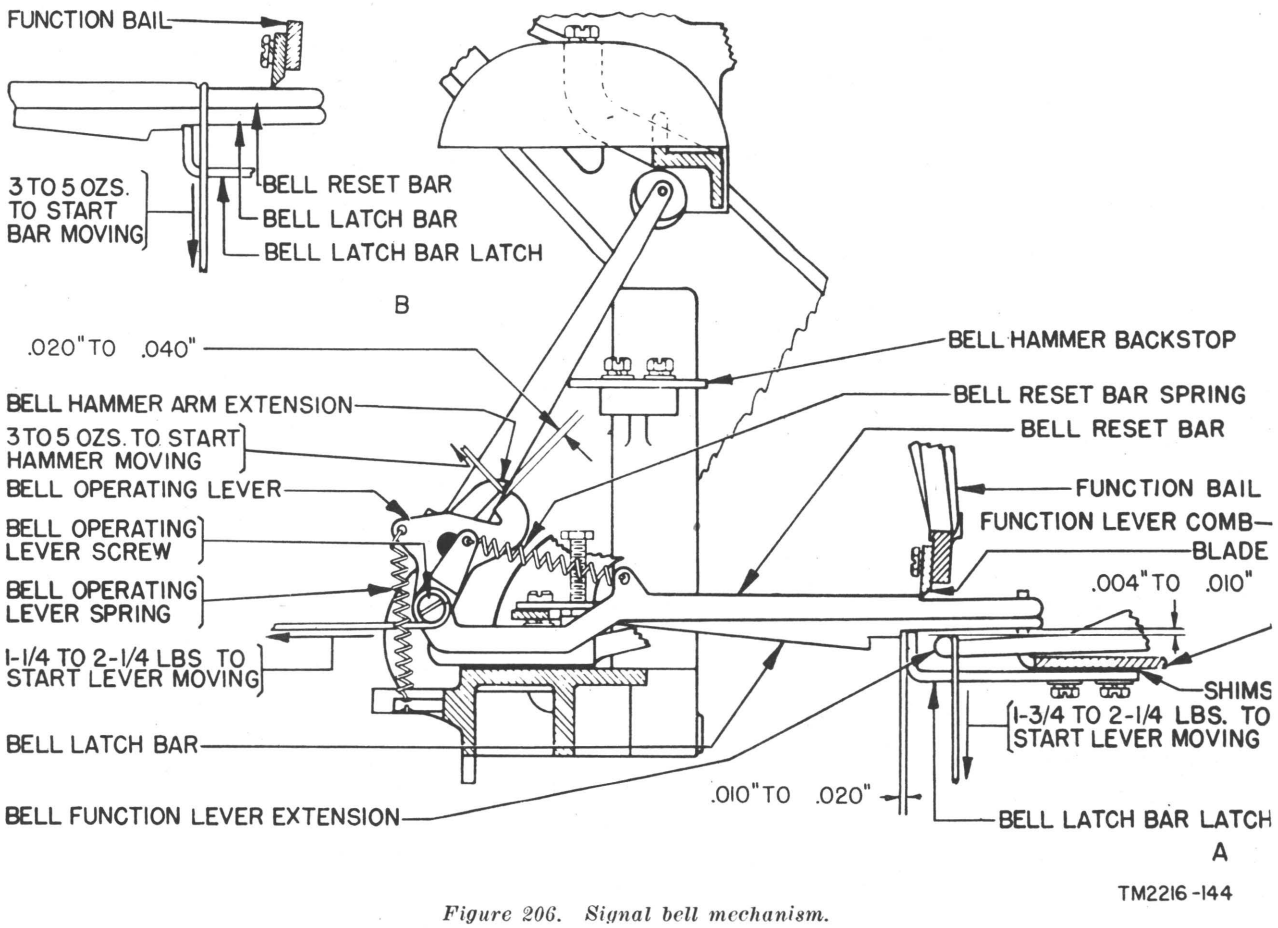


Figure 206. Signal bell mechanism.

332. Signal Bell Latch Bar Latch Shims

(fig. 206)

a. PREPARATION. Remove the typing unit from the base and place the unit on its right side.

b. REQUIREMENTS. With the platen in the LTRS position, set up the letter **S** combination. Rotate the main shaft until the printing bail is in its extreme forward position. When the front shoulder of the bell latch bar is latched fully on its latch, the clearance between the bell latch bar and the lobe on the rear extension of the bell function lever should be .004 to .010 inch.

c. ADJUSTMENT. Add or remove shims between the latch and the function lever guide.

333. Signal Bell Latch Bar Latch

(fig. 206)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. With the main shaft rotated until the function bail is in its extreme rear position, there should be a clearance of .010 to .020 inch between the front shoulder of the bell latch bar and its latch. When checking this clearance, the shoulder on the bell reset bar should be engaged fully with the function bail blade.

c. ADJUSTMENT. Loosen the mounting screws and position the bell latch bar latch toward the front or rear by means of its mounting slots. Tighten the mounting screws.

334. Signal Bell Hammer Backstop

(fig. 206)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. With the bell latch bar in its latched position, the clearance between the bell hammer arm extension and the bell operating lever should be .020 to .040.

c. ADJUSTMENT. Loosen the mounting screws and position the backstop by means of its mounting slots. Tighten the mounting screws.

335. Signal Bell Operating Lever Spring Tension

(fig. 206)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Unhook the bell reset bar spring. With the rear shoulder of the bell latch bar resting against the bell latch bar latch, hook a 12-pound scale under the head of the bell operating lever screw and pull parallel to the latch bar. A pull of 1¼ to 2¼ pounds should be required to start the lever moving. Rehook the bell reset bar spring.

c. ADJUSTMENT. Replace the signal bell operating level spring, if it fails to meet requirements, with a new spring.

336. Signal Bell Reset Bar Spring Tension

(fig. 206)

a. PREPARATION. The typing unit is removed from the base. Place the typing unit on its right side.

b. REQUIREMENTS. Rotate the main shaft until the function bail is in its extreme forward position. With the front shoulder of the latch bar resting against the latch, hook, an 8-ounce scale over the reset bar, just in front of the shoulder, and pull at right angles to the reset bar. A pull of 3 to 5 ounces should be required to start the reset bar moving.

c. ADJUSTMENT. Replace the signal bell reset bar spring, if it fails to meet requirements, with a new spring.

337. Signal Bell Function Lever Spring Tension

(fig. 206)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. Select any character and rotate the main shaft until the bell function lever rests against the vanes but is not selected. Hook a 12-pound scale over the rear extension of the bell function lever, just in front of the lobe that engages the bell latch bar, and pull at right angles to the lever. A pull of 1¾ to 2¼-pounds should be required to start the lever moving.

c. ADJUSTMENT. Replace with a new spring if the signal bell function lever spring fails to meet requirements.

338. Carriage Return Latch Bar Latch Shims

(fig. 207)

a. PREPARATION. The typing unit is resting on its right side.

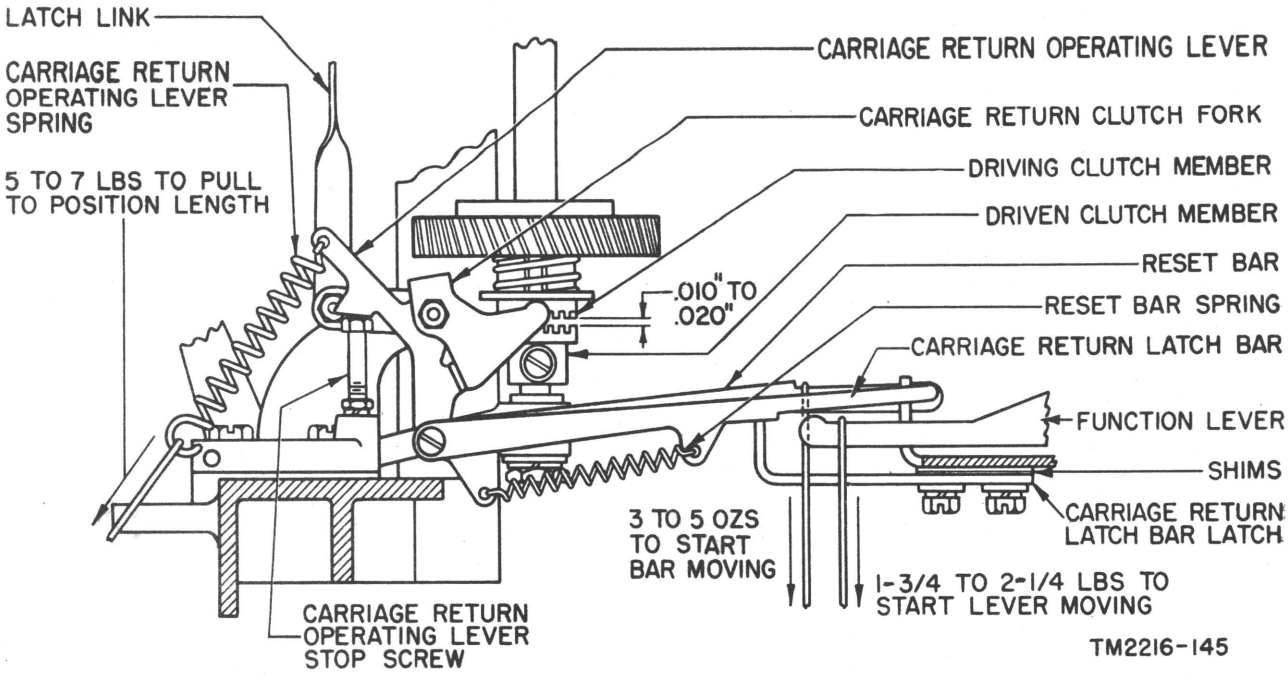


Figure 207. Carriage return mechanism.

b. REQUIREMENTS. With the letter O combination selected and the main shaft rotated until the printing bail is in its extreme forward position, there should be .004- to .010-inch clearance between the carriage return latch bar and the lobe on the rear extension of the carriage return function lever. When checking this clearance, the shoulder on the carriage return latch bar should be latched fully on the latch (similar to the signal bell latch bar latch shims adjustment (par. 332 and fig. 206)).

c. ADJUSTMENT. Add or remove shims between the carriage return latch bar latch and the function lever guide.

339. Carriage Return Latch Bar Latch

(fig. 207)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. With the main shaft rotated until the function bail is in its extreme rear position, the clearance between the shoulder on the carriage return latch bar and the latch should be .010 to .020 inch. When checking this clearance, the shoulder on the carriage return reset bar should be engaged fully with the function bail blade (similar to the signal bell latch bar adjustment (fig. 206)).

c. ADJUSTMENT. Loosen the mounting screws and position the latch to front or rear by means of its mounting slots. Tighten the mounting screws.

340. Carriage Return Lock Bar Latch Eccentric Screw

(fig. 208)

a. PREPARATION. The typing unit may be on or off the base; the rear of the unit is facing the repairman.

b. REQUIREMENTS. With the front end of the dash pot lever held in its extreme left position, clearance between the lower edge of the carriage return lock bar latch and the upper edge of the lock bar should be .006 to .015 inch. When checking this clearance, take up all the play between the lock bar and the shoulder stud in a direction to make the clearance a minimum.

c. ADJUSTMENT. Adjust by means of the lock bar latch eccentric screw. There are two positions of the lock bar latch eccentric screw at which proper adjustment can be obtained. Use the position which gives the greater tension to the latch spring.

341. Carriage Return Lock Bar Latch Spring Tension

(fig. 208)

a. Preparation. The typing unit may be on or off the base; the rear of the unit is facing the repairman.

b. Requirements. With the carriage return lock bar latch unlatched (resting on the upper part of the carriage return lock bar), hook a 32-ounce scale over the latch, just below the spring, and pull parallel to the lock bar. A pull of 7 to 10 ounces should be required to start the latch moving.

c. Adjustment. If the carriage return lock bar latch spring fails to meet requirements, replace it with a new spring.

342. Carriage Return Lock Bar

(figs. 207 and 208)

a. Preparation. Remove the typing unit from the base.

b. Requirements. With the carriage return lock bar in its latched position and the shoulder of the lock bar held against the edge of the latch, the clearance between the teeth of the carriage return clutch members should be .010 to .020 inch.

c. Adjustment. To obtain the required clearance, adjust the length of the lock bar by means of its sliding joint.

(1) Before adjusting the length of the lock bar, take up the play between the carriage return clutch driven member and its mounting screw, as follows:

(*a*) Place the typing unit on its back.

(*b*) Rotate the spacing shaft until the mounting screw of the carriage return clutch driven member is accessible.

(*c*) Operate the dash pot lever to engage the clutch teeth.

(*d*) Loosen the carriage return clutch driven member mounting screw and rotate the spacing gear in a clockwise direction (as viewed from the right, with respect to the front of the typing unit, end of the main shaft) until all the play between the clutch driven member and its mounting screw has been taken up. Tighten the mounting screw.

(*e*) Place the typing unit in its normal upright position, with the rear of the unit facing the repairman.

(2) Adjust the length of the lock bar by means of its sliding joint.

343. Carriage Return Operating Lever Stop Screw

(figs. 207 and 208)

a. Preparation. The typing unit is removed from the base.

b. Requirements. With the CAR RET combination selected and the main shaft rotated until the carriage return function lever just trips the

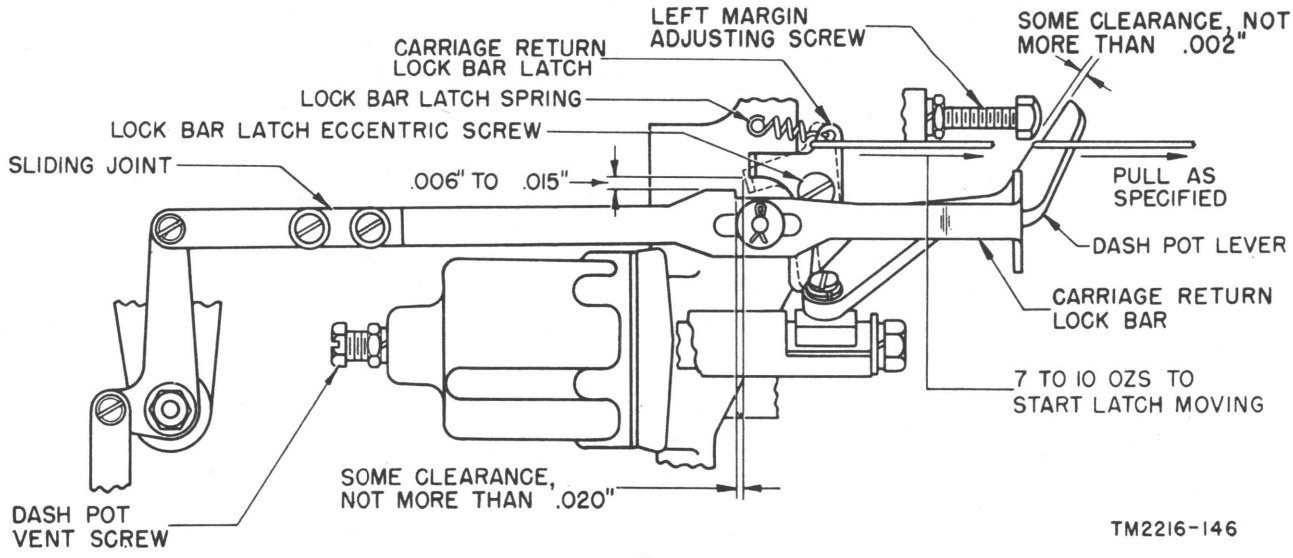


Figure 208. Lock bar latch.

carriage return latch bar off its latch, there should be some clearance, not more than .020 inch, between the lock bar shoulder and the edge of the lock bar latch. When checking this clearance, take up all the play in the lock bar connections in a direction to make the clearance a minimum. This can be done by pulling outward on the lock bar.

c. ADJUSTMENT. Change the height of the carriage return operating lever stop screw.

344. Carriage Return Reset Bar Spring Tension

(fig. 207)

a. PREPARATION. Place the typing unit on its right side.

b. REQUIREMENTS. Move the function bail to its extreme forward position and trip the carriage return latch bar off its latch. Hook an 8-ounce scale over the reset bar, just in front of the shoulder, and pull horizontally at right angles to the reset bar. A pull of 3 to 5 ounces should be required to start the reset bar moving.

c. ADJUSTMENT. If the carriage return reset bar spring fails to meet requirements, replace it with a new spring.

345. Carriage Return Function Lever Spring Tension

(fig. 207)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. Select any character and rotate the main shaft until the carriage return function lever is resting against the vanes but not selected. Hook a 12-pound scale over the rear extension of the function lever, just in front of the lobe that engages the latch bar, and pull at right angles to the lever. A pull of 1¾ to 2¼ pounds should be required to start the function lever moving.

c. ADJUSTMENT. If the carriage return function lever spring fails to meet requirements, replace it with a new spring.

346. Carriage Return Operating Lever Spring Tension

(fig. 207)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. With the shoulder of the carriage return latch bar against its latch and the carriage return operating lever spring unhooked from the spring post, hook a 12-pound scale in the carriage return operating lever spring eye. A pull of 5 to 7 pounds should be required to stretch the spring to position length. Rehook the carriage return operating lever spring.

c. ADJUSTMENT. If the carriage return operating spring fails to meet requirements, replace it with a new spring.

347. Carriage Return Clutch Spring Compression

(fig. 209)

a. PREPARATION. The typing unit is resting on its right side.

b. REQUIREMENTS. With the shoulder of the carriage return latch bar resting against its latch and the carriage return lock bar latch held away from the lock bar, apply the push end of a 12-pound scale to the end of the carriage return clutch fork which engages the latch link, and push downward as nearly in line with the latch link as possible.

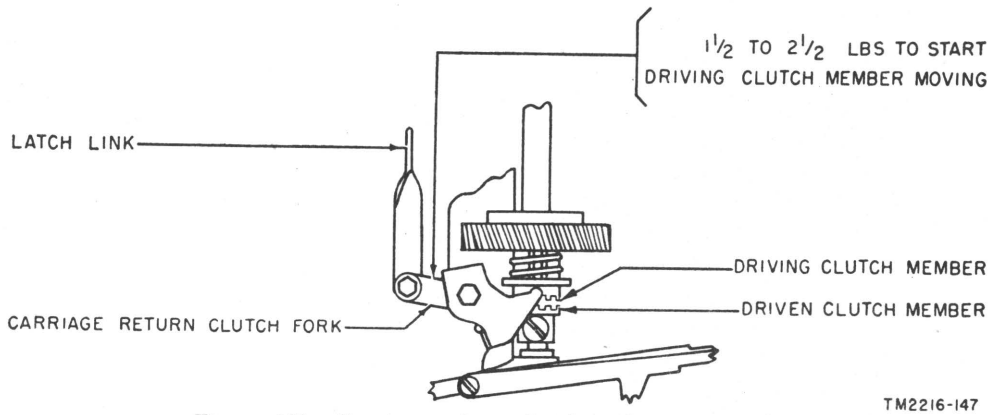


Figure 209. Carriage return clutch spring compression.

A pressure of 1½ to 2½ pounds should be required to start the clutch driving member moving away from the driven member.

c. ADJUSTMENT. If the carriage return clutch spring fails to meet requirements, replace it with a new spring.

348. Dash Pot Lever Spring Tension
(fig. 208)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Unhook the dash pot lever spring from the spring post on the dash pot lever and hook a 32-ounce scale in the spring eye. With the front end of the dash pot lever in its extreme right position, a pull of 16 to 22 ounces should be required to stretch the spring to its position length. Rehook the dash pot lever spring.

c. ADJUSTMENT. If the dash pot lever spring fails to meet requirements, replace it with a new spring.

349. Spacing Stop Lever Bracket
(fig. 210)

a. PREPARATION. The typing unit is removed from the base; the rear of the unit is facing the repairman.

b. REQUIREMENTS.

(1) The lower end of the spacing stop lever should clear the driving disk of the main shaft .060 to .080 inch.

(2) With the stop lever held against the stop on the bracket by the stop lever spring, there should be a clearance of .040 to .080 inch between the lower left edge of the stop lever and right side of a tooth on the spacing stop sleeve, when the tooth is opposite the lever.

c. ADJUSTMENTS.

(1) Loosen the mounting screws and move the stop lever bracket up or down in its enlarged mounting holes to meet the first requirements (*b* (1) above).

(2) Move the stop lever bracket horizontally to meet the second requirement *b*(2) above).

(3) Tighten the mounting screw.

350. Spacing Stop Lever Spring Tension
(fig. 210)

a. PREPARATION. The typing unit is removed from the base; the rear of the unit is facing the repairman.

b. REQUIREMENT. Hook a 32-ounce scale over

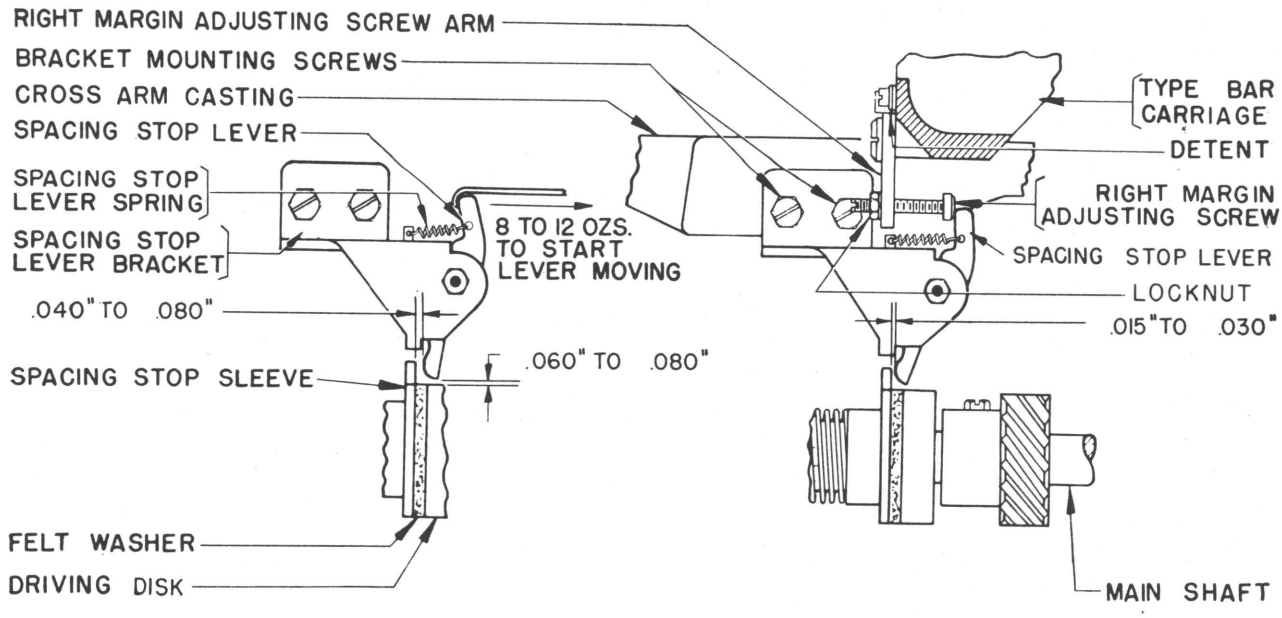


Figure 210. Spacing stop mechanisms.

the upper end of the stop lever and pull horizontally toward the right. A pull of 8 to 12 ounces should be required to start the lever moving.

c. ADJUSTMENT. If the spacing stop lever spring fails to meet requirements, replace it with a new spring.

351. Carriage Guide Screws

(fig. 178)

a. PREPARATION. Place the type bar carriage on the typing unit. The typing unit may be on or off the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, there should be some clearance, not more than .008 inch, between the upper surface of the guide screwheads and the upper surface of the groove in the front carriage track. Check for this clearance along the entire travel of the carriage.

c. ADJUSTMENT. Loosen the locknuts and turn the guide screws up or down as required. Tighten the locknuts.

352. Code Bars and Bell Cranks

(fig. 211)

a. PREPARATION. Place the type bar carriage on the typing unit and then place the typing unit on the base.

b. REQUIREMENTS. Alternately select the LTRS and blank combinations and turn the main shaft until the function levers are lifted from the rear edges of the vanes. When this is done, code bars should be carried firmly against their stops in both the marking and the spacing positions. Select the LTRS combination, move the vanes one by one from the marking to the spacing position, and let the vanes return slowly to the marking position. Check any code bars not carried firmly against their stops. Set up the blank combination and repeat the operation. Again check any code bars not carried firmly against their stops.

c. ADJUSTMENTS.

(1) If all the code bars are carried against the stops in the spacing position and not in the marking position, or vice versa, loosen the mounting screws and move the bell crank mounting plate up or down. Moving the plate up will cause the bars to move farther toward the left (toward the marking position).

(2) If only one or two code bars fail to be carried firmly against their stops in both marking and spacing positions, correct the travel of the code bars by turning the bell crank eccentric bushings.

(3) Make sure that the upper ends of the bell cranks do not engage the code bars deeply enough to bind.

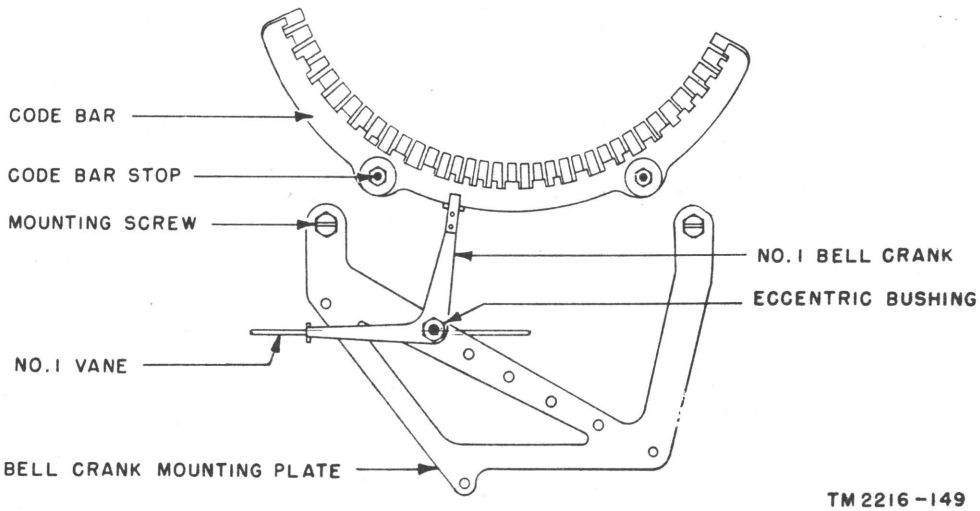


Figure 211. Code bar and bell crank.

353. Spacing Rack

(fig. 212)

a. PREPARATION. The type bar carriage is in place on the typing unit. The typing unit may be on or off the base.

b. REQUIREMENTS. There should be some back-

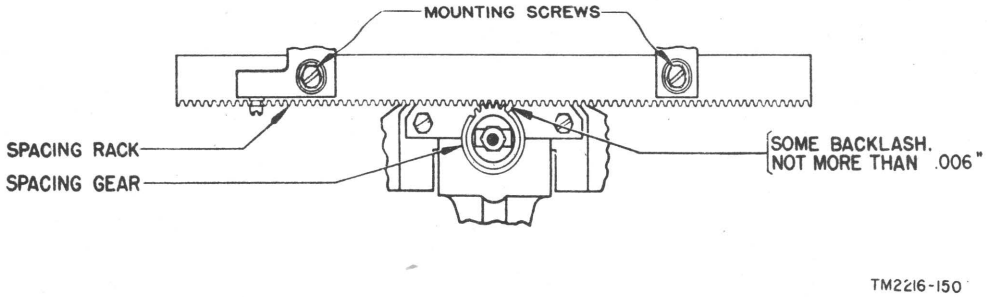


Figure 212. Spacing rack.

lash, but not more than .006 inch, between the spacing gear and the spacing rack along the entire travel of the rack.

c. ADJUSTMENT. Loosen the spacing rack mounting screws and move the rack toward the front or rear of the type bar carriage. Tighten the mounting screws.

354. Locking Function Lever Spring
(fig. 182)

a. PREPARATION. The type bar carriage is placed on the typing unit. The typing unit may be on or off the base.

b. REQUIREMENTS. Turn the main shaft until the printing bail is in its extreme rear position. Unhook the locking function lever spring from the spring plate and hold the locking function lever against its pivoting shaft. Hook a 12-pound scale in the locking function lever spring eye. A pull of 2½ to 3⅛ pounds should be required to stretch the spring to position length. Rehook the spring.

c. ADJUSTMENT. Replace with a new spring if requirements are not met.

355. Sixth Vane Detent Spring
(fig. 181)

a. PREPARATION. Remove the typing unit from the base (par. 157).

b. REQUIREMENTS. Hook an 8-ounce scale in the sixth vane detent spring hole and pull in line with the spring toward the rear of the typing unit. A pull of 6 to 8 ounces should be required to start the roller moving away from the sixth vane.

c. ADJUSTMENT. Replace with a new spring if requirements are not met.

356. Carriage Return Spring Drum
(fig. 129)

a. PREPARATION. The typing unit may be on or off the base. The type bar carriage must be on the typing unit.

b. REQUIREMENTS. Rotate the main shaft until the printing bail is in its extreme rear position. Hold the carriage return lock bar approximately in its latched position to disengage the carriage return clutch teeth and hold the dash pot lever in its operated position. Hook a 12-pound scale over the lower part of the right ribbon spool bracket and pull in a line parallel to the carriage track. A pull of 3¾ to 4¼ pounds should be required to start the type bar carriage moving away from its extreme left position.

c. ADJUSTMENT. To increase the tension, wind up the carriage return spring by turning the center shaft of the drum. To decrease the tension, operate the carriage return drum escapement lever.

357. Paper Spindle Drag Spring
(fig. 213)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Insert an empty paper spindle in the slots and lock the spindle in place with the retaining plates. With both ends of the spindle shaft in the bottom of their slots, apply the push end of a 12-pound scale to the left end of the paper spindle shaft and push toward the right side of the typing unit. A pressure of 5 to 8 pounds should be required to start the spindle moving.

c. ADJUSTMENT. Bend the spindle drag spring.

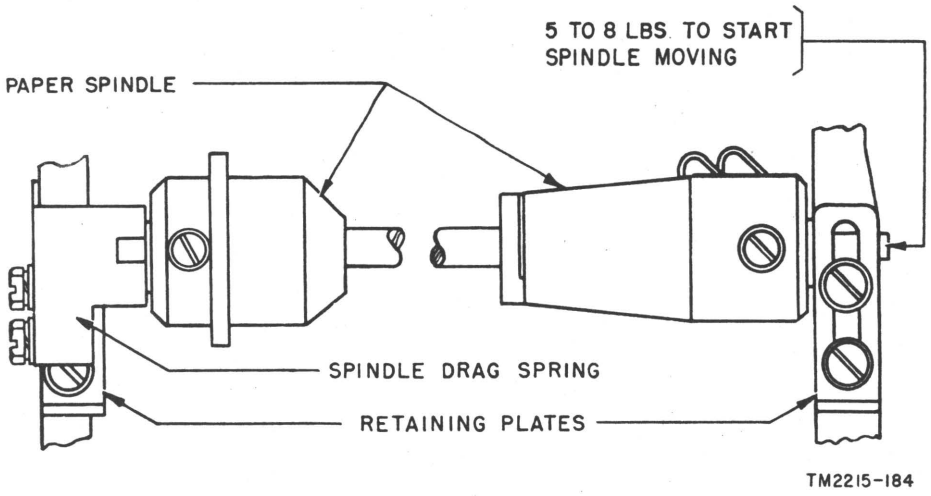


Figure 213. Paper spindle.

358. Platen Friction Assembly
(fig. 214)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Move the pressure roller release shaft arm to its extreme rear position. Unhook the line feed detent lever spring and place the platen handle straight up. Hook a 32-ounce scale at the end of the crank handle and pull horizontally toward the front of the typing unit. A pull of 5 to 9 ounces should be required to start the platen rotating. Rehook the line feed detent lever spring.

c. ADJUSTMENT. Increase or decrease the amount of friction by turning the adjusting nuts on the friction assembly.

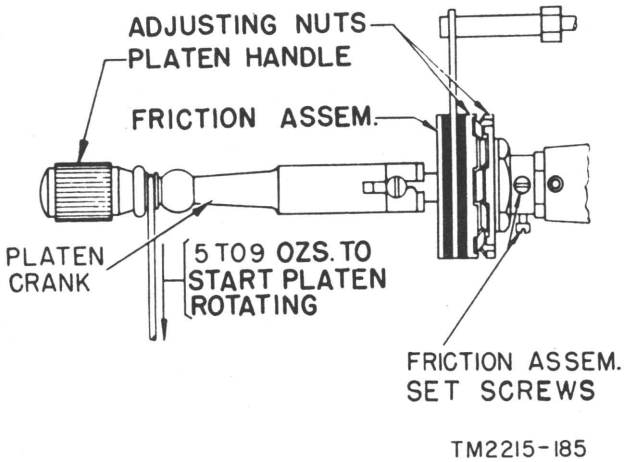


Figure 214. Platen friction assembly.

359. Send-Receive T Lever Friction Washer
(fig. 215)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, move the T lever so that the clearance between the T lever and the universal function lever extension is .040 to .060 inch. Hook an 8-ounce scale under the right extension of the T lever, just to the left of the universal function lever extension, and pull straight up. A pull of 5 to 6½ ounces should be required to start the lever moving.

c. ADJUSTMENT. If requirements are not met, replace the friction washer.

Note. The above adjustment applies only to old-style units which do not have the elastic stop nut. On units equipped with the 119925 elastic stop nut and the 71047 shim in place of the 3598 nut and 2191 lockwasher, the friction requirement of 5 to 6½ ounces may be obtained by adjusting the position of the stop nut.

360. Universal Function Lever Spring Tension
(fig. 215)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENT. With the printing bail in its extreme rear position, hook a 32-ounce scale under the extreme front end of the universal function lever extension and pull straight up. A pull of 14 to 17 ounces should be required to start the lever moving.

c. ADJUSTMENT. If the universal function lever spring fails to meet requirements, replace it with a new spring.

361. Blank Function Lever Spring Tension

(fig. 215)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, hook a 12-pound scale under the extreme front end of the blank function lever extension and pull straight up. A pull of 4½ to 6 pounds should be required to start the lever moving.

c. ADJUSTMENT. If the blank function lever spring fails to meet requirements, replace it with a new spring.

362. Send-Receive Mechanism Plate

(fig. 192)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS.

(1) Select the blank combination. Rotate the main shaft until the blank function lever is selected completely. Stop rotating the shaft at the point where the function lever bail roller just leaves the cam surface of the blank function lever. Under these conditions and with the left arm of the T lever in contact with the blank function lever extension, there should be some clearance, not more than .008-inch, between the right arm of the T lever and the universal function lever extension. When setting up these conditions on typing units equipped with a blank printing and spacing cut-out function lever, stop rotating the main shaft at the point where the function lever bail comes to rest on top of the blank printing and spacing cut-out function lever.

(2) On typing units from which the blank and universal function levers are omitted, the vertical clearance between both ends of the function lever spring plate and the send-receive mechanism plate should be .020 to .030 inch.

c. ADJUSTMENT. Make sure that the intermediate lever is clear of the blank function lever extension. Then position the send-receive mechanism plate by loosening the mounting screws and moving the plate in its mounting slots. Tighten the mounting screws.

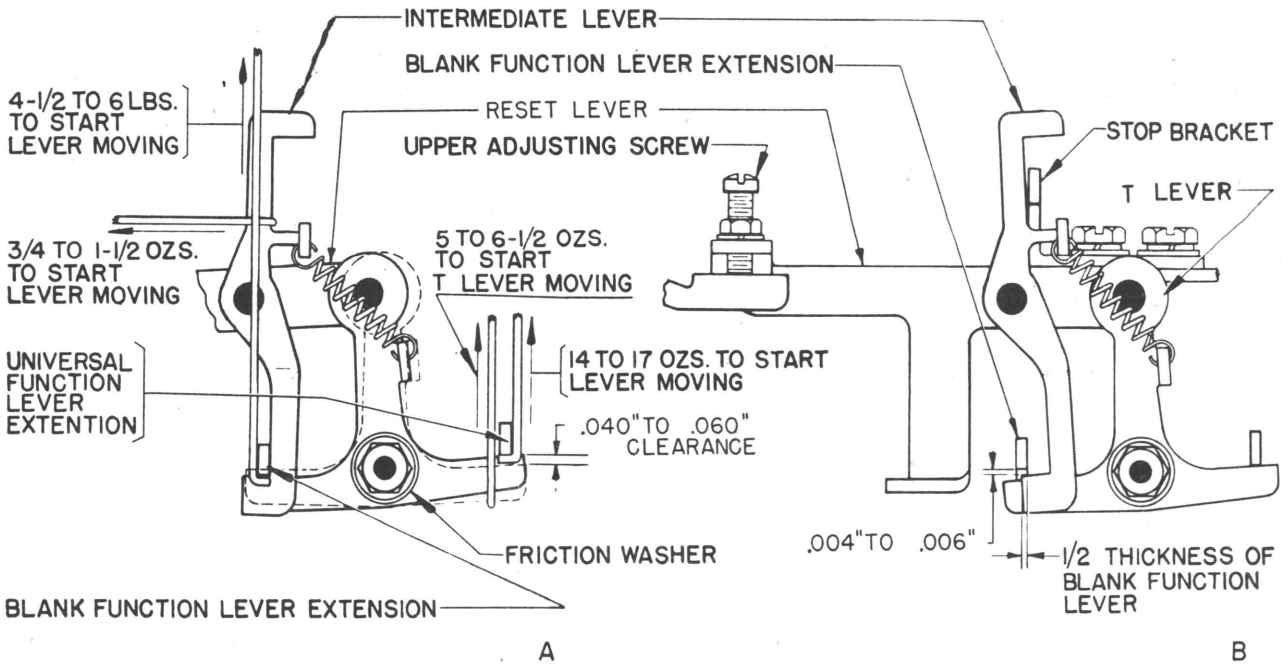


Figure 215. Intermediate lever.

363. Right Motor Stop Contacts

(figs. 191 and 192)

This adjustment applies only to teletypewriters equipped with a mechanical motor stop mechanism.

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, the selector armature held in the marking position, and the inner motor stop pawl engaged with its latch, there should be a slight clearance, not more than .006 inch, between the insulated end of the light contact spring of the right motor stop contacts and the upper end of the motor stop contact lever.

c. ADJUSTMENTS. To adjust, position the right contact spring bracket by means of its mounting holes so that the contact spring mounting surface of the bracket is approximately parallel to the top edge of the send-receive mechanism plate. Then bend the light contact spring, if necessary, to obtain the required clearance. Make certain that the heavy contact spring does not bear against the light spring. With the selector armature in the spacing position and the outer motor stop pawl engaged with the latch, there should be a clearance of .012 to .020 inch between the contact points. To adjust, bend the heavy spring of the right motor stop contacts.

364. Left Motor Stop Contacts

(fig. 192)

This adjustment applies only to teletypewriters equipped with a mechanical motor stop mechanism.

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, there should be some clearance, not more than .006 inch, between the insulated end of the contact spring of the left motor stop contacts and the lobe on the front extension of the motor stop function lever. To adjust, bend the light contact spring to obtain the clearance; make sure that the heavy spring does not bear against the light spring.

c. ADJUSTMENT. With the motor stop function lever selected and the main shaft rotated until the right-hand motor stop contact is just at the point of opening, the left-hand motor stop contact should just close. To adjust, bend the heavy contact spring of the left-hand motor stop contact.

365. Intermediate Lever Stop Bracket

(figs. 192 and 215)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. Select the blank combination and rotate the main shaft until the intermediate lever toe is under the blank function lever extension. Make sure that the intermediate lever is approximately vertical. Then select the **T** combination and rotate the main shaft until the printing bail is in its extreme forward position. During this last operation, the left end of the intermediate lever toe should move to a point at least one-sixteenth inch to the right of the blank function lever extension.

c. ADJUSTMENT. Position the intermediate lever stop bracket by means of its mounting slots.

366. Intermediate Lever Spring Tension

(fig. 215)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. With the printing bail in its extreme rear position, move the **T** lever so that its right end is in contact with the universal function lever extension; hold the reset lever so that its upper edge is horizontal. Hook an 8-ounce scale over the intermediate lever just above the spring arm and pull horizontally toward the left of the typing unit. A pull of ¾ to 1½ ounces should be required to start the lever moving.

c. ADJUSTMENTS. If the intermediate lever spring fails to meet requirements, replace it with a new spring.

367. Motor Plate

(fig. 216)

a. PREPARATION. The typing unit is in place on the base. Remove the keyboard.

b. REQUIREMENTS.

(1) Face the front of the base unit and visually check the lateral alinement of the main shaft gear and the motor pinion. The alinement of the gear and pinion should be such that a line through the center of the gear coincides with a line

through the vertical diameter of the pinion (fig. 154).

(2) There should be a barely perceptible amount of backlash between the motor pinion and the highest point on the main shaft gear.

c. ADJUSTMENTS.

(1) To adjust the alinement of the main shaft gear and motor pinion, proceed as follows:

(*a*) *For motors not having elongated mounting holes.*

1. Remove the typing unit from the teletypewriter base.

2. Loosen the four motor mounting screws.

3. Replace the typing unit on the teletypewriter base.

4. Shift the motor by taking up the play between the drilled motor mounting holes and the motor mounting screws until the center lines of the gear and pinion coincide as described in *b* (1) above. If there is insufficient play in the motor mounting holes to permit the motor to be shifted sufficiently to provide proper alinement, loosen the three motor plate mounting screws and shift the motor to obtain the best possible alinement of the main shaft gear and motor pinion. Tighten the motor plate mounting screws.

5. See that the edges of the motor base are parallel to the respective edges of the motor plate.

6. Remove the typing unit.

7. Tighten the four motor mounting screws.

(*b*) *For motors having elongated mounting holes.*

1. The adjustment procedure is the same as that given in *c* (*a*) above, except that in the usual case the elongated mounting holes will have sufficient play to provide proper alinement of the gear and pinion, and it will be unnecessary to use the motor plate mounting screws to aid in obtaining an alinement.

2. To correct the amount of backlash, proceed as follows:

(a) Loosen the rear motor plate mounting screw and the locknut on the motor plate adjusting screw. Slightly loosen the two front motor plate mounting screws to prevent stripping the threads while making the adjustment.

(b) Replace the typing unit and tighten the three typing unit mounting screws.

(c) With the motor plate adjusting screw, adjust the vertical position of the motor pinion until there is a barely perceptible amount of backlash between the motor pinion and the highest point on the main shaft gear. The highest point is found by rotating the main shaft for one complete revolution.

(d) Start the motor and carefully readjust the vertical position of the motor pinion by means of the adjusting screw until the gear noise is reduced to a minimum.

(e) Tighten the three motor plate mounting screws and the adjusting screw locknut. Recheck the backlash between the gears.

Caution: Be careful when adjusting the vertical position of the motor pinion while the motor is running to avoid damaging the main shaft gear and to avoid reducing the speed of, or overloading, the motor as the result of too close a mesh between the gear and the pinion.

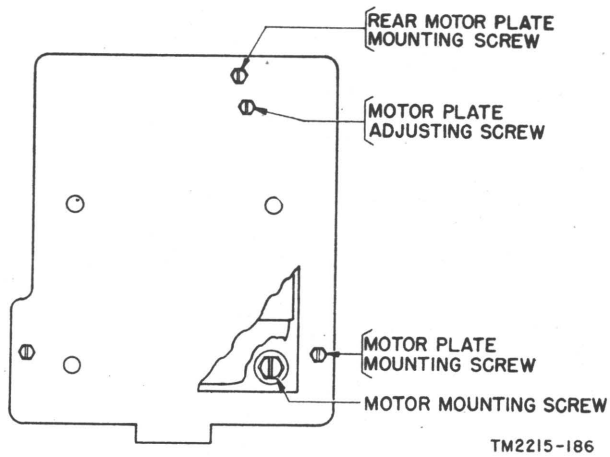


Figure 216. Motor plate.

368. Send-receive Reset Lever Upper Adjusting Screw

(B, fig. 215)

a. Preparation. Install the typing unit on the base.

b. Requirements. There should be .004- to .006-inch clearance between the upper edge of the intermediate lever toe and the bottom of the blank function lever extension under the following conditions: With the printing bail in its extreme position and the SEND–REC lever in the SEND position, move the toe of the intermediate lever under the blank function lever extension. Select the T combination and rotate the motor until the intermediate lever is moved to a position where the blank function lever extension overlaps the toe of the intermediate lever by one-half the thickness of the blank function lever extension.

c. Adjustment. Raise or lower the reset lever upper adjusting screw to obtain the required clearance.

369. Send-receive Reset Lever Lower Adjusting Screw

(A, fig. 217)

Omit this adjustment when the typing unit is not equipped with a mechanical motor stop mechanism.

a. Preparation. The typing unit is in place on the base.

b. Requirements. Place the platen in the LTRS position. Select the motor STOP combination. Rotate the motor until the printing bail is in its extreme forward position. Under these conditions and with the SEND—REC lever in the SEND position, there should be some clearance, but not more than .002 inch, between the head of the lower adjusting screws and the lower surface of the front extension of the motor stop function lever.

c. Adjustment. Raise or lower the reset lever lower adjusting screw to obtain the required clearance.

370. Send-receive Reset Lever Down Stop Screw

(A, fig. 217)

a. Preparation. The typing unit is in place on the base.

b. Requirements. With the SEND—REC lever in the SEND position and the toe of the intermediate lever under the blank function lever extension, select the blank combination and rotate the main shaft until the function lever bail roller just leaves the cam surface of the blank function lever. Depress the brake lever and immediately release it. The stop lever plate should just latch the upper contact lever and there should not be more than a .002-inch clearance between the stop lever plate and the upper contact lever.

c. Adjustment. Raise or lower the reset lever down stop screw.

371. Left Margin Adjusting Screw

(fig. 208)

a. Preparation. The type bar carriage is on the typing unit, and the typing unit is on the base.

b. Requirements. The left edge of the letter M should print 7/8 inch (plus or minus 1/16 inch)

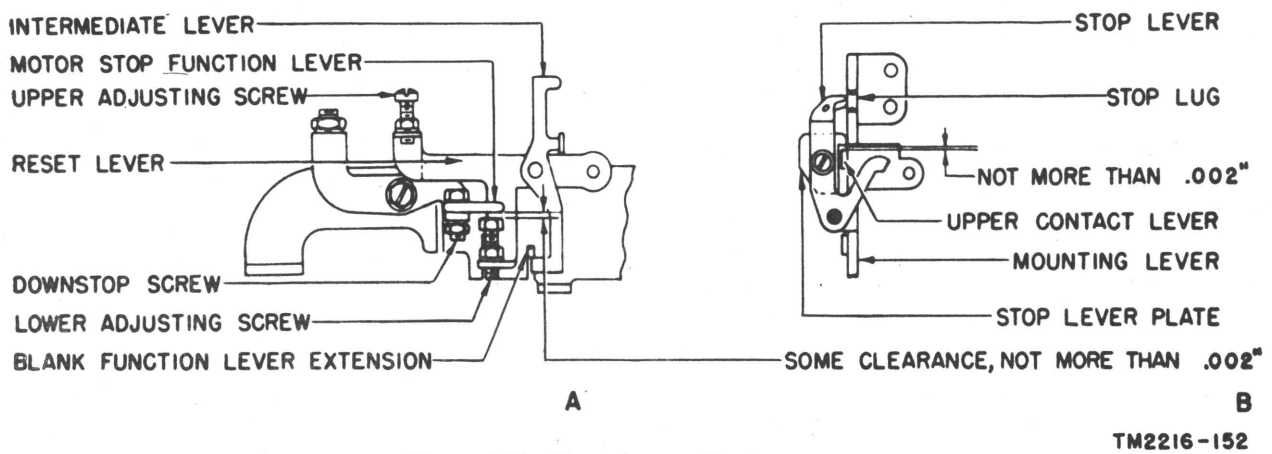


Figure 217. Reset lever adjustments.

from the left edge of the platen when used as the first character in lines of 72-character length. When lines of 76-character length are required, or when adjusting typing units that print 6 characters to the inch instead of the standard 10, the left edge of the letter M should print $1\frac{1}{16}$ inch (plus or minus $\frac{1}{16}$ inch) from the left edge of the platen.

c. Adjustment. To adjust, turn the left margin adjusting screw inward and lock the carriage in place by operating the dash pot levers so that the carriage will be in a position to print the letter M the required distance from the left edge of the platen. Make sure that the carriage clutch members are engaged fully. Then reposition the adjusting screw so that, when the locknut is tightened slightly to take up the end play in the threads, and a horizontal pull of 8 pounds is exerted on the dash pot lever at right angles to the curved surface one thirty-second inch behind the margin adjusting screw, there is a slight clearance (not more than .002 inch) between the end of the screw and the dash pot lever. Turn the left margin adjusting screw one-sixth turn in a direction to eliminate this clearance and tighten the locknut.

372. Right Margin Adjusting Screw

(fig. 210)

a. Preparation. Install the type bar carriage on the typing unit and the typing unit on the base.

b. Requirement. The teletypewriter normally should print 72 characters on a line (44 characters for typing units that print 6 characters to the inch instead of the standard 10) before spacing is blocked by the spacing stop pawl.

c. Adjustment. Return the carriage to the left end of the line and back off the right margin adjusting screw. Then, with the right margin adjusting screw arm in engagement with its detent, space the carriage one less space than the number of characters desired per line; that is 71 spaces for normal lines of 72 characters. The carriage then should be in position to print the last character for the desired length of line. Adjust the stop screw so that the spacing stop lever is moved within .015 inch to .030 inch from a projection on the spacing stop sleeve. When printing 72, 76, or 44 characters per line, pile-ups should occur on the 73d, 77th, and 45th characters, respectively.

373. Ribbon Oscillator Lever

(fig. 218)

a. Preparation. The type bar carriage is on the typing unit, and the typing unit is on the base.

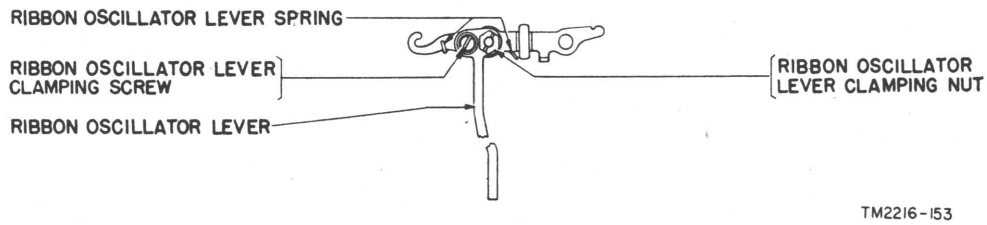


Figure 218. Ribbon oscillator lever.

b. Requirements. With the ribbon lock-out bar in its unoperated position (pulled out toward the right), the ribbon should cover fully any character as it is being printed. When the printing is completed and the main shaft clutch is disengaged, the top edge of the ribbon should not be above the bottom edge of the printed character.

c. Adjustment. Shift the platen to the FIGS position and loosen the ribbon oscillator lever clamping screw and nut. Position the ribbon oscillator lever and tighten the clamping screw and nut. Check this adjustment with the platen in the LTRS position.

374. Ribbon Lock-out Bar

(fig. 219)

This adjustment applies only to teletypewriters equipped with the adjustable ribbon lock-out bar.

a. Preparation. Remove the typing unit from the base.

b. Requirements. Hold the ribbon carrier down and move the ribbon lock-out bar to the left against its stop. The ribbon should be locked far enough below the printing line to prevent printing any portion of the characters.

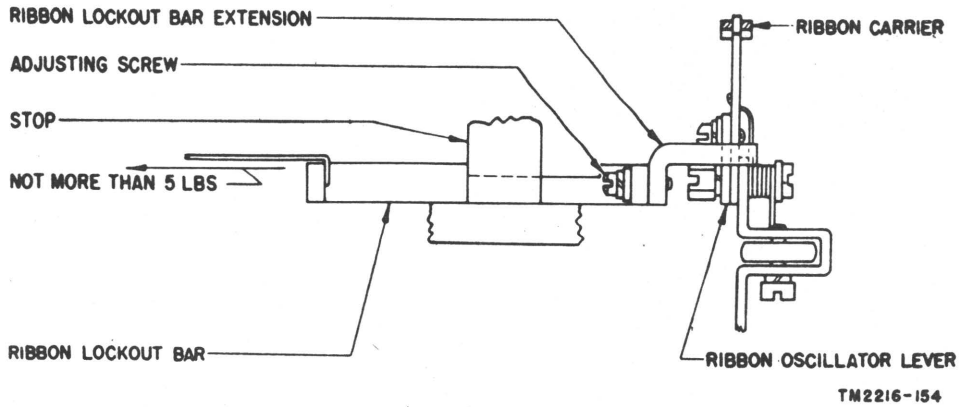


Figure 219. Ribbon lock-out bar.

c. ADJUSTMENT. Remove the ribbon, ribbon carrier, and type bar guide from the adapter plate and loosen the ribbon lock-out bar adjusting screws. Move the platen to the FIGS position. Hold the ribbon oscillator down and move the ribbon lock-out bar to the left against the stop; the lock-out bar extension slides over the top of the ribbon oscillator. Push the lock-out bar extension down so that the ribbon oscillator extension is held firmly against the type bar guide adapter plate. Hold the right end of the ribbon lock-out bar down and tighten the lock-out bar adjusting screws. Replace the type bar guide, the ribbon carrier, and the ribbon. With the ribbon lock-out bar in its operated position, hook a 12-pound scale over the end of the ribbon lock-out bar and pull directly in line with the bar. A pull of not more than 5 pounds should be required to move the lock-out bar to its unoperated position.

375. Spacing Clutch Torque
(fig. 220)

a. PREPARATION. The type bar carriage is on the typing unit, and the typing unit is on the base.

b. REQUIREMENTS. Run the motor for at least 10 minutes. Operate the lock bar. Hook a 32-ounce scale at the bottom of the uppermost projection on the spacing stop sleeve. Pull horizontally toward the rear of the typing unit until the leading edge of the spacing stop sleeve is approximately vertical. With the main shaft turning, a pull of 18 to 24 ounces should be required to hold the spacing stop sleeve stationary.

c. ADJUSTMENT. Saturate the felt washer with proper lubricating oil and recheck the requirement (*b*, above). If the requirement is not met, replace the spacing clutch spring with a new spring.

376. Margin Signal Bell
(fig. 205)

a. PREPARATION. The type bar carriage is on the typing unit, and the typing unit is on the base.

b. REQUIREMENTS. The bell should ring on the 66th printed character for lines of 72-character length, and on the 70th character for lines of 76-character length.

c. ADJUSTMENT. Return the carriage to the left end of the line. Then space the carriage 66 or 70 spaces to the right; this depends on the length of line being printed. Loosen the margin bell cam thumbscrew and adjust the cam so that its right

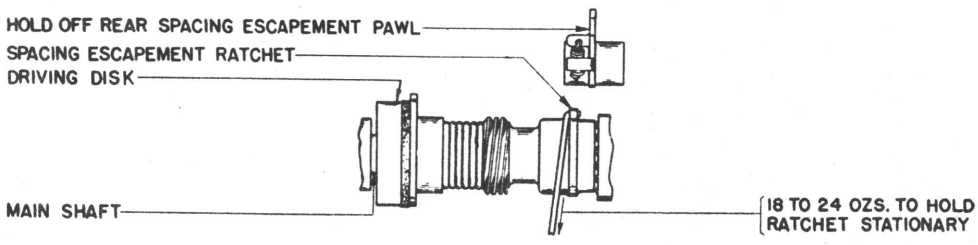


Figure 220. Main shaft spacing clutch.

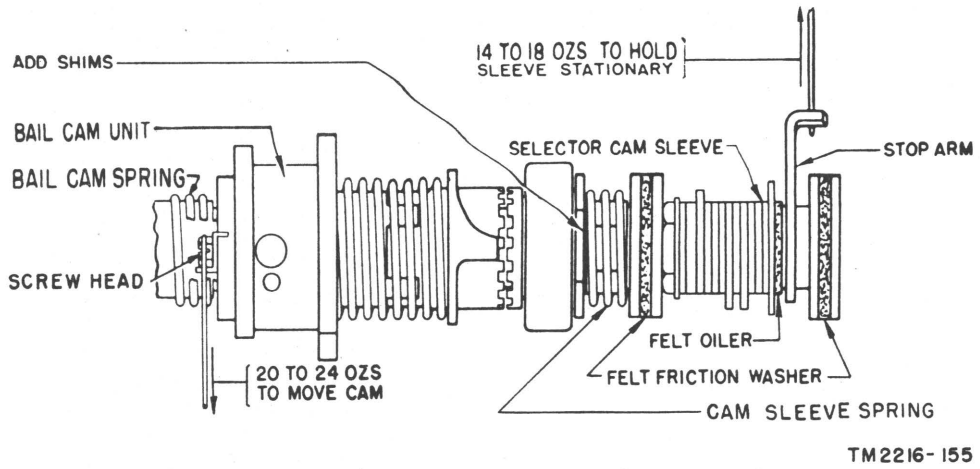


Figure 221. Bail cam and selector cam friction clutches.

side is in contact with the margin bell pawl and tighten the thumbscrew.

377. Selector Clutch Torque
(fig. 221)

a. PREPARATION. The type bar carriage is on the typing unit, and the typing unit on the base.

b. REQUIREMENTS. Run the motor for at least 10 minutes. Hook a 32-ounce scale to the selector cam sleeve stop arm. A pull of 14 to 18 ounces should be required to hold the sleeve stationary.

c. ADJUSTMENT. Saturate the felt washers with the proper lubricating oil and recheck the requirement (*b* above). If the requirement is not met, replace the cam sleeve spring with a new spring, or refer to (1) and (2) below.

(1) A more convenient method of regulating the selector clutch torque has been devised by the substitution of a 119540 keyed nut, a 122974 split capstan nut and a 122838 spacer for the 72515 nut and 72517 keyed nut on the main shaft. When these new parts are present, the torque is regulated by rotating the capstan nut in the proper direction. The 122974 capstan nut is split and the open ends are offset to insure a tight fit on the 119540 nut. To install the capstan nut the offset ends must be held approximately in line by using pliers or a clamp. The nut then can be screwed into place. To regulate the selector torque, the capstan nut may be positioned with a screw driver. To prevent the capstan nut from being turned downward against the bearing, install the 122838 spacer between the 119540 nut and the bearing.

(2) On units equipped with the 72515 nut and 72517 keyed nut, the selector clutch torque may be adjusted by the use of shims placed between the clutch spring and the 72515 nut. Remove the selector clutch spring from the shaft to apply the shims. Shims are available under the following numbers: 96763 shim (.012 inch thick), 96764 shim (.016 inch thick), and 96765 shim (.020 inch thick).

378. Bail Cam Unit Friction Clutch Torque
(fig. 221)

a. PREPARATION. The type bar carriage is on the typing unit and the typing unit is on the base.

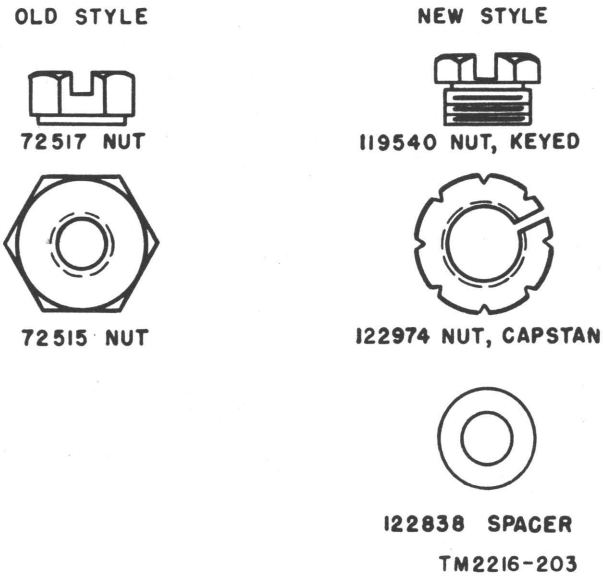


Figure 222. Selector clutch torque nuts.

b. REQUIREMENTS. Remove the function bail spring and hold the printing bail away from its adjusting screw. With the teletypewriter running on a close line (selector magnet energized or selector armature held in marking position to simulate a closed line), hook a 32-ounce scale over the screwhead on the cam unit and pull horizontally at a right angle to the main shaft. A pull of 20 to 24 ounces should be required to move the cam in a direction opposite to its normal direction of rotation.

c. ADJUSTMENT. Saturate the felt washer with the proper lubricating oil and recheck the requirement (*b*, above). If the requirement is not met, replace the bail cam spring with a new spring.

379. Dash Pot Vent Screw

(fig. 208)

a. PREPARATION. The type bar carriage is on the typing unit, and the typing unit is on the base.

b. REQUIREMENT. When the carriage return lock bar is held in its latched position, the carriage should return from its right margin stop to its left margin stop without bouncing and with minimum shock.

c. ADJUSTMENT. Loosen the dash pot vent screw in or out as required. Tighten the locknut.

380. Perforator Transmitter Adjustments

Unless otherwise specified, tests and adjustments given in paragraphs 381 through 459 are performed with the perforator transmitter removed from the base. To remove the perforator transmitter from the base, proceed as follows:

a. Remove the typing unit cover.

b. Loosen the two knurled thumbscrews which secure the perforator transmitter to the base.

c. Grasp the front part of the perforator transmitter frame and pull straight out to the front. When returning the perforator transmitter to position on the base, be sure the lock loop roller is resting against the lock loop cam. If the lock loop roller is hanging down, the roller will bar the perforator transmitter from sliding into position.

381. Transmitting Cam Cylinder End Play

(fig. 223)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENT. The transmitting cam cylinder should have some end play, not more than .002 inch.

c. ADJUSTMENT. Loosen the adjusting nuts of the bearing in the rear bearing bracket and position the bearing. Tighten the adjusting nuts.

382. Lock Loop Spring Tension

(fig. 224)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS. Rotate the transmitting cam sleeve until the lock loop roller rests on the low part of its cam. Hook an 8-ounce scale in the lock loop spring hole and pull in line with the spring. A pull of 4 to 5 ounces should be required to start the lock loop moving.

c. ADJUSTMENT. Replace with a new spring.

383. Locking Lever Bracket Shims

(fig. 224)

a. PREPARATION. Remove the filters and cam pulsing contact assembly by removing the two screws which mount them to the transmitter front bracket. Without disconnecting any wires, place the filters and contact assembly to one side so that access to the locking lever bearing is unobstructed.

b. REQUIREMENTS. With all contact levers on the high parts of their cams, there should be some

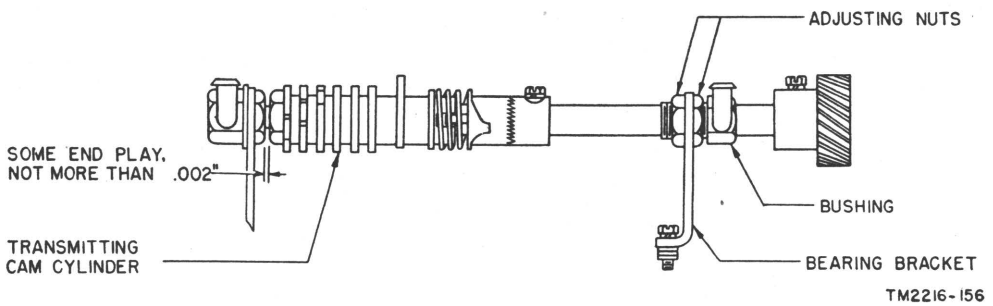


Figure 223. Transmitting shaft.

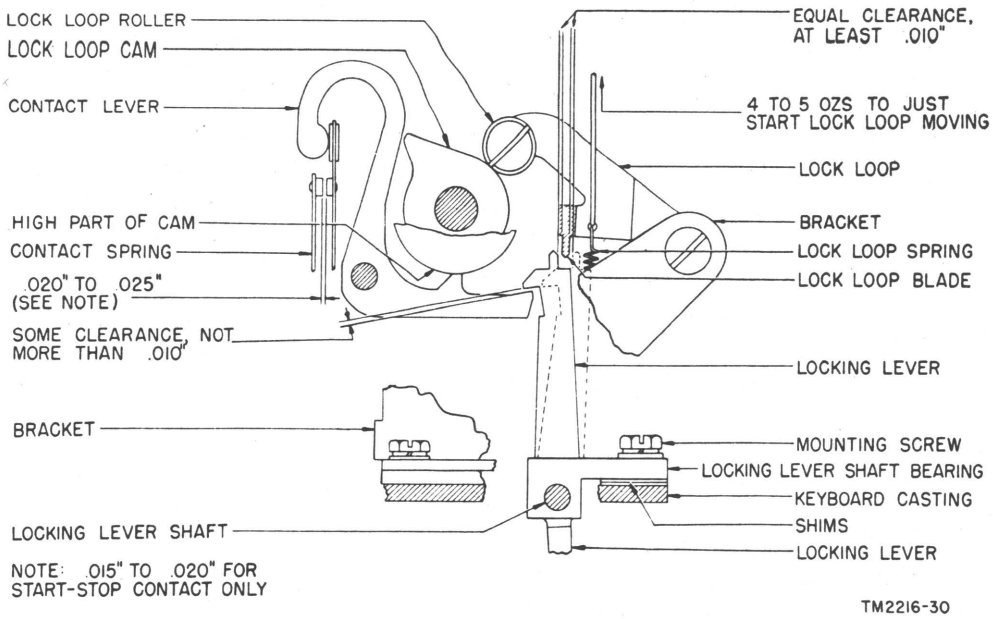


Figure 224. Transmitter contacts and lock loop.

clearance, not more than .010 inch, between the contact levers and the locking levers. When measuring this clearance, press the locking levers down by hand to make this clearance a minimum.

c. ADJUSTMENT. Loosen the locking lever shaft mounting screws and add or remove shims between the locking lever shaft bracket and the perforator transmitter casting.

384. Selector Bar Assembly Shims

(fig. 225)

a. PREPARATION. Remove the left and right keyboard slide plates. Disconnect the **Y** lever connecting link extensions (fig. 71) from the **Y** lever connecting links and remove the selector bar assembly. Be careful when handling the unit to avoid damaging the connecting link extensions when they are removed from their connecting links.

b. REQUIREMENTS.

(1) When the Q key lever is depressed fully, all other key levers should have some play between the leather upstop and the selector bars and there should be some clearance, not more than .030 inch, between the high portions of the first selector bar from the front (A–1) and the unoperated key levers in line with the high portions.

(2) When the T key lever is depressed fully there should be some clearance, not more than .020 inch, between the rearmost code selector bar (E–2) and the unoperated key lever having the least clearance.

c. ADJUSTMENTS. Increase or decrease the number of shims mounted to the selector bar assembly bracket at the front corners to meet the first requirement (*b*(1) above). Add or remove an equal number of shims to the bracket at each of the rear corners to meet the second requirement (*b*(2) above).

385. Selector Bar Assembly Bracket

(fig. 225)

a. PREPARATION. Remove the left and right keyboard slide plates.

b. REQUIREMENTS. The selector bar assembly should be parallel to the rear key lever guide and the locking levers should be engaged fully by the locking lever forks (fig. 71). There should be no interference between the sides of the locking levers and the selector bars.

c. ADJUSTMENT. Loosen the selector bar assembly mounting screws and position the assembly. Tighten the mounting screws.

386. Locking Lever Bracket Position

(fig. 224)

a. PREPARATION. Remove the filters and pulsing contact assembly (par. 383).

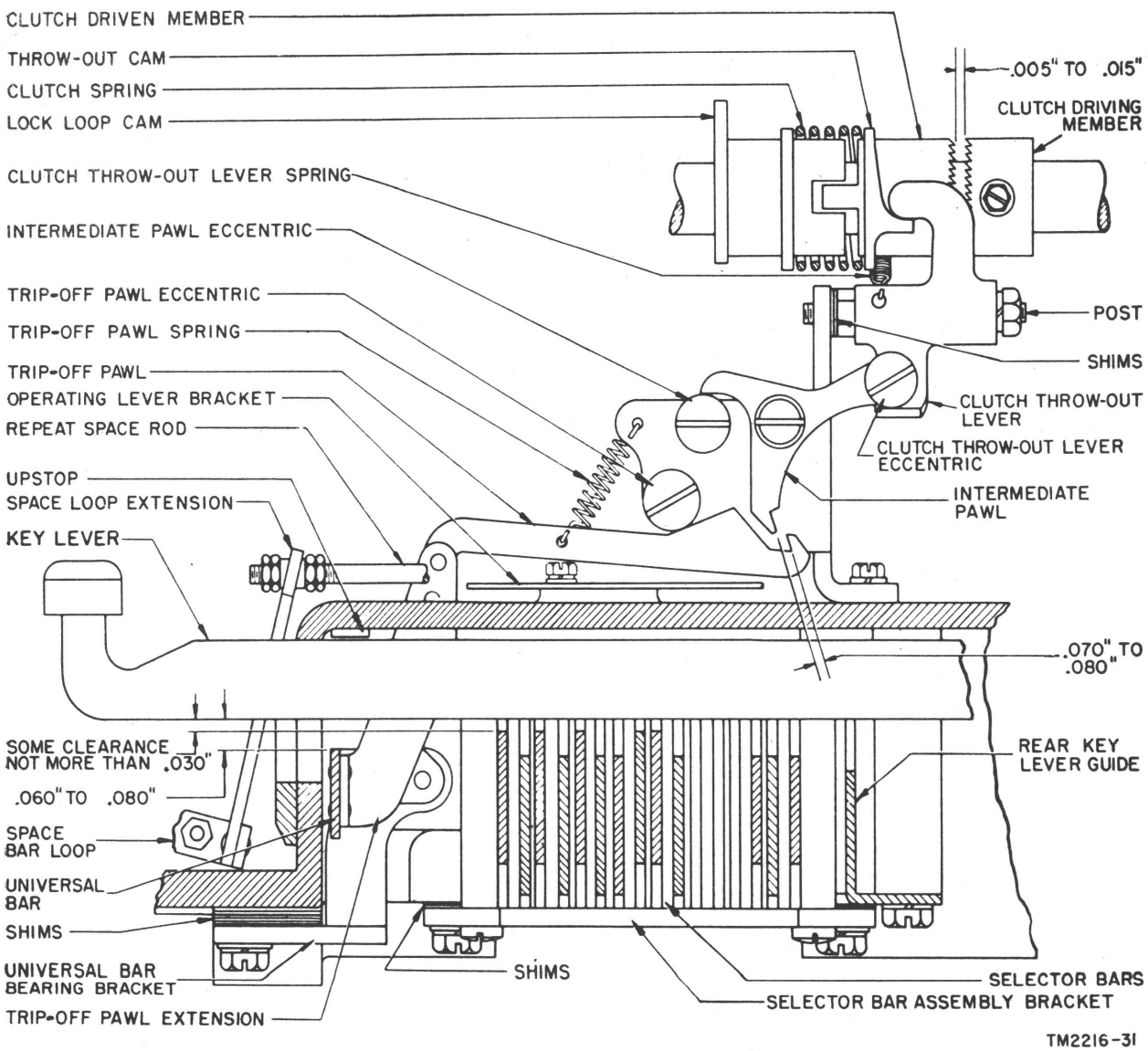


Figure 225. Transmitter clutch release mechanism.

b. REQUIREMENTS.

(1) Rotate the transmitting shaft until the lock loop roller rests on the high part of its cam. When the LTRS and blank key levers are depressed alternately, the locking levers should travel equally to either side of the lock loop blade. If the left-hand travel of the locking levers is limited by the contact levers, it will be satisfactory if the right-hand travel is greater than the left-hand travel.

(2) With either the LTRS or the blank key lever held depressed and the transmitting shaft rotated until the lock loop roller rests on the low part of its cam, there should be at least .010-inch clearance between the side of any locking lever and the side of the lock-loop blade.

c. ADJUSTMENT. Loosen the bracket mounting screws and position the bracket. Be careful to keep the locking levers in alinement with the contact levers. Tighten the mounting screws.

387. Clutch Throw-out Lever

(fig. 225)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENT. When the clutch is disengaged fully, there should be .005- to .015-inch clearance between the clutch teeth.

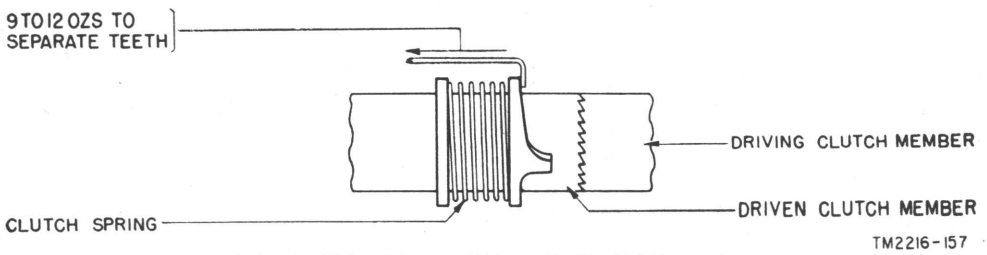


Figure 226. Transmitting shaft clutch spring.

c. ADJUSTMENT. Increase or decrease the number of shims installed between the clutch throwout lever post and the mounting bracket.

388. Clutch Spring Compression
(fig. 226)

a. PREPARATION. Same as described in paragraph 380.

b. REQUIREMENT. With the clutch teeth engaged, hook a 32-ounce scale over the projection on the clutch driven member and pull in line with the transmitting shaft. It should require 9 to 12 ounces to separate the clutch teeth.

c. ADJUSTMENT. Replace with a new spring.

389. Lock Loop Roller
(fig. 227)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS. Rotate the transmitting shaft until the clutch teeth are disengaged. Press the lock loop roller against its cam to disengage the clutch teeth fully. Position the locking levers directly below the lock loop blade to make the clearance a minimum. There should be .008- to .015-inch clearance between the lock loop blade and the locking lever having the least clearance.

c. ADJUSTMENT. Loosen the locknut and position the eccentric roller mounting screw in its elongated hole. Tighten the locknut.

390. Keyboard Control Operating Lever Bracket
(fig. 225)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS. With the screwdriver slot of the intermediate pawl eccentric in a horizontal position and the high part of the eccentric screwhead toward the front of the unit, there should be .070- to .080-inch clearance between the trip-off pawl and the intermediate pawl when the trip-off pawl is resting against the operating lever bracket and the intermediate pawl is against its eccentric.

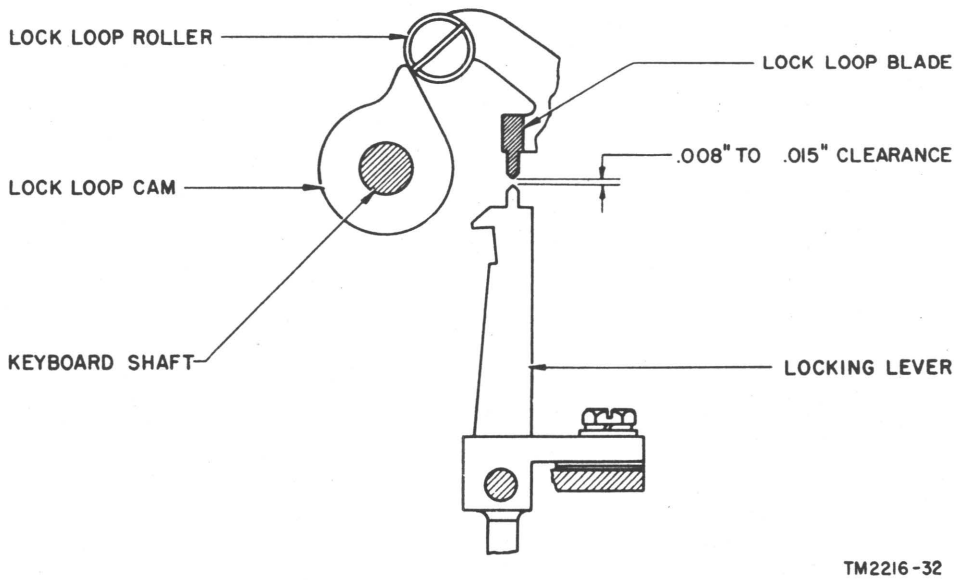


Figure 227. Lock loop and locking levers.

c. ADJUSTMENT. Loosen the operating lever bracket mounting screws and position the bracket. Tighten the mounting screws.

391. Universal Bar Bracket
(fig. 225)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS.

(1) There should be .060- to .080-inch clearance between the universal bar and the key levers when the trip-off pawl is resting against the operating lever bracket and the key levers are resting against their upstop.

(2) The trip-off pawl extension of the universal bar should be approximately equidistant from the sides of the key levers.

(3) The universal bar brackets should be parallel to the selector bar assembly and as close to it as possible. The universal bar should be free from binds, and should not have over .008-inch end play.

c. ADJUSTMENTS. Place shims between the universal bar brackets and the casting to meet the first requirements (*b*(1) above). Loosen the bracket mounting screws and position the brackets by means of their enlarged mounting holes to meet the second and third requirements (*b*(2) and *b*(3) above). Tighten the mounting screws. Recheck the first adjustment.

392. Intermediate Pawl Eccentric
(fig. 228)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS. When the trip-off pawl is resting against the operating lever bracket and the intermediate pawl is resting against its eccentric, there should be .050- to .060-inch clearance between the trip-off pawl and the intermediate pawl.

c. ADJUSTMENT. Loosen the intermediate pawl eccentric locknut and position the eccentric. Tighten the locknut. There are two positions of the eccentric that give the correct clearance. Use the position where the high part of the eccentric is toward the rear of the keyboard.

393. Clutch Throw-out Lever Eccentric
(fig. 228)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENT. With the transmitting shaft in the stop position and the clutch fully disengaged, hold the clutch throw-out lever against the driven member. Under this condition, the intermediate pawl should be held without perceptible play between the clutch throw-out lever and the intermediate pawl eccentric.

c. ADJUSTMENT. Loosen the clutch throw-out lever eccentric locknut and position the eccentric. Tighten the locknut.

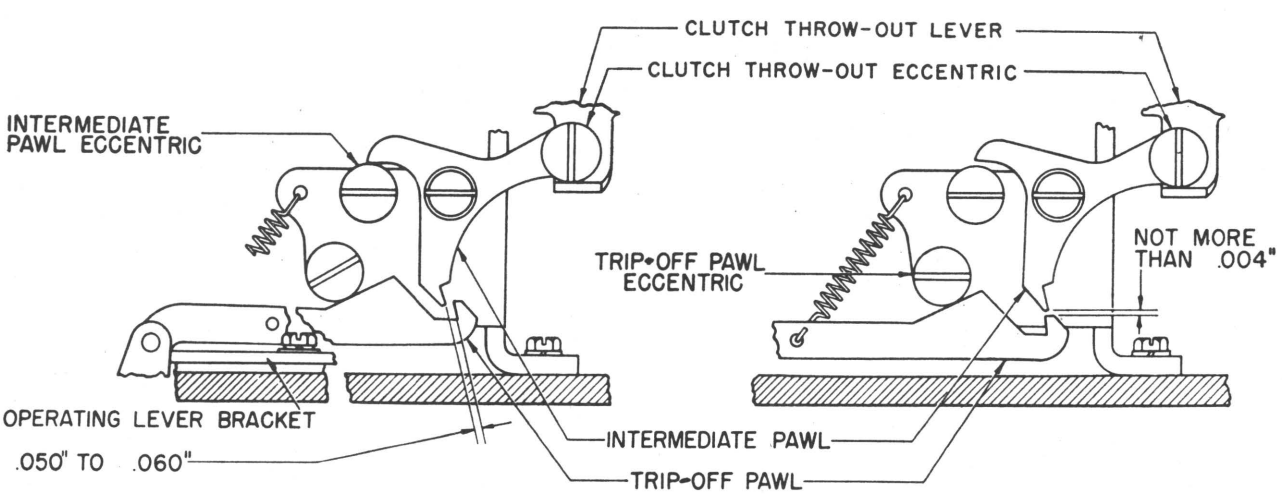


Figure 228. Intermediate and trip-off pawls eccentrics.

394. Trip-off Pawl Eccentric
(fig. 228)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENT. With the clutch throw-out lever resting against the high part of the cam on the driven clutch member and the clutch throw-out lever eccentric in contact with the clutch throw-out lever, the point on the trip-off pawl should clear the point on the intermediate pawl by not more than .004 inch when a key lever is depressed.

c. ADJUSTMENT. Loosen the locknut on the trip-off pawl eccentric screw and position the screw. Keep the center of the eccentric head to the rear of the center of the screw. Tighten the locknut. Recheck the universal bar bracket adjustment.

395. Trip-off Pawl Spring Tension
(fig. 229)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENT. Unhook the trip-off pawl spring from the bracket and hook an 8-ounce scale in the spring eye. With the trip-off pawl resting against the operating lever bracket, it should require a pull of 3½ to 4½ ounces to extend the spring to its installed length.

c. ADJUSTMENT. Replace the spring with a new one.

396. Clutch Throw-out Lever Spring Tension
(fig. 225)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIRMENTS. With the clutch teeth engaged and the clutch throw-out lever resting against the low part of the clutch driven member, hold the intermediate pawl against its eccentric. At the same time, hook an 8-ounce scale over the throw-out lever just above the spring hole and pull in line with the spring. A pull of 1¼ to 2½ ounces should be required to start the lever moving.

c. ADJUSTMENT. Replace with a new spring.

397. Transmitting Contact Gap
(fig. 224)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS. With any contact lever on the high part of its cam, the contact gap should be .020 to .025 inch. For start-stop contacts, the gap should be .015 to .020 inch.

c. ADJUSTMENT. Bend the shorter contact springs.

398. Transmitting Contact Spring Pressure
(fig. 230)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS. With any contact lever on the low part of its cam, apply the push end of an 8-ounce scale to each contact spring just above the contact point. A pressure of 4½ to 5½ ounces should be required to open the contact.

c. ADJUSTMENT. Bend the longer contact springs. Recheck the contact gap (par. 397).

399. Key Lever Spring Tensions
(fig. 231)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS.

(1) The springs on the character key levers and blank key lever should have openings of 1$^{3}/_{16}$ inches.

(2) The springs on the function key levers (CAR RET, LINE FEED, LTRS, FIGS) should have openings of 1$^{9}/_{16}$ inches.

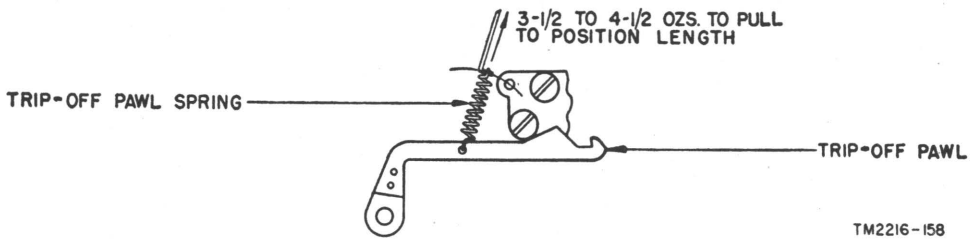


Figure 229. Trip-off pawl spring.

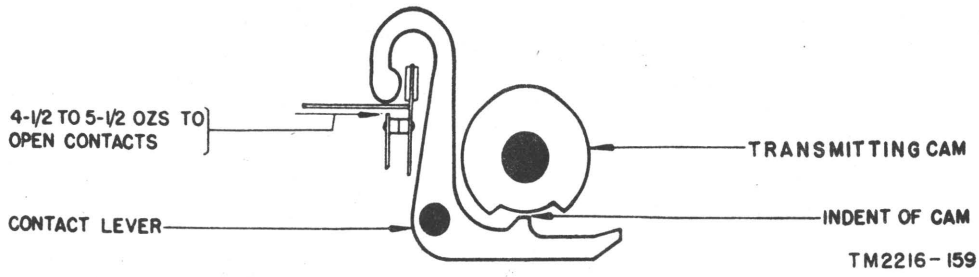


Figure 230. Transmitter contact springs.

(3) The spring on the space key lever should have an opening of 1¾ inches.

c. ADJUSTMENT. Bend the spring.

400. Repeat Space Rod Bracket
(fig. 231)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS. With the keyboard control operating lever in its upper position, and the space bar fully depressed, there should be some clearance, not more than .008 inch, between the repeat space rod and the transmitter rear bracket. When checking this adjustment, the repeat space rod slotted guide should be resting against its backstop screw and the play of the rod in the slot should be taken up in a direction to make the clearance a minimum.

c. ADJUSTMENT. Loosen the repeat space rod bracket mounting screw and position the bracket. Hold the repeat space rod bracket so that it is approximately parallel to the transmitter rear bracket when tightening the mounting screw. Check the repeat space rod for freeness after tightening the mounting screw.

401. Repeat Space Rod
(fig. 231)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENT. With the keyboard control operating lever in the upper position and the space bar depressed until the space key lever rests lightly against the A–1 and A–2 code bars, there should be .010- to .020-inch clearance between the

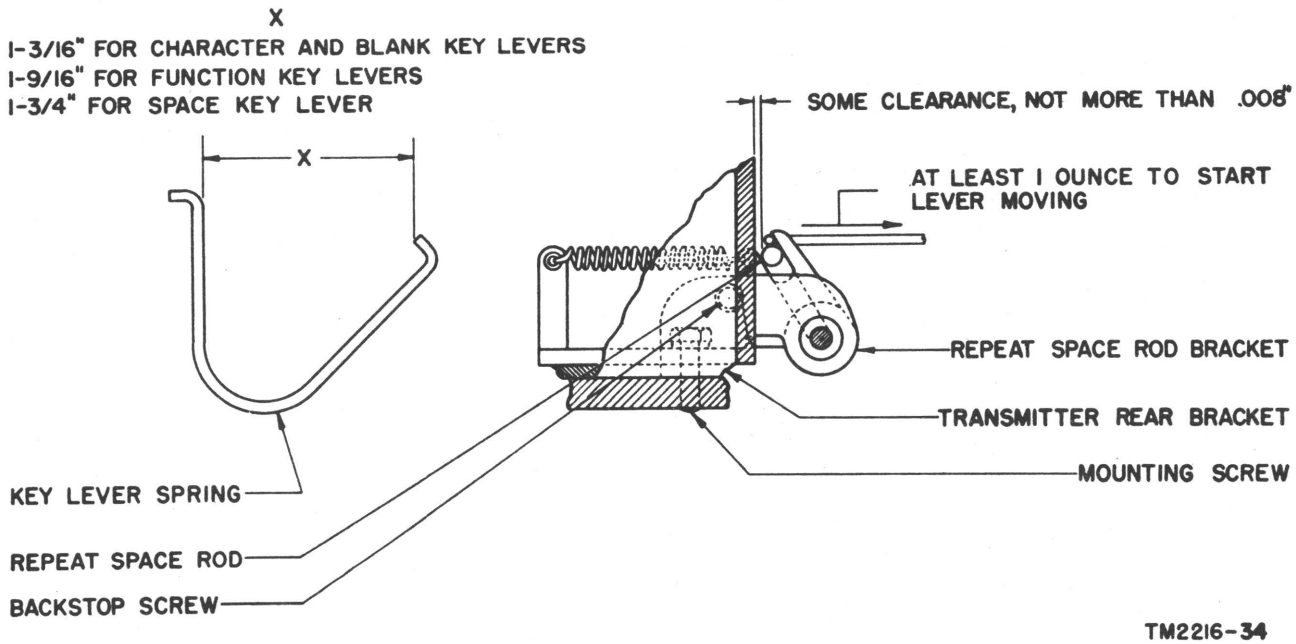


Figure 231. Key lever springs and repeat space rod bracket.

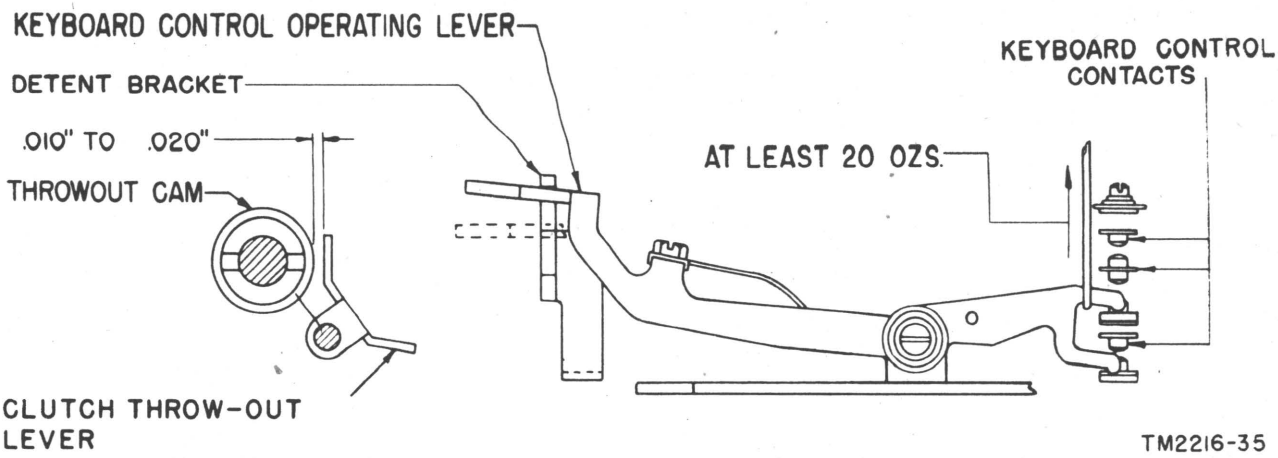


Figure 232. Clutch throw-out lever and keyboard control operating lever detent bracket.

clutch throw-out lever and the high part of the throw-out cam.

c. ADJUSTMENT. Position the repeat space rod adjusting nuts.

402. Repeat Space Rod Spring Tension

(fig. 231)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENT. With the keyboard operating lever in the upper position, hook an 8-ounce scale in the slot in the repeat space rod guide lever and pull in line with the spring. It should require not less than 1 ounce to start the lever moving away from its backstop screw.

c. ADJUSTMENT. Replace with a new spring.

403. Repeat Space Rod Cut-Out

(fig. 233)

a. PREPARATION. Refer to the preparation described in paragraph 380.

b. REQUIREMENTS.

(1) With the keyboard control operating lever in its lower position and the space bar fully depressed, there should be at least .010-inch clearance between the repeat space rod and the intermediate pawl.

(2) With the keyboard control operating lever in its center position, the cut-out should not engage the repeat space rod slotted guide.

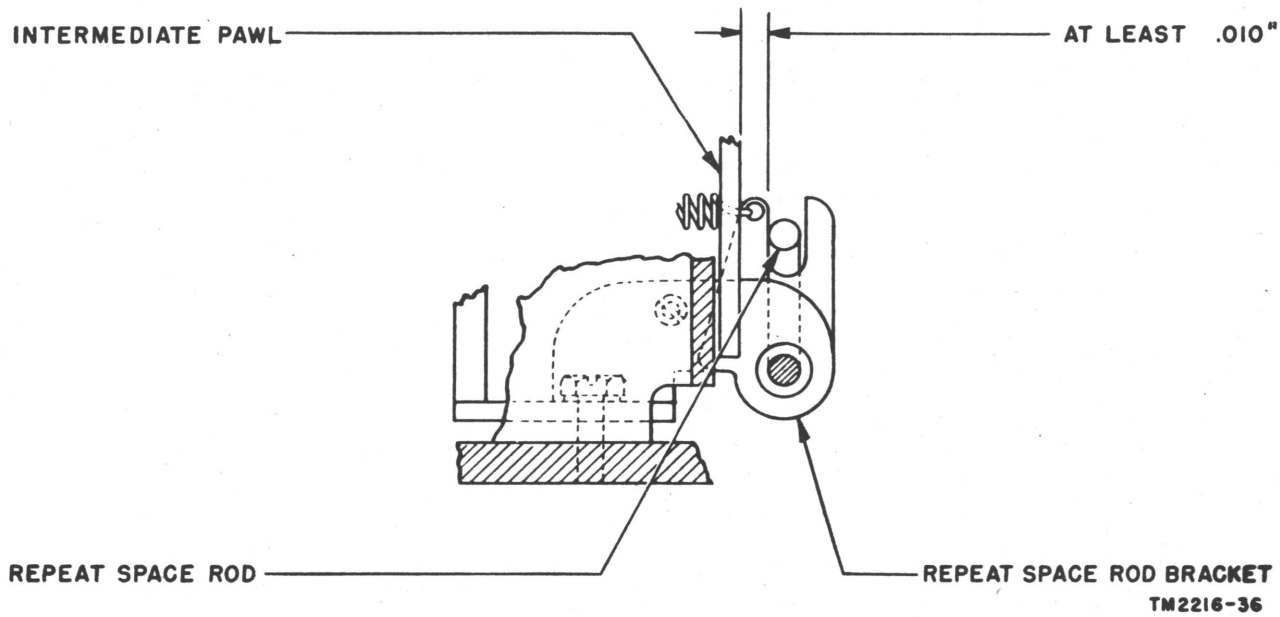


Figure 233. Repeat space rod and intermediate pawl.

c. ADJUSTMENT. Position the cut-out in its slot; use the elongated mounting hole.

404. Repeat Space Rod Extension
(fig. 225)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The repeat space rod extension should be centrally located between the adjacent key levers, and the horizontal part should be approximately parallel to the space bar rod.

c. ADJUSTMENT. Position the repeat space rod extension by means of its mounting screws.

405. Keyboard Control Contact Assembly

a. CONTACT ALINEMENT (figs. 234 and 235).

(1) *Preparation.* Remove the contact assembly cover.

(2) *Requirement.* The contact points should be in alinement with each other.

(3) *Adjustment.* Loosen the contact spring mounting screws and position the contact springs. Tighten the mounting screws.

b. CONTACT ADJUSTMENTS WITH KEYBOARD CONTROL OPERATING LEVER IN UPPER POSITION (fig. 234).

(1) *Preparation.* Same as outlined in *a*(1) above.

(2) *Requirements.*

(*a*) Both prongs of the keyboard control operating lever should engage the insulating tips of contact springs 3 and 5 approximately in the center. Be sure that neither prong touches the contact spring or the insulator rivets.

(*b*) There should be not less than .010-inch clearance between the keyboard casting and the insulating tip on contact spring 5.

(*c*) There should be .015- to .040-inch clearance between the contact points on springs 4 and 5.

(3) *Adjustments.*

(*a*) Loosen the contact assembly bracket mounting screws and position the bracket to meet the requirements of (2) (*a*) above. Tighten the mounting screws.

(*b*) Bend the spring between the contact point and the insulating tip to meet the requirements of (2) (*b*) above.

(*c*) Bend contact spring 4 to meet the requirements of (2) (*c*) above.

c. CONTACT ADJUSTMENTS WITH KEYBOARD CONTROL OPERATING LEVER IN CENTER POSITION (fig. 234).

(1) *Preparation.* Same as outlined in *a*(1) above.

(2) *Requirements.*

(*a*) There should be not less than .015-inch clearance between the lower prong on the keyboard control operating lever and the insulating tip on contact spring 5.

(*b*) With the insulating tip on contact spring 3 resting against the upper prong of the keyboard control operating lever, there should be .015- to .040-inch clearance between the contact points of springs 2 and 3.

(*c*) There should be .015- to .025-inch clearance between the contact points of springs 1 and 2.

(*d*) It should require a pull of not more than 1½ ounces to raise contact spring 2 so that the points of contact springs 1 and 2 just make contact.

(3) *Adjustments.*

(*a*) Bend contact spring 4 to meet the requirement of (2) (*a*) above. Recheck *b* (2) (*c*) above.

(*b*) Bend the backstop of contact spring 2 to meet the requirement of (2) (*b*) above.

(*c*) Bend contact spring 1 to meet the requirement of (2) (*c*) above.

(*d*) Bend contact spring 2 to meet the requirement of (2) (*d*) above. Recheck (2) (*b*) and (*c*) above.

d. CONTACT ADJUSTMENT WITH KEYBOARD CONTROL OPERATION LEVER IN LOWER POSITION (fig. 235).

(1) *Preparation.* Same as outlined in *a*(1) above.

(2) *Requirements.*

(*a*) It should require a push of 2 to 3 ounces to separate the contact points of springs 4 and 5.

(*b*) It should require a push of 3 to 4½ ounces to separate the contact points of springs 2 and 3 when spring 2 is held to prevent follow.

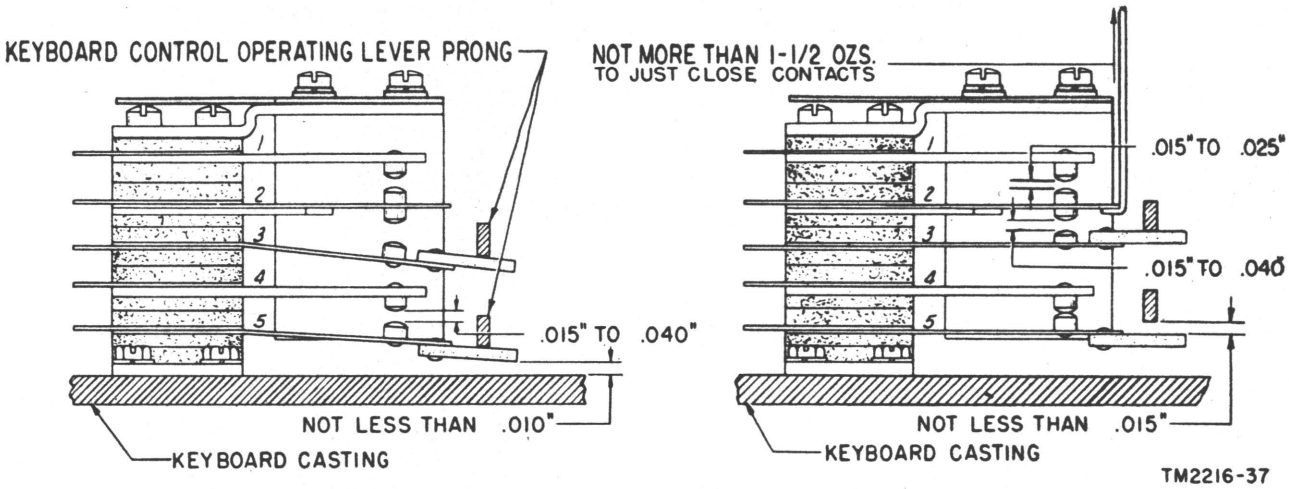


Figure 234. Keyboard control contact gaps.

(*c*) It should require a pressure of at least one-fourth ounce to separate the contact points of springs 1 and 2. To measure this pressure, allow contact spring 3 to bear against contact spring 2; apply the push and of an 8-ounce scale to contact spring 2 at the contact point and push vertically downward.

(3) *Adjustments.*

(*a*) Bend contact spring 5 to meet the requirement of (2) (*a*) above. Recheck *b* (2) (*c*) above.

(*b*) Bend contact spring 3 to meet the requirement of (2) (*b*) above. Recheck *c* (2) (*b*) above.

(*c*) To meet the requirements of (2) (*c*) above, remake the adjustments specified in *c* (2) (*d*) above and (2) (*b*) above, within limits, in a direction to increase the pressure between the contacts of springs 1 and 2.

406. Keyboard Control Contact Assembly Cover

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The rear extremity of the cover should not extend beyond the rear of the transmitting shaft rear bracket.

c. ADJUSTMENT. Loosen the cover mounting screws and position the cover by means of its elongated mounting holes. Tighten the mounting screws.

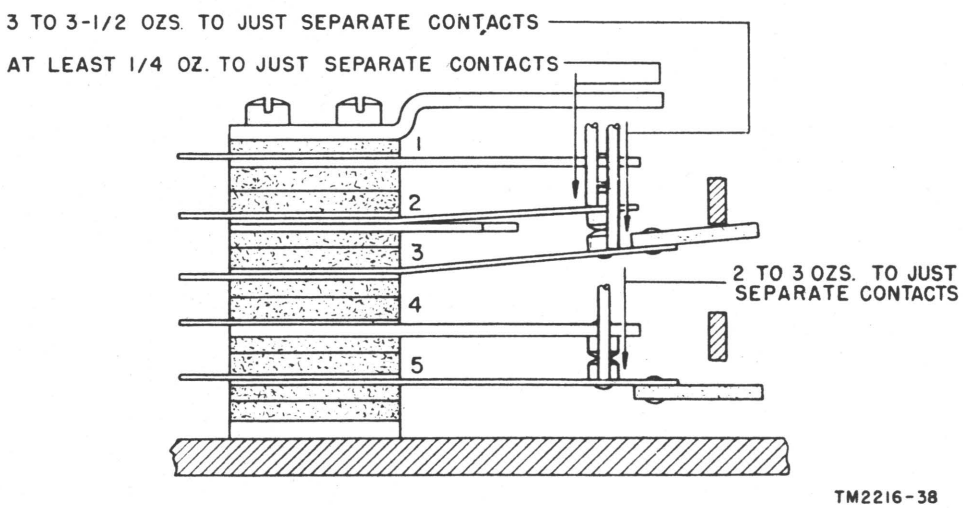


Figure 235. Keyboard control contact springs.

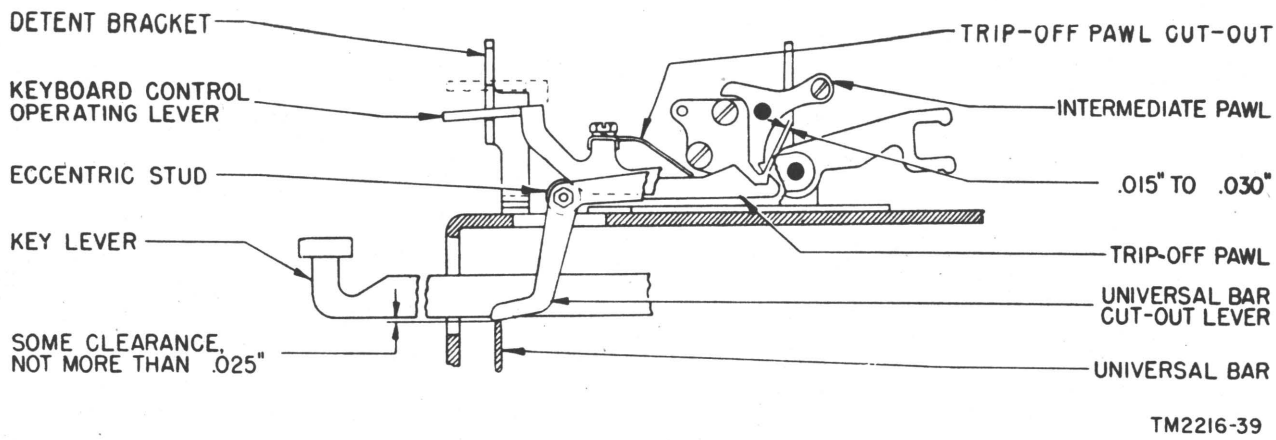


Figure 236. Universal bar cut-out lever and trip-off pawl cut-out.

407. Keyboard Control Operating Lever Detent Bracket

(figs. 232 and 236)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. With the keyboard control operating lever in its upper position, hook at 32-ounce scale under the rear extension of the operating lever just in front of the lobes and pull vertically upward. It should require a pull of at least 20 ounces to move the operating lever from the upper position to the center position.

c. ADJUSTMENT. Loosen the detent bracket mountings screws and position the bracket. Tighten the screws.

408. Universal Bar Cut-out Lever

(fig. 236)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. With the keyboard control operating lever in its lower position, there should be some clearance (not more than .025 inch) between the universal bar and any key lever when the key lever is depressed fully. Check all key levers.

c. ADJUSTMENT. Position the eccentric stud on the universal bar cut-out lever.

409. Universal Bar Cut-out Lever Return Spring

(fig. 237)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. With the keyboard control operating lever in its center position and all key levers in the unoperated position, there should be some clearance (not more than $\frac{1}{16}$-inch) between the universal bar and the cut-out lever.

c. ADJUSTMENT. Bend the universal bar cut-out lever return spring.

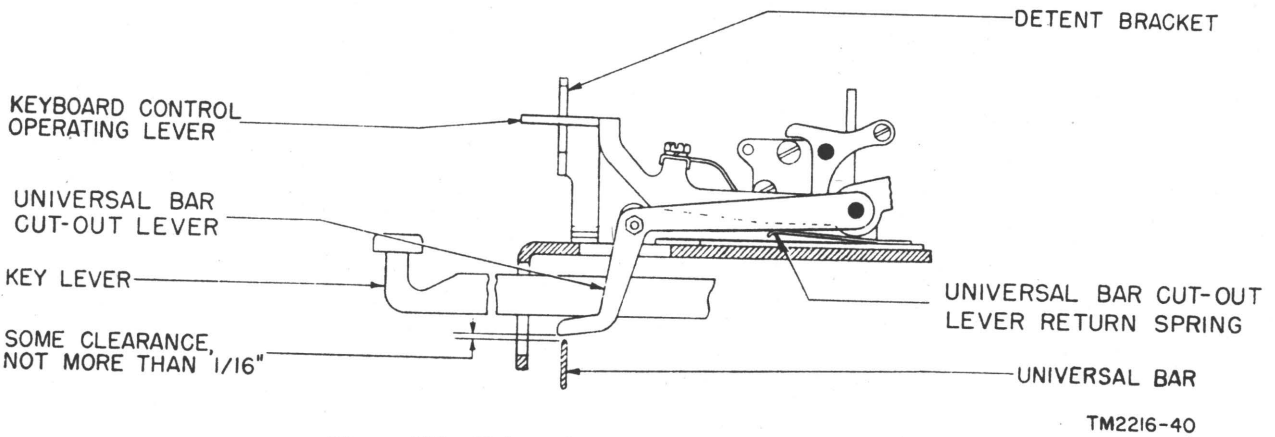


Figure 237. Universal bar cut-out lever return spring.

410. Trip-off Pawl Cut-out
(fig. 236)

a. PREPARATION. Same as indicated in paragraph 380.

b. REQUIREMENT. Rotate the transmitting shaft until the clutch throw-out lever is resting against the low part of its cam. When the keyboard control operating lever is moved slowly from the center position to the lower position, there should be .015- to .030-inch clearance between the trip-off pawl and the intermediate pawl at the point where the clearance is a minimum. When the operating lever is in its lower position there should be some clearance between the trip-off pawl cut-out and the repeat space rod and between the trip-off pawl and the keyboard casting.

c. ADJUSTMENT. Bend the trip-off pawl cut-out.

411. Cam Pulsing Contact Assembly Adjustments for Old and New Types

a. CONTACT ALINEMENT FOR BOTH TYPES. (fig. 238).

(1) *Preparation.* Same as outlined in paragraph 380.

(2) *Requirement.* The cam follower should ride centrally on the cam and the contact points should be in alinement.

(3) *Adjustment.* Loosen the mounting screws and shift the contact assembly. Tighten the mounting screws.

b. CONTACT CLEARANCE FOR BOTH TYPES (fig. 238).

(1) *Preparation.* Same as outlined in paragraph 380.

(2) *Requirement.* With the contacts open, there should be .010- to .020-inch clearance between the contact points.

(3) *Adjustment.* Bend the short contact spring.

c. CONTACT TENSION FOR OLD STYLE (A, fig. 238).

(1) *Preparation.* Remove filter units.

(2) *Requirement.* With the contacts closed, hook an 8-ounce scale under the top contact near the contact point and pull vertically upward. It should require a pull of 3½ to 4½ ounces to separate the contacts.

(3) *Adjustment.* Bend the contact springs. Recheck *b* above.

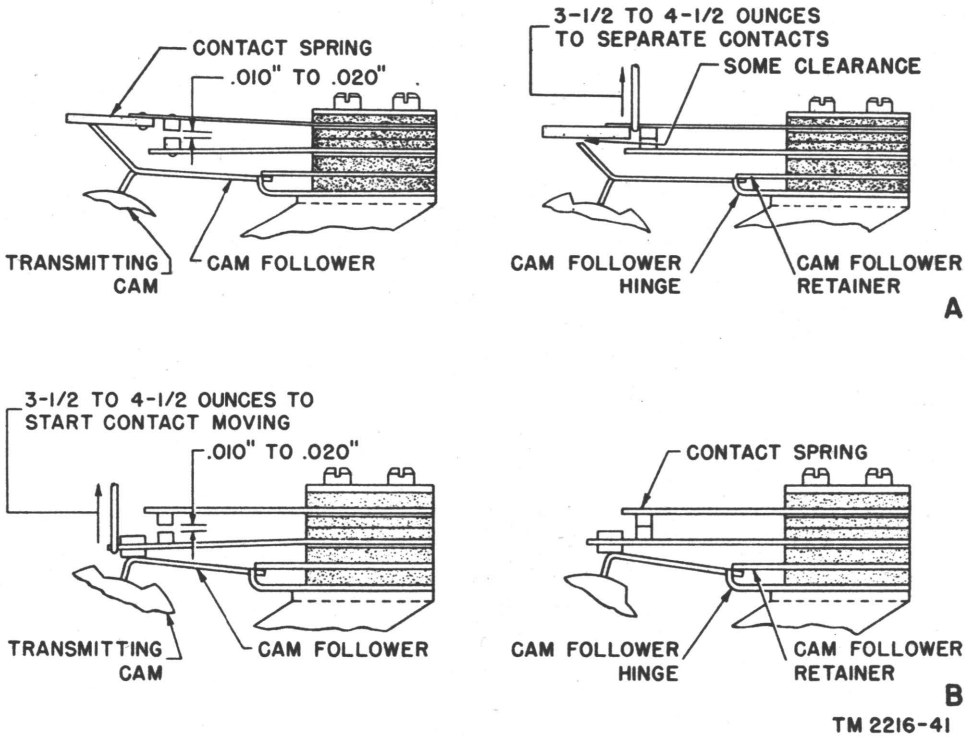


Figure 238. Cam pulsing contact assembly.

d. CAM FOLLOWER CLEARANCE FOR OLD STYLE (A, fig. 238).

(1) *Preparation.* Same as outlined in paragraph 380.

(2) *Requirement.* With the cam follower in the indent of the cam there should be some clearance between the cam follower and the insulator tip of the contact spring.

(3) *Adjustment.* Refine the adjustments indicated in *b* and *c* above.

e. CONTACT TENSION FOR NEW STYLE (B, fig. 238).

(1) *Preparation.* Remove the filter units.

(2) *Requirements.* With the contacts open, hook an 8-ounce scale under the lower contact near the contact point and pull vertically upward. It should require a pull of 3½ to 4½ ounces to start the contact moving.

(3) *Adjustment.* Bend the contact spring. Recheck *b* above.

412. Tape Feed Roll
(fig. 239)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The tape feed roll should be free from binds and should not have over .003-inch end play. To check for binds, hold off the tape tension lever, the feed pawl, and detent lever.

c. ADJUSTMENT. Increase or decrease the number of shims installed between the feed roll bracket and the casting. Utilize the play in the bracket mounting holes to position it so that the feed roll is free. Tighten the screws.

413. Tape Tension Lever Stud
(fig. 239)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The feed pins on the feed roll should not touch either side of the slot in the tape tension lever when the play in both the feed roll and tape tension lever is taken up in opposite directions.

c. ADJUSTMENT. Increase or decrease the number of shims installed between the tape tension lever stud and the feed roll bracket.

414. Tape Tension Lever Spring Tension
(fig. 240)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. Hook a 32-ounce scale over the end of the slotted extension of the tape tension lever and pull at a right angle to the lever. It should require a pull of 14 to 16 ounces to start the slotted extension moving away from the feed roll.

c. ADJUSTMENT. Loosen the tape tension lever stud locknut and rotate the stud in either a clockwise or counterclockwise direction. Tighten the locknut.

415. Backspacer Spring Tension
(fig. 241)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. Apply the push end of an 8-ounce scale to the upper end of the backspace lever and push vertically downward. It should require 4 to 6 ounces to start the lever moving.

c. ADJUSTMENT. Replace with a new spring.

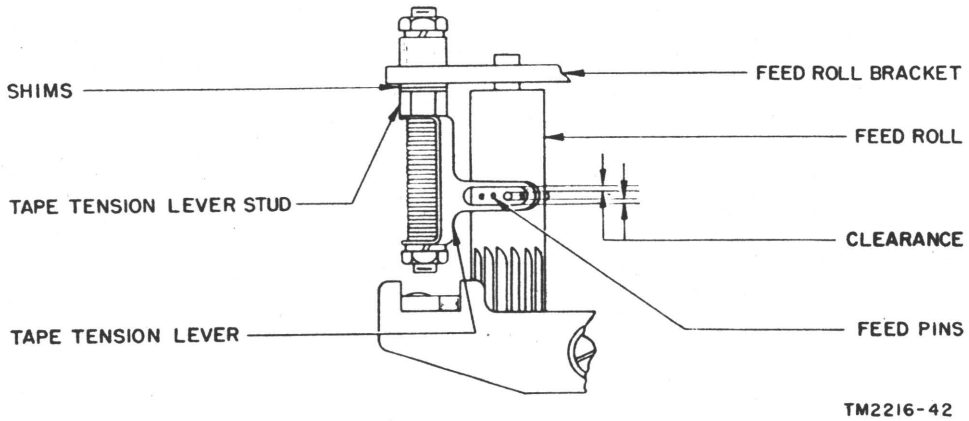


Figure 239. Tape feed roll and tension lever stud.

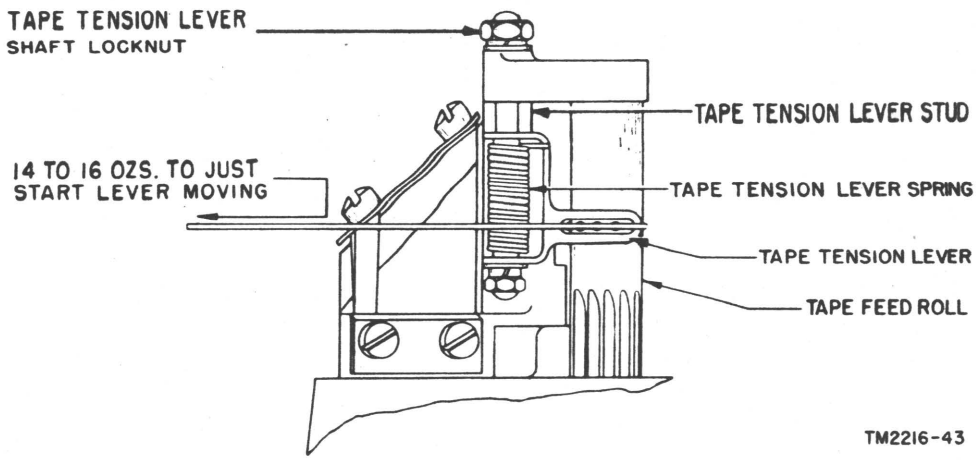


Figure 240. Tape tension lever spring.

416. Backspace Pawl Spring Tension
(fig. 241)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. Hook an 8-ounce scale under the pawl below the spring hole and pull vertically upward. It should require 1 to 2 ounces to start the feed pawl moving.

c. ADJUSTMENT. Replace with a new spring.

417. Feed Roll Detent Preliminary Adjustment
(fig. 242)

a. PREPARATION. Remove the counter unit.

b. REQUIREMENT. With the detent lever roller resting between two teeth of the star wheel and the armature lever in the operated position, insert the feed roll positioning gage (No. 73517) in the punch block guide slot so that the projection of the gage stops against the feed hole punch. Under these conditions a pin on the feed roll should line up with the center hole of the gage.

c. ADJUSTMENT. Loosen the detent eccentric bushing mounting screw and position the bushing, keeping the center of the eccentric bushing below the center of the mounting screw. Tighten the mounting screw.

418. Feed Roll Detent Spring Tension
(fig. 242)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. Hook a 32-ounce scale over the detent lever at the roller and pull downward

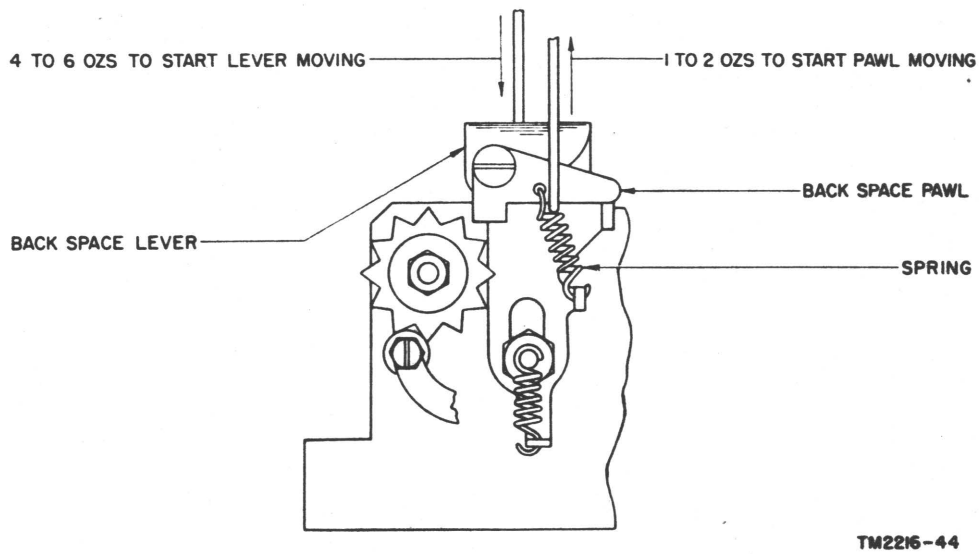


Figure 241. Backspacer spring.

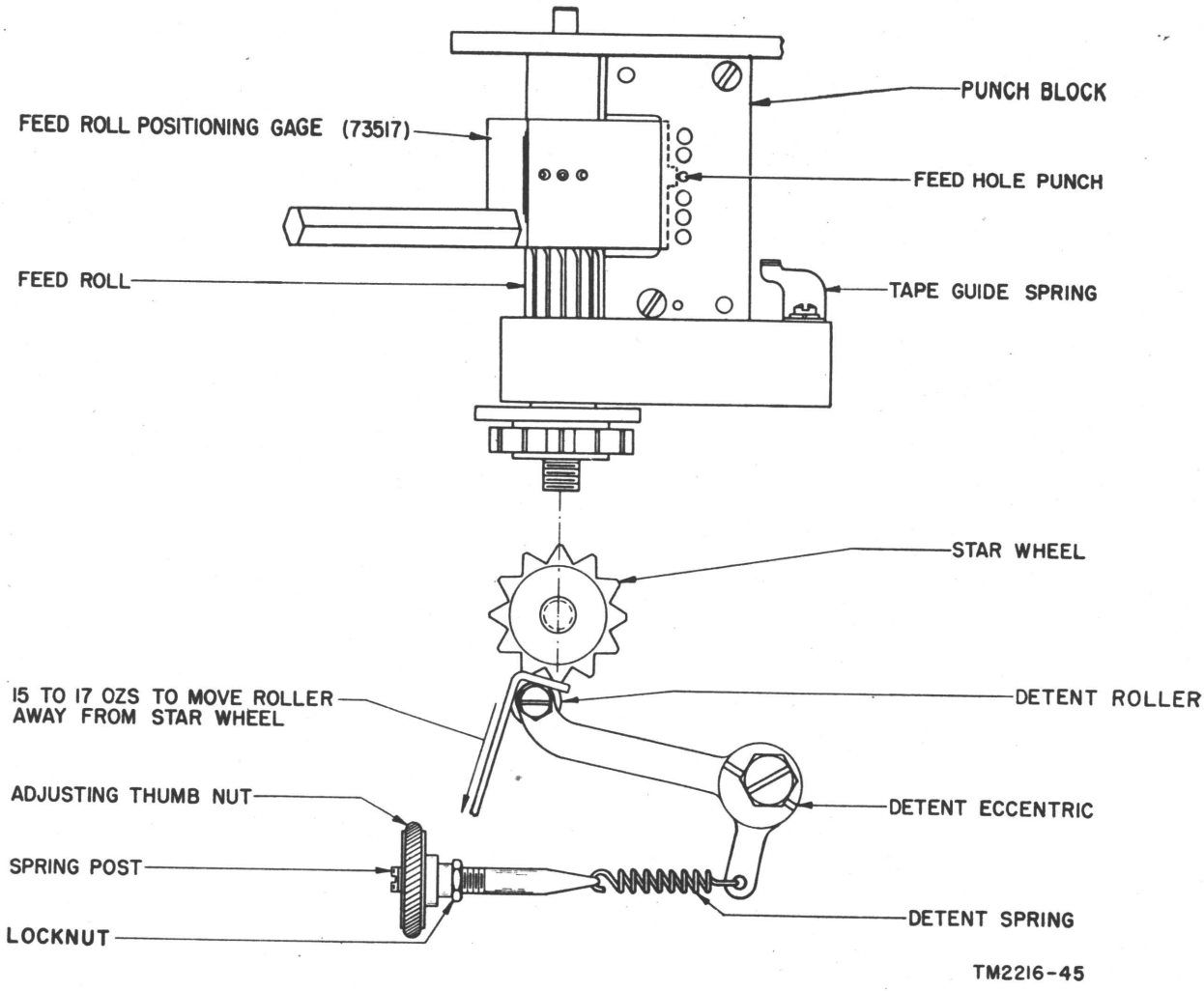


Figure 242. Feed roll detent.

at a right angle to the lever. It should require 15 to 17 ounces to start the roller moving away from the star wheel.

c. Adjustment. Hold the thumbnut and loosen the locknut. Then turn the thumbnut to obtain the proper tension. Hold the thumbnut while tightening the locknut.

419. Selector Lever Bracket
(fig. 243)

a. Preparation. Same as outlined in paragraph 380. The following 18 adjustments will be facilitated by removing the tape stripper plate and the tape knife (figs. 68 and 248).

b. Requirements. With the selector bars in their neutral position, the engaging tips of all the movable selector fingers should be under the punches by not more than half the diameter of the punches, gaged by eye. To move the selector bars to a neutral position, depress the LTRS, LINE FEED, and blank key levers equally until they are stopped by the selector bars. To facilitate this procedure, place a suitably sized wrench or some other flat object across the three keytops and depress the key levers by applying pressure to the wrench. When checking this adjustment, hold the three key levers depressed and take up the play of the selector levers and fingers in a direction to make the engagement with the punches a maximum.

c. Adjustment. Loosen the selector lever bracket mounting screws and position the bracket. Tighten the mounting screws.

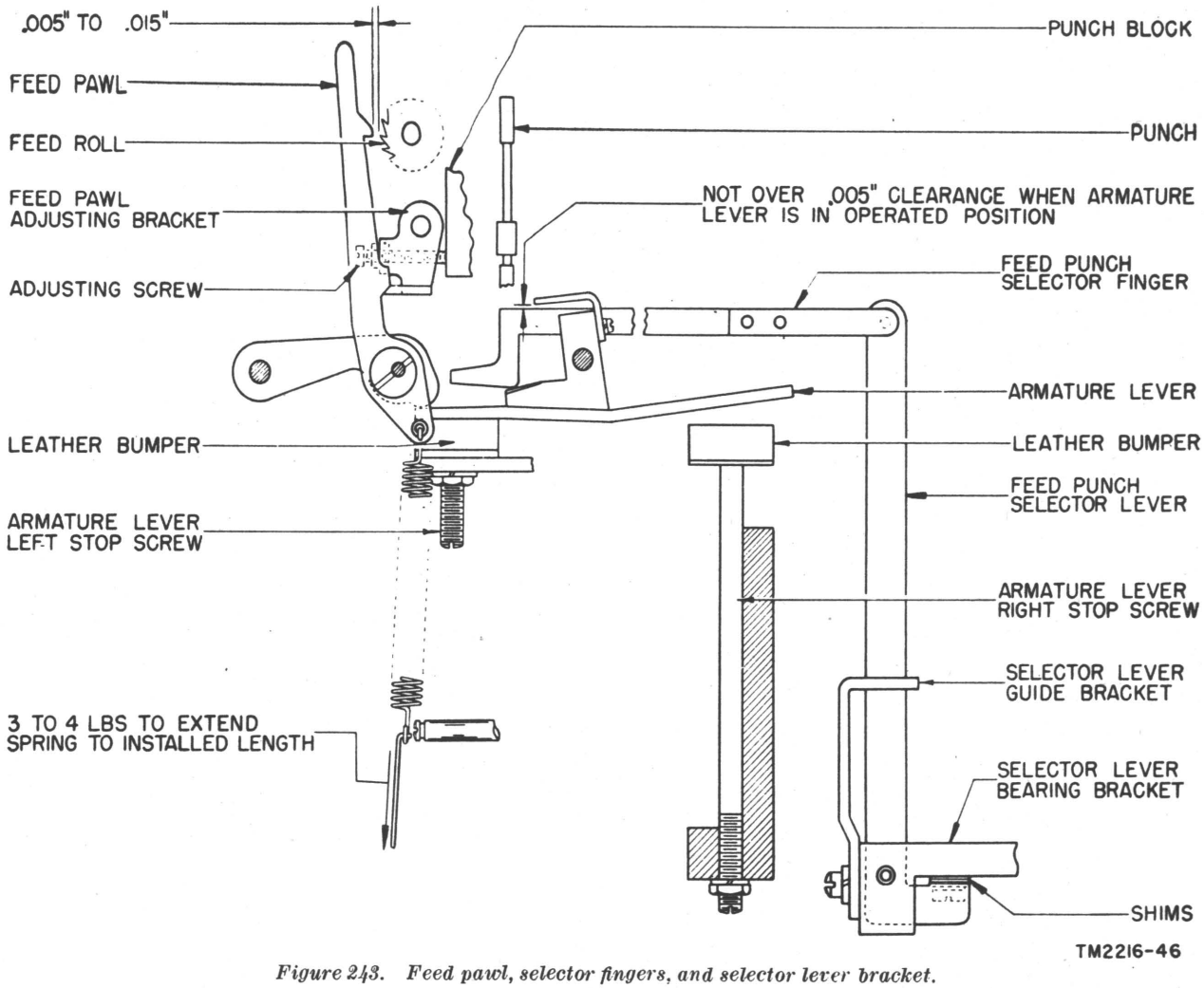


Figure 243. Feed pawl, selector fingers, and selector lever bracket.

420. Feed Punch Selector Lever
(fig. 243)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The left end of the uppermost section of the feed punch selector finger should line up with the left end of the feed punch pin. Gage by eye.

c. ADJUSTMENT. Position the feed punch selector lever by increasing or decreasing the number of shims between the formed-over ear and the selector lever bracket.

421. Armature Lever Left Stop Screw
(fig. 244)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. With the armature lever held firmly against its left stop and the left end of the uppermost section of the feed punch selector finger in line with the left edge of the feed punch pin, the clearance between the feed punch selector finger and the feed punch should be .025 to .030 inch.

c. ADJUSTMENT. Position the armature lever left stop by means of its locknut (fig. 243).

422. Armature Lever Right Stop Screw
(fig. 244)

a. PREPARATION. Same as outlined in paragraph 380. Rotate the transmitting cam sleeve to the stop position and connect a source of 110 volts d-c to terminals 52 and 53 (the second and third slip connection terminals from the perforator unit looking at the front of the keyboard). As a protective measure it is recommended that this source of current be provided with fuses of 2- or 3-ampere capacity. Be careful to guard against shock

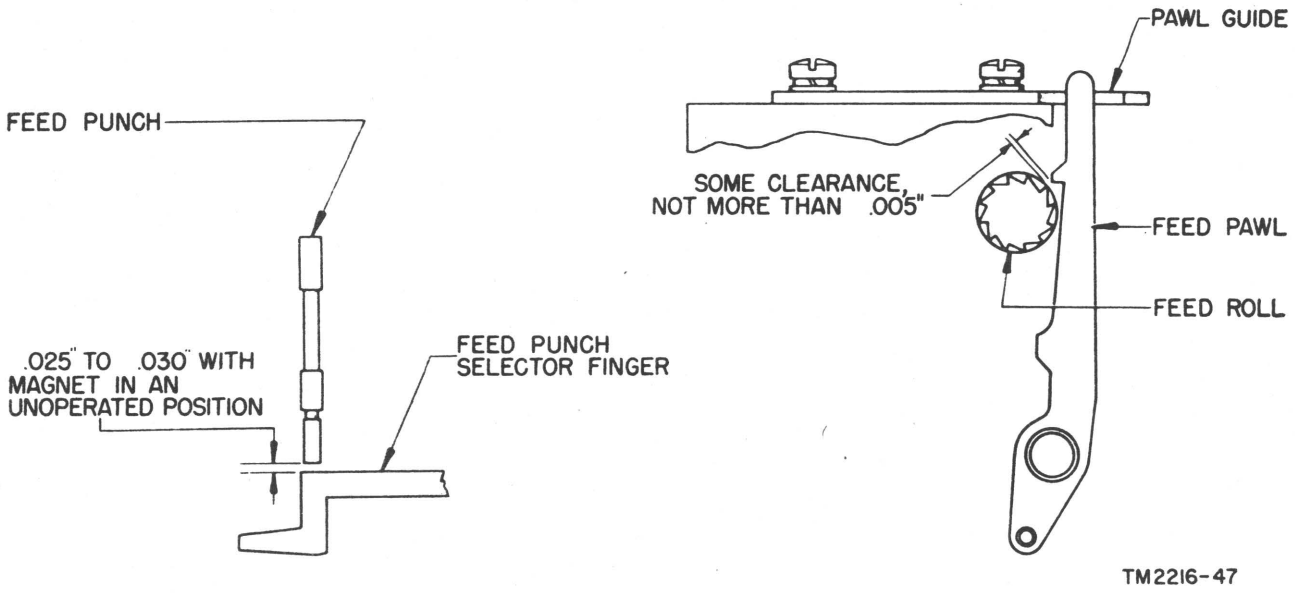


Figure 244. Feed punch, selector finger, and feed pawl.

or short-circuiting when handling the unit with power applied to it.

b. REQUIREMENT. Operate the keyboard control operating lever to its lower position.

c. ADJUSTMENT. Place all the punch selector fingers under the punch pins so that the left end of each selector finger lines up with the left end of the feed punch selector finger. Adjust the armature lever right stop screw so that the punches fail to punch through the tape when the punch magnets are energized by closing the punch contacts by hand. Back off the stop screw until all the punches just punch through the tape when the punch magnet contacts are operated by hand. All the punches should perforate the tape when the selector fingers are positioned as far to the left as possible. Back off the right stop screw more, if necessary, then back off the stop screw one-quarter turn more for margin. Make certain that there is some clearance between the armature and the magnet core when the armature lever is held firmly against its right stop. Tighten the locknut.

423. Selector Finger Retainer

(fig. 243)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. There should be some clearance, not more than .005 inch, between the retainer and the top of the feed punch selector lever when the armature lever is held in its operated position by the magnet. The selector finger retainer should be equidistant (within .005 inch) from selector fingers 1 and 5 when the ends of all the selector fingers are in line.

c. ADJUSTMENT. Loosen the retainer mounting screws and adjust the retainer. Tighten the mounting screws.

424. Tape Guide Spring

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENTS.

(1) The edge of the spring should be parallel to the edge of the casting on which it is mounted.

(2) The spring should hold the tape securely against the side of the guide in the die block adjacent to the punch 1 without buckling the tape. Take up the play of the tape in the die block toward the spring and observe whether the spring returns the tape to the far side when the tape is released.

c. ADJUSTMENTS.

(1) Position the spring to meet the requirement in *b*(1) above.

(2) Bend the spring to meet the requirement in *b*(2) above.

425. Punch Contact Bracket
(fig. 245)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The punch contact bracket should be positioned so that its mounting screws are in the center of the elongated holes in the bracket. Remove one mounting screw at a time to determine whether the bracket is adjusted properly.

c. ADJUSTMENT. Loosen both mounting screws and position the bracket. Tighten the mounting screws.

426. Punch Contacts
(fig. 245)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENTS.

(1) With the antichatter contact lever resting against its adjusting screw, the armature lever against its left-hand stop, and the right-hand punch contact held away from the left-hand punch contact by the contact operating lever, hook an 8-ounce scale over the left-hand contact spring at the contact point and pull at a right angle to the spring. It should require 2 to 3 ounces to separate the insulator from the antichatter lever (fig. 245).

(2) With any key lever depressed, hook an 8-ounce scale over the right-hand contact spring at the contact point and pull at a right angle to the spring. It should require 2 to 3 ounces to separate the contacts (fig. 245).

c. ADJUSTMENTS.

(1) Bend the left-hand contact spring to meet the requirements of *b*(1) above.

(2) Bend the right-hand contact spring to meet the requirement of *b*(2) above.

427. Key Pressure Adjusting Mechanism
(fig. 246)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The contact operating lever return spring adjusting assembly should be free from binds over the entire range of the adjusting screw, and the punch contact operating lever backstop screw should line up centrally (approximately) with the contact operating lever.

c. ADJUSTMENT. Position the key pressure adjusting mechanism by means of its mounting screws.

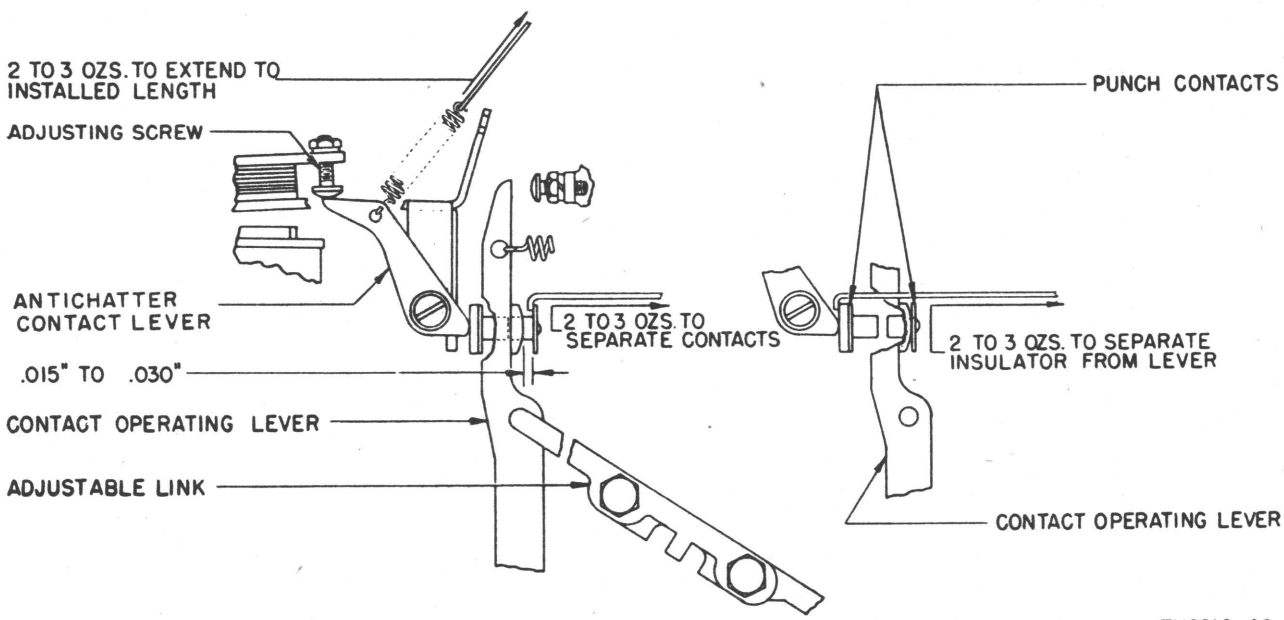


Figure 245. Punch contacts and antichatter contact lever.

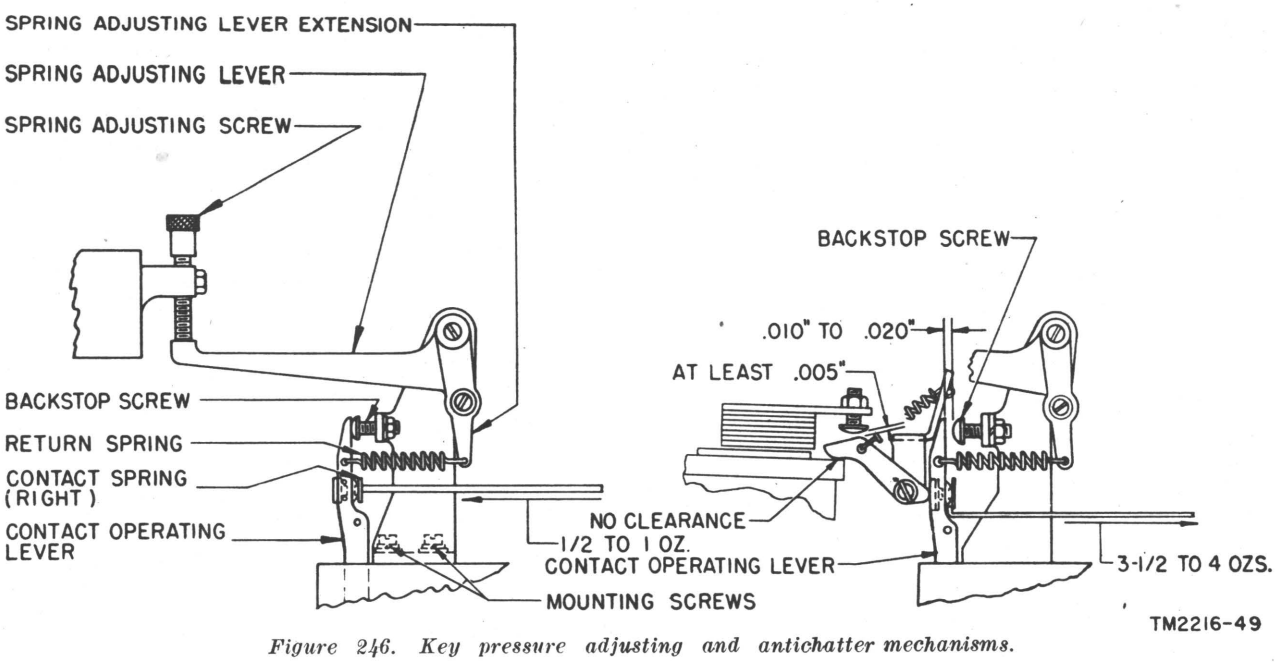


Figure 246. Key pressure adjusting and antichatter mechanisms.

428. Antichatter Mechanism
(fig. 245)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENTS.

(1) With the armature lever resting firmly against its left-hand stop and the antichatter lever in contact with the adjusting screw in the armature, the edge of the uppermost portion of the antichatter contact lever should be approximately horizontal. When adjusted in accordance with the foregoing requirement, the following conditions also should prevail:

(*a*) With the armature lever resting firmly against its right-hand stop and the antichatter lever held against the magnet spool head, there should be at least .005-inch clearance between the antichatter lever and its adjusting screw (fig. 246).

(*b*) With the armature lever resting firmly against its left-hand stop, the end of the antichatter lever should extend at least one-thirty-second inch to the left of the center of its operating screw. If necessary, refine the adjusting screw adjustment between these limits so that both conditions are met.

(2) Unhook the antichatter contact lever spring from the bracket and hook an 8-ounce scale in the spring eye. It should require 2 to 3 ounces to pull the spring to position length.

c. ADJUSTMENT.

(1) Position the adjusting screw to meet the requirements of *b*(1) above.

(2) Replace with a new spring to meet the requirements of *b*(2) above.

429. Punch Contact Operating Lever Link
(fig. 245)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. Determine that the key lever (including the space key lever) which, when depressed fully, moves the punch magnet operating lever the least amount. With this key lever (or space bar) completely depressed, there should be .015- to .030-inch clearance between the right-hand contact spring and the insulator on the contact operating lever.

c. ADJUSTMENT. Loosen the two screws which clamp the adjustable link together and shorten or lengthen the link. Tighten the screws. With the foregoing adjustment, the punch contacts will not close until the key levers nearly reach the bottom of their travel. It is permissible to adjust the link so that the punch contacts will close on a

shorter key lever stroke, provided that all the punch selector fingers engage their associated punch pins by the full diameter of the pin at the time the punch contacts close. To check this adjustment, position all the punch selector fingers toward the right and then depress the LTRS key lever slowly until the punch contacts close. Connect a test lamp across the contacts to determine when they close. To adjust for a shorter key lever stroke, lengthen the punch contact operating lever link.

430. Punch Control Operating Lever Backstop
(fig. 246)

a. PREPARATION. Connect the unit to a source of 110 volts dc (par. 422).

b. REQUIREMENT. With the unit connected to a source of 110 volts dc, operate any key lever and then release the pressure on the keytop slowly until the contact points on the two punch operating contact springs are just separated by the contact operating lever as it is pulled toward the right by the contact operating lever return spring. With the key lever held in this position, there should be .010-inch to .020-inch clearance between the contact operating lever backstop and the right-hand edge of the contact operating lever.

c. ADJUSTMENT. Loosen the backstop screw locknut and position the screw. Tighten the locknut.

431. Punch Contact Operating Lever Spring Tension
(fig. 246)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. In making this measurement, the right contact spring should be allowed to bear freely against the fiber on the contact operating lever. Apply the push end of an 8-ounce scale to the right contact spring at the contact point and push in a horizontal direction. It should require ½ to 1 ounce to just start the contact operating lever moving away from the backstop screw.

c. ADJUSTMENT. Turn the spring adjusting screw to its highest position, then position the extension on the adjusting lever by means of the elongated slot in the extension to meet the requirement above.

432. Feed Pawl Eccentric
(fig. 243)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The feed pawl should just engage a tooth on the feed roll, without overtravel, when the armature lever is raised slowly by hand until the feed punch selector finger just touches the feed punch.

c. ADJUSTMENT. Loosen the feed pawl eccentric bushing mounting screw and position the bushing. Tighten the bushing mounting screw. To facilitate making the adjustment, remove the counter unit from its bracket by loosening its mounting screws and sliding the unit from its mounting slots.

433. Feed Pawl Spring Tension
(fig. 243)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. Unhook the lower end of the spring from its post and hook a 12-pound scale into its eye. Pulling downward, it should require 3 to 4 pounds to stretch the spring to position length.

c. ADJUSTMENT. Replace with a new spring.

434. Feed Pawl Throw-out Adjusting Bracket
(fig. 243)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. With the armature resting against its left-hand stop, there should be .005- to .015-inch clearance between the tip of the tooth on the feed pawl and the tips of the teeth on the feed roll throughout a complete revolution of the feed roll.

c. ADJUSTMENT. Loosen the bracket mounting screw and the adjusting screw locknut and set them both friction-tight. With the adjusting screw in contact with the punch block, advance or withdraw the screw until the desired clearance is obtained. Tighten the locknut and the mounting screw.

435. Feed Pawl Guide
(fig. 244)

a. PREPARATION. Connect the unit to a source of 110 volts dc (par. 422).

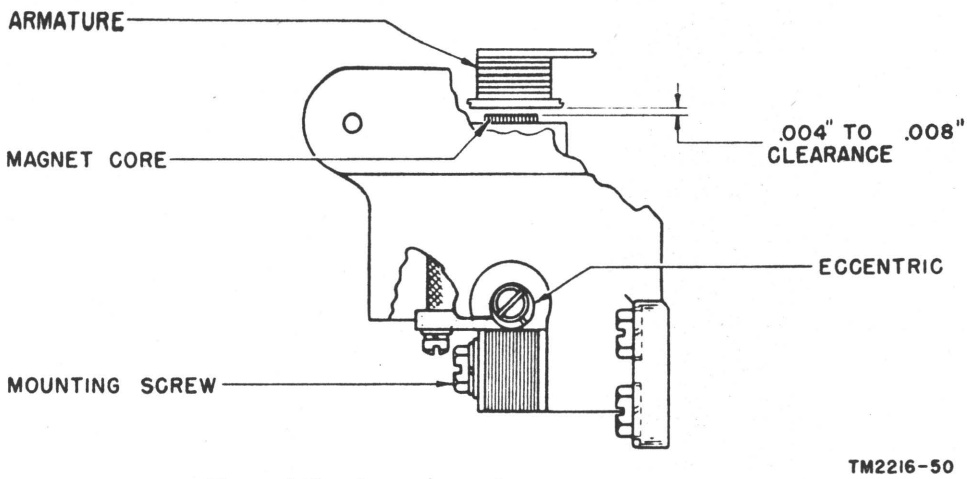


Figure 247. Armature and armature magnet cores.

b. REQUIREMENT. When the armature is held in its operated position by energizing the punch magnet, and the feed pawl is rotated, there should be some clearance (not more than .005 inch) between the feed pawl and the nearest feed roll tooth.

c. ADJUSTMENT. Position the feed pawl guide by means of its two mounting screws.

436. Punch Magnet
(fig. 247)

a. PREPARATION. Connect a source of 110 volts dc to the unit (par. 422). Remove the counter unit and its mounting bracket.

b. REQUIREMENT. With the punch magnet energized and the armature lever resting against its right-hand stop, there should be .004- to .008-inch clearance between the magnet cores and the armature.

c. ADJUSTMENT. Loosen the two eccentric stop mounting screws and rotate the eccentrics away from the core. Loosen the magnet core mounting screws and position the core. Tighten the mounting screws. Rotate the eccentrics so that they make contact with the core, then tighten the eccentric mounting screws.

437. Tape Stripper Plate
(fig. 248)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENTS. There should be some clearance (not over .010 inch) between the tape stripper plate and the feed roll throughout a complete revolution of the feed roll.

c. ADJUSTMENT. Loosen the mounting screws and position the plate. Tighten the mounting screws.

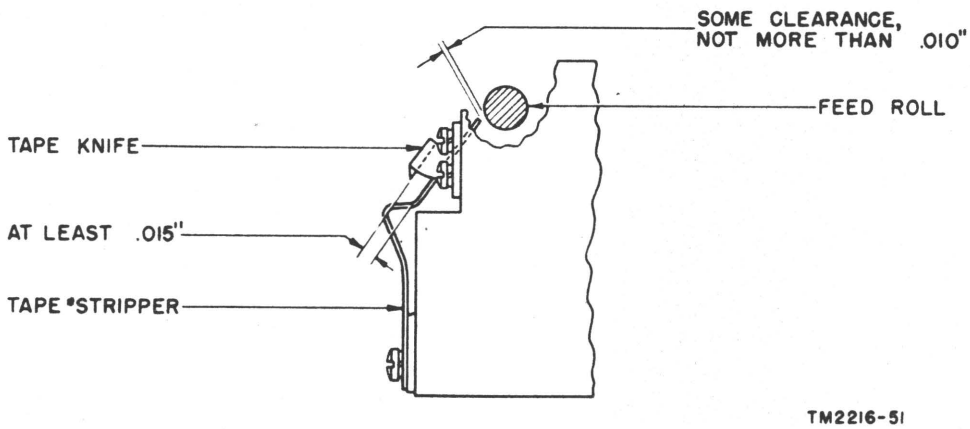


Figure 248. Tape stripper plate and tape knife.

438. Tape Knife

(fig. 248)

a. PREPARATION. Same as outlined in paragraph 380.

b. REQUIREMENT. The tape knife should be approximately horizontal and there should be at least .015-inch clearance between the tape knife and the tape stripper at their closest point.

c. ADJUSTMENT. Loosen the tape knife mounting screws and position the knife. Tighten the mounting screws.

439. Feed Roll Detent Final Adjustment

(fig. 242)

a. PREPARATION. Remove the counter from the unit.

b. REQUIREMENT. The perforations in the tape should conform to the standard spacing of 10 holes to the inch. Check the tape against the tape gage (No. 2215).

c. ADJUSTMENT. Loosen the detent lever eccentric bushing mounting screw and position the bushing using the lower semicircle of its adjusting range. Tighten the mounting screw.

440. Counter Control Contact Operating Mechanism

(fig. 249)

a. PREPARATION. Same as paragraph 380.

b. REQUIREMENTS.

(1) With the FIGS key lever and any two other key levers depressed until they are stopped by the selector bars, the relation between the key levers and the cam levers on the contact operating mechanism should be such that the cam levers are displaced completely. To check this adjustment, depress the FIGS and any two other key levers until they are stopped by the selector bars. Then, observing the counter control contact operating fiber extension, there should be very little or no further displacement as the FIGS key lever is depressed to its full depth of stroke. In a similar manner repeat this check, using the CAR RET key lever. It is important that the full displacement of the cam lever is not reached until the function key lever just reaches its neutral position.

(2) With the cam lever links against their backstops (unoperated position) there should be approximately equal clearance between the CAR RET and LINE FEED key levers and the tips of their respective cam levers.

c. ADJUSTMENTS. Add or remove shims located between the contact operating mechanism casting and the two rear mounting ears of the capacitor cover to meet the requirements of *b*(1) above. Position the counter control contact operating mechanism laterally by means of the elongated holes in the mounting ears to meet the requirements of *b*(2) above.

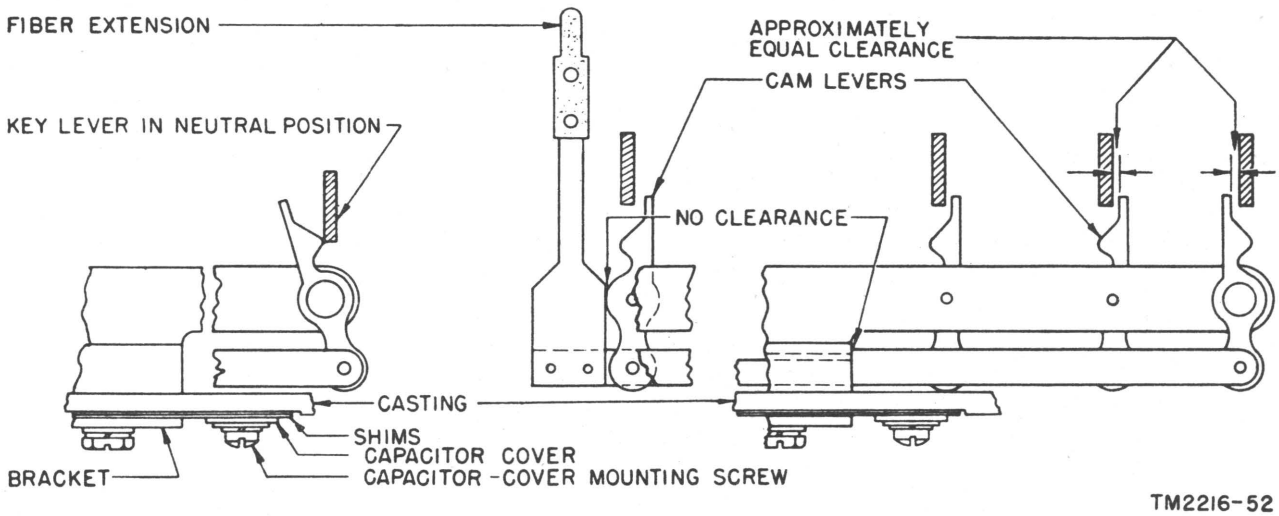


Figure 249. Counter control contact operating mechanism.

441. Counter Control Contact Assembly (fig. 250)

a. PREPARATION. Remove the contact cover by loosening its mounting nuts. The contact springs are numbered from left to right, with contact spring 3 nearest to the resistor. When measuring the spring tensions specified, apply an 8-ounce scale to the contact spring at the contact point and pull or push at right angles to the spring without power on the perforator circuit.

b. REQUIREMENTS. The requirements for this assembly are listed below with their associated adjustments (*c*(1)–(7)).

c. ADJUSTMENTS.

(1) Contact springs 1 and 2 should be approximately at right angles to the insulator pile-up in the assembly, and each contact point should have a follow of .005 to .010 inch when the other spring is moved away from it. Adjust by bending the stiffeners for contact springs 1 and 2.

(2) It should require a force of 1 to 1½ ounces to separate the contact points on contact springs 1 and 2. To adjust, bend contact spring 1 or 2 and recheck (1).

(3) The contact operating fiber extensions of the counter control contact mechanism should move freely in the guide slots, and there should be not more than .005-inch clearance between contact spring 2 and the right edge of the fiber tip, when the rear contact operating fiber extension is held to the right against the backstop. To adjust, position the counter control contact assembly by means of the elongated mounting holes in the bracket.

(4) Contact spring 3 should be held by its backstop so that when the CAR RET key lever is depressed slowly, contact spring 3 will be moved .005 to .010 inch by the action of the contact point on contact spring 2. To adjust, bend the stiffener for contact spring 3.

(5) With the CAR RET key lever depressed fully, it should require a force of three-fourths to 1 ounce applied to contact spring 3 to separate the contact points on contact springs 2 and 3. To adjust, bend contact spring 3 and recheck (4).

(6) With the contact operating fiber extensions on the counter contact operating mechanism not touching contact springs 1 and 2, there should be at least .015-inch clearance between the contact points on contact springs 2 and 3. If this clearance does not exist, refine the preceding adjustments to obtain proper clearance.

(7) When the CAR RET key lever is depressed, contact spring 2 should move toward the right and should break contact with the contact point on contact spring 1 before it makes contact with the contact point on contact spring 3. If adjustment is necessary, refine the preceding

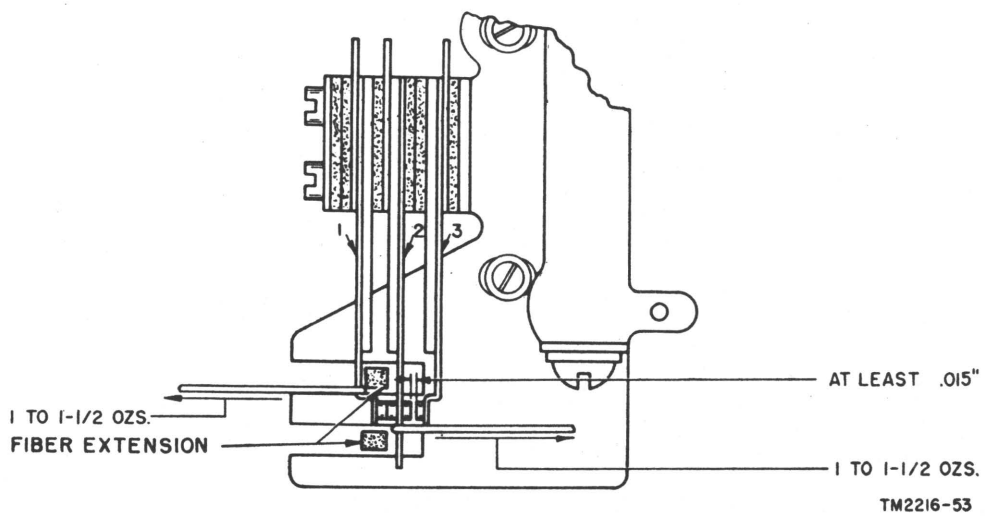


Figure 250. Counter control contact assembly.

adjustments to meet the break-before-make requirement.

Note: When replacing the contact cover, hold the mounting screws with a screw driver, and tighten the nuts to avoid loosening the contact pile-up mounting screws.

442. Counter Adjustments

Paragraphs 443 through 460 cover the adjustments of the counter unit. To facilitate making these adjustments, the counter should be removed from the perforator transmitter. To remove the counter, loosen the two screws just below the counter unit and slide the counter from its mounting bracket. Place the counter unit face down to one side of the perforator transmitter without disconnecting the wires.

443. Feed Pawl Bracket
(fig. 251)

a. PREPARATION. Same as 380 and 442 .

b. REQUIREMENT. With the counting magnet armature play taken up in an outward direction, the outer edge of the pawl should not extend more than .035 inch outside the outer surface of the ratchet. With the play taken up in the opposite direction, the outer surface of the pawl should be no more than .015 inch within the outer surface of the ratchet.

c. ADJUSTMENT. Remove the armature assembly from the unit. Set the screws which hold the bracket to the armature so that the bracket is friction-tight, and replace the armature assembly on the unit. Adjust the bracket for the correct position of the pawl, remove the armature assembly, and tighten the bracket mounting screw. Replace the armature assembly.

444. Ratchet Return Spring
(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. The ratchet should be free throughout a complete revolution in a counterclockwise direction.

c. ADJUSTMENT. Remove the dash pot carefully to permit the ratchet spring to unwind

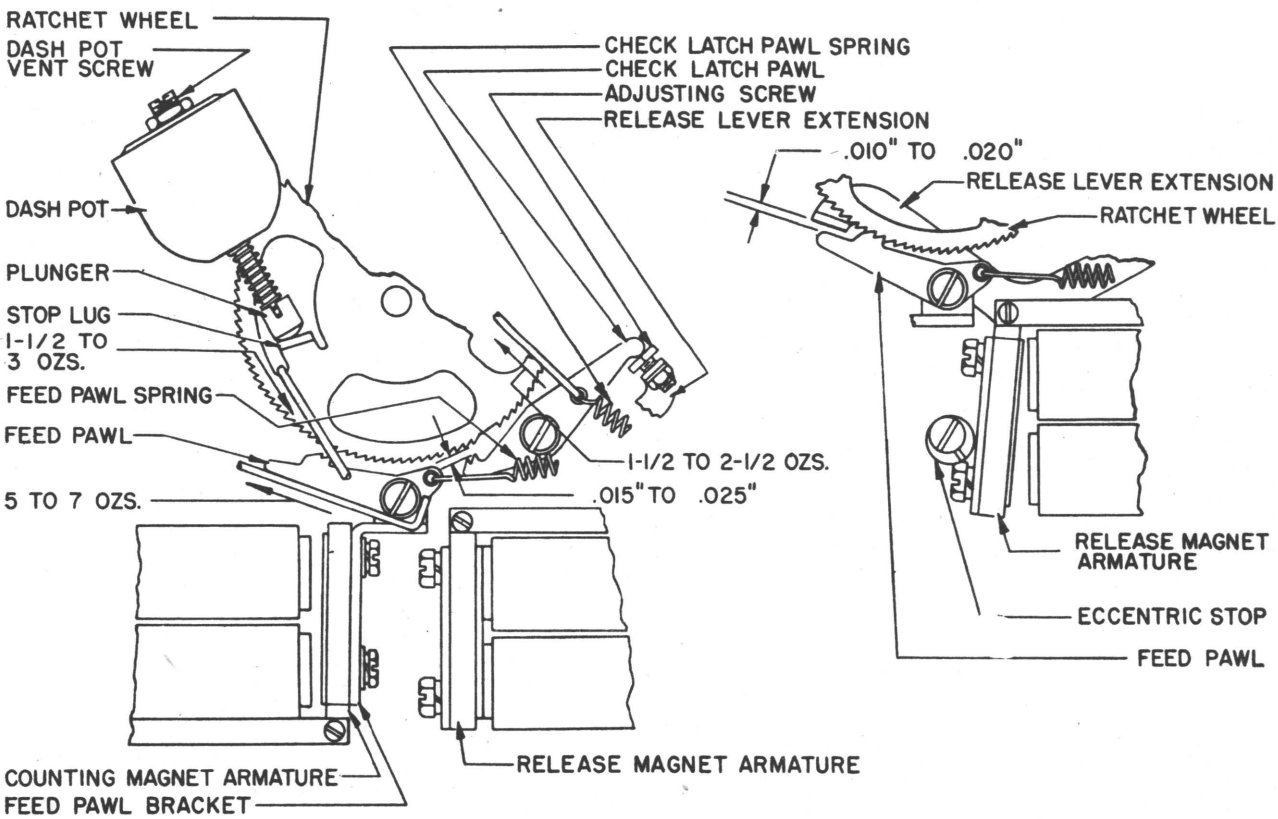


Figure 251. Counter Mechanism.

slowly and thus avoid breaking the spring. Wind the ratchet spring by turning the ratchet in a counterclockwise direction until the spring is tight. Then return the ratchet in a clockwise direction not less than one, nor more than two, complete revolutions. Position the ratchet so that the stop lug is in the approximate location of 45° in the lower left-hand quadrant as the ratchet is viewed from the rear. Engage the latch pawl to hold the ratchet in place. Replace the dash pot and position it so that the stop lug is in full engagement with the plunger throughout the stroke of the plunger.

445. Ratchet Spring Tension

(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. Operate the release magnet armature and hold the dash pot plunger depressed. Hook an 8-ounce scale over the spoke of the ratchet that carries the stop lug at the point on the spoke nearest the periphery of the ratchet and pull in a counterclockwise direction at a right angle to the radius. It should require 1½ to 3 ounces to move the stop lug away from the end of the plunger.

c. ADJUSTMENT. Replace with a new spring.

446. Release Magnet Armature Eccentric Stop

(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the feed pawl in full engagement with the teeth on the ratchet, there should be .010- to .020-inch clearance between the release lever extension and the feed pawl when the release magnet armature is against its stop.

c. ADJUSTMENT. Loosen the eccentric stop mounting screw and position the eccentric. Tighten the mounting screw.

447. Check Latch Pawl Bracket

(fig. 252)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. Back off the release lever extension adjusting screw and hold the check latch pawl in full engagement with a tooth on the ratchet. With the counting magnet armature against the magnet cores, the teeth on the feed pawl should overtravel the ratchet teeth by .008 to .020 inch.

c. ADJUSTMENT. Loosen the check latch pawl bracket mounting screws and position the bracket. Tighten the mounting screws.

448. Release Lever Extension Adjusting Screw

(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. Hold the release magnet armature in its operated position. Hold the ratchet so that the teeth on the check latch pawl are not opposite the place on the ratchet where the teeth are missing. There should be .015- to

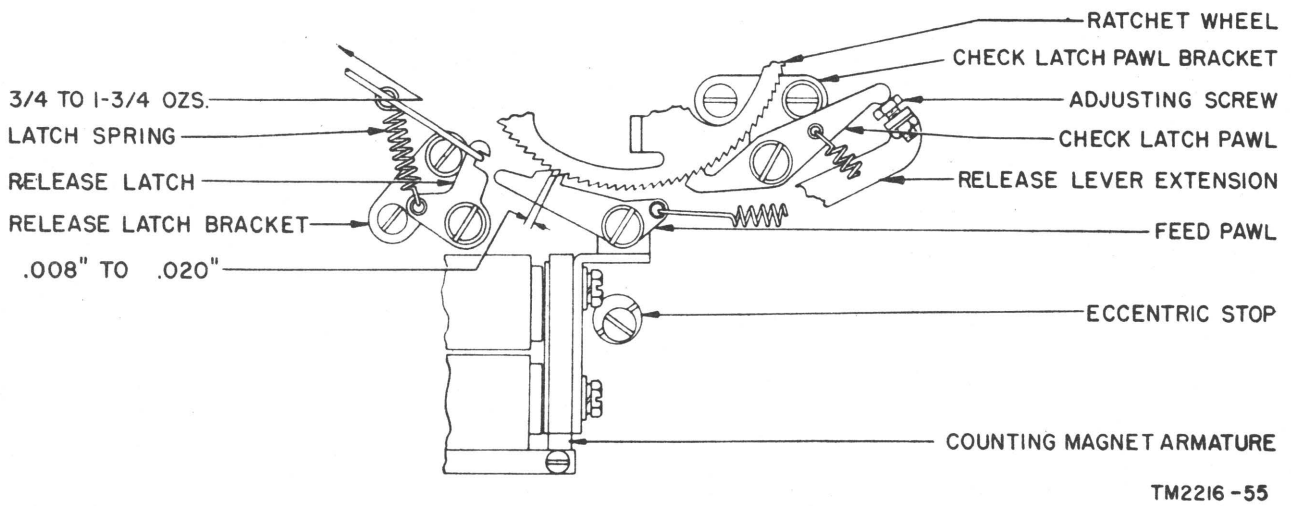


Figure 252. Check latch pawl bracket and release latch spring.

.025-inch clearance between the check latch pawl and the ratchet.

c. ADJUSTMENT. Loosen the release lever extension adjustment screw locknut and position the screw. Tighten the locknut.

449. Counting Magnet Armature Eccentric Stop
(fig. 253)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. When the counting magnet armature is operated, its feed pawl should rotate the ratchet one tooth and the check latch pawl should be in full engagement with a tooth on the ratchet. There should be an overtravel of not more than .010 inch, when the counting magnet armature is against its eccentric stop. Check this overtravel throughout a complete revolution of the ratchet.

c. ADJUSTMENT. Loosen the eccentric stop mounting screw and position the eccentric. Tighten the mounting screw.

450. Release Latch Bracket
(fig. 253)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the release magnet armature against the magnet cores, the release lever extension should overtravel the notch in the release latch by .004 to .015 inch.

c. ADJUSTMENT. Loosen the release latch bracket mounting screws and position the bracket. Tighten the screws.

451. Check Latch Pawl Spring Tension
(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the release magnet armature against the magnet cores, hook an 8-ounce scale in the spring hole of the check latch pawl and pull in line with the spring. It should require 1½ to 2½ ounces to start the pawl moving.

c. ADJUSTMENT. Replace with a new spring.

452. Release Latch Spring
(fig. 252)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the release latch in its unlatched position, hook an 8-ounce scale in the notch in the release latch and pull in a direction so that the scale wire passes over the spring post. It should require three-fourths to one and three-fourths ounces to start the latch moving.

c. ADJUSTMENT. Replace with a new spring.

453. Dash Pot Position
(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

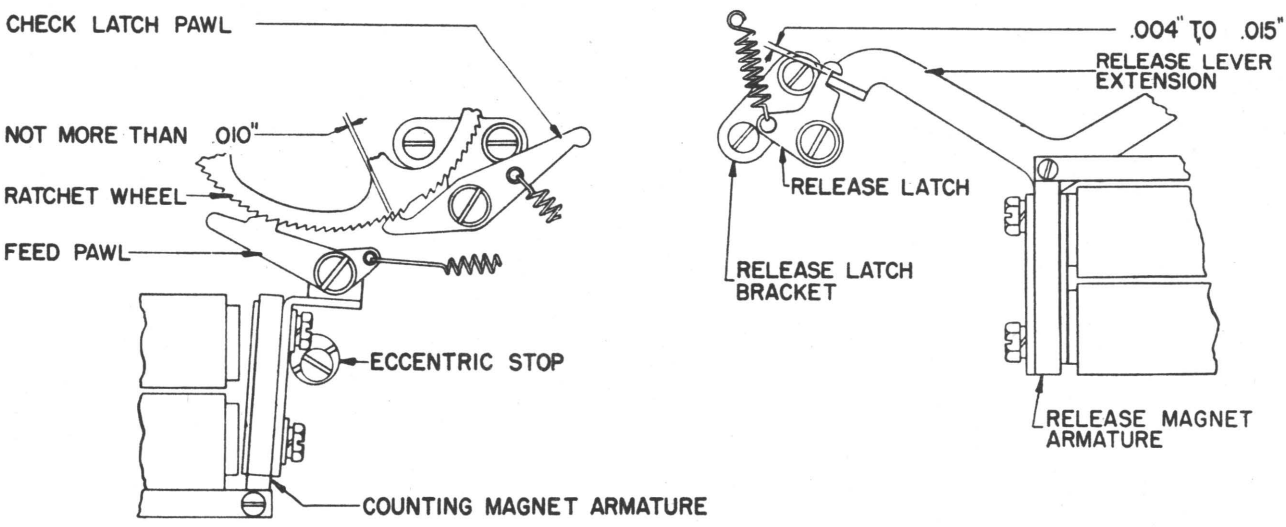


Figure 253. Counting magnet armature eccentric and release latch bracket.

b. REQUIREMENT. With the plunger depressed completely into the dash pot cylinder, the stop on the ratchet resting firmly against the end of the plunger shaft, and the check latch pawl in engagement with the ratchet, there should be some clearance, not more than .004 inch, between the engaging faces of the first tooth on the ratchet and the first (outer) tooth on the check pawl. On units which have an indicator and a scale, under the foregoing conditions, the indicator should point to zero on the scale. Also, the point of contact of the plunger against the ratchet stop lug should be at least .040 inch from the edge of the stop lug throughout the stroke of the plunger.

c. ADJUSTMENT. Loosen the dash pot mounting screws and position the dash pot. Tighten the mounting screws, then loosen the indicator set screws and position the indicator. Locate it so that the outer edge of the hub is flush with the end of the shaft before tightening the set screws.

454. Feed Pawl Springs

(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. Hold the release magnet armature against the magnet cores, hook an 8-ounce scale over the feed pawl bearing screw, and pull as nearly parallel as possible to the feed pawl. It should require 5 to 7 ounces to start the pawl moving.

c. ADJUSTMENT. Replace with a new spring.

455. Contact Bracket

(fig. 254)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the contact lever on the low part of the contact cam, there should be some clearance, not more than .015 inch, between the contact lever and the insulator.

c. ADJUSTMENT. Loosen the contact bracket mounting screws and position the bracket. Tighten the mounting screws.

456. Contact Spring

(fig. 254)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the contact operating lever on the low part of its cam, there should be .010- to .015-inch clearance between the contact points.

c. ADJUSTMENT. Bend the short contact spring stiffener. The contact spring should make contact with the stiffener throughout its length.

457. End-of-Line Indicator Contact Pressure

(fig. 254)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the contact lever on the high part of the cam, hook an 8-ounce scale over the short contact spring between the contact and the stiffener and pull at a right angle to the spring. It should require 2 to 3 ounces to separate the contacts.

c. ADJUSTMENT. Bend the short contact spring.

458. Contact Cam

(figs. 78 and 254)

a. PREPARATION. Same as paragraphs 380 and 442.

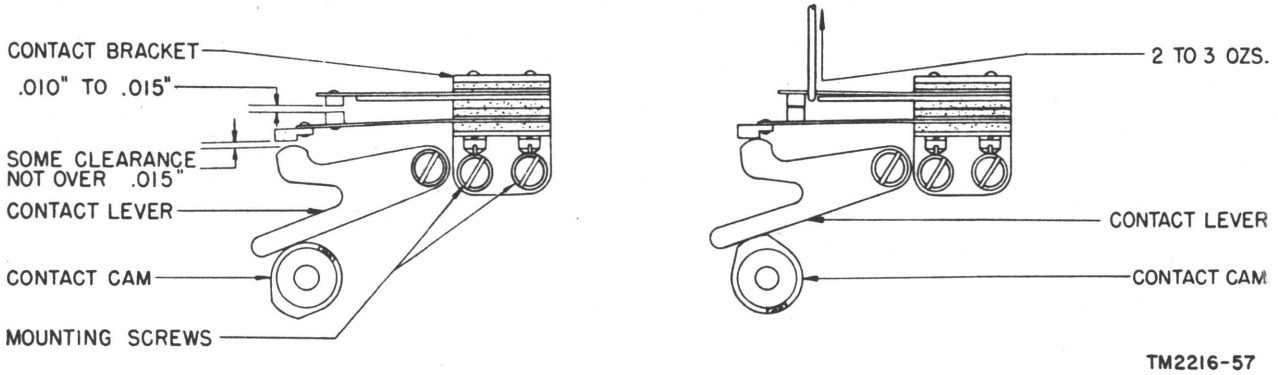


Figure 254. End-of-line indicator contact and bracket.

b. REQUIREMENT. Operate the release magnet armature and then operate the counting magnet armature 64 times. The contacts should close on the 65th operation.

c. ADJUSTMENT. Loosen the contact cam set screw and position the cam simultaneously, locating it so that the ratchet shaft has some end-play, not more than .004 inch. Tighten the set screw.

459. Dash Pot Air Vent Screw

(figs. 78 and 251)

a. PREPARATION. Connect the unit to a source of 110 volts dc (par. 422).

b. REQUIREMENT. The ratchet should return from its farthest advanced position to the zero position without bouncing. When it is returned from its eighth space, the ratchet should return quickly enough to prevent feeding of more than one tooth when a character key lever is depressed immediately after the ratchet has been released.

c. ADJUSTMENT. Loosen the dash pot vent screw locknut and position the vent screw. Tighten the locknut.

460. Dash Pot Plunger Spring Tension

(fig. 251)

a. PREPARATION. Same as paragraphs 380 and 442.

b. REQUIREMENT. With the dash pot held in a vertical position and the ratchet rotated clockwise to move the ratchet stop arm away from the plunger, apply an 8-ounce scale to the end of the plunger and push upward. It should require from ½ to 1 ounce to move the plunger all the way.

c. ADJUSTMENT. Replace with a new spring.

461. Motor Adjustments

a. GENERAL. Teletypewriter TT–7/FG or TT–8/FG may be equipped either with a series-governed motor or a synchronous motor.

(1) Tests and adjustments for series-governed motors are described in paragraphs 461 through 470.

(2) Tests and adjustments for synchronous motors are described in paragraph 471.

b. PLATE ADJUSTMENT. The motor plate adjustment described in paragraph 367 is common to both types of motors and should precede the other tests and adjustments.

c. WHEEL DISASSEMBLY. To disassemble the governor wheel assembly (fig. 258) on series-governed motors, proceed as follows:

(1) Remove the screws that hold the governor adjusting bracket to the brush spring plate bracket and to the brush spring plate, respectively. Lift off the governor adjusting bracket.

(2) Remove the screws that hold the brush spring plate to the brush spring plate bracket. Lift the governor brush assembly off the governor shell and place the brush assembly out of the way, to the right. It will be unnecessary to disconnect the leads connecting the governor brushes to the filter.

(3) Remove screws that hold the target and governor cover to the governor shell. Remove target and governor cover.

(4) Remove the screw at the back of the governor shell, and slide the governor shell and shims off the motor shaft; note the number of shims.

d. SEQUENCE OF TESTS. Experience in making tests and adjustments indicates that the most logical and efficient sequence for making tests and adjustments on the motor is the order in which the procedures are presented in paragraphs 462 through 471.

Caution: A change in any one of a chain of adjustments requires that all related adjustments be checked.

462. Governor Contact Alinement and Squareness

(fig. 255)

a. PREPARATION. Remove the governor adjusting bracket, governor brush assembly, target, governor cover, and governor shell. Place the governor shell as shown in figure 256. Unhook the speed adjusting spring. Place a small piece of white paper behind the contact to aid in viewing there.

b. REQUIREMENTS

(1) The contacts should be positioned so that the top contact is directly above the bottom contact and the edges should be in line.

(2) The bottom surface of the upper contact and the top surface of the lower contact

should be parallel when the contacts are touching (not touching on one side only).

(3) There should be a gap of .015 to .040 inch between the governor contacts.

(4) The surface of the contacts should be free of build-ups but may have small pits. Refer to section VII of this paragraph for detailed repair procedure of governor contacts.

(5) All governor contacts can be adjusted for alinement of edges; only those governor shells which provide elongated mounting holes for the fixed contact bracket permit adjustment of the contact for height by positioning the contact bracket. (Check with the retractile spring tension adjusted so that the contacts just make, or to the limit of the adjusting screw).

c. Adjustments. To position the governor contacts, proceed as follows:

(1) Loosen the two screws that hold the governor spring bracket and the two screws that hold the fixed contact bracket. These screws may be reached from the under side of the governor shell.

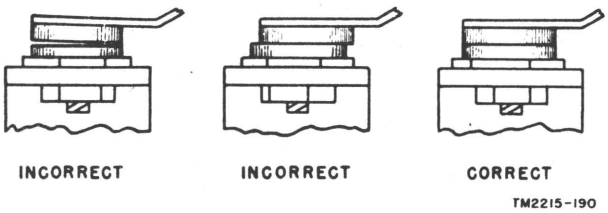


Figure 255. Governor contact alinement.

(2) Line up edges of contacts by means of the floating contact hinge mounting screw.

(3) Adjust contacts for squareness from right to left by positioning the height of the fixed contact bracket with the elongated mounting holes in the governor shell.

(4) To adjust from front to back, twist the floating contact hinge, applying pressure to the arm near the contact.

Note. Check with a .002-inch gage between the edges of the contacts to see that the gage either enters or does not enter equally on all sides.

(5) Tighten the governor spring bracket and fixed contact bracket mounting screws.

(6) To obtain the required clearance between the governor contacts, bend the governor contact spring.

Note. The end of the speed adjusting spring post should not touch the governor shell; there must be some clearance between the shell and the end of the spring post.

(7) Rehook the speed adjusting spring.

463. Governor Speed Adjusting Wheel Friction Washer

(fig. 256)

a. Preparation. To check the requirements, a preliminary adjustment must be made. Remove the target and governor cover. Hook a 32-ounce scale over the contact spring near the contact and pull in line with the speed adjusting spring. Turn the speed adjusting wheel to the right or left until

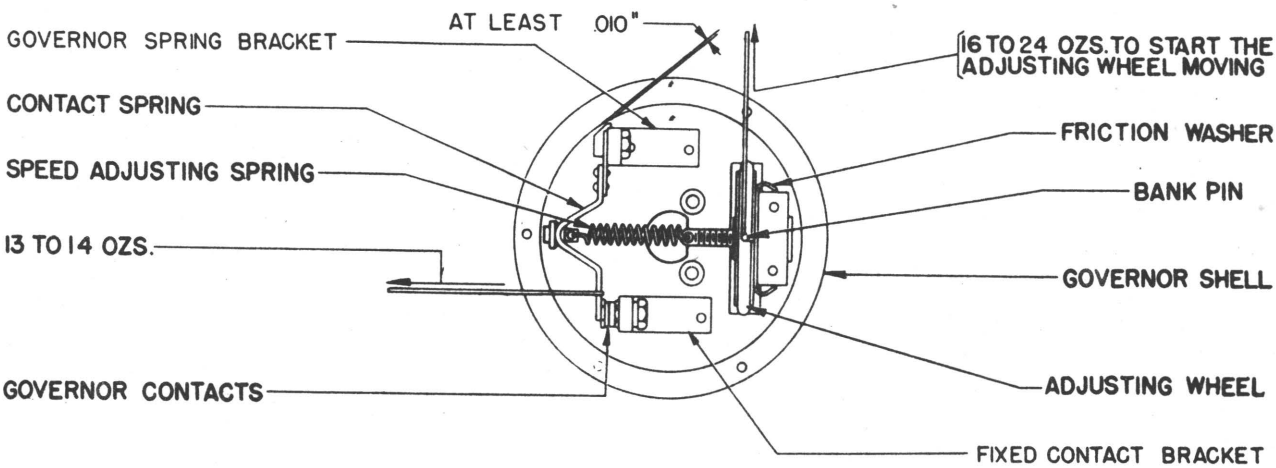


Figure 256. Governor speed adjusting wheel.

a pull of 13 to 14 ounces just separates the governor contacts.

b. Requirements. Hook a 32-ounce scale over a bank pin inserted radially in the leather of the speed adjusting wheel and pull at a right angle to the radius. A pull of 16 to 24 ounces should be required to start the wheel moving.

c. Adjustment. If the friction washer fails to meet requirements, proceed as follows:

(1) Loosen the two friction washer mounting screws on the under side of the governor shell.
(2) Lift out the adjusting wheel assembly.
(3) Separate the bearing assembly, upper from lower, and remove the friction washer.
(4) Bend the flat projections of the friction washer, as necessary to meet requirements.
(5) Replace the bearing assembly.
(6) Replace the adjusting wheel assembly in the governor shell, and fasten in place with the two friction washer mounting screws.

464. Governor Inner and Outer Disk Contact Springs

(fig. 257)

a. Preparation. Remove the governor brush spring plate, and the governor cover (fig. 258).

b. Requirements.

(1) The distance from the inner surface of the governor cover to the highest point on the contact spring should be twenty-five thirty-seconds to twenty-seven thirty-seconds inch.
(2) Place a D-socket wrench over the nut located in the center of the governor cover. Use a 6-inch scale to measure the radial distance from the vertical surface of the wrench to the point where the scale touches the curved surface of the inner disk contact spring. This distance should measure seventeen thirty-seconds to nineteen thirty-seconds inch.
(3) Measure the distance from the wrench to the point of contact on the outer disk contact spring in the same manner as described in subparagraph b (2) above. This distance should measure seven-sixteenths to one-half inch.

c. Adjustment. Bend the inner and outer disk contact springs as required. Avoid any sharp bends or the springs may break. Replace the governor cover and target.

465. Governor Brush Spring Plate Bracket

(fig. 258)

a. Preparation. Remount the brush spring plate if it was not remounted as part of the previous adjustment.

b. Requirements.

(1) A line through the center of the outer disk should pass through the center of each carbon contact brush (A, fig. 258).
(2) The surface of the brush spring plate bracket on which the brush spring plate is mounted, should be in line with the outer surface of that part of the governor cover on which the target is mounted (B, fig. 258).

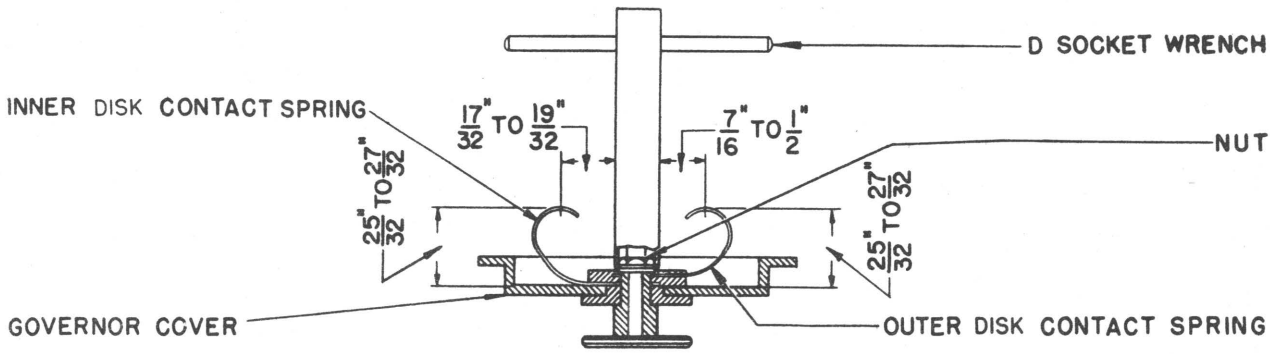


Figure 257. Governor inner and outer disk contact springs.

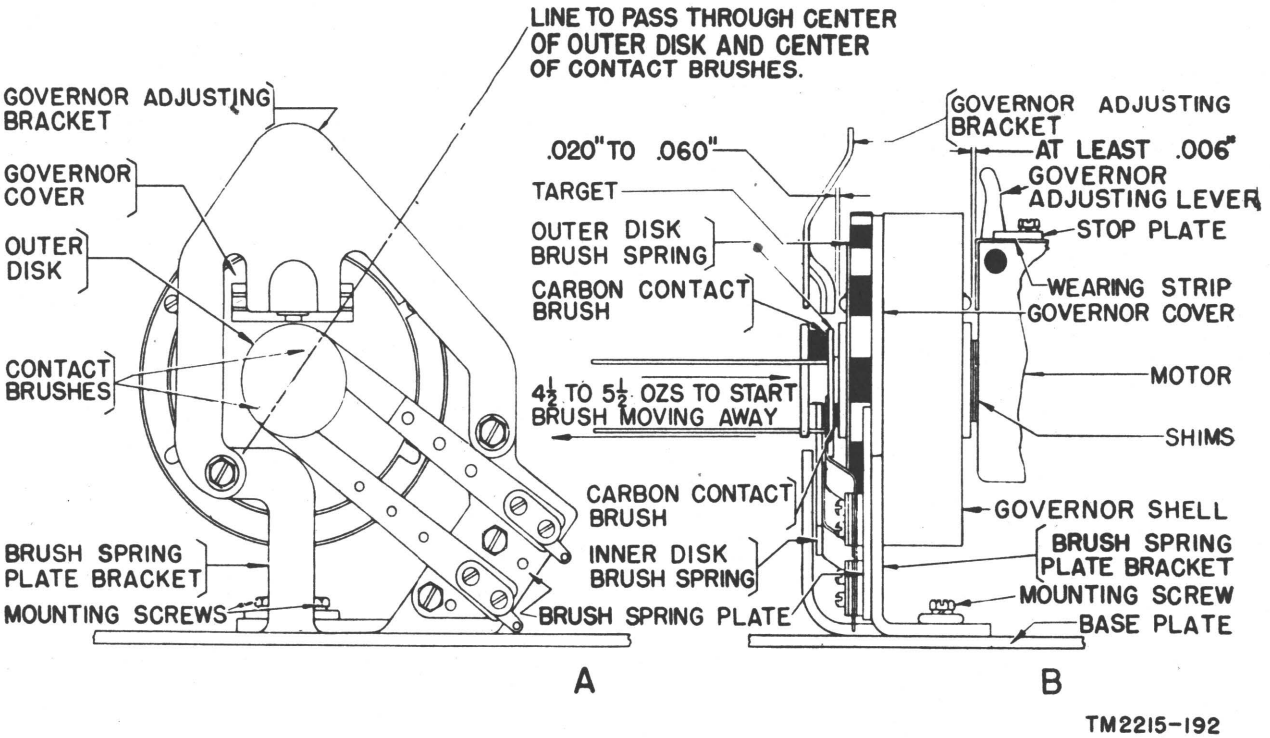


Figure 258. Governor parts and adjustments.

(3) The brush spring plate bracket should be parallel to the edge of the motor base plate.

c. ADJUSTMENT. Loosen the two brush spring plate bracket mounting screws and reposition the bracket. Tighten the mounting screws.

466. Governor Brush Spring Pressure

(B, fig. 258)

a. PREPARATION. None required.

b. REQUIREMENTS.

(1) Apply an 8-ounce scale to the brush springs near the carbon brush and push (or pull) horizontally in line with the armature shaft. A push (or pull) of 4½ to 5½ ounces should be required to start each brush moving away from its associated disk.

(2) Both carbon brushes should lie flat against their associated disks and the outer edges of the brushes should be flush with, or not more than three-sixty-fourths inch inside of, the outer edge of the disks.

c. ADJUSTMENT. Loosen the two brush spring clamping screws and slip out the brush springs. Bend the springs as necessary. Remount the springs and position properly. Tighten the clamping screws.

467. Governor Adjusting Bracket

(B, fig. 258)

a. PREPARATION. Fasten the adjusting bracket in position with its mounting screws.

b. REQUIREMENTS. The governor adjusting surface on the governor adjusting bracket should clear the speed adjusting wheel .020 to .060 inch.

c. ADJUSTMENT. To obtain the required clearance, bend the governor adjusting bracket.

468. Governor Adjusting Lever Stop Plate

(B, fig. 258)

a. PREPARATION. The shell must be fastened in place on the motor shaft.

b. REQUIREMENTS. There should be a clearance of .006 to .050 inch between the wearing strip and the governor shell when the speed adjusting lever is held against the stop plate.

c. ADJUSTMENT. Loosen the two stop plate mounting screws and reposition the stop plate. Tighten the mounting screws.

469. Governor Shims
(B, fig. 258)

a. PREPARATION. Slide the shims and governor shell on the motor shaft; fasten the shell in place with its mounting screw.

b. REQUIREMENTS. With the governor adjusting lever in its unoperated position, there should be a clearance of at least .006 inch between the wearing strip and the adjusting wheel. This condition should exist when the adjusting wheel is opposite the wearing strip and all the end play of the motor armature is taken up in a direction to make the clearance a minimum.

c. ADJUSTMENT. Increase or decrease the number of shims on the armature shaft between the governor hub and the end frame casting of the motor.

470. Motor Brushes (Governed Motor)
(fig. 259)

a. PREPARATION.

(1) Remove the filter lead screws: one on each side of the motor.

(2) Remove the brush-holder caps, which hold the motor brush springs and carbon brushes in place.

Note. When removing the brushes, note or mark the mounting location and position of each brush so that each may be replaced in the same holder and with the same side uppermost. If the brush has a number stamped on the carbon, this may be used as a guide.

b. REQUIREMENTS. The motor brushes should be free in their holders without excessive play and should be at least five-eighths inch long, not including the brush spring or the spring mounting extension. At least one-third of the area of the ends of the brushes should be in contact with the commutator.

c. ADJUSTMENTS.

(1) Replace excessively worn or damaged brushes with new brushes.

(2) If brush springs are weak, replace the brush springs with new springs.

(3) Resurface the ends of the carbon brushes; use fine sandpaper. (Refer to paragraph 164 for one method that may be used.)

d. ASSEMBLY.

(1) Replace the brush-holder caps.

Caution: The cable attaching the brush to the brush-holder cap may tend to wind up, thus shortening itself. When replacing the brush, be sure that the cable on the brush is not wound up but is extended to its greatest limit.

(2) Replace the filter lead screws.

471. Synchronous Motor Adjustments
(fig. 260)

a. PREPARATION. Remove motor from base.

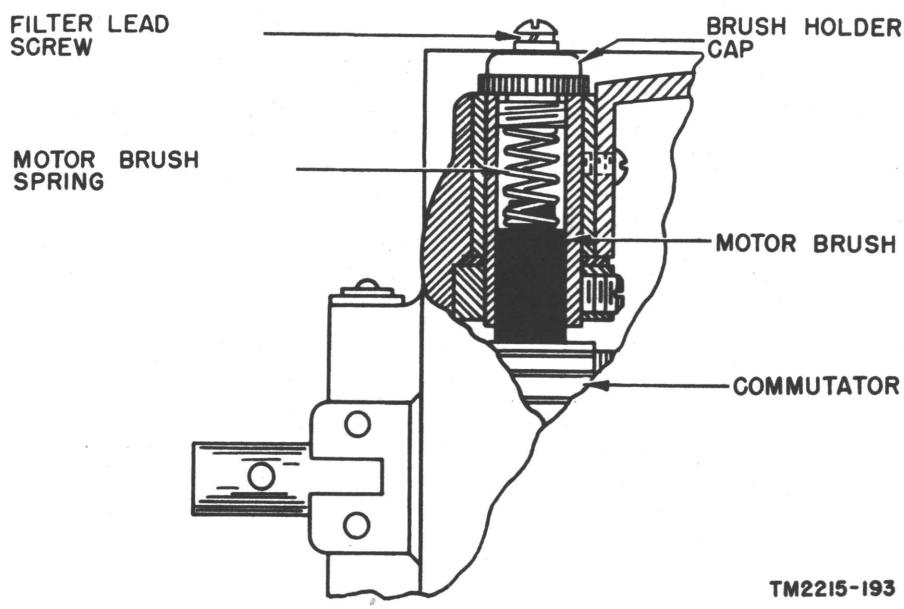


Figure 259. Governed motor brushes.

b. REQUIREMENTS. On synchronous motors with a three-brush starting switch, the switch should meet the following requirements:

Note. These requirements should not be checked unless there is reason to believe the starting switch is out of adjustment.

(1) Remove the motor unit from the base and remove the motor fan and pinion.
(2) Remove the switch end shield screws and the switch commutator mounting screws. Remove the switch and shield.
(3) Pull out the rotor until the brush-holder spring is accessible and remove the spring.
(4) The tension of the spring for 60-cycle motors should measure 3 to 3¾ ounces when extended to a length of 5 inches, using an 8-ounce scale. The tension of the spring for 50-cycle motors should measure 1½ to 2½ ounces when extended to a length of 5 inches, using an 8-ounce scale.
(5) The brush holders should be mounted by means of the center set of mounting holes and should be free.
(6) The brush-holder stop pins should be safely within the holes of the fiber disk when all the play in the brush holders has been taken up to make the engagement of the pins with the disk a minimum.
(7) Replace the brush-holder spring; be certain that the spring eyes are engaged fully with each other.
(8) Replace the switch commutator screws and tighten the two screws alternately a little at a time until both screws are tight.

c. ADJUSTMENT. Replace worn or damaged parts. Refer to paragraphs 155 through 197.

472. Motor Unit Slip Connector Springs (fig. 54)

a. PREPARATION. Remove the typing unit from the base.

b. REQUIREMENTS.

(1) With the motor unit in position on the base, hook a 12-pound scale under one of the motor unit slip connector end springs, just above the head of the terminal screw on the motor connection block. Pull

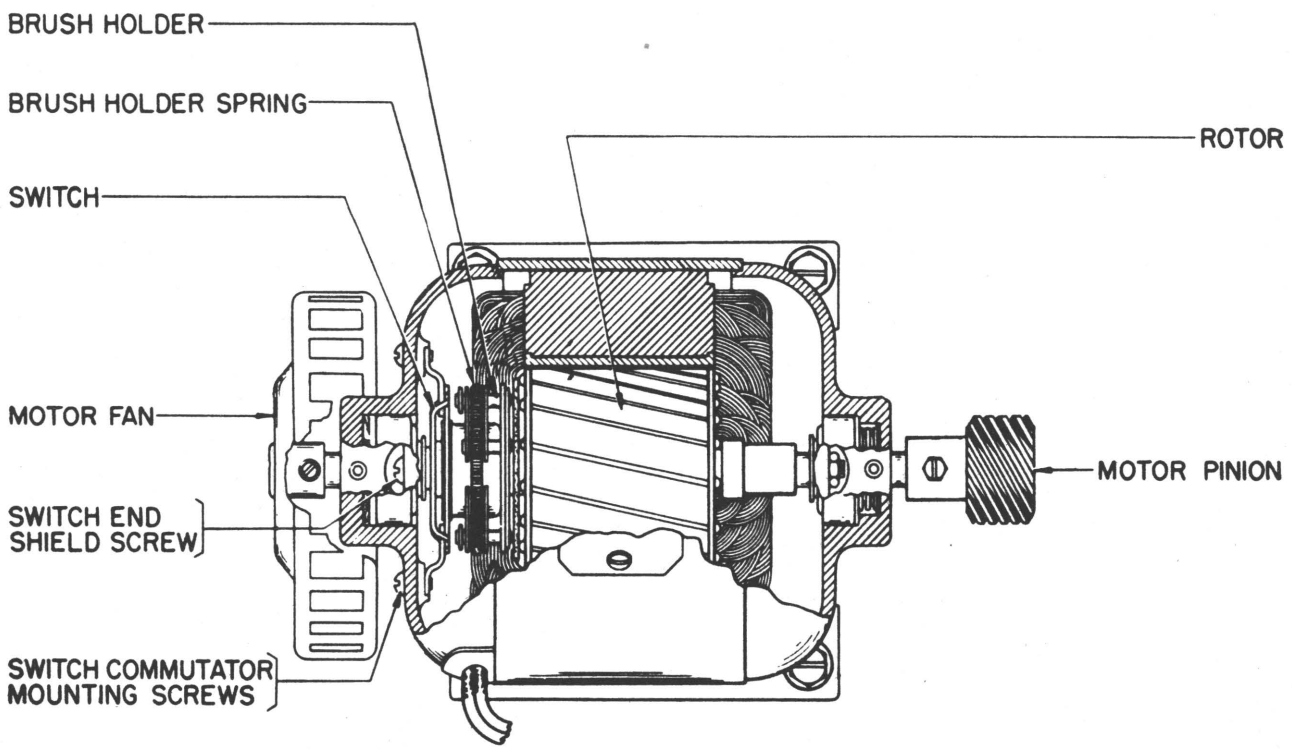


Figure 260. Synchronous motor.

toward the front of the base at a right angle to the spring. A pull of 2 to 4 pounds should be required to separate the contacts. Measure the pressure of the opposite end slip connection spring in the same manner.

(2) With the motor unit removed, place a straightedge across the two end springs. There should be some clearance, but not more than .015 inch, between the two inner springs and the straightedge.

c. ADJUSTMENT. Remove the motor unit from the base and bend the two inner springs.

473. Line Jack Springs

(fig. 54)

a. PREPARATION. Remove the typing unit and the keyboard from the base.

b. REQUIREMENTS.

(1) Apply the push end of a 12-pound scale to the curved part of the jack spring. A pressure of 1 to 2 pounds should be required to open the contacts.

(2) Place the typing unit in position on the base. The line jack contact should be separated .020 to .060 inch.

c. ADJUSTMENT. Remove the typing unit from the base and bend the long contact spring.

474. Keyboard Jack Springs

(fig. 54)

a. PREPARATION. Remove the typing unit and keyboard from the base.

b. REQUIREMENTS.

(1) The two keyboard jack springs are contacts 51 and 54 (from left to right, with respect to the front of the teletypewriter, the first and fourth of the keyboard slip connection springs). Hook a 12-pound scale under the curved portion of contacts 51 and 54, in turn, and pull vertically upward. It should require a 1- to 2-pound pressure on the curved part of the keyboard jack spring to open the contact.

(2) Insert the keyboard in the base. The keyboard jack springs should be separated .025 to .075 inch. Measure this clearance by inserting a wire gage between the contact jack springs.

(3) All keyboard slip connection springs should be in line.

c. ADJUSTMENTS. If the keyboard jack springs fail to meet requirements, and the springs must be adjusted, remove the bakelite sheet which covers them. Because the screws holding the bakelite cover can be removed only from the under side of the equipment, first remove the base plate. Upend the teletypewriter base and remove the four base plate mounting screws from the under side of the base; then remove the base plate. With the teletypewriter base upended, remove the four screws that hold the slip connection mounting plate assembly; remove the bakelite cover and then replace the four slip connection mounting plate assembly screws.

(1) Measure the pressure of contacts 51 and 54. To obtain the proper spring tension (*b*(1) above), bend the longer of the two jack springs.

(2) Insert the keyboard in the base. Measure the spring clearance from above the base by inserting a wire gage between the contact jack springs. With the bakelite cover removed, the keyboard jack springs should be separated .005 to .025 inch. To obtain the proper contact gap, bend the shorter of the two jack springs.

(3) Remove the keyboard from the base and lay a straightedge across the two keyboard jack springs. Aline the other slip connection contact springs, by bending, so that they just touch the straightedge.

(4) Upend the teletypewriter base, remove the four slip connection mounting plate screws, insert the bakelite cover in its original position, and replace the slip connection mounting plate screws. Install the base plate on the base.

475. Typing Unit Slip Connection Springs

(fig. 54)

a. PREPARATION. Remove the typing unit from the base.

b. REQUIREMENTS. Hold a straightedge flush against the left rear milled surface on the base and extend the straightedge over the typing unit slip connections. There should be a 7/8-inch clearance (plus or minus one sixty-fourth inch) between the straightedge and the top of the curved part of the springs.

c. ADJUSTMENT. Bend the slip connection springs to obtain the necessary clearance.

476. Polar Relay RY–30
(fig. 261)

a. Efficient operation of the RY–30 relay in the teletypewriter circuits depends on a periodical routine of inspection, cleaning, and adjustment. The adjustments are interrelated so that it is important that each adjustment be made in the sequence given below. If an adjustment is changed, check all subsequent adjustments.

(1) Remove the relay cover and blow out any accumulated dust. Wipe the relay and cover with a clean soft cloth.

(2) Loosen both knurled tension knobs and back off both pole piece screws as far as possible. Back off both contact screws.

(3) Pits and build-ups on the contacts should be removed with a contact file. When an armature contact is being cleaned, the armature should be supported at its mid-position against the opposite contact screw to avoid bending the armature or the contact springs. Be careful when filing the armature contacts; use a light pressure. After using the file, blow out any loose particles and polish the contacts with a burnisher.

(4) Remove particles adhering to the armature or pole piece screws by pressing a fresh piece of friction tape, wrapped around a piece of thin stiff nonmagnetic metal, against the particles. Do not rub the tape against the armature or pole piece screws because this will leave a residue which will collect further particles.

(5) Make sure that pole piece screws and relay terminals are clean.

b. Adjustments of the relay are covered in paragraphs 477 through 480.

477. Armature
(fig. 261)

a. Requirements. The armature should not touch the inside of the spool and the contacts should aline so that the centers of the contacts will not be out of alinement by more than 25 percent of the contact diameter.

b. Adjustments. Loosen the screws that hold the spool heads to the relay frame and position the spool to meet the first requirement. Tighten the screws. Loosen the armature clamping screws and position the armature both vertically and

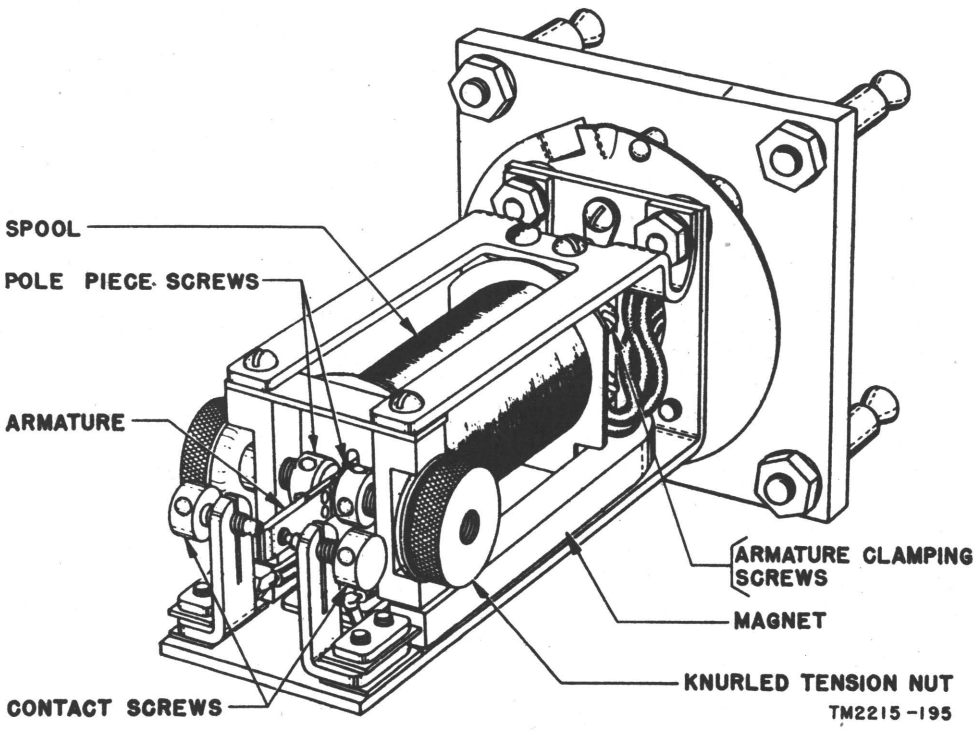


Figure 261. Polar line relay RY–30.

horizontally to meet the second requirement. Tighten the screws.

Note. If necessary, position the contact screw brackets by moving them in the enlarged holes in the relay frame to aid in meeting the latter requirement.

478. Armature Contact Spring Alinement
(fig. 261)

a. REQUIREMENTS. The armature contact springs should be parallel to the armature. The tips of the armature contact springs should rest against each other, approximately flat across their width, with a pressure of three-fourths to one and three-fourths ounces measured on one spring at the contact with the other spring held so that it cannot follow its mate. If necessary, back off the contact screws.

b. ADJUSTMENTS. Bend the spring toward or away from the other contact spring, as required, and as close as practicable to the point where it is riveted to the armature. Reset the contact screws.

479. Contact Screws
(fig. 261)

a. REQUIREMENTS. The clearance between the armature in its normal unoperated position and either contact screw should be approximately equal and, when the armature is held against one contact screw, there should be a .003- to .005-inch clearance between the armature and the other contact screw.

b. ADJUSTMENTS. Back off the pole piece screws as far as possible and position the contact screws to meet this requirement.

Note. The contact screws should be sufficiently tight in their brackets to hold any adjusted position. If necessary, remove a contact screw from a bracket and force the two portions of the split end of the bracket closer together to meet this requirement.

480. Pole Piece Screws
(fig. 261)

a. REQUIREMENTS.

(1) When the armature is held first against one contact screw and then against the other, the armature stop pins should not touch the pole piece screws.

(2) The armature should be centered in the magnetic field between the pole piece screws; the armature should either float in the gap between the contact screws or it should stay against either contact with approximately the same pressure as when it is moved there by hand.

b. ADJUSTMENTS.

(1) Back off both pole piece screws and check the contact screw adjustment. Readjust it if necessary.

(2) Advance the right pole piece screw until, with its locknut tight, the right pole piece screw pushes the armature far enough to touch the left-hand contact screw. Back off the right pole piece screw approximately one-fourth turn from this position until the requirement described in *a*(1) above is met. Tighten the locknut.

(3) Advance the left pole piece screw until the requirement described in *a*(2) above is met. Tighten the locknut. If this disturbs the adjustment, reposition the left pole piece screw and retighten the locknut to meet the requirement.

Note. When adjusting pole piece screws on RY–30 relays, the knurled tension nut should be sufficiently tight to hold the pole piece screws in the adjusted position.

481. Relay Jack Contact Gaps and Springs

a. CONTACT GAPS.

(1) *Preparation.* None required.

(2) *Requirements.*

(*a*) When the jack plunger is held flush with the relay connection block mounting plate, there should be a gap of .010 to .015 inch between the contact points of contact springs 3 and 4.

(*b*) When the jack plunger is held flush with the relay connection block mounting plate there should be a .020- to .025-inch clearance between the contact points of contact springs 1 and 2.

(3) *Adjustments.*

(*a*) Bend contact spring 3 to meet the requirements described in (2) (*a*) above.

(*b*) Bend contact spring 2 to meet the requirements described in (2) (*b*) above.

b. CONTACT SPRINGS (A, fig. 262).

(1) *Preparation.* None required.

(2) *Requirements.* When an 8-ounce scale is hooked to contact springs 1 or 4 at right angles to the springs, it should require a pull of 5 to 7 ounces to separate the

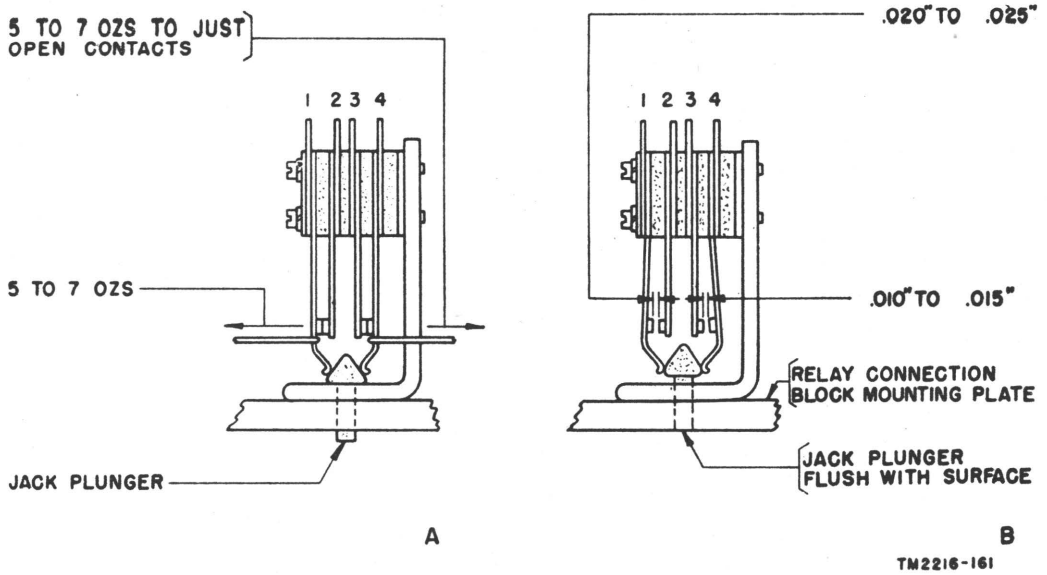


Figure 262. Relay jack contact springs and gaps.

contact points of springs 1 and 2 or of contact springs 3 and 4, respectively.

(3) *Adjustment.* Bend contact springs 1 and 4.

482. Motor Control Relay Adjustments

(fig. 263)

a. For break operation, adjust the control relay to meet the following requirements:

(1) With the relay plunger held operated, there should be a .005- to .015-inch clearance between the contact surfaces of the outer and middle contact springs. Adjust by bending the outer contact spring.

(2) With the plunger held operated, there should be a .025- to .030-inch clearance between the contact surfaces of the inner and middle contact springs. Adjust by bending the inner contact spring.

(3) When an 8-ounce scale is hooked over the middle contact spring at the side of the contact and pulled horizontally at a right angle to the contact spring, it should require 5 to 6 ounces to cause the middle contact spring to break contact with the inner contact spring. Adjust by bending the middle contact spring.

(4) Recheck the clearance given in (2) above.

b. For make operation adjust the control relay to meet the following requirements:

(1) Hold the relay plunger operated and hook a 32-ounce scale over the end of the outer contact spring and pull horizontally at a right angle to the contact spring. It should require 12 to 16 ounces to cause the outer contact spring to break contact with the middle contact spring. Adjust by bending the outer contact spring.

(2) With the relay plunger held operated, there should be a .030- to .040-inch clearance between the contact surfaces of the inner and middle contact springs. Adjust by bending the inner contact spring.

(3) Hook an 8-ounce scale over the middle contact spring at the side of the contact and pull horizontally at a right angle to the contact spring. It should require 1½ to 2 ounces to cause the middle contact spring to break contact with the inner contact spring. Adjust by bending the middle contact spring.

(4) Recheck the clearance given in (2) above. The operating current for the control relay should be between 50 and 60 ma when adjusted for either make or break operation.

483. Send-Receive Stop Lever Plate

(A, fig. 264)

a. PREPARATION. Remove the typing unit from the base.

b. REQUIREMENTS. Hold the left end of the upper contact lever up against the stop lug on

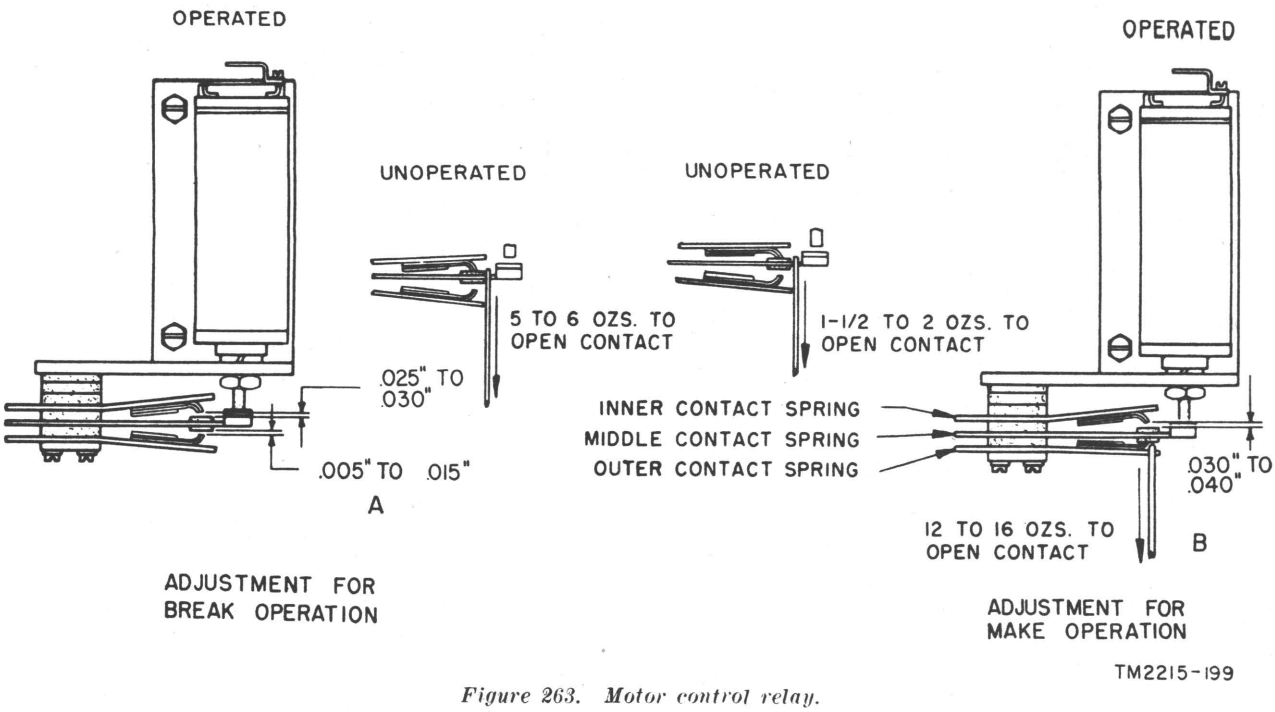


Figure 263. Motor control relay.

the send-receive stop lever plate. There should be a .004- to .015-inch clearance between the shoulder in the notch in the upper contact lever and the top of the lower contact lever.

c. Adjustment. Position the send-receive stop lever plate with the mounting screw.

484. Break Lever Adjusting Plate

(B, fig. 264)

a. Preparation. The typing unit is removed from the base.

b. Requirements. There should be some clear-

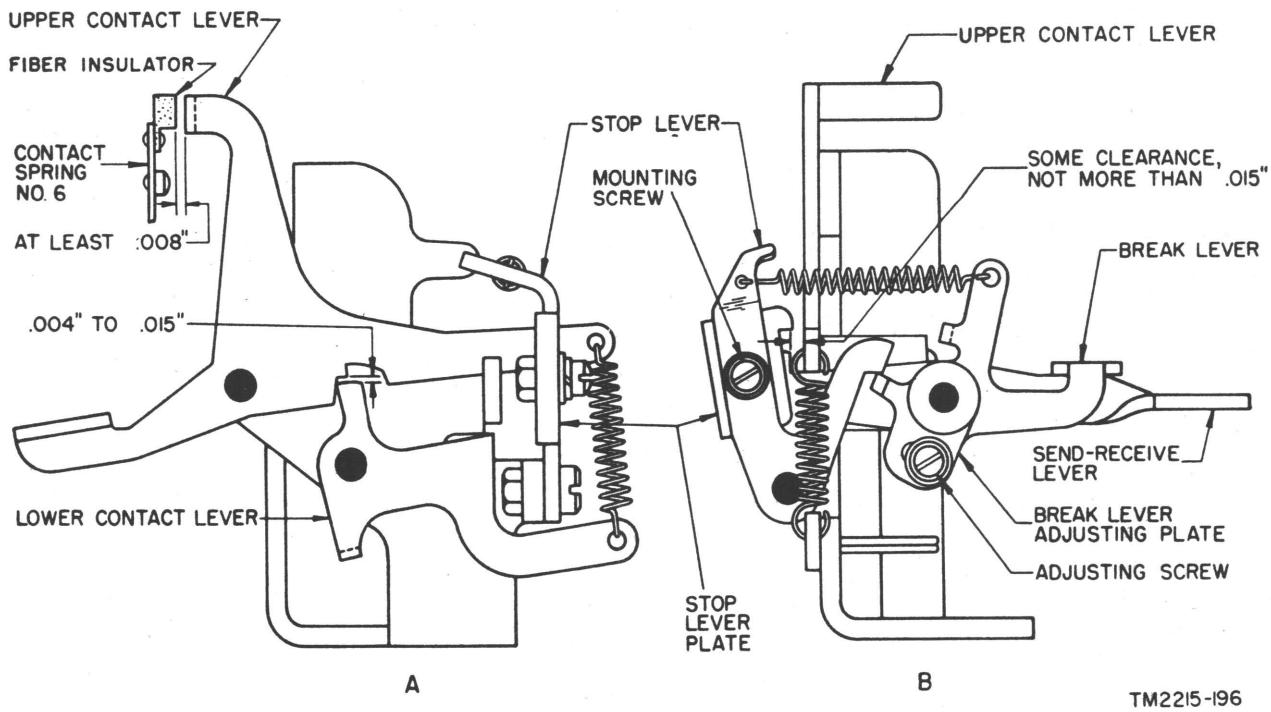


Figure 264. Stop lever plate.

ance, not more than .015 inch, between the rear upper corner of the beveled edge on the left end of the upper contact lever and lower front edge of the stop lug on the send-receive stop lever plate, when the break lever is operated slowly by hand until the two edges are just opposite each other.

c. ADJUSTMENT. Position the break lever adjusting plate with the adjusting screw.

485. Stop Lug

(A, fig. 265)

a. PREPARATION. The typing unit is removed from the base.

b. REQUIREMENTS. When the send-receive stop lever is in its unoperated position, the upper extension of the stop lever should rest against the stop lug on the mounting bracket; there should be some clearance, not more than .030 inch, between the rear side of the upper contact lever and the front edge of the send-receive stop lever plate.

c. ADJUSTMENT. Bend the stop lug on the mounting bracket.

486. Upper Contact Lever Spring Tension

(B, fig. 266)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Place the SEND-REC lever in the SEND (up) position and hold contact spring 3 away from the extension on the upper contact lever. Hook an 8-ounce scale under the left end of the upper contact lever at the spring hold and pull up vertically, in line with the spring. It should require 3 to 5 ounces to start the upper contact lever moving.

c. ADJUSTMENT. If the upper contact lever spring fails to meet requirements, replace it with a new spring.

487. Stop Lever Spring Tension

(A, fig. 265)

a. PREPARATION. The typing unit may be on or off the base.

b. REQUIREMENTS. Operate the stop lever so that it rests against the stop lug on the mounting bracket. Hook an 8-ounce scale in the spring mounting hole in the stop lever and pull in line with the spring. It should require 1 to 2 ounces to start the stop lever moving.

c. ADJUSTMENT. If the stop lever spring fails to meet requirements, install a new spring.

488. Send-Receive-Break Contact Springs

(figs. 265 and 266)

a. PREPARATION. None required.

b. REQUIREMENTS AND ADJUSTMENTS.

(1) Viewing the base from the front, the send-receive-break contact springs are

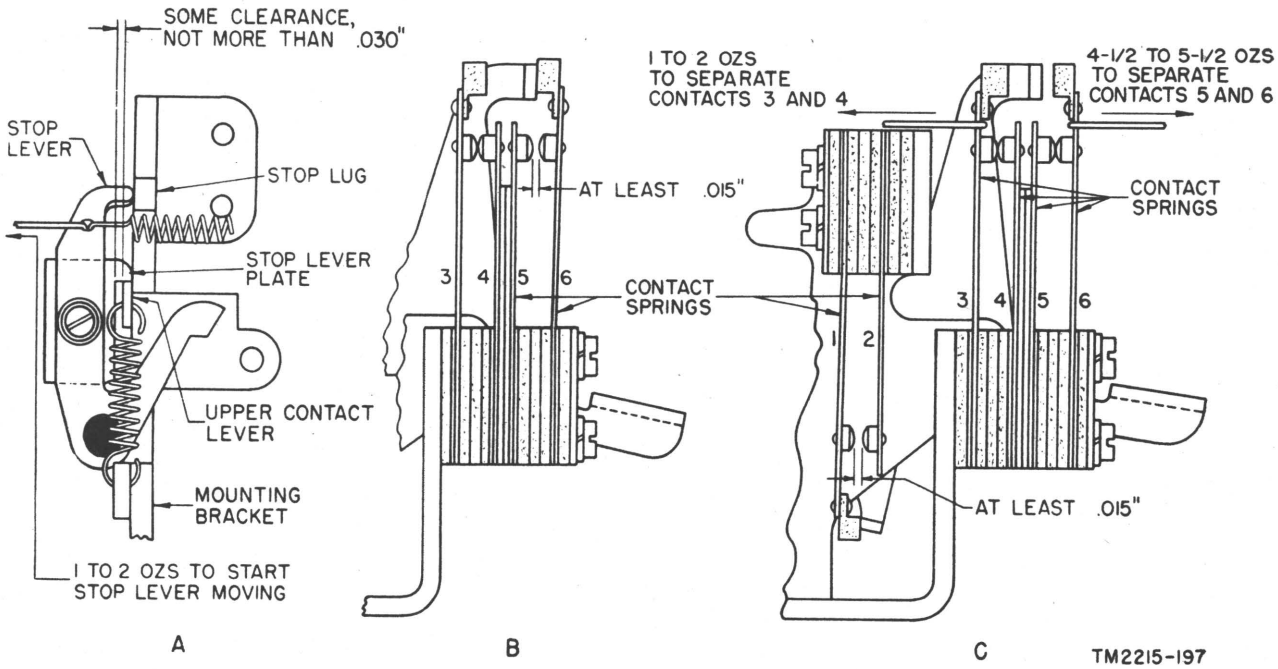


Figure 265. Stop lug.

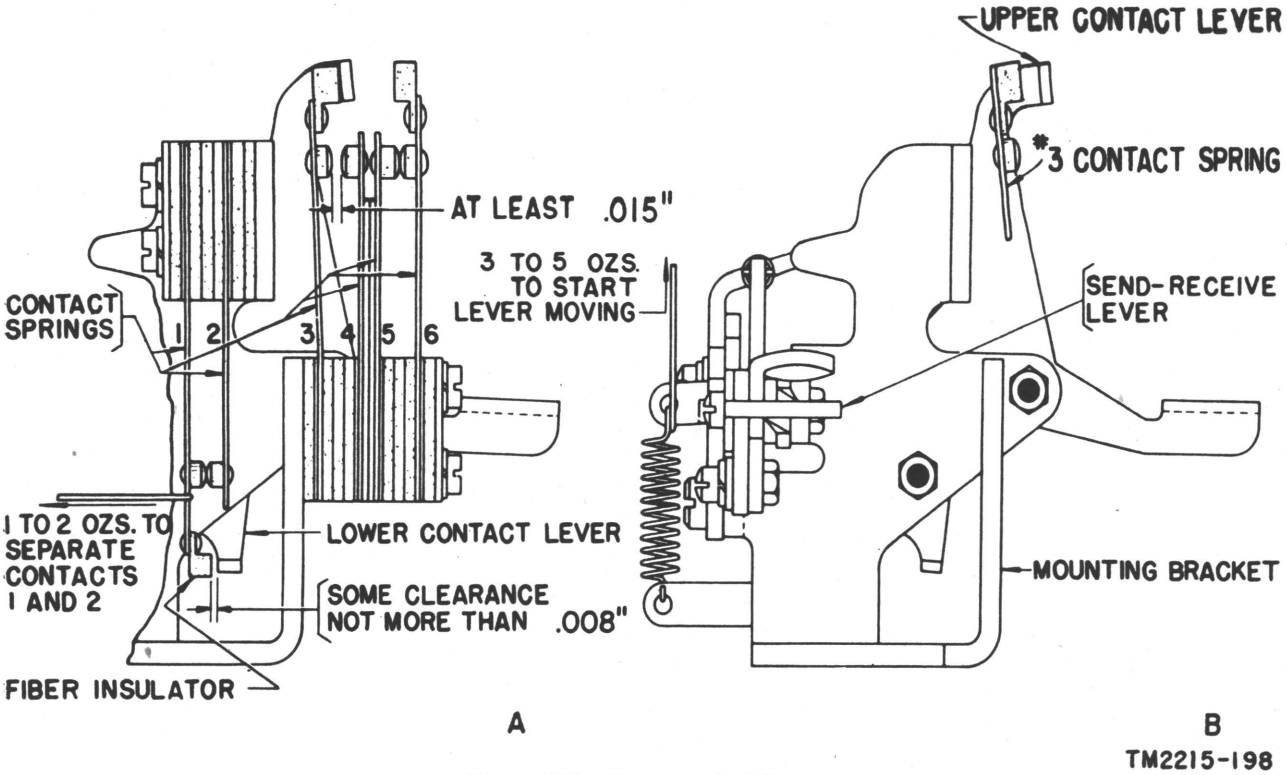


Figure 266. Upper contact lever.

numbered 1, 2, 3, 4, 5, and 6 from left to right.

(2) Move the SEND—REC lever to the SEND position (up).

(*a*) All contact springs and points should be in line.

(*b*) There should be some clearance, not more than .008 inch, between the fiber insulator on the lower end of contact spring 1 and the extension on the lower contact lever to the right of it. When checking this clearance, hold the lower contact lever firmly against its top. Adjust by bending contact spring 2.

(*c*) Contact 1 should exert a pressure against contact 2. Hook an 8-ounce scale around contact spring 1, just below the contact point, and pull horizontally toward the left. It should require 1 to 2 ounces to separate contacts 1 and 2. Adjust by bending contact spring 1. Recheck the clearance given in (*b*) above.

(*d*) All the clearance requirements pertaining to contact springs 3 through 6, inclusive, given in the following paragraphs usually will be met if these three preliminary requirements are met:

1. The stiffeners for contact springs 4 and 5 should be straight.

2. Contact springs 4 and 5 should rest against their respective stiffeners with perceptible tension. There should be no gaps between the ends of the stiffeners and the contact springs when the contacts are open. However, a gap of not more than .004 inch will be permissible at any other point.

3. With the SEND—REC lever in the REC position (down), the extension on the upper contact lever should be approximately midway between imaginary lines extending up from contact springs 4 and 5. If necessary, bend the extension on which the double contact springs are mounted to meet this requirement. It will be permissible to vary this requirement, if necessary, in cases where the clearance requirements given in the subparagraphs below cannot be met.

(*e*) With the SEND—REC lever in the SEND position (up), there should be a clearance of at least .015 inch be-

tween contacts 3 and 4. If it is necessary to adjust it, refer to (*d*) above.

(*f*) Move the SEND—REC lever to the REC position (down) and make sure that contacts 3 and 4 close.

(*g*) There should be at least a .015 inch clearance between contacts 1 and 2. Adjust by bending contact spring 2. Recheck the clearance given in (*b*) above and refer to C, figure 265.

(*h*) Contact 3 should exert a pressure against contact 4. Hook an 8-ounce scale around contact spring 3, just above the contact point, and pull horizontally toward the left. It should require 1 to 2 ounces to separate contacts 3 and 4. Adjust by bending contact spring 3. Recheck the clearance given in (*e*) above and refer to C, figure 265.

(*i*) With the left end of the upper contact lever held against the stop lug on the stop lever plate, there should be at least a .008-inch clearance between the fiber insulator on contact spring 6 and the extension on the upper contact lever. Be sure that contacts 5 and 6 are separated by at least .015 inch when the break lever is operated.

(*j*) Contact 6 should exert a pressure against contact 5. Hook an 8-ounce scale around contact spring 6, just above the contact point, and pull horizontally toward the right. It should require 4½ to 5½ ounces to separate contacts 5 and 6. Adjust by bending contact spring No. 6 (C, fig. 265).

489. Table

(figs. 28, 30, 274, and 275)

a. Preparation. Remove the covers from the electrical service assembly at the back of the table.

b. Requirements. Wiring must comply with the actual wiring diagram (fig. 275). With the rectifier properly adjusted, the local test (dummy) loop circuit containing resistor R602 must have a steady current of 60 ma when a meter is inserted in series with this circuit at jack J608 or J609 or at any terminal point in the circuit. All jacks, spring contacts, and slip or switch contacts must be clean and make good contact under tension. All connections and terminal screws should be clean, tight, and free of excess solder.

c. Adjustments. Move the slider on the 2,500-ohm slide-wire resistor R602 until a correct test loop reading of 60 ma is obtained on the meter. To adjust contacting surfaces, clean with compressed air, burnish or file contacts, bend springs, and replace as required.

490. Rectifier REC–30

(figs. 28, 267, and 272)

Operate the power switch to the OFF position and open the hinged door of the cover. The secondary voltage of the transformer is 400 volts. Do not make any adjustments or change any tubes while the unit is in operation.

a. To adjust for a-c input voltage, connect the flexible lead on the left-hand and top side of the panel to the terminal with the marking which most nearly corresponds to the voltage of the available a-c supply.

b. To adjust for frequency, connect the flexible lead on the right-hand side of the control panel to the terminal having a marking which most nearly corresponds to the frequency of the available a-c supply.

c. To adjust the d-c output voltage, connect a 60-watt, 115-volt Mazda lamp in series with a suitable ammeter across the d-c output of the rectifier and adjust the potentiometer with the screw driver slot located in the center of the tap panel until the ammeter reads .5 ampere.

(1) The rectifier must be connected to the a-c current supply for approximately 20 seconds before d-c output is available. This time delay is necessary for the protection of the grid-controlled rectifier tubes. Check this adjustment when the unit is installed; check periodically thereafter.

(2) The time delay may be adjusted with the adjusting screw and locknut located on the tie bar between the two bimetal strips.

(3) The time-delay relay is located under a metal cover at the top of the door opening. The cover is removed by loosening one screw and sliding the cover off to the right.

(4) Adjust the time-delay switch contacts by bending so that the d-c output from the tubes is available before the a-c output from the autotransformer.

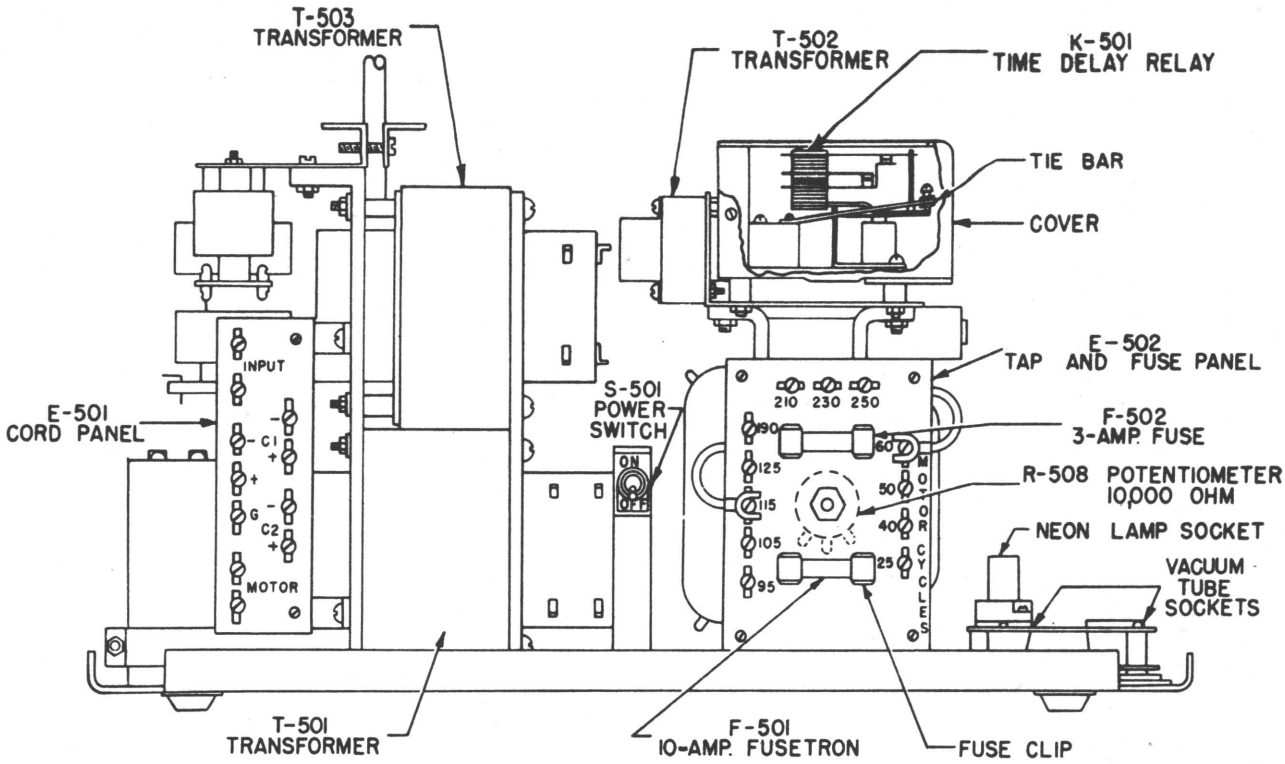


Figure 267. REC–30 rectifier taps.

Section X. REFINISHING

491. Cleaning

a. First clean the surface to be painted. Use solvent (SD) to soften, and sandpaper to clean rust spots and metal surfaces that are corroded.

Caution: Do not use steel wool. Minute particles of steel wool frequently adhere to inner surfaces and enter the internal mechanism of the equipment, which cause shorts or grounds of electrical circuits.

b. Use only the type of paint authorized by existing regulations.

c. Refer to paragraph 47 for weatherproofing instructions after repairs.

492. Painting

When a touch-up job is required on painted surfaces of the teletypewriter, apply paint with a small brush. When extensive damage to the painted surface warrants complete repainting of the item, do the work where there is no possibility of damaging any of the mechanisms of the teletypewriter.

Section XI. DIAGRAMS

493. Schematic and Wiring Diagrams

Figures 268 through 276 are schematic and wiring diagrams for Teletypewriters TT–7/FG and TT–8/FG. Reference to these diagrams will aid in tracing the various over-all circuits and in locating the different circuit elements.

494. Application of Diagrams

Figures 268 through 276 apply equally to Teletypewriter TT-7/FG and Teletypewriter TT-8/FG except for the motor control contacts S101 and S102, which are not incorporated in Teletypewriter TT-8/FG; otherwise the teletypewriters are similar electrically. Paragraph 18 gives instructions for making connections to ground, signal loops, and power.

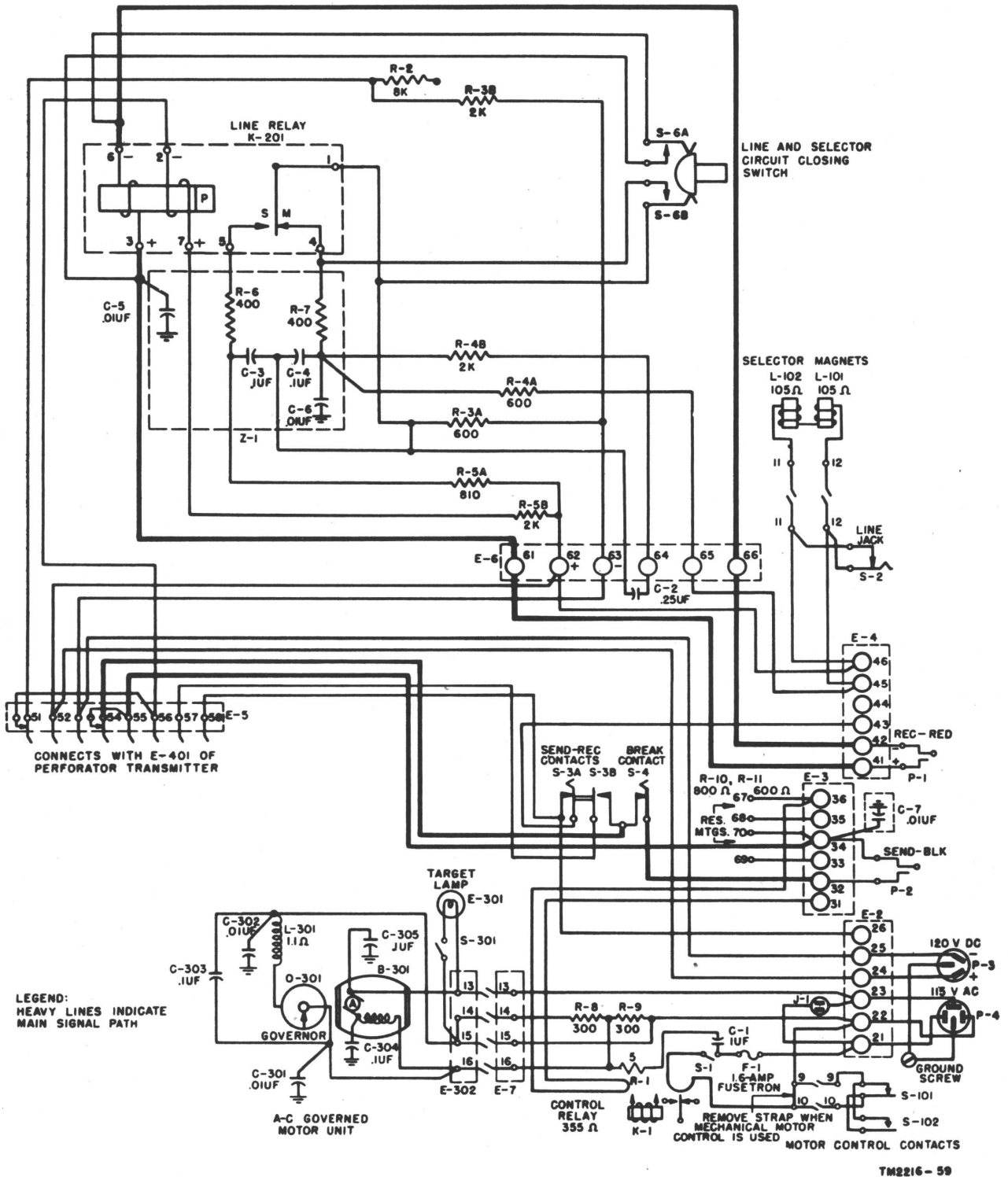


Figure 268. Typing unit, base and relay, schematic wiring diagram.

NOTES:

1. THE MOTOR CONTROL RELAY IS NOT WIRED AT FACTORY. TO USE RELAY, REMOVE, SPLICE TOGETHER AND TAPE WIRES SHOWN CONNECTED TO A AND B ON SWITCH S-1. CUT WIRE LOOP AT SWITCH AND CONTROL RELAY COIL K-1 AND CONNECT TO RESPECTIVE UNITS. FOR BREAK OPERATION CUT WIRE LOOP F-G, CONNECT G TO CONTROL RELAY CONTACT E AND F TO CONTACT D. FOR MAKE OPERATION CUT LOOP F-G, CONNECT G TO CONTACT C AND CONNECT F TO CENTER CONTACT D AS FOR BREAK OPERATION ABOVE. USE 0.065 AMPERES THROUGH COIL L-1 TO OPERATE CONTROL RELAY.
2. FOR BREAK OPERATION OF CONTROL RELAY K-1 INVERT POWER SWITCH S-1 SO THAT ON AND OFF DESIGNATIONS ON COVER AGREE WITH OPERATION OF SWITCH.
3. TO OPERATE PRINTER WITHOUT LINE RELAY K-201, MOVE YELLOW WIRE FROM TERMINAL 62 TO 61; MOVE WHITE WIRE FROM TERMINAL 65 TO 66; REMOVE AND TAPE GREEN WIRE GOING TO LINE RELAY K-201 FROM TERMINAL 61.
4. FOR 0.02-AMP. SIGNAL LINE OPERATION, CONNECT THE 8000-OHM RESISTOR R-2 IN SERIES WITH THE BIAS CIRCUIT BY MOVING ONE OF THE LEADS ON A TO B.
5. RECOMMENDED FUSETRON OR FUSTAT (AND ALTERNATE FUSE) PROTECTION.

MOTOR	FUSETRON OR FUSTAT	FUSE
110 VOLTS A.C. 60-CYCLE GOVERNED	1.60-AMPS	3-AMPS SEE FUSE F-1

6. TO DISABLE SEND RECEIVE BREAK MECHANISM: (A) SPLICE AND TAPE WIRES FROM SWITCH S-3A MARKED X; (B) TAPE WIRE TO S-3B MARKED Y; (C) SPLICE AND TAPE WIRES TO S-4 MARKED Z.
7. ELEMENTS SHOWN DOTTED ARE UNDERNEATH BASE CASTING.
8. WHEN THE A-C SERIES MOTOR MUST BE DRIVEN FROM 25-CYCLE POWER SUPPLY, CONNECT A 25 OHM RESISTOR IN SERIES WITH THE POWER LEADS IF COMPENSATION HAS NOT BEEN MADE FOR 25 CYCLES BY ADJUSTMENT OF THE RECTIFIER (SUCH AS REC 29) TAPS.
9. WHEN KEYBOARD IS NOT INSTALLED AND POLAR SIGNALS ARE RECEIVED, REMOVE JUMPER BETWEEN BACK CONTACT NUMBER 51 AND SLIP CONNECTION CONTACT NUMBER 56 ON BASE.
10. CONTACTS SHOWN BETWEEN TERMINALS 9 AND 10 ARE PRESENT ON TYPING UNIT ONLY WHEN MOTOR CONTROL ON FIGURE H IS USED. WHEN MOTOR CONTROL (MECHANICAL THROUGH S-101 AND S-102) IS USED, REMOVE STRAP BETWEEN 9 AND 10.
11. K-201 RELAY (RY 30; W.E. 255-A)-136 OHMS PER WINDING (FOR 0.060 OR 0.020 AMPERE SIGNALING—SEE NOTE 4 ABOVE)
12. WIRE COLOR CODE (SOLID COLOR OR TRACER IN WHITE WIRE)

BK	BLACK	O	ORANGE	BL	BLUE
BR	BROWN	Y	YELLOW	W	WHITE
R	RED	G	GREEN		

LEGEND:

- ——— WIRING
- ═══ MAIN SIGNAL PATH WIRING
- — — — INCLOSES UNITS
- – – – – – – INCLOSES FILTERS
- ---------- OUTLINES ELEMENTS UNDER CASTING
- ——X—— INDICATES WIRES TAPED OR SPLICED AND TAPED

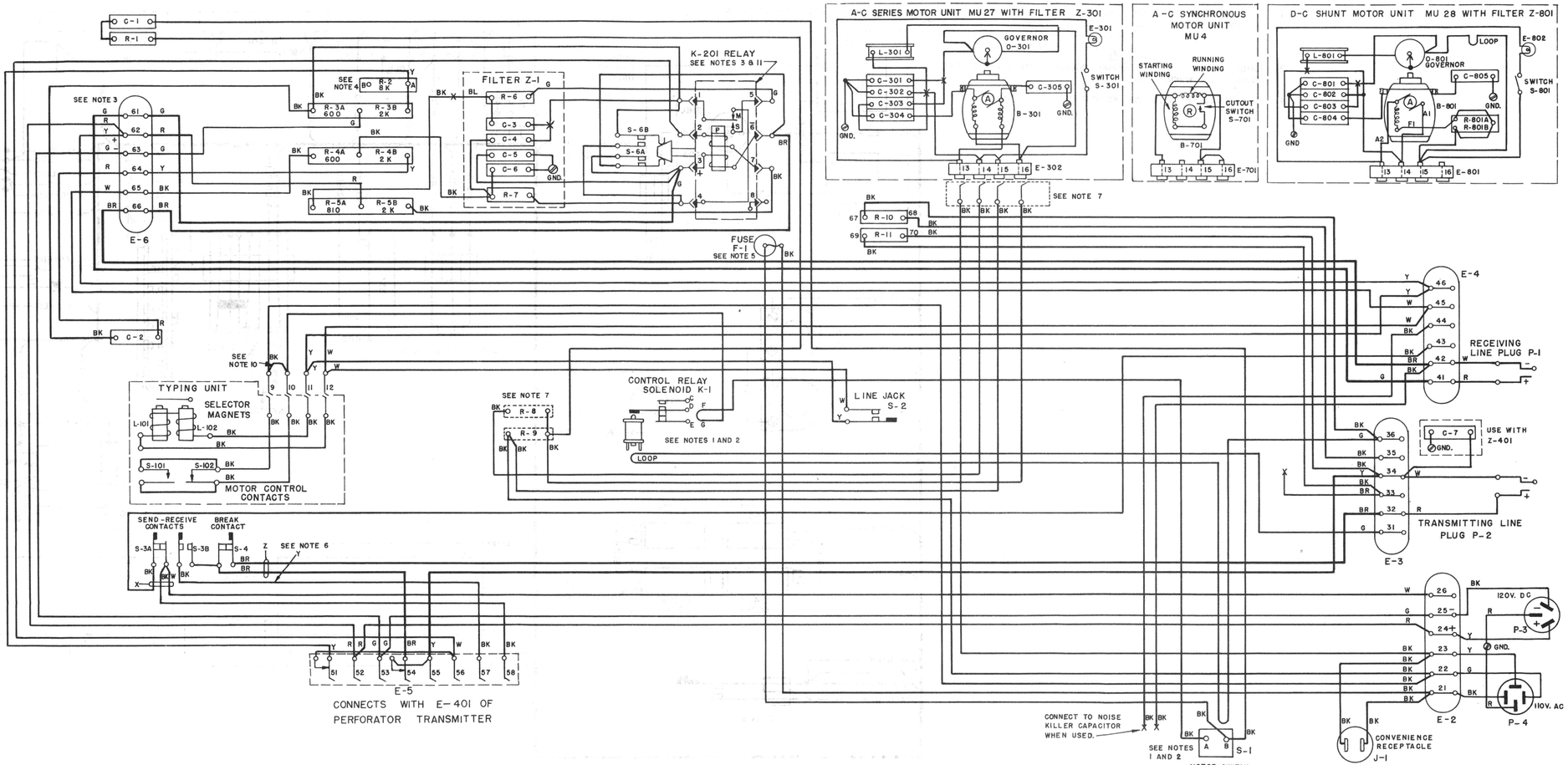


Figure 269. Typing unit, base and relay, actual wiring diagram.

NOTES

1. WIRING CHANNEL DESIGNATED BY A DOES NOT REPRESENT CABLE, BUT ASSISTS IN TRACING CONNECTIONS.
2. CHANNEL LEGEND:
   - CHANNEL IDENTIFICATION
   - CHANNEL WIRE NUMBER
   - WIRE COLOR CODE

   A-1-YEL
3. PLUGS, CONNECTORS & TERMINAL BOARDS VIEWED FROM SCREW TERMINAL OR WIRING SIDES.
4. ALL VALUES OF COILS AND RESISTORS ARE IN OHMS

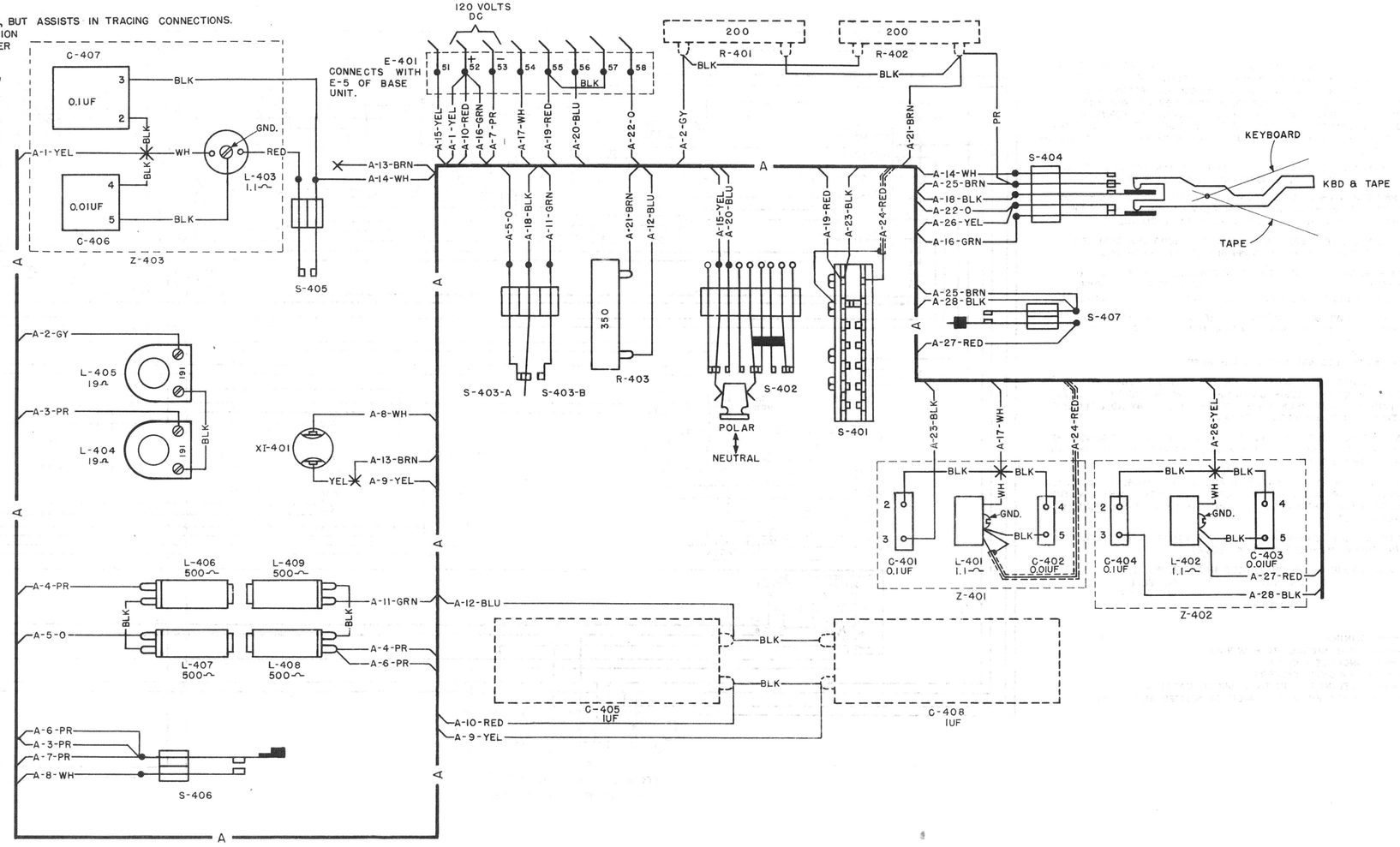


Figure 271. Perforator transmitter, actual wiring diagram.

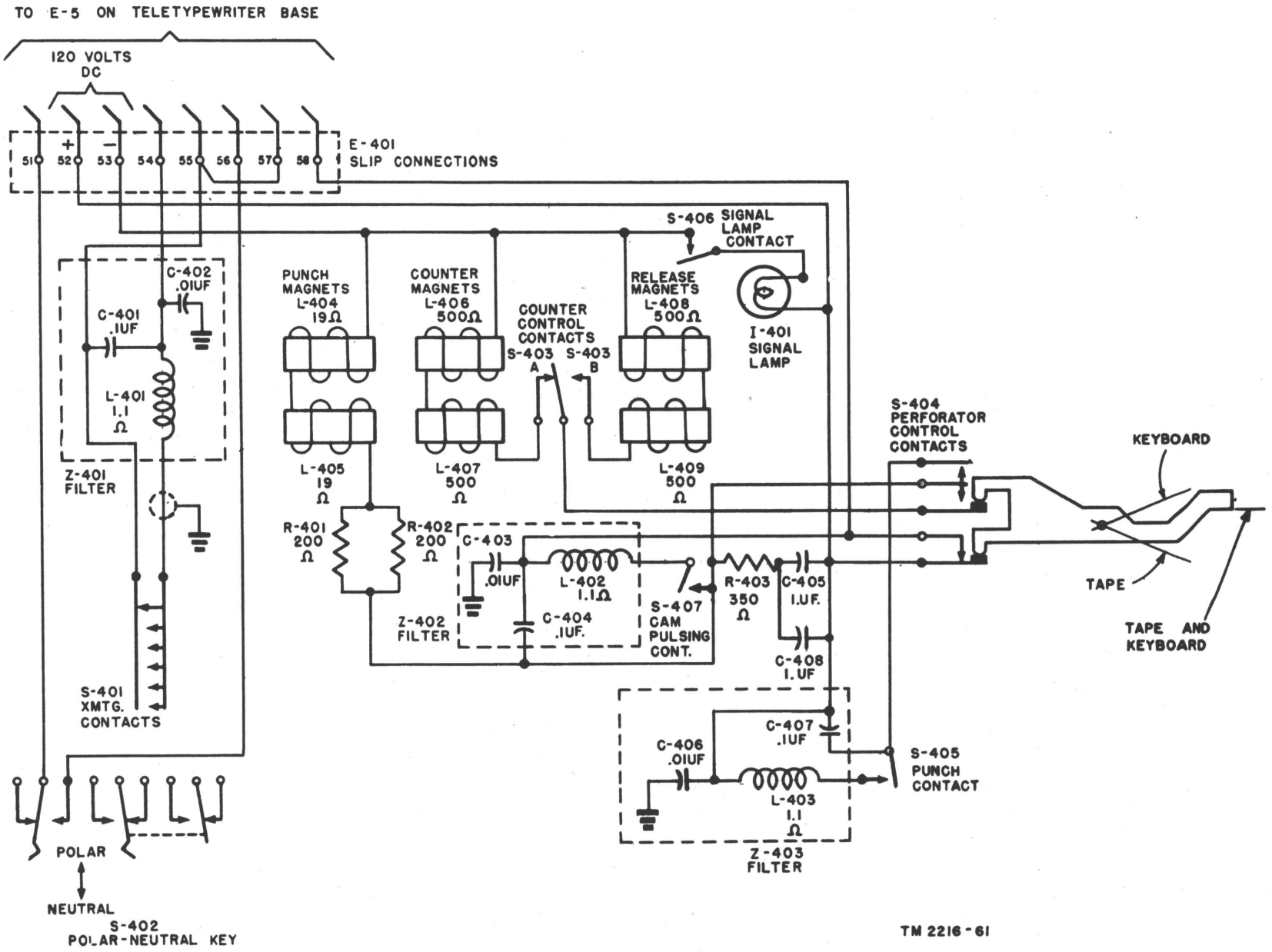


Figure 270. Perforator transmitter, schematic wiring diagram.

NOTES

1. X AND Y DESIGNATED WIRES FROM V-501 AND V-502 CONNECT TO X AND Y DESIGNATED WIRES OF T-501.
2. X' AND Y' DESIGNATED WIRES FROM V-503 CONNECT TO X' AND Y' DESIGNATED WIRES OF T-501.

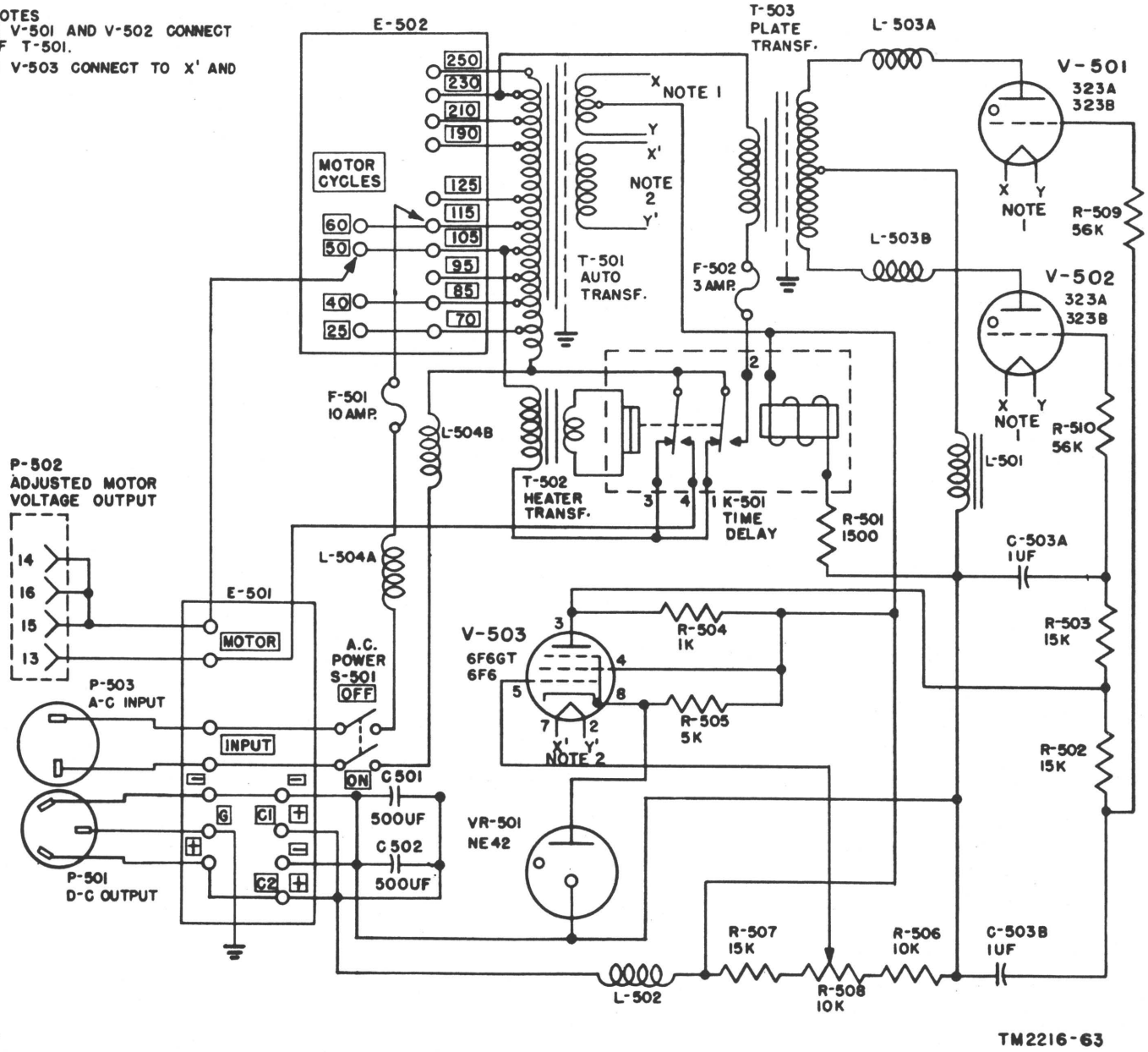


Figure 272. Rectifier, schematic wiring diagram.

1. WIRING CHANNEL DESIGNATED BY A DOES NOT REPRESENT CABLE, BUT ASSISTS IN TRACING CONNECTIONS.
2. CHANNEL LEGEND:
   - CHANNEL IDENTIFICATION
   - CHANNEL WIRE NUMBER
   - WIRE COLOR CODE

   A-1-BLK
3. PLUGS, CONNECTORS & TERMINAL BOARDS VIEWED FROM SCREW TERMINAL OR WIRING SIDES.

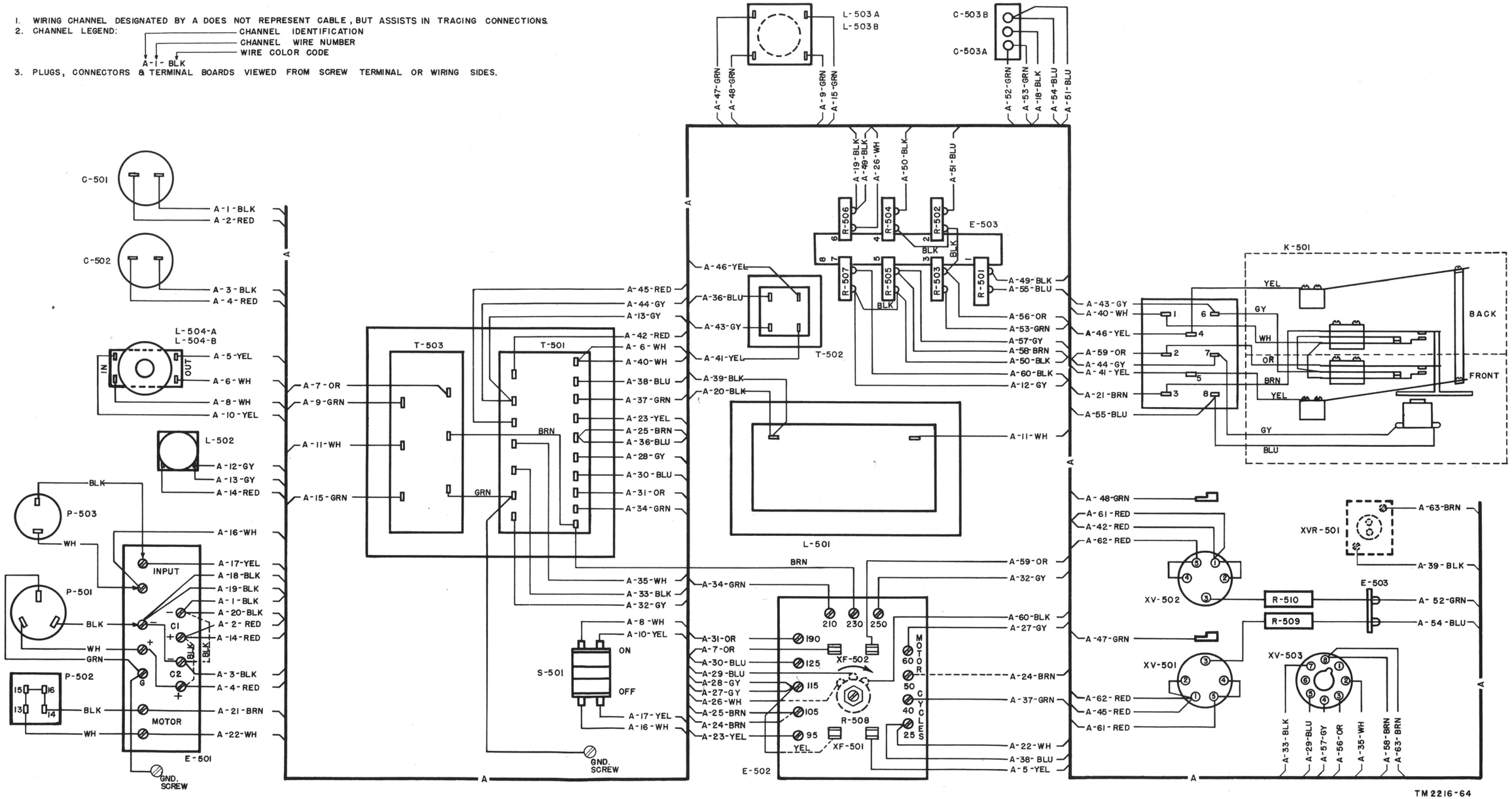


Figure 273. Rectifier, actual wiring diagram.

NOTES:

1. TRANSMITTER DISTRIBUTOR.
   A. FOR OPERATION OF TRANSMITTER RELEASE MAGNET FROM 115 V D-C POWER SUPPLY, OMIT STRAP FROM 1 AND 2 OF R-901A. THIS PLACES 525 OHMS IN SERIES WITH MAGNET.
   B. FOR OPERATION ON 115 V. 25-CYCLE POWER SUPPLY, STRAP TERMINALS 2 AND 3 OF R-901 B AND OMIT STRAP FROM TERMINALS 1 AND 2 OF R-901A.
   C. FOR OPERATION ON 40, 50, OR 60-CYCLE POWER SUPPLIES, WITH ADJUSTED MOTOR VOLTAGE FROM REC-30, OR FOR OPERATION ON 115-V. 60-CYCLE POWER SUPPLY, STRAP TERMINALS 1 AND 2 OF R-901A AS SHOWN.
   D. TO OPERATE TRANSMITTER DISTRIBUTOR RELEASE MAGNET ON DIRECT CURRENT FROM RECTIFIER, REMOVE STRAPS 39 TO 41 AND 38 TO 42 ON BLOCK E-602. ADD STRAP 37 TO 38 AND 35 TO 39 ON E-602. REMOVE STRAP FROM RESISTOR R-901A OF TRANSMITTER DISTRIBUTOR RELEASE MAGNET SO THAT 525 OHMS ARE IN THE CIRCUIT. REFER TO TM 11-2222.
2. FOR INDEPENDENT TRANSMISSION FROM THE KEYBOARD REMOVE, SPLICE AND TAPE THE TWO WIRES CONNECTED TO TERMINALS 1 AND 2 OF E-603, THEN RUN THE SEND LINE TO TERMINALS 1 AND 2 AS SHOWN DOTTED.
3. THE LOCAL TEST LOOP CAN BE EXTENDED TO INCLUDE OTHER EQUIPMENT BY REMOVING THE STRAP FROM TERMINALS 5 AND 6 OF E-605 AND CONNECTING THE OTHER EQUIPMENT TO THESE TERMINALS.
4. UNLESS OTHERWISE SHOWN ALL RESISTORS ARE IN OHMS.

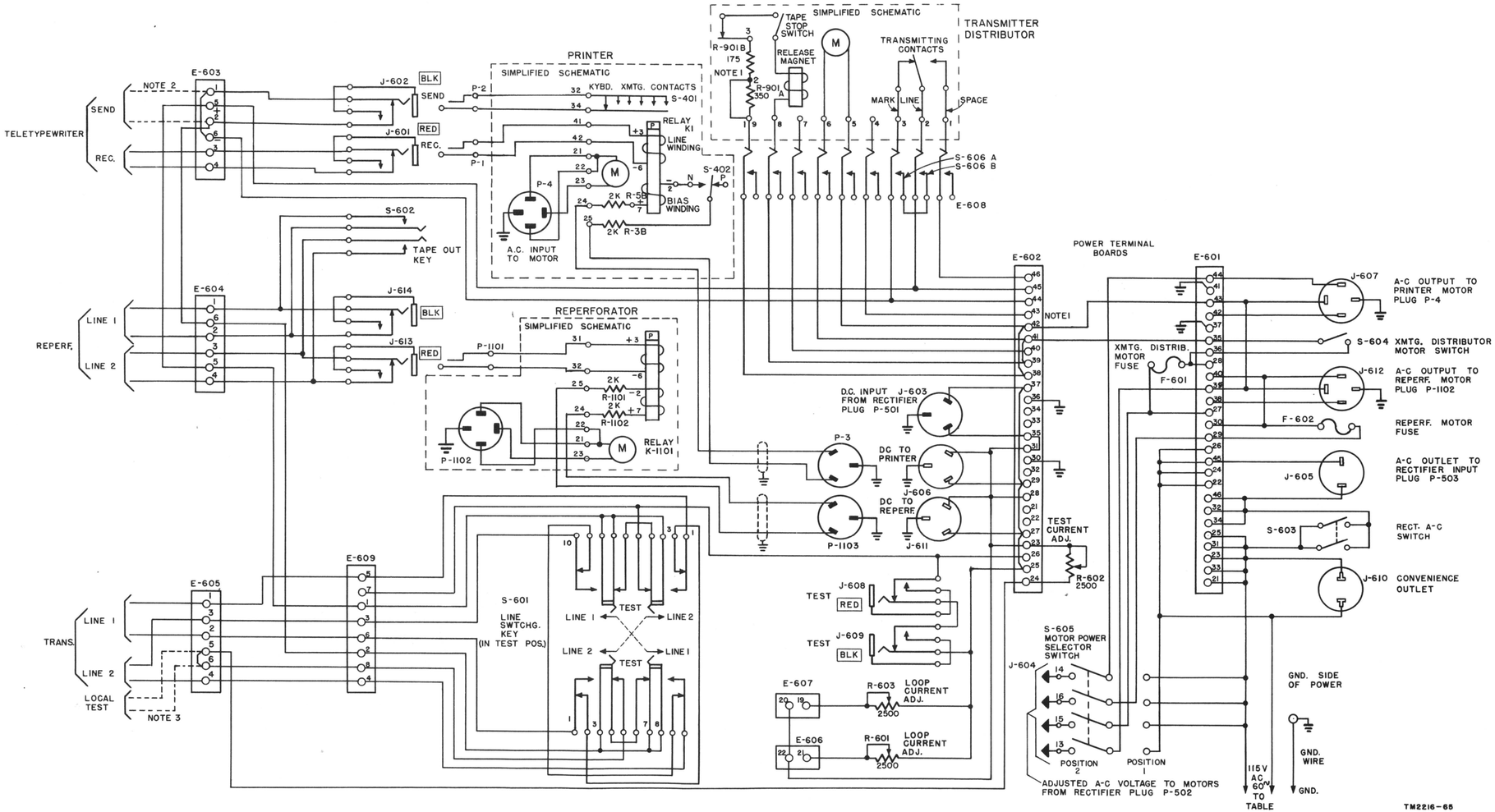


Figure 274. Table, schematic wiring diagram.

NOTES

1. WIRING CHANNELS DESIGNATED BY A, B AND C DO NOT REPRESENT CABLES, BUT ASSIST IN TRACING CONNECTIONS.
2. CHANNEL LEGEND:
   - CHANNEL IDENTIFICATION
   - CHANNEL WIRE NUMBER
   - WIRE COLOR CODE

   A-1-BLK
3. PLUGS, CONNECTORS & TERMINAL BOARDS VIEWED FROM SCREW TERMINAL OR WIRING SIDES.
4. NO CONSISTANT COLOR CODE FOR WIRING BETWEEN E-609 AND S-601.
5. ——K—— DENOTES WIRES WITH TAPED ENDS
   ▒▒▒▒▒▒▒▒▒▒ DENOTES WIRES IN BX CABLE.
6. - - - - - - WIRES TERMINATING IN BROKEN LINES ON E-601, E-602, E-606 & E-607 ARE SOLDERED TO ENDS OF SCREW TERMINALS.
7. POWER ARRANGEMENTS WITH 110-120 V 60~, A-C SERIES GOVERNED MOTOR.

	POWER SOURCE	APPLICABLE RECTIFIER	CONNECTION AND STRAPPING INSTRUCTIONS
A.	90 TO 130 V OR 180 TO 260 V AC AT 25, 40, 50 OR 60 CYCLES	REC-30	1. THROW SWITCH S-605 UP TO POSITION 2. 2. THROW RECTIFIER SWITCH S-603 TO OFF POSITION. 3. OPEN THE HINGED RECTIFIER DOOR TO THE TAP & FUSE PANEL AND MOVE THE YELLOW VOLTAGE TERMINAL WIRE AT THE LEFT, IF NECESSARY, TO THAT TAP WHICH MOST NEARLY REPRESENTS THE VOLTAGE OF THE POWER SOURCE. 4. MOVE THE WHITE WIRE AT THE RIGHT, IF NECESSARY, TO THAT TAP WHICH MOST NEARLY REPRESENTS THE FREQUENCY OF THE POWER SOURCE (REFER TO RECTIFIER DIAGRAM). 5. CONNECT A-C POWER LEADS TO TERMINALS 21 & 22 OF E-601 AS SHOWN.
B.	115 V AC 60 CYCLES ONLY	REC-13	1. THROW SWITCH S-605 DOWN TO POSITION 1. 2. CONNECT A-C POWER LEADS TO TERMINALS 21 & 22 OF E-601 AS SHOWN.
C.	115 V AC 60 CYCLES AND 115 V DC	NONE REQUIRED	1. FOR THE MOTOR CIRCUIT THROW SWITCH S-605 DOWN TO POSITION 1. 2. FOR LOCAL D-C CIRCUITS AND TERMINAL BOARDS. A. MOVE UPPER END OF STRAP, A-82-BLK ON E-602, FROM TERMINAL 37 TO 22. B. MOVE UPPER END OF STRAP, A-84-BLK ON E-602, FROM TERMINAL 35 TO 21. C. CONNECT THE POSITIVE LEAD FROM THE 115 V DC POWER SOURCE TO TERMINAL 21 AND CONNECT THE NEGATIVE LEAD TO TERMINAL 22 ON E-602. 3. CONNECT A-C POWER LEADS TO TERMINALS 21 AND 22 OF E-601 AS SHOWN. 4. FOR TRANSMITTER DISTRIBUTOR CONNECTIONS REFER TO SCHEMATIC DIAGRAM OF TABLE AND TO TM 11-2222.

8. THE RECTIFIER A-C INPUT SWITCH S-603 AND THE TRANSMITTER DISTRIBUTOR SWITCH S-604 UNDER THE FRONT OF THE TABLE TOP ARE ON WHEN THEIR HANDLES ARE POINTED TOWARD THE OPERATOR.
9. ADJUST SIGNAL LOOP RESISTORS R-601 & R-603 TO 2000 OHMS OR FOR 60 MILLIAMPERES, WHEN REQUIRED, FOR USE IN A LOOP.
10. ADJUST LOCAL TEST LOOP RESISTOR R-602 FOR 60 MILLIAMPERES.
11. TO INSERT BATTERY IN ANY ONE OF THE LOOPS ENTERING THE TABLE MAKE CONNECTIONS AT TERMINAL BOARD E-603, E-604 OR E-605 USING TERMINALS OF E-607 OR E-606 AS THE BATTERY SOURCE. PROCEED AS FOLLOWS:
    A. REMOVE THE WIRE FROM UPPER TERMINAL 1 OR 3 OF E-603, E-604 OR E-605 DEPENDING ON WHICH LOOP IS TO BE SUPPLIED, THEN CONNECT THIS WIRE TO THE UPPER (–) TERMINAL OF E-607.
    B. REMOVE THE LOWER WIRE OF THE SAME LOOP EXTENSION FROM TERMINAL 1 OR 3 (DIRECTLY UNDER ONE REMOVED IN SUB PAR. A ABOVE) AND CONNECT IT TO THE LOWER (+) TERMINAL OF E-607.
    C. ADJUST THE 2500-OHM RESISTOR R-603, IF NECESSARY, TO PROVIDE THE CORRECT SIGNAL LOOP CURRENT OF 60 MILLIAMPERES.
    D. IF IT IS DESIRED TO PROVIDE LINE BATTERY IN A SECOND LOOP APPLY THE SAME PROCEDURE AS GIVEN ABOVE BUT USE TERMINAL BOARD E-606 AS A SOURCE AND R-601 TO ADJUST CURRENT.
12. TERMINALS 5 & 6 OF E-605 MUST BE STRAPPED TO COMPLETE THE DUMMY TEST LOOP WHEN ONLY THE ONE LOCAL TELETYPEWRITER SET IS TO BE TESTED IN ITS TEST CIRCUIT THROUGH USE OF THE LINE SWITCHING KEY.
13. HALF DUPLEX OPERATION.
    A. IF DESIRED, THE RECEIVING COMPONENT CONNECTED TO TERMINALS 3 & 4 OF E-603 MAY BE CONNECTED IN SERIES WITH THE ALREADY EXISTING SERIES CIRCUIT CONTAINING THE PERFORATOR (WITH KEYBOARD) TRANSMITTER, THE TRANSMITTER DISTRIBUTOR, AND THE LINE SWITCHING KEY. THIS MAY BE ACCOMPLISHED AT EITHER ONE OF THE LOWER TERMINALS NUMBERING 2, 5, OR 6 OF E-603. POLARITY OF BATTERY APPLIED TO RECEIVING POLAR RELAYS MUST BE AS INDICATED ON DIAGRAM.
    B. FOR EXAMPLE, ON E-603 REMOVE ANY UNUSED WIRES FROM LOWER TERMINALS 3 & 4, MOVE THE WIRE FROM LOWER TERMINAL 2 TO LOWER TERMINAL 4, THEN STRAP LOWER TERMINAL 3 TO LOWER TERMINAL 2. THE TRANSMITTING AND RECEIVING COMPONENTS OF THE SET ARE THUS ARRANGED IN SERIES AND MAY BE SWITCHED TO LINE 1, LINE 2, OR TEST (TERMINATING AT E-605) BY THE LINE SWITCHING KEY.
14. FULL DUPLEX OPERATION.
    ARRANGE EQUIPMENT THE SAME AS IN NOTE 13, THEN CONNECT IT TO THE SEND LOOP. CONNECT A REPERFORATOR AND/OR A SECOND PRINTER TO THE RECEIVE LOOP.
15. INSERT 1.6 AMPERES PRINTER MOTOR FUSE IN XF-1 OF BASE UNIT, INSERT 1.25 AMPERES TRANSMITTER DISTRIBUTOR MOTOR FUSE IN XF-601, AND IF USED, INSERT 1.4 AMPERES REPERFORATOR MOTOR FUSE IN XF-602.

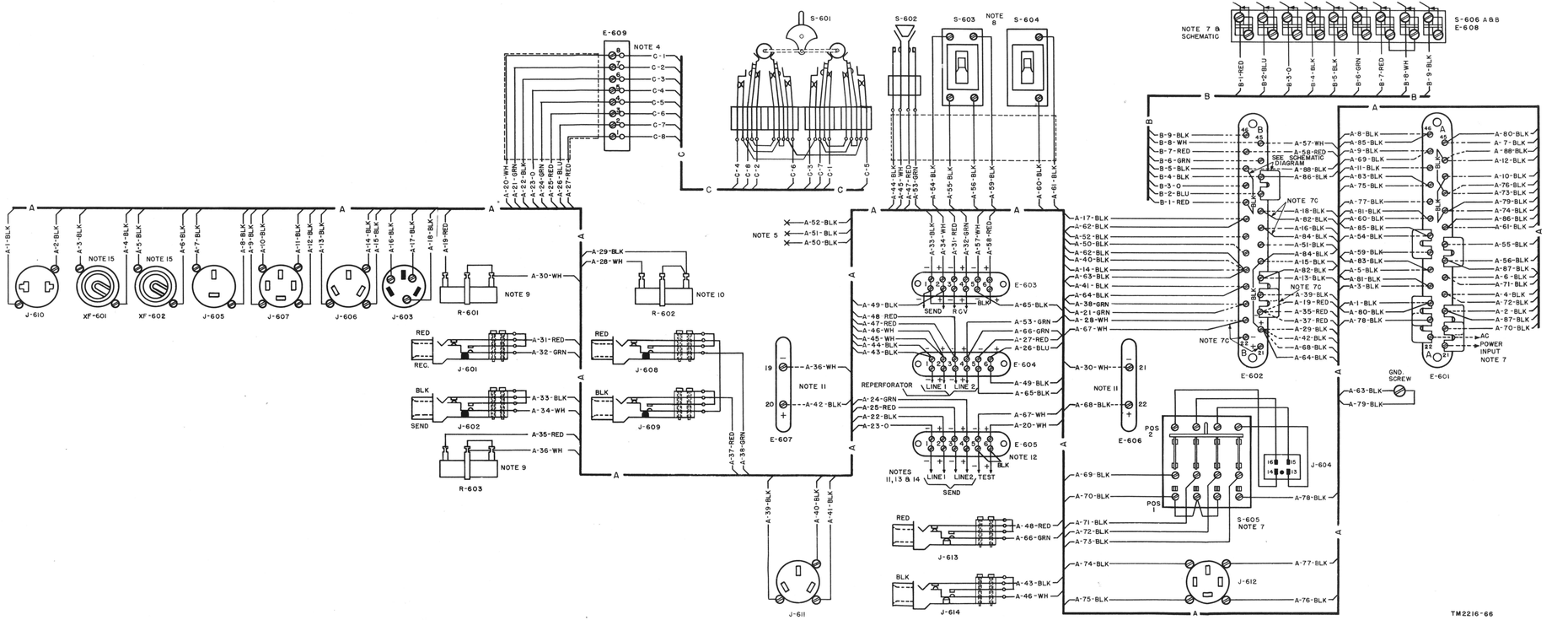


Figure 275. Table, actual wiring diagram.

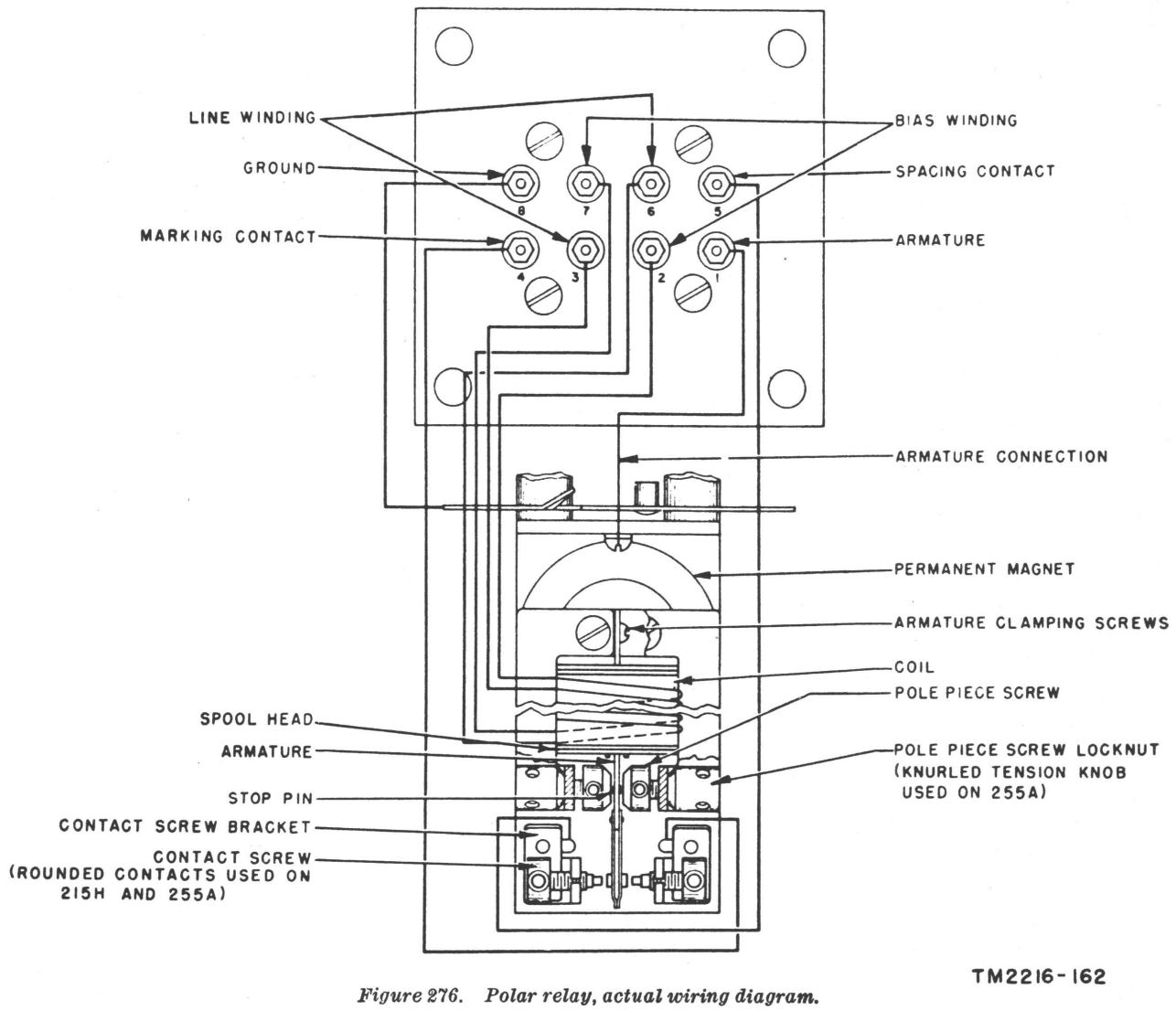


Figure 276. Polar relay, actual wiring diagram.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

495. General

a. Teletypewriters TT–7/FG and TT–8/FG are fixed-plant equipments, and, therefore, they are not likely to be dismantled and shipped once they have been put into use. If one of these sets is moved to another location, however, it may be unnecessary to disassemble the equipment. If practicable, remove only the typing unit, the rectifier, and transmitter distributor from the table. If the storage building or warehouse in which the teletypewriters are to be stored is in a damp area, perform the export packing process including the use of metal containers and the insertion of the correct quantity of desiccant to protect the equipment against the effects of moisture.

b. Indicate on the packing case the date the equipment is removed from service and whether it was functioning properly at the time of its removal. If the equipment was functioning improperly, indicate what caused the faulty operation and notify authorized maintenance personnel of this fact. Packing instructions which are given in paragraphs 496 through 511 follow procedures used in original packing; the packing containers illustrated are those used by the manufacturer. If these containers are not retained by using organizations at the time of initial unpacking and other containers are necessary, the illustrations will furnish information that will aid in improvising necessary cartons and boxes.

496. Disassembly for Repacking

Disassemble the teletypewriter as follows:

a. Remove the paper spindle, platen crank, ribbon, and tape. Place the spindle and crank in drawstring bag PK–21300.

b. Remove the cover from the typing unit and base and the copyholder from the cover.

c. Remove the perforator transmitter from the base.

d. Remove the typing unit from the base; replace the three thumbscrews in their holes in the base.

e. Remove the motor unit from the base; replace the screws in the base.

f. Remove the line relay from its mounting bracket on the base.

g. Remove the base from the table top.

h. Remove the rectifier from the shelf in the back of the table.

i. Remove the transmitter distributor from the table.

497. Repacking Teletypewriters

a. General. Except for the elimination of the metal and moisture-vaporproof barriers, packaging for domestic shipment generally is similar to that for export shipping. Shipment may be made in shipping containers similar to those described in *b* below. For storage for short periods in dry places there will be no need for inclusion of a dehydrating agent or desiccant, and it may be possible that the use of excelsior cushioning also will be unnecessary. A teletypewriter may remain wholly or partly assembled when weight and protection requirements permit.

b. Export Packing Data. Seven boxes (including box 7/7 with 16 rolls of teletypewriter paper) are required to package each TT–7/FG or TT–8/FG. The weights, dimensions, and contents of each export package are listed in *c* below. Boxes are numbered 1/6 to 6/6 if paper is not included as part of a set.

c. TABLE OF WEIGHTS, DIMENSIONS, AND BOX NUMBERS FOR EXPORT PACKING.

Wooden box No.	Component	Unit net weight (lb)	Unit type container	Wooden export box, gross weight (lb)	Export box dimensions (in.)	Export box dimensions (cu. ft.)
1/7	REC-30 Rectifier	106	Metal	193	33 x 16 x 26	7. 9
2/7	XRT202AA Table	112	Metal	363	32¼ x 47 x 36	31. 9
3/7	BP22/210 or BP93/221 typing unit.	29	Metal	159	30¼ x 28 x 30½	10. 9
4/7	PEXC200AA cover	38	Tar paper and carton.			
	PEX25JX or PEX25KQ perforator transmitter.	24	Metal	212	30⅜ x 48¾ x 20	17. 5
5/7	MU–27 motor unit	14	Metal.			
	BB44 base	21	Metal	190	44 x 23 x 27	15. 7
	RY–30 relay	2	Foil.			
	80374 set of gears	½	Foil.			
	103628 tuning fork	1	Foil.			
6/7*	115700AA copyholder	2	Foil.			
	XD200AA transmitter distributor	30	Metal.			
	TM 11–2216 (2) manuals	3	Foil	151	27 x 30 x 22	10. 3
7/7	4T1 teletypewriter paper (16 rolls)	50	Foil	85	22¾ x 20¼ x 12	3. 2
	Total	432½		1, 353		97. 4

*Gross weight of box 6/7 includes spare parts and fuses not listed above. If rolls of paper are not included as part of a set, six boxes marked 1/6 to 6/6 inclusive, may be used for one complete set.

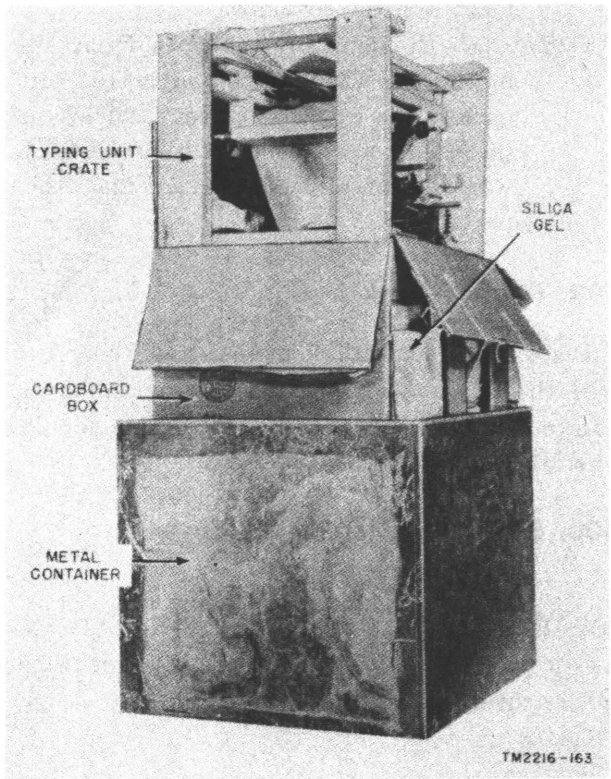


Figure 277. Typical metal barrier packing arrangement.

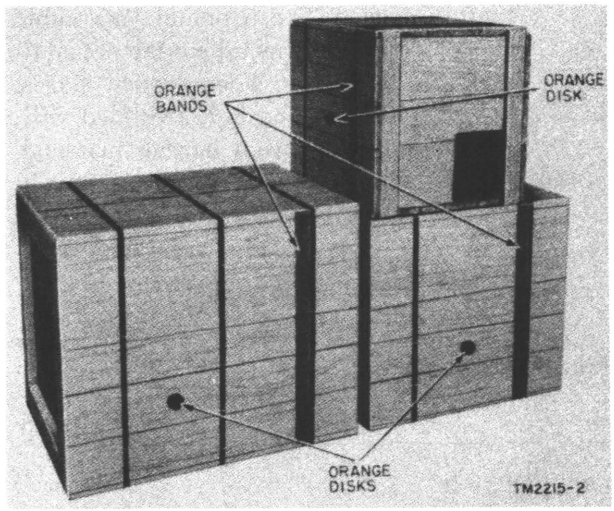


Figure 278. Typical export packages.

d. PACKING PROCEDURE.

(1) Brace, cushion, and place the component parts in cartons (with some exceptions) as for domestic shipment. Then seal the carton seams and flaps with 3-inch gummed tape or special staples. Inclose them and seal them in either a rigid metal

barrier container with silica gel to absorb the moisture, a flexible waterproof paper barrier material, or flexible moisture-vaporproof foil material in preparation for export shipping.

(2) The cartons to be sealed in flexible barriers (those least subject to damage from moisture) should have corners blunted before wrapping and sealing in the flexible barrier. Pad the cartons in metal barriers by filling the space between metal and carton with flat fiberboard padding to prevent movement within the barrier.

(3) Seal all metal barriers by soldering the lids in place with 50/50 solder and painting the outside soldered seams with waterproof cement.

(4) Seal the waterproof paper barriers with waterproof cement and moisture-vaporproof the foil-lined barriers with adhesive or other suitable material equal in strength and waterproofing qualities to the barrier material.

(5) Float the metal typing unit, rectifier, and table containers in a nailed wooden box containing 3 inches of excelsior cushioning, packed 3 to 5 pounds per cubic foot. Float other metal containers similarly, in cartons. The wooden boxes, except boxes 2/7 and 3/7, are lined with the flexible waterproof barrier material.

(6) Fill all large vacant spaces with void details of correct size and shape. Box numbers, contents, and reference paragraphs for packing are listed in *e* below

e. Box Numbers, Contents, and Reference Paragraphs.

Box No.	Item	Par. ref
1/7	Rectifier	509
2/7	Table	511
3/7	Typing unit	504
4/7	Perforator transmitter and cover	500, 503
5/7	Motor unit and base	505, 507
6/7	Transmitter distributor and parts (including relay).	508, 510
7/7	16 rolls of paper	510

498. Copyholder

(fig. 6)

a. Domestic Materials. The domestic packing materials for the copyholder consists of the following: one PK–8537 carton, and gummed tape to seal the carton.

b. Additional Material for Export Packing. The export packing material includes one PK–23197 metal foil bag and one PK–8540 carton.

c. Procedure for Domestic Packing.

(1) Insert the screws in their holes through the copyholder and the wooden filler block or the metal filler framework, depending on which is used. Twist wire around the ends of the screws to hold all parts of the assembly together.

(2) Wrap the entire assembly in tissue paper, place it in the PK–8537 corrugated carton, and seal the carton with 3-inch gummed tape.

d. Additional Procedure for Export Packing.

(1) Place this assembly in the foil-lined PK–23197 moisture-vaporproof envelope; seal the envelope.

(2) Place this moisture-vaporproof package in the PK–8540 fiberboard carton and pack in the PK–9518 carton, which is in the nailed wooden box 6 (marked 6/7), with the consolidated package and other parts.

499. Platen Crank

Place the platen crank in the drawstring bag with the paper roll spindle and ribbon. Tie the bag to the typing unit and wooden crate for domestic or export packing.

500. Perforator Transmitter Cover

(fig. 279)

a. Domestic Materials. The PK–23314 domestic packing materials for the perforator transmitter cover consists of the following:

Quantity	Part No.	Material
1	PK–10786	Corrugated carton.
1	PK–22312	Set of packing details consisting of: 1 corrugated detail No. 1 (15¾″ x 62¾″); 1 corrugated detail No. 2 (15½″ x 68¼″); 1 corrugated detail No. 3 (17½″ x 67⅛″); 1 corrugated detail No. 4 (22½″ x 38½″).
1	PK–22048	Wooden base.
1	PK–21333	Unpacking instructions.
1	PK–21250	Label "FRAGILE MATERIAL, HANDLE WITH CARE".

b. Additional Material Needed (Not Furnished). The additional material needed consists of 15 feet of gummed paper tape (3 inches wide), and 12 square feet of tissue paper.

c. Additional Material For Export Packing. The additional material needed for export packing consists of one PK–10786 inner corrugated carton, one PK–19024 waterproof barrier, and one PK–10899 outer corrugated carton.

d. Procedure For Domestic Packing.

(1) Form the bottom of the PK–10786 corrugated carton as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around the bottom edges of the carton.

(2) Insert the wooden base PK–22048 in the carton. Remove the tape reel container cover and the tape retainer from the cover, and place the cover on the wooden base.

(3) Insert the semiliner detail No. 2.

(4) Place the rear cushion detail No. 3 between the rear of the cover and the carton with part of the detail extending over the top of the cover.

(5) Wrap the tape reel container cover and tape retainer in tissue paper and place them inside the front cushion (detail No. 4).

(6) Place the front cushion detail No. 1 between the semiliner and the front of the carton.

(7) Locate the top cushion detail No. 4 between the front of the cover and the semiliner and paste the unpacking instructions PK–21333 to the top of this detail.

(8) Close the top flaps of the carton and seal the carton as outlined in (1) above.

(9) Paste the label "FRAGILE MATERIAL, HANDLE WITH CARE" on the top of the carton.

(10) Stencil "This Side Up" and "Open Here" on top of the carton; use waterproof stencil ink.

e. Additional Procedure For Export Packing. For export packing, seal the above carton in a moisture-vaporproof metal barrier (PK–19024). Completely seal all joints, seams, and closures with an adhesive, or other suitable seal to give moisture resistance equal to that of the barrier material. Inclose this package in another carton (PK–10899) and place it in wooden box 4 (4/7, PK–989) with the perforator transmitter.

501. Set of Gears (If Packed Separately)

This paragraph provides instruction for domestic and export packing of the 80374 set of gears.

a. Domestic Materials. The domestic and export packing materials for the 80374 set of gears consists of the following:

(1) *Motor pinion 74505 packing materials.*

Quantity	Material	Part No.
	Cleaning solvent	PK–21228
	Rust preventative	PK–21229
	Oil, lubricating, preservative	PK–21220
	Greaseproof paper	PK–22025
1	Metal foil bag (required for export pack).	PK–23163

(2) *Bakelite main shaft gear 74151 packing material.* This packing material includes one PK–21128 paper envelope and one PK–23163 metal foil bag (required for export pack).

(3) *Container for both gears.*

(*a*) One PK–7532 carton (either domestic or export) is used for both gears.

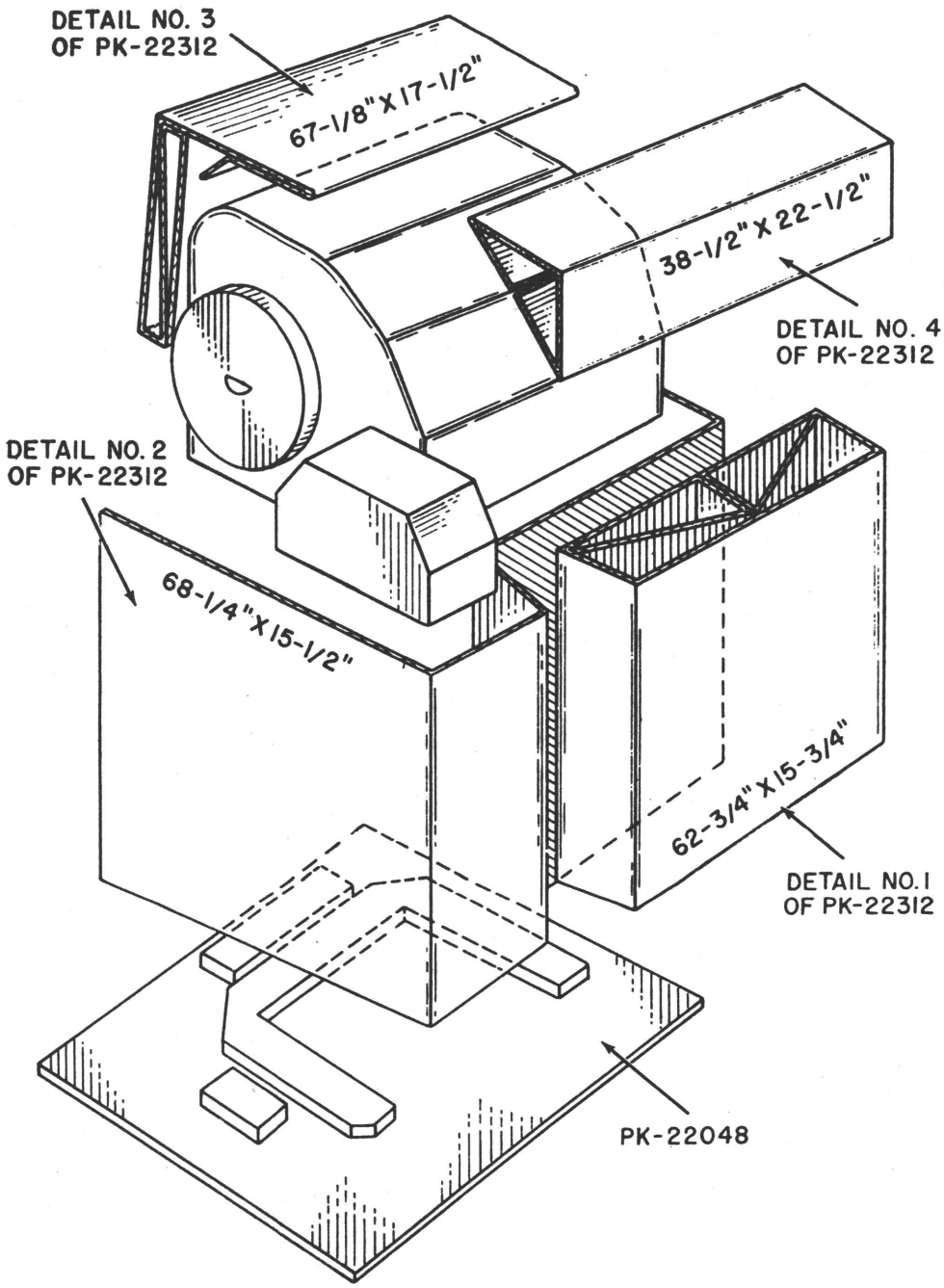


Figure 279. Details for packing perforator transmitter cover.

(*b*) Pack the gear set for export, with other parts, in consolidated parts carton PK–9518 which in turn should be packed in box 6/ with the transmitter distributor.

b. Procedure for Domestic Export Packing.

(1) Remove the main shaft gear from the right side of the typing unit and the pinion gear from the motor unit.

(2) Clean, dry, neutralize, and lubricate with preservative grease, and wrap the motor pinion in greaseproof paper PK–22025. Place the bakelite gear in a PK–21128 paper envelope.

(3) For export packing, place each gear in a PK–23163 metal foil bag.

(4) Place both gears in the PK–7532 carton and pack the carton with other parts in PK–9518 and in the wooden box with the transmitter distributor.

502. Paper Spindle

(figs. 21 and 27)

Place the spindle in the PK–21300 drawstring bag with the platen crank and ribbon. Tie this bag to the 74909 right side frame between the 74878 spindle drag spring and the 74056 retaining plate of the typing unit (fig. 282).

503. Perforator Transmitter

a. Domestic Materials. The PK–23313 domestic packing materials for the perforator transmitter with the counter consists of the following

Quantity	Material	Part No.
1	Corrugated carton	PK–9518
1	Wooden base	PK–22038
1	Corrugated liner (21 1/16" x 12 9/16" x 7 7/16").	PK–22041
1	Corrugated pad (21¾" x 12⅝")	PK–22251
1	Corrugated mailing box	PK–21280
2	4¾" bolts with nuts	PK–21266
1	Steel clamp	PK–21326
1	Bolt with nut	PK–21399
2	¼" washers	RM–72296
2	¼" lockwashers	RM–72316
1	Label "FRAGILE MATERIAL, HANDLE WITH CARE".	PK–21250

b. Additional Material Needed (Not Furnished). Additional material needed consists of the following:

(1) Twelve feet of gummed paper tape (3 inches wide).

(2) Twelve feet of cloth tape (at least 2 inches wide).

(3) Felt pad (approximately 1 inch square).

(4) Tissue paper as required.

(5) Rubber bands.

c. Additional Material Used for Export Packing (Box 4/7).

Quantity	Material	Part No.
1	Label	PK–21328
1	Pad	PK–22177
1	Pad	PK–22178
1	Metal box	PK–17411
6	Silica gel, 6 lb (replace after exposure to atmosphere).	PK–21203
1	Silica gel tray	PK–21353
1	Carton container	PK–10869
1	Barrier material	PK–19026
1	Void detail	PK–21354
1	Wooden box marked "4/7" (for perforator transmitter and cover).	PK–989
	Excelsior (3 to 5 lb per cu ft)	
	Steel strapping for 3 bands	PK–21207
	Strap seals	PK–21210
	Staples for strapping (to be located at 6" intervals).	PK–21208
	Packing slip	PK–21382
	Packing slip barrier envelope	PK–21211
	Packing slip barrier protector	PK–21212

d. Procedure for Domestic Packing.

(1) Place the perforator transmitter on the PK–22038 wooden base.

(2) Attach the unit (with the counter at the left-hand side) to the PK–22038 wooden base with the two PK–21266 bolts and nuts, two RM–72296 washers, and two RM–72316 lockwashers at the left end (fig. 280). Use the PK–21326 steel clamp and the PK–21399 bolt with the nut at the right end (fig. 280). Place a piece of felt under the steel clamp to prevent damage to the finish of the casting.

(3) Remove the end-of-line indicator lamp. Wrap the lamp in tissue paper and place it in the PK–21280 mailing box. Thread the two metal tabs of the mailing box with twine. Wrap and attach the box securely to the wooden base.

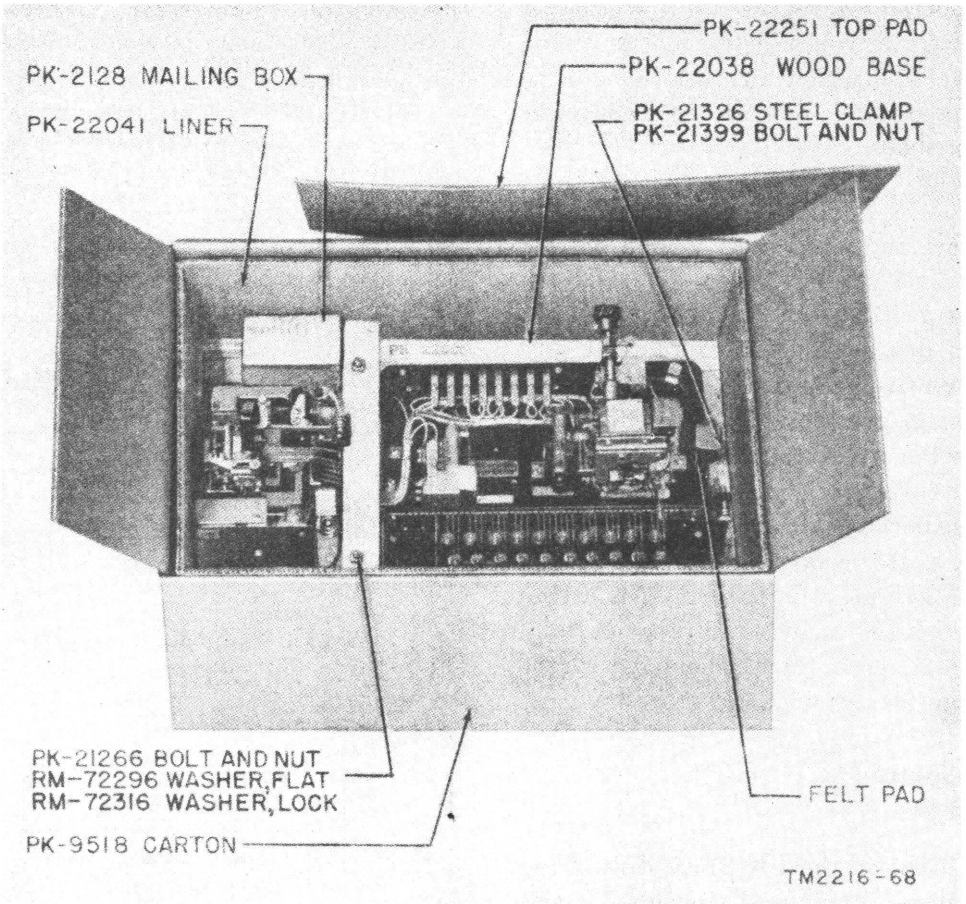


Figure 280. Perforator transmitter in PK–951 carton.

(4) Fasten a rubber band or some twine around each of the thumbscrews in the casting at the front of the unit to prevent the screws from rattling.

(5) Form the bottom of carton PK–9518 as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(6) Place the mounted unit in the appropriate carton and insert the PK–22041 liner in carton PK–9518 (fig. 280).

(7) Place the PK–22251 top pad in the PK–9518 carton, close the flaps, and seal the carton with gummed paper tape.

(8) Reinforce the sealed carton with cloth tape, girthwise around the carton about 3 inches from each end, and lengthwise around the center.

(9) Paste the PK–21250 label "**FRAGILE MATERIAL, HANDLE WITH CARE**" to the top of the carton.

(10) Stencil "This Side Up" and "Open Here" on top of the carton; use waterproof stencil ink.

e. Additional Procedure for Export Packing (Box 4/7).

(1) Place the packed PK–9518 carton in the PK–17411 rigid metal barrier with the PK–21328 label, PK–22177 and PK–22178 pads, and the PK–21253 silica gel tray with 6 pounds of silica gel.

(2) Seal the metal container with solder.

(3) Float the sealed metal PK–17411 with excelsior in the PK–10869 fiberboard carton and seal the carton.

(4) Place the perforator transmitter (carton PK–10869) and the perforator transmitter cover (carton PK–10899) with the void detail PK–21354 in the wooden box

PK–989 *after* it has been lined with the moistureproof barrier PK–19026.

(5) Nail the cover on the wooden box PK–989 and strap with 3 bands PK–21207, located 8 inches from the outer ends; seal the straps with PK–21210 strap seals and staple the straps at 6-inch intervals with PK–21208 staples.

(6) Seal the PK–21382 packing slip in the PK–21211 packing slip (waterproof) barrier envelope; the envelope cover with the PK–21212 packing slip barrier protector and securely attach it to the outside of wooden box PK–989.

504. Typing Unit

(figs. 281 through 287)

a. Domestic Materials. The PK–23301 domestic packing materials for a standard model 15 typing unit consists of the following:

Quantity	Material	Part No.
1	Corrugated inner carton	PK–10718
1	Corrugated outer carton (for domestic packing only; do not use for export).	PK–11289
1	Unpacking instruction card	PK–21217
1	Label "FRAGILE MATERIAL, HANDLE WITH CARE".	PK–21250
10	No. 8 wood screws	PK–21277
1	Bracket	PK–21296
1	Bracket	PK–21297
1	Cloth bag	PK–21300
1	Sheet of wax paper	PK–21305
4	No. 8 wood screws	PK–21345
2	Scored corrugated detail sheets (20″ x 46½″) (Not used for export packing).	PK–22214
4	Socred corrugated detail sheets (17⅜″ x 35″) (Not used for export packing).	PK–22215
1	Set of packing details consisting of: 2 detail No. 4 plywood panels. 1 detail No. 5 L-shaped wooden block, 1⅛″ thick. 1 detail No. 6 small wooden block, 1⅛″ thick with clearance cut. 1 detail No. 7 wooden base assembly.	PK–22238
1	Lower blocking assembly	PK–22239
1	Upper blocking assembly	PK–22240
1	Top frame assembly	PK–22241
4	Wedge locks	82074

b. Additional Material Needed (Not Furnished).

Quantity	Material
10	Fivepenny nails.
8	Fourpenny nails.
4 sq ft	Tissue paper.
33 ft	Gummed paper tape (3″ wide).
15 ft	Cloth tape (at least 2″ wide).
2	1″ spacer blocks (approx 2″ wide, 6″ long).

c. Additional Material Used for Export Packing (Box 3/7).

Quantity	Material	Part No.
1	Rigid metal barrier	PK–18328
1	Nailed wooden box (marked 3/7)	PK–1156
11	Silica gel (11 lb)	PK–21203
1	Tray of ¼″ plywood with top and bottom slots to permit movement of air.	PK–21336
	Cushioning pads	PK–22191
	Excelsior (3 to 5 lb per cu ft).	
	Steel strapping (⅝″ x .020″) for two bands.	PK–21207
	Strap seals for the two bands	PK–21210
	Strap staples (for 6″ intervals)	PK–21208

d. Procedure for Domestic Packing.

(1) Place the typing unit on the detail No. 7 base assembly of PK–22238 so that the two printer studs (74016) are centered in the 1¼-inch clearance holes of members E and F of detail No. 7 (fig. 284). There should be no space between the rear of the side frames and members G and H of detail No. 7 (fig. 285).

(2) Place detail No. 5 of PK–22238 firmly against the 74909-right side frame and insert two PK–21345 wood screws in the holes provided (fig. 284).

(3) Place detail No. 6 of PK–22238 firmly against the 74410-left side frame and insert two PK–21345 wood screws in the holes provided (fig. 284).

(4) Loosen the 6810 (front) screws on the 74126 right and left lower carriage track supports (fig. 23).

(5) Free the type bar carriage by depressing the carriage return lock bar and move it to its central position. While holding

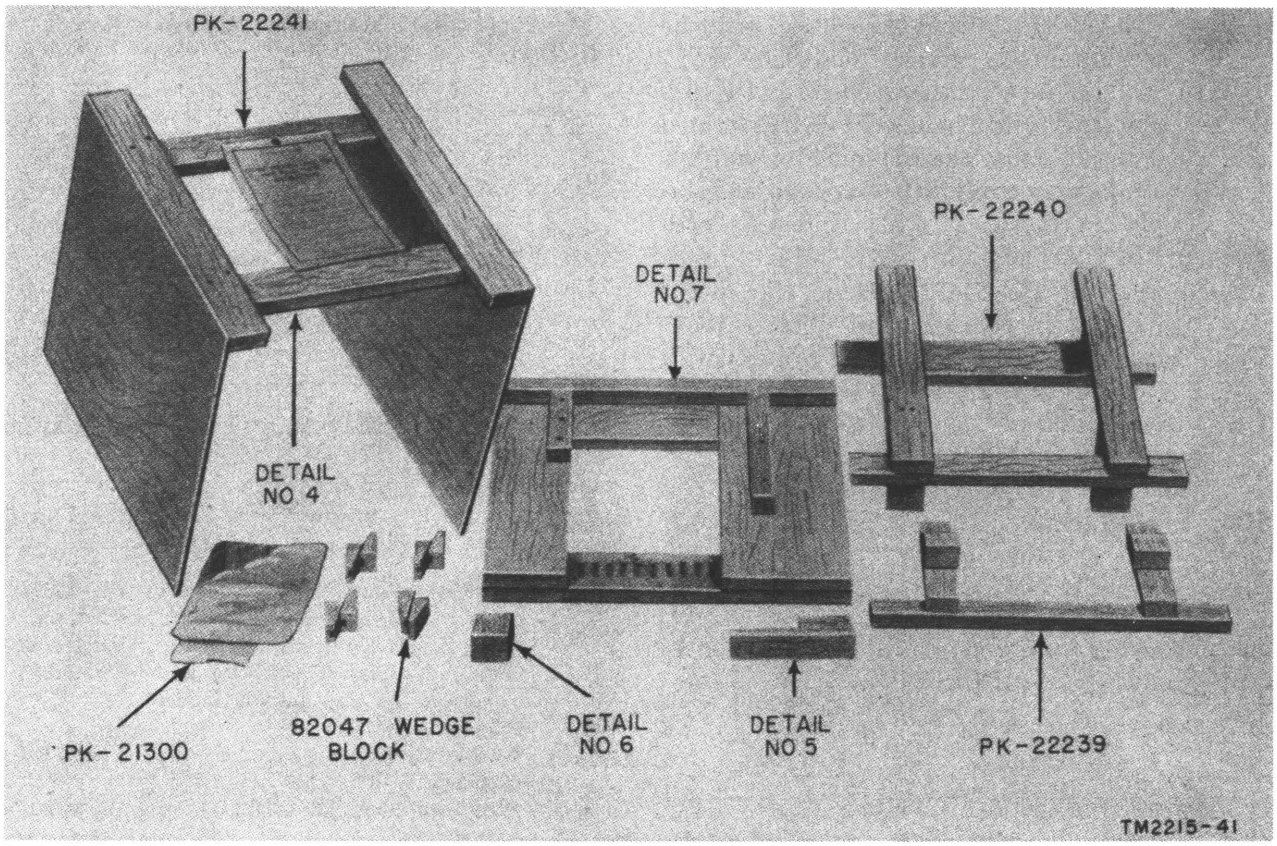


Figure 281. PK details for typing unit crate.

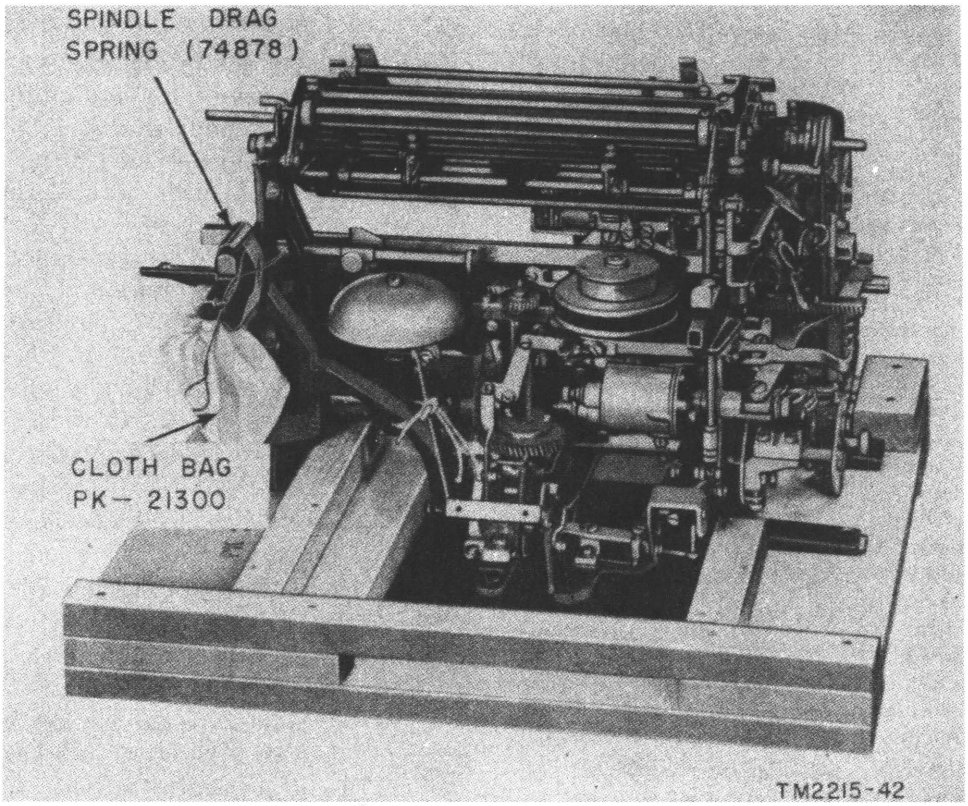


Figure 282. Typing unit on wooden base packing assembly, rear view.

the carriage in this position, place the PK–21296 (right) bracket under the front washer of the front screw and over the rear screw on the right carriage track support. Engage the $^{33}/_{64}$-inch hole of the bracket with the 125218 (rear) nut of the 74243 guide roller assembly on the carriage and fasten the bracket friction-tight in this position by the screw previously loosened. Do not tighten the screw.

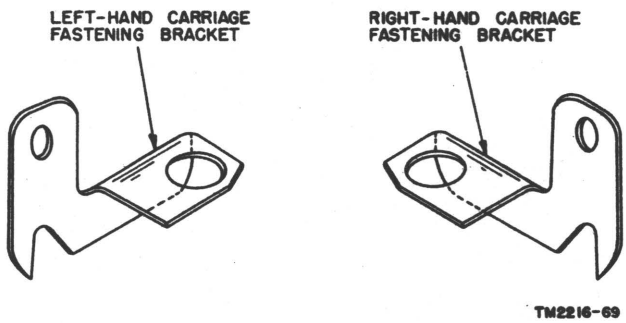


Figure 283. Right carriage bracket PK–21296.

(6) Mount the PK–21297 (left) bracket in a similar manner and tighten the track front mounting screws (figs. 23 and 283).

(7) Press the carriage return lock bar again to make certain that any stress on the spacing mechanism is relieved (fig. 285).

(8) Remove the 74876 paper roll spindle, the 7835 ribbon, and the 80466 platen crank. Place them in the PK–21300 cloth bag and tie the bag to the side frame between the spindle drag spring and the retaining plate.

(9) Fasten the other end of the bag to detail No. 5 with a tack or nail (fig. 284). Fasten the cloth bag sufficiently tight to prevent it from swinging.

(10) Tie the signal bell hammer to the rear crossbar with a suitable string.

(11) Place the PK–21305 sheet of wax paper between the type bar backstop and the type bars (fig. 284).

(12) Fold the tissue paper into a pad and place it on top of the type bars. Bind the paper pad in position so that the type bars

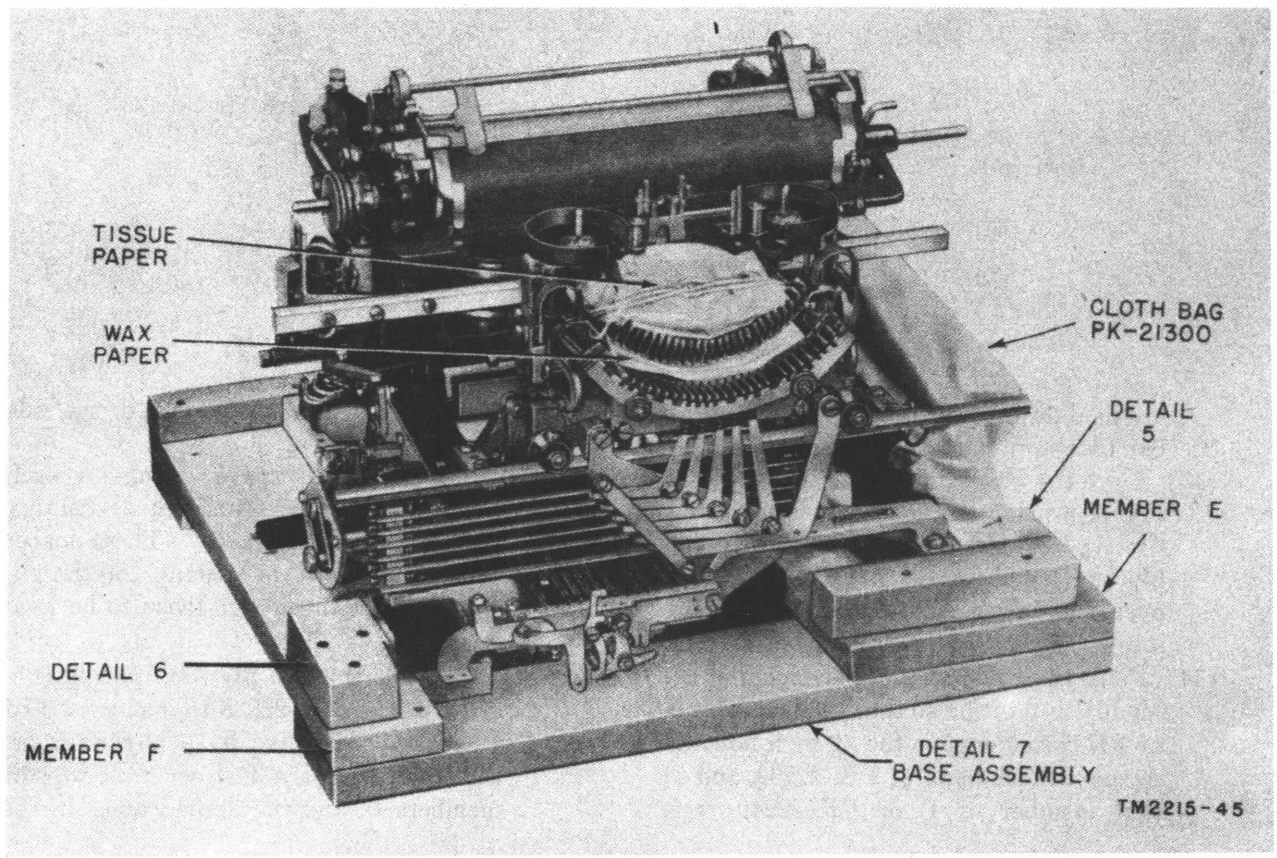


Figure 284. Typing unit in place on wooden base assembly, front view.

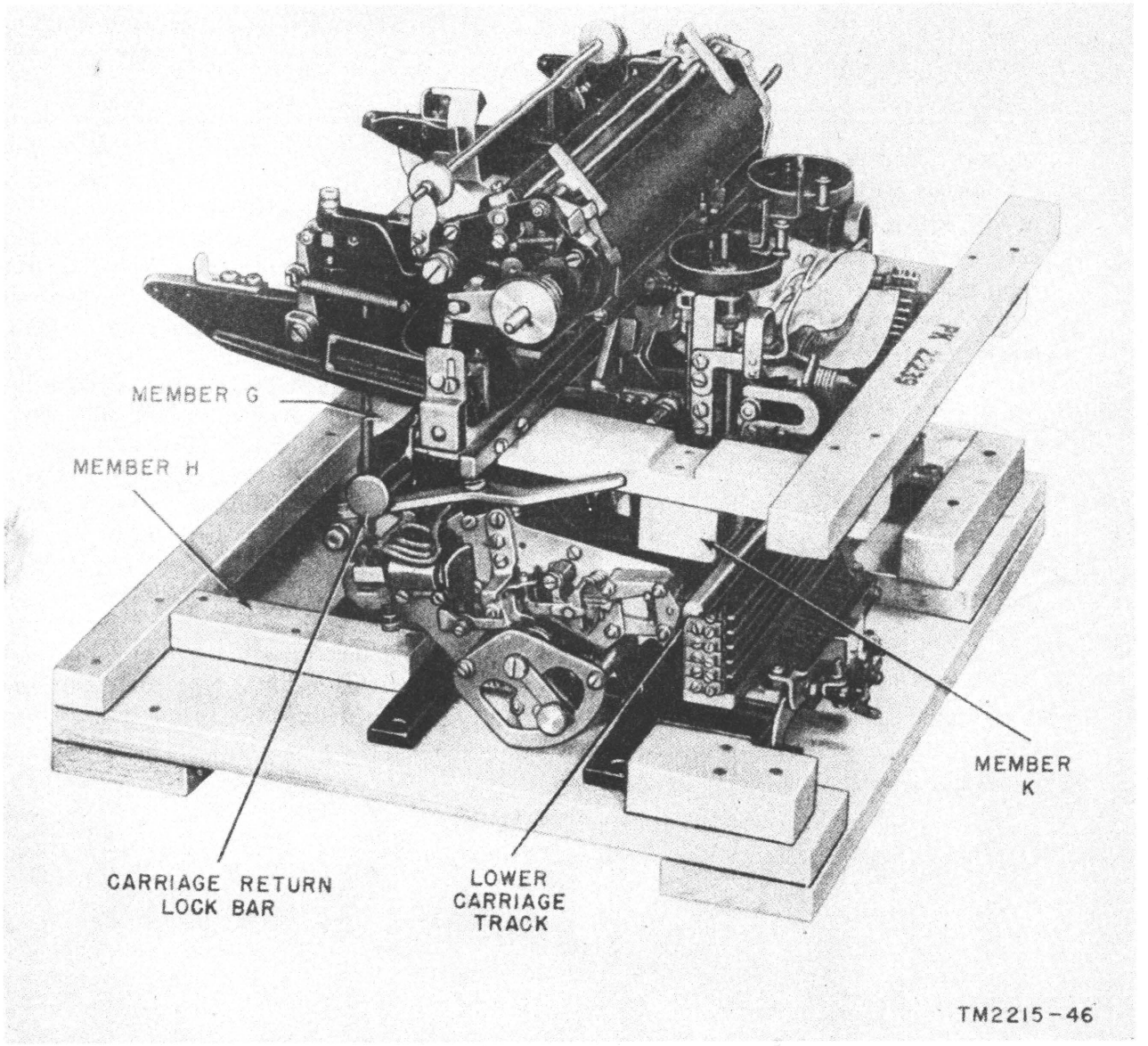


Figure 285. Typing unit in place on wooden base assembly, left side view.

are held down by a string tied to the type bar backstop (fig. 284).

(13) Place the PK–22239 lower block assembly in position on the typing unit so that the 7/16-inch clearance holes in the cubic blocks (members K) of PK–22239 are over the lower carriage track support screws (fig. 285).

(14) Place the PK–22240 upper blocking assembly in position so that the members N of PK–22240 engage the 7/8-inch notched section of member J of PK–22239, and so that member of P of PK–22240 rests firmly on the rear projections of the side frames (fig. 286).

(15) Place a 1-inch spacer block on each member L of PK–22240 an equal distance from each end (fig. 286). These spacer blocks give uniform spacing for the engagement of the wedge locks to be used later.

(16) Assemble the two plywood panels (detail No. 4 of PK–22238 to members B of PK–22241 with five fivepenny nails, so that the panels are flush with the tops of members B, and the drilled holes in the

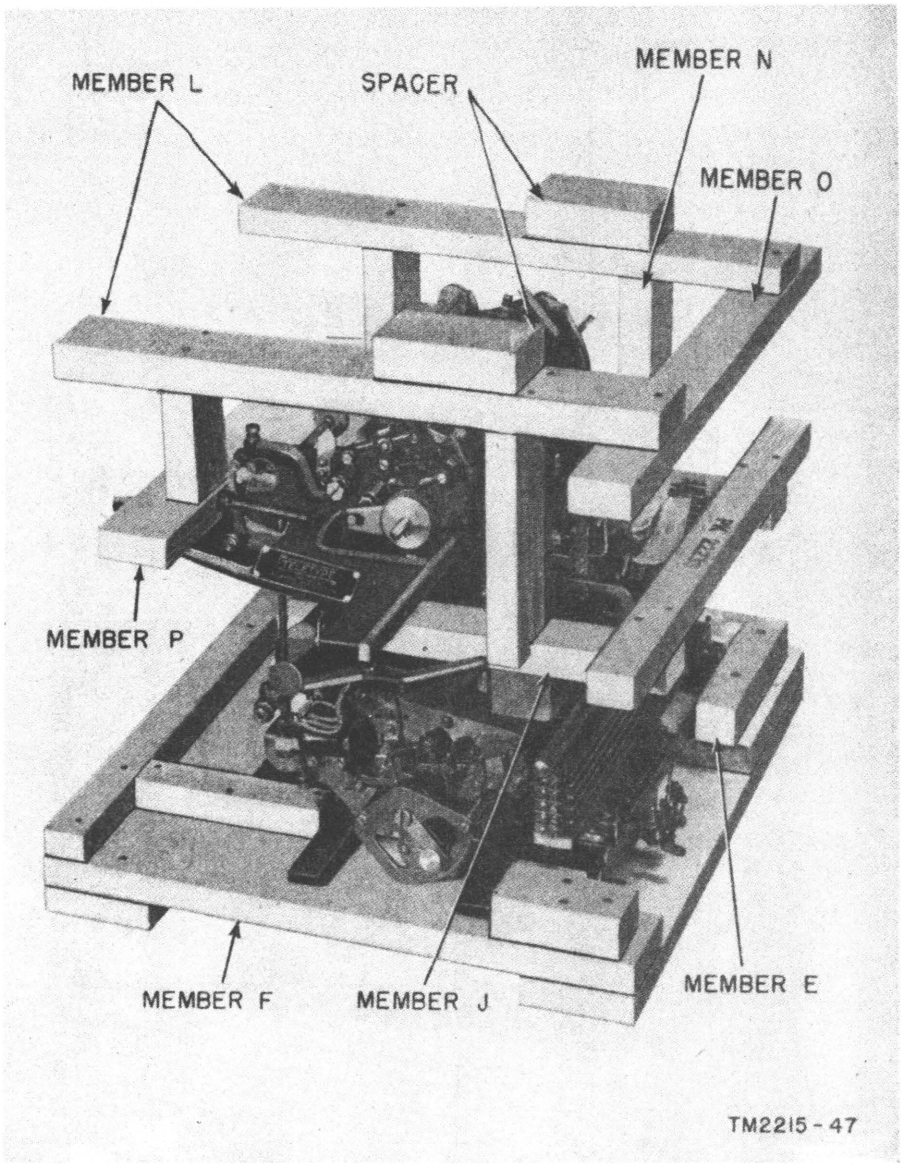


Figure 286. Construction of typing unit crate.

panels are located at the bottom (opposite end from members B) (fig. 287).

(17) Place the assembly over the typing unit with the plywood panels to the front and rear of the typing unit.

(18) Fasten the plywood panels (detail No. 4) to members C, E, and F of detail No. 7 with 10 No. 8 wood screws inserted through the holes drilled in the panels. The panels should be flush with the bottom of members C (fig. 287).

(19) Assemble the four wedge locks (82074) with the ends of their springs hooked to the nail in each half of the wedge lock and insert them between the parallel members of A of PK–22241 and member L of PK–22240 directly above the vertical members of PK–22240 (fig. 287).

(20) Remove the spacer blocks (fig. 287) and tap members A lightly above the wedge locks to increase the tension applied by the wedge locks and to remove any looseness in the assembly.

(21) Fasten each *top wedge only* of the wedge locks with two 1-inch nails to member A.

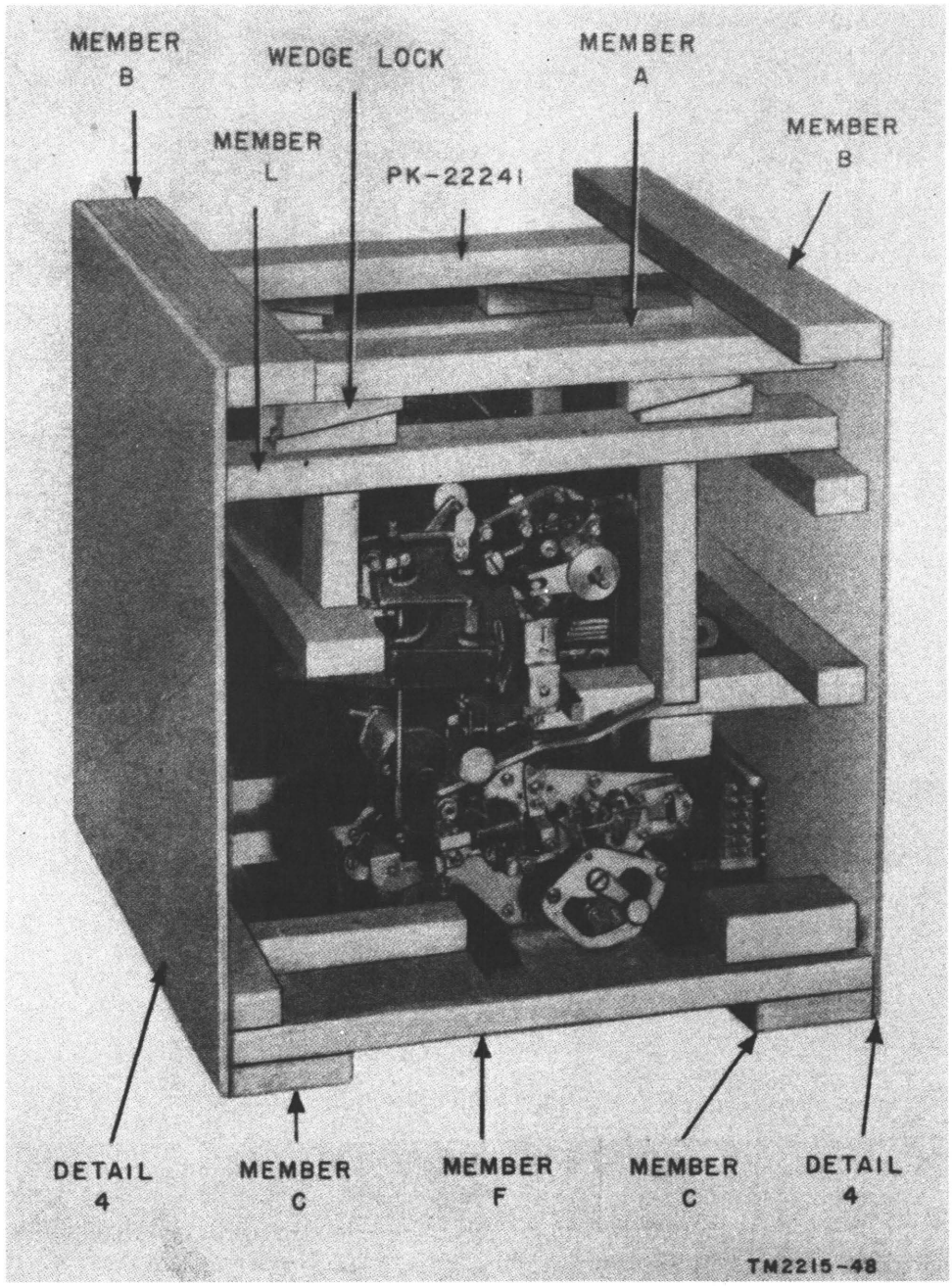


Figure 287. Typing unit in wooden crate.

(22) Check all details for correct position and for any movement between the typing unit and the assembled crate.

(23) Staple or tack the unpacking instruction card PK–21217 to the members A of the top frame PK–22241 (fig. 281).

(24) Form the bottom of the corrugated carton PK–10718 as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Two additional strips of gummed paper tape should be used to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(25) Place the crated typing unit in the PK–10718 carton and seal the flaps as indicated in 24 above.

(26) Stencil "This Side Up" and "Open Here" on top of the carton with waterproof ink.

(27) For domestic shipment, also make up corrugated carton PK–11289, close and seal the bottom as indicated in 24 above if required.

(28) Form one PK–22214 corrugated detail sheet (for domestic shipment only) as scored and place it in the bottom of PK–11289 carton with the pleats downward and adjacent to the bottom flaps of the carton.

(29) Place the sealed carton PK–10718 inside carton PK–11289 (for domestic shipment ony) on top of the formed corrugated detail.

(30) Form and insert one corrugated detail sheet of PK–22215 (for domestic shipment only) at each corner of the sealed carton. Disregard (27) through (31) if export packing is desired.

(31) Form another PK–22214 (for domestic shipment only) corrugated detail sheet and place it on top of the sealed carton.

(32) Close the top flaps of the PK–11289 carton (if used) and seal as indicated in (24) above.

(33) Place two bands of cloth tape, girthwise, around the PK–11289 (if used) approximately 4 inches from the edges. The ends of the tape should overlap other approximately 3 inches.

(34) The top of the PK–11389 carton (or the PK–10718 carton if for export) should be stenciled "This Side Up" and "Open Here."

(35) Apply the label "FRAGILE MATERIAL, HANDLE WITH CARE" to the top of the carton.

e. Additional Procedure for Export Packing (Box 3/7).

(1) Place the typing unit carton PK–10718 in the rigid metal barrier PK–18328 with the PK–22191 pads and the PK–21336 silica gel tray with 11 pounds of PK–21203 silica gel on top.

(2) Seal the metal barrier with 50/50 solder.

(3) Float the metal barrier with 3 inches of excelsior (packed 3 to 5 pounds per cubic foot) in the PK–1156 nailed wooden box marked "3/7".

(4) Nail the cover in place and strap the wooden shipping box with two PK–21207 steel bands placed 5 inches from the ends of the box and seal the bands with PK–21210 seals.

(5) Staple the bands at 6-inch intervals with PK–21208 staples.

(6) Stencil the contents clearly on the outside of the wooden box.

505. Motor Unit

(fig. 288)

a. Domestic Material. The PK–23006 domestic packing material for a motor unit (synchronous or governed) consists of the following:

Quantity	Material	Part No.
3	Screws	RM–71677
3	Nuts	RM–71292
3	Lockwashers	2669
6	Washers	RM–72295
1	Corrugated carton (with liner)	PK–9603
1	Label "FRAGILE MATERIAL, HANDLE WITH CARE."	PK–21250
1	Label	PK–21328
1	Set-up (lamp) box	PK–21280
1	Wood base (pallet)	PK–22113

b. Additional Material Needed (Not Furnished). Additional materials needed are 10 feet gummed paper tape (3 inches wide) and 4 square feet of tissue paper.

c. Additional Material for Export Packing.

Quantity	Material	Part No.
1	Rigid metal barrier	PK–17201
1	Outer corrugated carton	PK–10568
3	Silica gel (3 lb gel)	PK–21203
1	Silica gel tray	PK–21340
2	Pads	PK–22319
	Pads	PK–22288
	Excelsior	

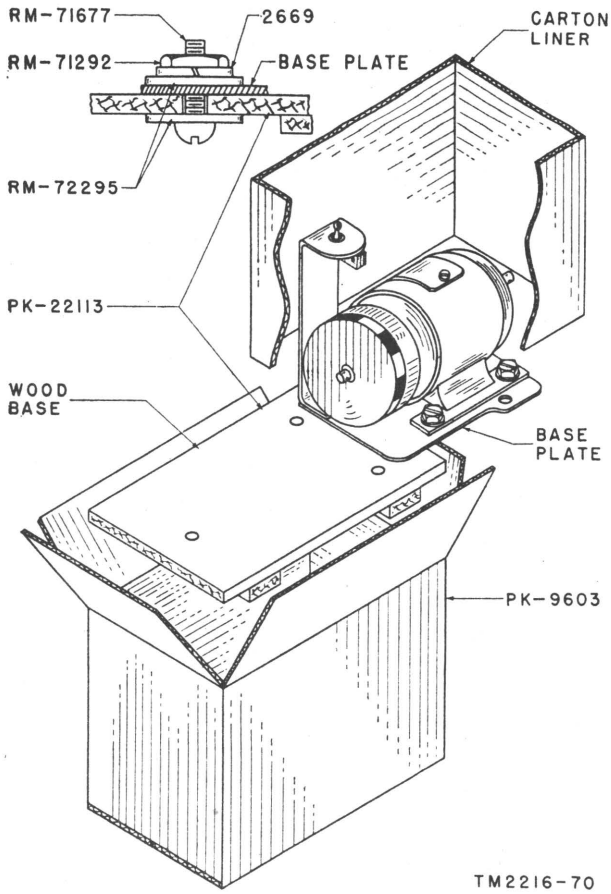


Figure 288. Motor unit packing details.

d. Procedure for Domestic Packing.

(1) Place the motor unit on the wooden base PK–22113 so that the three motor plate mounting holes line up with the three drilled holes in the wooden base.

(2) Fasten the motor unit to the wooden base with the three RM–71677 screws, 74032 washers, RM–72295 washers, 2669 lockwashers, and RM–71292 nuts (fig. 288). If the motor unit has a target lamp, remove the lamp, wrap it in tissue paper, place it in set-up box PK–21280, and tie the box securely to the lamp bracket with a string passed through the wire loops of the box.

(3) Form the bottom of the corrugated carton PK–9603 as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(4) Place the motor unit and its attached wooden base in the carton so that the wooden base rests on the bottom of the carton.

(5) Place the corrugated liner around the inside of the carton so that its bottom end rests on top of the wooden base. Make certain that the top edge of the liner does not extend above the top of the carton.

(6) Close the top flaps of the carton and seal the carton.

(7) Apply the label "FRAGILE MATERIAL, HANDLE WITH CARE" to the top of the carton.

e. Additional Procedure for Export Packing.

(1) Place the packed PK–9603 motor unit carton in the PK–17201 rigid metal barrier with the PK–22319 and the PK–22288 pads, and with the PK–21340 tray containing 3 pounds of PK–21203 silica gel.

(2) Seal the PK–17201 metal barrier with 50/50 solder and waterproof cement.

(3) Float the sealed metal PK–17201 in 3 inches of excelsior in the PK–10568 carton.

(4) Place the packed PK–10568 in wooden box 5 (marked "5/7").

506. Relay

(fig. 289)

This paragraph provides instruction for domestic and export packing of the RY–30 relay and for protection of this unit against excessive contact erosion and formation of black dust due to presence of hydrocarbon vapors.

a. MATERIALS NEEDED. The domestic and export packing materials for an RY–30 relay consist of the following:

Quantity	Material	Part No.
1 (domestic packed).	Manufacturer's carton	None
1	Corrugated fiberboard carton.	PK–8741
1	Corrugated fiberboard detail.	PK–22156
1	Moisture-vaporproof barrier.	PK–23188
2	2-oz bag of silica gel	PK–21226
4′	3″ gummed paper tape	PK–21205

Note. Pack in PK–9518 carton and then in wooden box with the transmitter distributor and other parts.

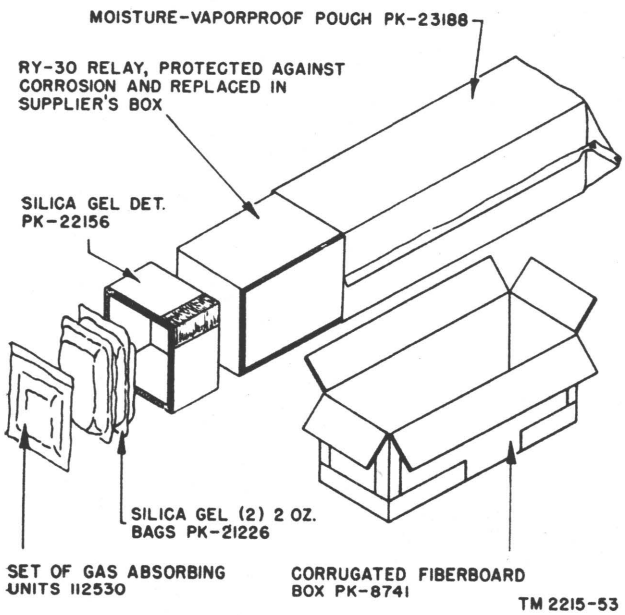


Figure 289. Line relay packing detail.

b. PROCEDURE FOR EXPORT PACKING. This subparagraph covers export packing of the RY–30 relay in a heat-sealed moisture-vaporproof barrier with a dehydrating agent. The relay should be packed in accordance with the methods and sequence of operations as follows:

(1) Place the RY–30 relay packed (domestic) in the supplier's carton in moisture-vaporproof barrier PK–23188.

(2) Place the corrugated fiberboard detail (PK–22156) over the relay carton with two 2-ounce bags of silica gel (PK–21226, all within PK–23188).

(3) Insert the barrier bag containing the gas adsorbing detail unit 112530 against the silica gel inside the gel tray and heat-seal the barrier (PK–23188).

(4) Form the corrugated fiberboard carton PK–8741. Seal the long seams of the bottom flaps with 3-inch gummed tape and use additional strips for sealing the flaps along the ends of the carton.

(5) Place the sealed moisture-vaporproof barrier (PK–23188) in the outer carton (PK–8741).

(6) Close the top flaps of the carton and seal it with 3-inch gummed tape.

(7) Mark the carton as required and place it in the PK–9518 carton with the other parts.

(8) Pack in wooden box 6/7 with consolidated parts.

507. Base Unit

(fig. 290)

a. MATERIALS NEEDED. The PK–23304 domestic packing material for a standard model 15 base consists of the following:

Quantity	Material	Part No.
1	Corrugated carton	PK–9920
1	Label "FRAGILE MATERIAL, HANDLE WITH CARE".	PK–21250
1	Corrugated detail set consisting of scored sheets as follows: 1 detail A (15⅝″ x 47⅝″). 3 detail B (10¼″ x 28¾″). 1 detail C (10¼″ x 27 1/16″). 2 detail D (6¾″ x 18″).	PK–22139

b. ADDITIONAL MATERIAL NEEDED (NOT FURNISHED).

(1) Gummed paper tape 3 inches wide, 18 feet long.

(2) Tissue paper, 10 square feet.

c. Additional Material for Export Packing Packing Base (Box 5/7).

Quantity	Material	Part No.
1	Rigid metal barrier	PK–17623
1	Outer corrugated carton	PK–11363
1	Silica gel tray	PK–21346
6	Silica gel (6 lb)	PK–21203
	Excelsior	
1	Label	PK–21250
1	Void detail	PK–21362
1	Void detail	PK–21363
1	Waterproof liner for wooden box PK–1334.	PK–19029
1	Wooden box (marked 5/7) for motor unit and base unit.	PK–1334
	Steel strapping (⅝″ x .020″) for 3 bands. Locate outer bands 7″ from outer ends of PK–1334.	PK–21207
	Strap seals	PK–21210
	Strap staples to be located at 6″ intervals.	PK–21208
	Packing slip	PK–21383
	Packing slip waterproof envelope	PK–21211
	Packing slip envelope protector	PK–21212

d. Procedure for Domestic Packing. Remove the relay from the mounting bracket.

(1) Fold the base cords, wrap them with tissue paper, place them in the large cavity of the base, and tie them securely with string inserted through a large hole at the right side.

(2) Form the bottom of the corrugated carton (PK–9920) as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(3) Fold detail A of PK–22139 as scored (fig. 290). Place the detail centrally in the bottom of the carton.

(4) Place the model 15 base in the carton between the folded sections of detail A, with the rear part of the casting toward the smaller folded section.

(5) Fold detail C of PK–22139 as scored (fig. 290). Place it between the side of the base and the inside of the carton at the corner of the base where the toggle switch is mounted. Make sure that the top of the detail is flush with the top of the carton.

(6) Fold the three details B of PK–22139 as scored (fig. 290). Place them between the side of the base and the inside of the carton at the other three corners of the base. Make sure that they are flush with the top of the carton.

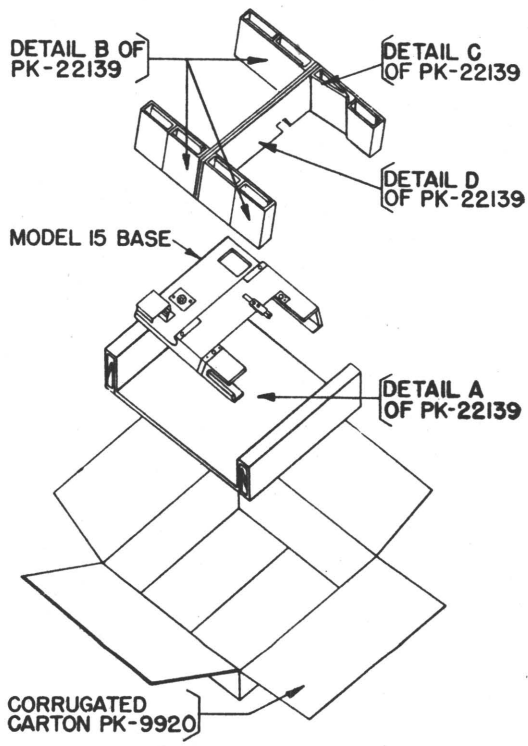


Figure 290. Packing details for model 15 base.

(7) Place the two details D of PK–22139 together so that the slits in their edges meet. Form a notch at the slits to provide clearance for the contact pile-up near the middle of the base (fig. 290).

(8) Place the two details D edgewise across the top of the base so that one end fits between the two details B and the other end between detail B and detail C. Make sure that the top edges of details D are flush with the top edge of the carton.

(9) Close the top flaps of the carton and seal them with gummed paper tape.

e. Additional Procedure for Export Packing (Box 5/7).

(1) Place the packed base unit carton PK–9920 in the rigid metal barrier (PK–17623) with the PK–22326 pads, and with the (PK–21346) tray containing 6 pounds of the PK–21203 silica gel.
(2) Seal the metal barrier.
(3) Float the sealed metal barrier in 3 inches of excelsior in the PK–11363 carton, seal the carton, and add the PK–21250 label.
(4) Place the sealed PK–11363 carton containing the base in the PK–1334 wooden box marked 5/7 and lined with PK–19029 waterproof paper. Place the packed motor unit in the same wooden box along with the PK–21362 and PK–21363 void details.
(5) Nail the cover in place and strap the wooden box with three PK–21207 steel straps. Locate the outer bands 7 inches in from the ends of the box.
(6) Seal the steel straps with PK–21210 strap seals, then staple at 6-inch intervals with PK–21208 staples.
(7) Attach the packing slip list of contents securely to the wooden box.

508. Transmitter Distributor

(fig. 291)

a. Necessary Materials. The PK–23310 domestic packing materials for a transmitter distributor consist of the following:

Quantity	Material	Part No.
1	Corrugated carton	PK–9730
1	Corrugated liner (16 15/16″ x 9 13/16″ x 9 13/16″).	PK–22071
1	Corrugated tray (18⅛″ x 13 15/16″)	PK–22086
1	Wooden base	PK–22084
1	Wooden cover frame	PK–22085
1	Label "Fragile Material, Handle With Care."	PK–21250

b. Additional Material Needed (Not Furnished).

(1) Gummed paper tape, 3 inches wide, 12 feet long.
(2) Cloth tape at least 2 inches wide and 8 feet long.
(3) Tissue paper as required.

c. Additional Material Used for Export Packing (Box 6/7).

Quantity	Material	Part No.
1	Label	PK–21328
1	Rigid metal barrier	PK–17576
5	Silica gel (5 lb)	PK–21203
1	Silica gel tray	PK–21350
2	Pads	PK–22122
2	Pads	PK–22177
	Excelsior	
1	Corrugated carton	PK–11121
1	Void detail	PK–21373
1	Void detail	PK–21374
1	Waterproof paper liner for wooden box PK–7132.	PK–19033
1	Wooden box (marked 6/7) for transmitter distributor, relay, and small parts.	PK–1132
	Steel strapping (⅝″ x .020″) for 2 bands, outer bands to be located 5½″ from ends.	PK–21207
	Strap seals	PK–21210
	Strap staples	PK–21208
	Packing slip	PK–21384
	Packing slip envelope	PK–21211
	Packing slip envelope protector	PK–21212

d. Procedure for Domestic Packing.

(1) Wrap the tape stop arm to hold it in a horizontal position and to protect it from possible damage.
(2) Place the unit inside the PK–22084 wooden base with the transmitter end over the smaller of the two wooden blocks.

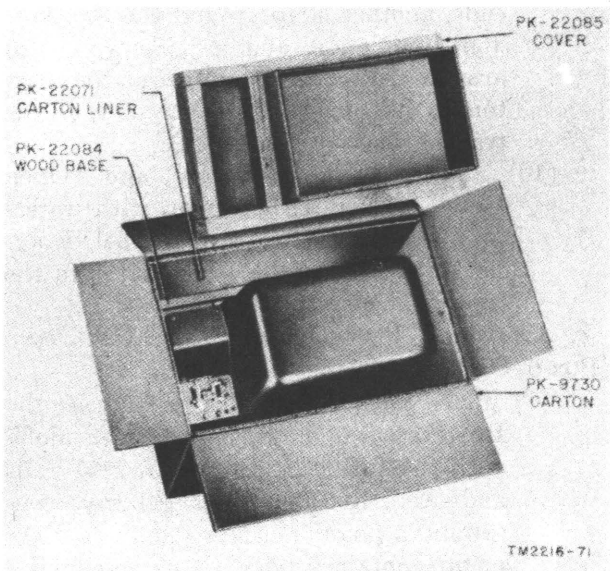


Figure 291. Transmitter distributor packing details.

(3) Shape the PK–22071 corrugated liner and place it around the outside of the PK–22084 wooden base so that the liner is flush with the bottom of the wooden base.

(4) Form the PK–22086 corrugated tray as scored and place it over the cover of the unit with the flanges of the tray projecting downward inside the liner.

(5) Place the PK–22085 (top) wooden cover frame over the PK–22086 tray. The wooden cover frame and corrugated tray should fit snugly over the unit cover and should be flush with the top edges of the liner.

(6) Form the bottom of the PK–9730 corrugated carton as scored. Seal the long seam formed by the bottom flaps with gummed paper tape. The tape should extend approximately 3 inches up the sides of the carton. Use two additional strips of gummed paper tape to seal the edges of the flaps along the bottom of the carton. These strips should extend approximately 3 inches around each corner of the bottom edges of the carton.

(7) Place the PK–9730 open carton over the assembled unit and press it downward. Turn the packed carton over so that its open end is upward.

(8) Close and seal the carton.

(9) Reinforce the sealed carton by placing a strip of cloth tape around the sides and ends, another strip around the top, bottom, and ends, and a strip girthwise around the center. Restore the carton to its upright position so that the transmitter will be upright.

(10) Stencil "This Side Up" and "Open Here" on top of the carton with waterproof stencil ink. Paste the label "Fragile Material, Handle With Care" to the top of the carton.

e. Additional Procedure for Export Packing (Box 6/7).

(1) Place packed carton PK–9730 in the PK–17576 rigid metal container along with the PK–22122 and PK–22177 pads and the PK–21350 silica gel tray containing 5 pounds of silica gel. Seal the metal container with 50/50 solder and cement.

(2) Place the packed metal container in the PK–11121 corrugated carton lined with 3 inches of excelsior packed 3 to 5 pounds per cubic foot. Seal the carton.

(3) Place this PK–11121 carton in the PK–1132 wooden box after lining the box with moistureproof paper barrier. Arrange the transmitter distributor in the box with void details PK–21373 and PK–21374 and other smaller parts.

(4) Nail the cover in place and strap the PK–1132 wooden box with 2 bands of steel strapping located 5½ inches from the outer ends and seal the straps with PK–21210 seals. Staple the straps at 6-inch intervals with PK–21208 staples.

509. Rectifier

a. Packing Materials (Box 1/7).

Quantity	Material	Part No.
1	Rigid metal barrier	PK–17762
1	Wooden base details	PK–21352
2	Cushioning pads	PK–22251
2	Cushioning pads	PK–22325
1	Silica gel tray	PK–21351
5	Silica gel (5 lb)	PK–21203
1	Nailed wooden box	PK–1333
	Excelsior (packed 3 to 5 lb per cu ft).	
	Steel strapping (⅝″ x .020″) for 2 bands.	PK–21207
	Strap seals	PK–21210
	Strap staples, to be located at 6″ intervals.	PK–21208

b. Procedure For Export Packing (Box 1/7).

(1) Coil the cords together on top of the rectifier and wrap paper around the plug and the two receptacles to pad and hold them in place.

(2) Place the rectifier in its regular fiberboard carton.

(3) Place the carton containing the rectifier in the PK–17762 rigid metal barrier with the PK–21351 tray containing 5 pounds of silica gel on top. Seal the lid of the metal barrier.

(4) Float the sealed metal barrier with 3 inches of excelsior in the PK–1333 nailed wooden box No. 1 (1/7).

(5) Nail the cover on the box and strap the box with two PK–21207 metal bands located 5½ inches from the outer ends of the box.

(6) Seal the bands with PK–21210 strap seals and staple them at 6-inch intervals with PK–21208 strap staples.

(7) Clearly stencil contents on the outside of the box.

510. Spare Parts (Consolidated Package PK–9518)

a. Packing Materials. This paragraph provides a list of all parts or spare parts that go into the consolidated package, carton PK–9518, which is to be packed with the transmitter distributor in wooden box PK–1132, marked 6/7.

b. Consolidated Package Export Packing (Box 6/7). Each of the following parts is placed in the PK–9518 carton after individual packing and sealing:

(1) *RY–30 relay.* Refer to paragraph 506 for the necessary materials and instructions for packing the relay.

(2) *Fusetrons.* Fusetrons are wrapped in tissue paper, placed in individual foil bags, and then put in PK–6796 cartons.

(3) *Set of gears.* Paragraph 501 gives the list of materials necessary for packing the 80374 set of gears and instructions for packing them.

(4) *Tuning fork.* Remove the tuning fork from the box or container in which it is kept and clean it with PK–21228 cleaning solvent; then lubricate it with PK–21220 lubricating oil. Wrap the tuning fork in greaseproof paper and then place it in the PK–6261 carton; put the carton in a PK–23154 foil bag and seal the bag. Place the sealed bag in a PK–6774 carton.

(5) *Lamps.* Do not remove the 74557 lamps from the sleeves furnished by the manufacturer. Wrap the lamps individually in tissue paper, then place them in the foil bags furnished for packing, and put the foil bags in the two PK–6793 cartons. Wrap the 125404 lamp in tissue paper, then put it in a PK–6417 carton. Place that carton in a PK–7125 carton which is put in a PK–23192 foil bag.

(6) *Ribbons.* First, place the teletypewriter ribbons in a foil bag, then in a PK–6793 carton.

(7) *Rectifier tubes.* Wrap the 106858 rectifier tube in kimpak, then place it in a foil bag and then in an outer box. Replace the two 105405 rectifier tubes in the manufacturer's cartons in which they were shipped, and then put these cartons in individual foil bags.

(8) *Neon lamp.* Wrap the 106859 neon lamp in kimpak, place it in a PK–6971 carton and place in a foil bag. Place the foil bag in carton PK–7005 and place that carton in the PK–6971 box.

(9) *Technical manuals.* Place two technical manuals regarding the equipment individually in foil bags.

(10) *Copyholder.* Place the copyholder in a PK–8537 carton, put the carton in a PK–23197 foil bag, and place the bag in a PK–8540 carton.

c. Transmitter Distributor Export Package. This unit, carton PK–11121, also is packed in wooden box 6/7 with the consolidated package of spare parts. Refer to paragraph 508 for instructions in packing the transmitter distributor and the wooden box marked 6/7.

d. Teletypewriter Paper (Box 7, Marked 7/7). This carton contains 16 rolls of foil-wrapped, yellow teletypewriter paper. If the paper is not part of the set, the boxes will be numbered from 1/6 to 6/6.

511. Table

a. Packing Materials. Domestic packing materials for the table consist of the following:

Quantity	Material	Part No.
1	Nailed wooden box	PK–1138
4	Wooden block details	PK–22147
4	Felt pad 5″ x 2½″ x ⅜″	PK–21242
1 sheet	Tissue paper	PK–21298
1	Gummed label	PK–21250
1	Gummed label	PK–21328
As required	Suitable twine	
8	¾″ nails	PK–21355
28	8-d nails	MM–1857

b. Export Packing Material Used for Packing Table (Box 2/7).

Quantity	Material	Part No.
1	Rigid metal barrier	PK–18245
1 set	Details (frame, cushioning, and silica tray).	PK–22145
4	Fiberboard cushioning details.	PK–22045
9	Silica gel (9 lb)	PK–21203
1	Silica gel (½ lb bags)	PK–21202
1	Wooden box	PK–1568
	Excelsior	
	Steel strapping (for 3 bands to be spaced 8″ from ends of box).	PK–21207
	Strap seals	PK–21210
	Strap staples (at 6″ intervals).	PK–21208

c. Procedure for Domestic Packing Only. The table should be packed for domestic shipping as follows:

(1) Wrap the wiring diagram together with the muslin bag containing the rubber feet and fuses, in tissue paper and tie securely to the shelf of the table with suitable twine.

(2) Remove the cover from wooden box PK–1138 and attach four felt pads PK–21242 by nailing them at the four upper inside corners of the box approximately 2 inches from the top with ¾-inch nails (PK–21355). Fold the felt at the center and attach it so that it will engage and protect the sides and end corners of the table top, and eliminate all free play and clearance.

(3) Place the table inside the box and see that the felt pads in the corners of the box engage and protect the table top corners.

(4) Place one block with the felt engaging the top of the table at each of the four corners of the box. The height of these blocks should be such that when the felt is compressed slightly the top of the wooden block PK–22147 should be flush with the top edge of box PK–1138.

(5) After locating the cover boards, nail blocks to the cover boards with one eight-penny nail MM–1857 before attaching the cover.

(6) Nail the cover boards to the ends and sides of the box with approximately 24 eight-penny nails MM–1857.

(7) Tear the top white sheet from the RM–150929A shipping tag and paste it securely to the upper right end of the box.

(8) Paste label PK–21250 to the top rear left of the box, and paste a PK–21328 label to the top rear right of the box to indicate *Open Here* and *This Side Up*.

d. Procedure for Export Packing.

(1) Place the two U-shaped details (PK–22145) in the PK–18245 metal barrier, one at each end, so that the open felt-lined sides are vertical and the felt-lined surfaces face each other toward the inside center of the barrier.

(2) Fill in the space between the metal and U pieces with the scored fiberboard pads, PK–22045. Set the table in the metal barrier so that its edges are protected by the felt-lined corners formed by the U pieces.

(3) Place one of the two crosspieces of detail PK–22145 along each side with its notch toward the center of the container and the felt pads pressing down against the top of the table. The ends of the crosspieces should engage the top ends of the U pieces in the metal container.

(4) Place the silica gel tray on top of the table so that its wooden lugs fit into the notches of the crosspieces.

(5) Place the silica gel units PK–21203 and PK–21202 (approximately 10 lb) in the silica gel tray and hold them in place with the two ¼-inch plywood covers.

(6) Seal the cover on the metal container with 50/50 solder.

(7) Float the sealed metal container in 3 inches of excelsior, packed 3 to 5 pounds per cubic foot, in wooden box PK–1568 and nail the cover in place on the box.

(8) Strap the PK–1568 wooden box with three PK–21207 metal bands; locate the outer bands 8 inches in from the ends of the box. Seal the straps with PK–21210 seals and staple the straps at 6-inch intervals with PK–21208 staples. Clearly stencil contents on the outside of the box.

Section II. DEMOLITION TO PREVENT ENEMY USE

512. Methods of Demolition

a. SMASH. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

b. CUT. Use axes, handaxes, and machetes.

c. BURN. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

d. EXPLODE. Use firearms, grenades, and TNT.

e. OTHER. Use anything immediately available for destruction of this equipment.

f. DISPOSAL. Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

513. Destruction of Components

When ordered by the commander, destroy all equipment to prevent its being used or salvaged by the enemy.

a. Smash (par. 512*a*) selecting and transmitting mechanisms, relays, transformers, coils, resistors, capacitors, motor frames and armatures, rectifier tubes, main power unit, switches, slip connection contacts, jacks, plugs, covers, table and name plates and other identifying marks.

b. Cut (par. 512*b*) all wiring, cords, cables, selector magnet, relay, rectifier transformer, and motor windings.

c. Burn (par. 512*c*) circuit labels, diagrams, and instruction books.

d. Bury or scatter (par. 512*e*) all smashed, bent, and otherwise destroyed parts.

e. Destroy everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, check SR 310–20–3 for field manuals, training aids, and JANAP's. Check SR 310–20–4 for technical manuals, technical bulletins, and changes.

1. Technical Manuals on Associated Equipment

TM 11–356	Radio Teletype Terminal Equipment, AN/FGC–1 or AN/FGC–1X.
TM 11–358	Telegraph Central Office Set TC–3 and Switchboard BD–100.
TM 11–486	Electrical Communication Systems Engineering.
TM 11–2056	Test Unit I–236 and I–236–A.
TM 11–2201	Reperforator Teletypewriter Sets TC–16 and TC–17.
TM 11–2203 AFM 102–2	Teletypewriter Sets AN/TGC–1 and AN/TGC–1A AFM 102–2.
TM 11–2208	Test Set TS–2/TG. Teletype Manual No. 43.
TM 11–2209	Teletypewriter Repeater Mixer AN/FGQ–1.
TM 11–2210	Instruction Book, 132A2 Teletypewriter Subscriber Set and Associated Equipment.
TM 11–2211	131A1 Teletypewriter Table and Associated Printer Apparatus.
TM 11–2214	Teletypewriter Set AN/TGC–3.
TM 11–2215	Teletypewriters TT–5/FG and TT–6/FG.
TM 11–2217	Distortion Test Set TS–383/GG and TS–383A/GG.
TM 11–2219	Typing Reperforator Sets 10.4A and 10.5A (Teletypewriter).
TM 11–2222	Receiving Transmitter Distributors TT–12/FGQ–1, TT–13/FGQ–1 and Transmitter Distributors TT–21/FG, TT–25/FG, TT–26/FG, TT–52/FG (Including other Teletype Model 14 Transmitter Distributors).
TM 11–2223	Typing and Nontyping Reperforators, Teletype Model 14.
TM 11–2234	Teletypewriter TT–4/TG.
TM 11–2235	Teletypewriter Set AN/PGC–1.
TM 11–2236	Teletypewriter TT–61/FG.

2. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69	Lubrication of Ground Signal Equipment.

3. Packaging and Packing Information

a. Joint Army-Navy Packaging Specifications.

JAN–D–169	Desiccants, Activated.
JAN–P–100	Packaging and packing for overseas shipment—General specification.
JAN–P–106A	Packaging and packing for overseas shipment—Boxes, wood, nailed.
JAN–P–116	Packaging and packing for overseas shipment—Preservation, methods of.
JAN–P–131	Packaging and packing for overseas shipment—Barrier-material, moisture-vaporproof, flexible.

b. U. S. Army Specification.

100–2E	Marking Shipments by Contractors.

4. Decontamination

TM 3–220	Decontamination.

5. Demolition

FM 5–25	Explosives and Demolitions.

6. Other Publications

SR 310–20–3	Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications).
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.
SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247).
SR 745–45–5 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), and AF–MC–U2 (Air Force)).
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TM 1–455	Electrical Fundamentals.
TM 11–462	Signal Corps Tactical Communication Reference Data.
TM 11–680	Teletypewriter Circuits and Equipment (Fundamentals).
TM 11–5500	Multimeter TS–297/U.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in the table in paragraph 2 of this appendix is not sufficient basis for requisitioning the item. Requisitions must cite a T/O & E, T/A, Sig 7 & 8, list of allowances of expendable material, or other authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

1. Identification Illustrations

Figures 292 through 334 illustrate and identify parts used in Teletypewriters TT–7/FG and TT–8/FG. Numbers for these parts are the manufacturer's part numbers. Signal Corps stock numbers for the parts appear in paragraphs 2 through 10 of this appendix, and, in most instances, they are the manufacturer's parts numbers plus the prefix 4T.

2. Teletypewriters TT–7/FG Sig C Stock No. 4T4.15A–1) and TT–8/FG (Sig C Stock No. 4T4.13A–1)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
292	BASE ASSEMBLY, printer: cast alloy, black enamel finish; approx 16″ lg x 16″ wd x 9″ h o/a. Paragraph 3, appendix II, contains identification table of parts for the base assembly.	Mounts typing unit, motor, and keyboard.	4TBB44
327	COVER, teletypewriter: printer and perforator; black wrinkle finish; counter on left, includes perforator cover, printer cover, reel bracket, reel cover, container, and glass rails. See paragraph 4, appendix II for detail identification table of parts for the cover.	Covers teletypewriter	4TPEXC200AA
323	MOTOR UNIT PU–109/GG, AC: Teletype part #MU–27; series-governed; 1/25 hp, 110-volt; 60-cyc, single ph, 2100 rpm. Refer to paragraph 5, appendix II for an identification table of parts for the motor unit.	Furnishes mechanical power to drive teletypewriter.	4TMU27
9	PERFORATOR TRANSMITTER, 5-unit code: combination typing and punching at predetermined speed. See paragraph 6, appendix II, for an identification table of parts for the perforator transmitters. Keytops for the TT–7/FG perforator transmitter have communication characters. Keytops for TT–8/FG perforator transmitter have weather characters.	Transmits teletypewriter code signals to the line and perforates teletypewriter tape simultaneously or separately.	4TPEX25JX (TT–7/FG) 4TPEX25KQ (TT–8/FG)
331	RECTIFER REC–30, electron tube type: output 120 v dc; input 95 to 125 or 190 to 250 v ac, 25, 40, 50, or 60 cyc. See paragraph 7, appendix II, for an identification table of parts for Rectifier REC–30.	Provides filtered dc for signal circuits and adjusted ac for a-c motors.	4TREC30
330	RELAY, armature: polarized; SPDT; 5 25/32″ lg x 2 11/16″ wd x 2 11/16″ dia o/a. See paragraph 8, appendix II, for an identification table of parts for the polar relay.	Repeats signals to selector magnets.	4TRY30
332, 333	TABLE, metal: model 19; electrical service, assembly; black wrinkle finish; equipped with rubber feet; felt pad on top. See paragraph 9, appendix II, for an identification table of parts for the table.	Supports teletypewriter, rectifier, and transmitter distributor, and provides terminals for line and battery connections.	4TXRT202AA

2. Teletypewriters TT–7/FG (Sig C Stock No. 4T4.15A–1) and TT–8/FG (Sig C Stock No. 4T4.13A–1)—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
10	TRANSMITTER DISTRIBUTOR: single channel, 7.42 unit; 110 v ac, 60 cyc, governed motor w/single 10-spot target geared for 368.1 opm at 2102 rpm. For a detailed identification table of parts for the transmitter distributor, refer to TM 11–2222.	Transmits teletypewriter 5-unit, start-stop code from 11/16-inch tape.	4TXD200AA
13	TYPING UNIT: page printer; 5 unit code; friction paper feed. See paragraph 10, appendix II, for an identification table of parts for the typing unit. *Note.* Typing units for TT–7/FG and TT–8/FG are idential, except that TT–7/FG has type pallets for communications characters and is equipped with a mechanical motor stop. TT–8/FG has type pallets bearing weather characters and is not equipped with a mechanical motor stop.	Prints teletypewriter messages on paper.	4TBP22/210 (TT–7/FG) 4TBP93/221 (TT–8/FG)

3. Base of Model 15 Printer (Sig C Stock No. 4TBB44)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
292	CLAMP: cable; .036″ steel, zinc finish; L shape; 1 45/64″ lg x 7/16″ wd x 25/64″ d o/a.	Holds base wiring in place	4T91767
292	CLAMP: cable; .035″ steel, zinc finish; 1½″ lg x 7/16″ wd x 23/32″ d o/a.	Same as above	4T91766
292	CLAMP: cable; 3/32″ steel, zinc plated, chromate finish; 3½″ lg x ½″ wd x 7/16″ d o/a.	Same as above	4T99959
292	CLAMP: cable; retaining; .067″ steel, zinc plated, chromate finish; 3⅝″ lg x 1″ wd x 15/32″ d.	Same as above	4T99818
292	CLAMP: cable; .033″ steel, zinc plated, chromate finish; 31/32″ lg x ½″ wd x 21/64″ d o/a.	Same as above	4T8254
294	CONTACT, switch; spring type; tung contact	Part of SEND—REC—BREAK mechanism.	4T105221
294	CONTACT, switch; spring type; silver contact	Same as above	4T105222
294	CONTACT, switch: spring type; nickel silver; silver contact.	Same as above	4T105223
294	CONTACT, switch: steel, nickel silver finish	Same as above	4T74964
294	CONTACT, switch: .012″ steel, nickel finish; tung contact.	Same as above	4T82927
294	CONTACT, switch: .032″ nickel silver; jack type; solder lugs straight.	Closes line circuit when typing unit is removed from base.	4T2291
294	CONTACT, switch: .033″ nickel silver; jack type; solder lug straight.	Same as above	4T2924.
294	CONTACT, switch: spring type; .042″ steel, nickel finish.	Part of SEND—REC—BREAK mechanism.	4T82930
292	HOLDER, fuse: cut-out; for single-base plug fuse	Holds motor fuse	4T74628
274	LEVER: 1/16″ steel, zinc plated, chromate finish	Break lever of SEND—REC—BREAK mechanism.	4T82921
294	LEVER: steel, zinc plated, chromate finish	Send-receiver lever of SEND—REC—BREAK mechanism.	4T74885
294	LEVER: .065″ steel, zinc plated, chromate finish	Upper contact lever of SEND—REC—BREAK mechanism.	4T82925
292	SCREW, thumb: knurled head; steel, chromate finish; ¼″–20 thd; ¾″ lg.	Secures typing unit to base	4T74720
292, 296	SPRING: flat, jack-type; .038″ nickel silver	Makes connections to typing unit and motor unit.	4T7094
294	STIFFENER, contact spring: steel, zinc plated, chromate finish.	Part of SEND—REC—BREAK mechanism.	4T70529
292	SWITCH, toggle: SPST; 3 amp, 250 v; bakelite body; 2 screw-type term.	Teletypewriter motor power switch	4T74620
292	WASHER, lock: split ring	Used with thumbscrews to secure typing unit to base.	4T2322

4. Cover (Sig C Stock No. 4TPEXC200AA)

Fig. No. symbol	Name of part and description	Function of part	Signal Corps stock No.
329	CLIP: spring; flat; .028″ thk, steel, nickeled	Holds tape reel cover	4T82279
328	GUIDE, line: chrome-plated	Holds copy	4T111329
327	NUT, hexagon: #6–32	Used in the mounting of mechanical parts	4T83885
327	STRIP, felt: black, 20 oz; 5 9/16″ lg x 1½″ wd	Cushions glass cover	4T74759
328	WINDOW: glass; ⅛″ thk; laminated nonshattering glass.	Cover for character counter	4T83427

5. Motor Unit PU–109/GG (Sig C Stock No. 4TMU27)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
324	ARM ASSEMBLY: contact; nickel silver or steel w/zinc plate, chromate finish; u/w inner disk.	Connects to inner disk	4T78400.
324	ARM ASSEMBLY: contact; nickel silver or steel w/zinc plate, chromate finish; u/w outer disk.	Connects to outer disk	4T78399.
323	ARMATURE, motor: ac; series-governed; 110 v, 60 cyc, 1/25 hp.	Motor rotor	4T78239.
323	BEARING, ball: single row, self-alining; bore .5118″; 1.1811″ OD x .2756″ wd.	Mounts motor armature	4T5061.
324	BRUSH, electrical contact: carbon, copper plated; 15/64″ lg x ¼″ dia.	Inner and outer disk contact brushes	4T78403.
323	BRUSH, electrical contact: carbon w/compression spring and end cap.	Makes connection to motor commutator	4T8094.
323	CAP: brush holder; bakelite; 21/32″ dia x ½″ lg	Holds commutator brush	4T70873.
324	CONTACT ASSEMBLY, switch: governor; single tungsten contact.	Mounts 72835 contact point used in control of motor speed.	4T6314.
324	CONTACT, governor: flat spring; .159″ thk; hook-shaped.	Connects to outer contact disk	4T78496.
324	CONTACT, governor: flat spring; .159″ thk; hook-shaped.	Connects to inner contact disk	4T78497.
324	CONTACT, governor: screw type; #6–32 screw w/tungsten contact welded to head.	Used in control of motor speed	4T6320.
322	LAMP, incadescent: 115–125 v, 15 w	Illuminates governor target	4T74557.
324	SPRING: extension; .033″ music wire; 1 3/16″ lg x .259″ dia o/a.	Tensions governor contact arm assembly	4T6323.
322	SWITCH, toggle	Target lamp ON-OFF switch	4T94009.

6. Perforator Transmitter (Sig C Stock No. 4TPEX25JX for TT–7/FG and 4TPEX25KQ for TT–8/FG)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
302	ARM ASSEMBLY: detent; steel punch unit; 1.568″ lg x 797″ wd x .280″ thk.	Equalizes tape feeding	4T91205
302	ARM: selector; steel, 3⅛″ lg x ⅛″ wd x 1/16″ thk	Determines associated punch operation	4T81524
302, 303	ARMATURE, electromagnet: soft iron, laminated core; 2½″ lg x 1 1/16″ wd x .330″ thk.	Operates selector fingers to perforate tape.	4T97641
305	BUMPER: leather; laminated sole leather; .688″ OD x .315″ thk.	Silencer for perforator armature	4T81532
305	BUMPER: leather; flat, .688″ OD x .120″ ID x .219″ thk.	Silencer for perforator	4T97642
299	BUSHING: threaded; bronze, male; 2 3/64″ lg; bushing 7/16″ OD x 5/16″ ID x ¼″ lg.	Mounts transmitter shaft	4T7373

6. Perforator Transmitter (Sig C Stock No. 4TPEX25JX for TT–7/FG and 4TPEX25KQ for TT–8/FG)—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
299	CONTACT, switch: .041″ nickel silver spring; 6 tungsten contacts.	Short transmitting contact	4T9177
299	CONTACT, switch: multiple spring type; nickel silver; 2¼″ lg x 2″ wd x 7/32″ dia o/a.	Long transmitting contact	4T9178
300	CONTACT, switch: spring type; .040″ nickel; 2 3/16″ lg x 5/16″ wd x ⅛″ thk.	Part of perforator control contacts	4T84903
302	CUTTER, tape: 1/16″ hardened steel, zinc plated, chromate finish; 1¾″ lg x ⅝″ wd x ⅜″ h o/a.	Provides tearing edge for tape	4T81603
299	FITTING, lubrication: steel, nickel finish, 90° angle	Oil cup for lubricating transmitter shaft	4T89896
299	INSULATOR, bushing: tubular; tan bakelite; 5/16″ lg x .215″ OD x 9/64″ ID.	Insulates transmitting contacts	4T2529
	INSULATOR, bushing: tubular; brown bakelite; .125″ ID x .187″ OD x .422″ lg.	Insulates perforator magnet contacts	4T74965
321	KEYTOP (A—)	Function of all keytops is to designate characters and functions resulting from operation of keys. Keytops which bear weather communication symbols are for TT–8/FG only.	4T78946
321	KEYTOP (B ?)		4T78947
321	KEYTOP (C :)		4T78948
321	KEYTOP (D $)		4T78949
321	KEYTOP (E 3)		4T78950
321	KEYTOP (F !′)		4T78951
321	KEYTOP (G &)		4T78952
321	KEYTOP (I 8)		4T78954
321	KEYTOP (J ′)		4T78995
321	KEYTOP (K ()		4T78956
321	KEYTOP (L))		4T78957
321	KEYTOP (M .)		4T78958
321	KEYTOP (N ,)		4T78959
321	KEYTOP (O 9)		4T78960
321	KEYTOP (Q 1)		4T78962
321	KEYTOP (R 4)		4T78963
321	KEYTOP (T 5)		4T78964
321	KEYTOP (U 7)		4T78965
321	KEYTOP (V ;)		4T78966
321	KEYTOP (W 2)		4T78967
321	KEYTOP (X /)		4T78968
321	KEYTOP (Y 6)		4T78969
321	KEYTOP (Z ″)		4T78970
321	KEYTOP (blank)		4T78971
321	KEYTOP (FIGS)		4T78972
321	KEYTOP (LTRS)		4T78973
321	KEYTOP (CAR RET)		4T78976
321	KEYTOP (LINE FEED)		4T78978
321	KEYTOP (S BELL)		4T78980
321	KEYTOP (H STOP)		4T82607
321	KEYTOP (— ′)		4T89413
321	KEYTOP (A ↑)		4T89414
321	KEYTOP (D ↗)		4T89415
321	KEYTOP (F →)		4T89416
321	KEYTOP (G ↘)		4T89417
321	KEYTOP (H ↓)		4T89418
321	KEYTOP (J ↙)		4T89419
321	KEYTOP (K ←)		4T89420
321	KEYTOP (L ↖)		4T89421
321	KEYTOP (Z +)		4T89422

6. Perforator Transmitter (Sig C Stock No. 4TPEX25JX for TT–7/FG and 4TPEX25KQ for TT–8/FG—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
321	KEYTOP (C ═)		4T89423
321	KEYTOP (V ═)		4T89424
321	KEYTOP (B ⊕)		4T89425
321	KEYTOP (N ⓓ)		4T89426
321	KEYTOP (P Ø)		4T99564
305	LAMP, incandescent: 110 to 130 v, 10 w, 2 cp	Character counter end-of-line indicator	4T125404
299	LEVER: clutch; hardened steel, zinc plated, chromate finish; irregular shape.	Controls transmitter shaft clutch	4T7409
303	LEVER: tape tension	Holds perforated tape against feed roll	4T73481
302	PAWL: ratchet; .120″ steel, nickel finish	Operates feed roll ratchet to feed tape	4T97634
304	PLUNGER: dash pot; polished copper; 1 15/32″ lg x .608″ dia o/a.	Absorbs shock from character counter ratchet.	4T78744
303	SCREW: #4–40 x 9/16″	Mounts perforator contacts	4T1206
305	SCREW: #2–56 x 1/4″	Part of punch block	4T5740
302	SPRING: extension; .016″ music wire; 1/2″ lg x 5/32″ dia.	Tensions backspace lever	4T45104
302	SPRING: extension; .030″ music wire; 23/32″ lg x 3/16″ dia.	Tensions star wheel detent lever	4T74700
299	SPRING: extension; .014″ music wire; 3/4″ lg x 1/64″ dia o/a.	Tensions transmitter clutch throw-out lever.	4T90260
299	SPRING: extension; .014″ music wire; 5/8″ lg x .149 dia o/a.	Tensions trip-off pawl	4T91120
302	SPRING, extension: .035″ music wire; 1/4″ dia x 1.655″ lg o/a.	Tensions perforator armature	4T82727
302	SPRING, extension: .010″ music wire; .410″ lg x .120″ dia.	Tensions backspace pawl	4T84758
302	SPRING, extension: .022″ music wire; .906″ lg x .221″ o/a.	Tensions contact operating lever	4T91577
303	SPRING, flat: steel, copper finish; approx 1 3/16″ lg x 5/16″ wd x 3/8″ thk.	Guides tape	4T2410
297	SPRING, loop: .039″ music wire; 2.203″ lg x .984″ wd o/a.	Tensions space key lever	4T89330
297	SPRING, loop: .035″ music wire; 2 13/16″ lg x 2 3/4″ wd x 5/16″ thk o/a.	Tensions LINE FEED, FIGS, LTRS, and Ø key levers. P	4T85376
303	SPROCKET, tape: w/ratchet wheel; tool steel zinc plate; 12 teeth.	Feeds tape	4T110682
299	STUD, mounting: steel; clutch lever	Mounts transmitter clutch throw-out lever.	4T7386
299	WICK, oiling: 11/32″ dia x 7/32″ lg	Aids in lubricating transmitter shaft	4T90438

7. Rectifier REC–30 (Sig C Stock No. 4TREC30)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
331	FUSE, cartridge: 3 amp	Protects output circuit	4T76218
331	FUSE, 10 amp	Protects input circuit	4T105980
331	LAMP, glow: LP3 type	Delays output current until rectifier is heated.	4T106859
331	RELAY, time delay	Prevents load on rectifier while heating	4T105987
272	RESISTOR: WW; 5000 ohms	Part of circuit to cathode of amplifier tube	4T106013
272	RESISTOR: WW; 1000 ohms	Controls plate voltage on amplifier tube	4T106012
272	RESISTOR: WW; 1500 ohms	Limits current flow through winding of slow release relay.	4T106009

7. Rectifier REC–30 (Sig C Stock No. 4TREC30)—Continued

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
272	RESISTOR: WW; 15,000 ohms	Part of circuit that controls operation of tubes.	4T106010
272	RESISTOR: WW; 10,000 ohms	Part of circuit that controls operation of tubes.	4T106014
331	STRIP, bimetallic	Operates time-delay relay	4T105973
331	SWITCH, toggle, DPST	Input power ON-OFF switch	4T105314
322	TRANSFORMER, heater type	Controls operation of slow release relay	4T105992
331	TUBE, electron: 323A type	Rectifier tube	4T105405
331	TUBE, electron: 6F6G type	Amplifier tube	4T106858

8. Polar Relay RY–30 (Sig C Stock No. 4TRY30)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
330	ARMATURE, relay: w/nickel silver contacts; .042″ soft iron armature; 3⅜″ lg x 3/16″ wd x ⅛″ thk o/a.	Determines whether signals to magnets are mark or space.	4T99857
330	BRACKET, brass: L-shape; ⅞″ lg x 9/16″ wd x 13/32″ d o/a.	Left contact screw mounting	4T78869
330	BRACKET, brass: L-shape; ⅞″ lg x 9/16″ wd x 13/32″ d o/a.	Right contact screw mounting	4T78868
330	COIL, solenoid: double parallel windings, 136 ohms each.	Line and bias windings of relay	4T99858
330	INSULATOR, bushing: flat, rectangular; tan bakelite.	Insulates contact screw mountings	4T78853
330	INSULATOR, bushing: tubular; black bakelite	Insulates contact mounting bracket screw	4T78854
330	MAGNET, U-shape: steel, black finish; for polar relay.	Controls operation of relay	4T78860
330	NUT, knurled: w/friction washer; brass, natural finish.	Locks pole piece in position	4T99852
330	SCREW, adjusting: capstan head, steel; #10–40 thd; 7/16″ under head.	Operates relay armature to mark or space contact.	4T99864
330	SCREW, adjusting: capstan head; w/contact	Mark and space relay contacts	4T94092
330	SCREW, machine: steel, bright nickel finish; #4–8 thread; threaded full length.	Secures armature to relay	4T99851

9. Model 19 Table (Sig C Stock No. 4TXRT202AA)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
292, 333	FUSETRON: 3.2 amp	Protects transmitter distributor and nontyping reperforator motors.	4T103284
333	RESISTOR, adjustable: WW; 2500 ohms, 20 w; 2″ lg x 9/16″ OD x ⅜″ ID.	Part of local test circuit	4T95005
333	SCREW, machine: straight side; binding head, brass; #6–40 thd.	Terminal screw used in making electrical connections.	4T91744
332	SWITCH, lever: 2-position, locking	Arranges set for lines 1 and 2 or for local test operation.	4T95008
332	SWITCH, push: nonlocking	Feeds out tape from nontyping reperforator.	4T95009
332	SWITCH, toggle: DPST, 2-position; ON-OFF; locking.	Rectifier input power switch	4T95007
332	SWITCH, toggle: single-pole	Transmitter distributor motor power switch.	4T81273

10. Typing Unit (Sig C Stock No. 4TBP22/210 and TT–7/FG a nd TBP93/221 for TT–8/FG)

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
309	ARM, extension: sixth vane; 1.281″ lg x .844″ wd x .375″ thk.	Operates shift vane #6	4T82963
313	ARM, right	Operates ribbon reverse mechanism	4T93168
313	ARM, left	Operates ribbon reverse mechanism	4T93167
319	ARMATURE, electromagnet: steel, irregular shape; 2″ lg x 1⅝″ wd x $^{15}/_{16}$″ h o/a.	Controls positioning of selector swords	4T8508
319	ARMATURE, locking stud: #22–56 thd, .188″ lg	Operates by locking lever to lock armature in position.	4T8472
308	BALL, bearing: steel, .188″ ±.001″ dia	Part of main shaft spacing gear	4T4323
314, 315	BALL, bearing: steel, .09375″ ±.00025″ dia	Parts of rear type bar carriage roller	4T2451
311	BAR, code: 1D	The function of all code bars is to control operation of the pull bars.	4T74180
311	BAR, code: 2D		4T74181
311	BAR, code: 3D		4T74182
311	BAR, code: 4D		4T74183
311	BAR, code: 5D		4T114432
314	BAR, pull: standard (26 per unit)	Operates associated type bar	4T74185
321	BAR, type: #3	All type bars mount type pallets to accomplish printing.	4T74203
321	BAR, type: #4		4T74204
321	BAR, type: #5		4T74205
321	BAR, type: #6		4T74206
321	BAR, type: #7		4T74207
321	BAR, type: #8		4T74208
321	BAR, type: #9		4T74209
321	BAR, type: #10		4T74210
321	BAR, type: #11		4T74211
321	BAR, type: #12		4T74212
321	BAR, type: #13		4T74213
321	BAR, type: #14		4T74214
321	BAR, type: #15		4T74215
321	BAR, type: #16		4T74216
321	BAR, type: #17		4T74217
321	BAR, type: #18		4T74218
321	BAR, type: #19		4T74219
321	BAR, type: #20		4T74220
321	BAR, type: #21		4T74221
321	BAR, type: #22		4T74222
321	BAR, type: #23		4T74223
321	BAR, type: #24		4T74224
321	BAR, type: #25		4T74225
321	BAR, type: #26		4T74226
321	BAR, type: #27		4T74227
321	BAR, type: #28		4T74228
308	BEARING, ball: steel, 1.0236″ OD x .315″ ID x .315″ thk.	Mounts main shaft	4T72644
311	BEARING, roller: single row radial: .500″ OD x .703″ lg o/a.	Operates printing and function bails	4T91175
311	BEARING, sleeve: eccentric; $^{5}/_{32}$″ o/a; bushing .218″ OD x $^{9}/_{64}$″ ID; hex. head.	Used in adjusting bell cranks	4T74199
314	BUMPER, leather	Type bar backstop	4T74279
308	CAM ASSEMBLY, sleeve: steel, solder-dipped	Operates selector levers, locking lever, and clutch throw-out lever.	4T8507
318	CONTACT, switch: phosphor bronze, bakelite insulated; 2 $^{23}/_{32}$″ lg x 1 $^{1}/_{32}$″ wd x 1 $^{7}/_{64}$″ h.	Right and left motor stop contacts on TT–7/FG only.	4T73593
318	CONTACT, switch: phosphor bronze, copper contact; 2⅜″ lg x ¼″ wd x $^{11}/_{64}$″ o/a.	Right and left motor stop contacts on TT–7/FG only.	4T73588

10. Typing Unit (Sig C Stock No. 4TBP22/210 and TT–7/FG and TBP93/221 for TT–8/FG)—Con.

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
316	CRANK, platen; steel, bakelite finish	Used to feed paper manually	4T80466
306, 311	FITTING, lubrication: brass, 90° elbow; 5/8″ lg x 7/16″ wd x 9/16″ h o/a.	Lubrication points for mechanical parts	4T86710
309	FORK, clutch: steel, U-shaped; 2″ lg x 1/32″ wd x .042″ thk.	Controls operation of spacing shaft clutch	4T74071
308	GEAR, clutch: steel; .750″ dia x 1.125″ thk; 16 teeth	Driving clutch member of main shaft clutch.	4T72562
308	GEAR, clutch: steel; .938″ OD x .781″ lg; 16 teeth	Driven member of main shaft clutch	4T74502
308, 322	GEAR, helical: worm gear type; bakelite linen base; 35 spiral teeth.	Meshes with motor pinion to transmit mechanical power to main shaft.	4T74151
317	GUIDE, paper: two; steel; 2 7/8″ lg x 1 5/16″ wd; irregular shaped.	Guides paper	4T74469 (right) 4T74470 (left)
314	GUIDE, ribbon: .028″ CRS, 2″ lg x 1 1/8″ wd x 13/32″ thk.	Holds and guides ribbon	4T74371
316	HANDLE, crank: blk fiber, 1″ lg x .547″ dia	Used for manual paper feed	4T41341
309	LATCH, lever: steel, nickel finish; 1 11/32″ lg x 7/8″ wd x .344″ thk.	Operates lock bar	4T74161
316	LEVER, line feed: .095″ CRS; 2.140″ x 2.031″ x 13/32″ h o/a.	Operates line feed pawl	4T74465
320	LEVER, selector sword: steel, sword-shaped w/2 arms and 1 pivot; 1 3/4″ lg x 1.074″ wd x .045″ thk o/a.	Positions T lever	4T6685
320	LEVER, steel; selector, right side; 1.468″ lg x 1.271″ wd x .45″ thk o/a.	Operates selector sword	4T8157
320	LEVER, steel: selector, left side; 1.641″ lg x 1.068″ h x .045″ thk o/a.	Operates selector sword	4T8158
320	LEVER, steel: clutch throw-out; 1.634″ lg x .578″ wd x 1.384″ h.	Controls main shaft clutch	4T6971
319	LEVER, steel: zinc plate, chromate finish; trip latch for rangefinder.	Controls operation of stop lever on rangefinder.	4T6830
320	LEVER, T: #1, #2, #3, #4, #5	Positions respective vanes	4T74133 4T74134 4T74135 4T74136 4T74137
321	PALLET, type bar (Z ″)	The function of all type bar pallets is to print characters. Pallets with weather characters are used only on TT–8/FG.	4T74303
	PALLET, type bar (K ()		4T74304
	PALLET, type bar (B ?)		4T74305
	PALLET, type bar (Y 6)		4T74307
	PALLET, type bar (M .)		4T74308
	PALLET, type bar (U 7)		4T74309
	PALLET, type bar (L))		4T74310
	PALLET, type bar (H £)		4T74311
	PALLET, type bar (O 9)		4T74312
	PALLET, type bar (I 8)		4T74313
	PALLET, type bar (N ,)		4T74314
	PALLET, type bar (E 3)		4T74315
	PALLET, type bar (T 5)		4T74316
	PALLET, type bar (A –)		4T74317
	PALLET, type bar (J ′)		4T74318
	PALLET, type bar (R 4)		4T74319
	PALLET, type bar (D $)		4T74320
	PALLET, type bar (C :)		4T74321

10. Typing Unit (Sig C Stock No. 4TBP22/210 and TT–7/FG and TBP93/221 for TT–8/FG)—Con.

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
	PALLET, type bar (F !)		4T74322
	PALLET, type bar (W 2)		4T74323
	PALLET, type bar (G &)		4T74324
	PALLET, type bar (V ;)		4T74325
	PALLET, type bar (Q 1)		4T74326
	PALLET, type bar (X /)		4T74327
	PALLET, type bar (S ')		4T74328
	PALLET, type bar (A ↑)		4T82147
	PALLET, type bar (D ↗)		4T82148
	PALLET, type bar (F →)		4T82149
	PALLET, type bar (G ↘)		4T82150
	PALLET, type bar (H ↓)		4T82151
	PALLET, type bar (J ↙)		4T82152
	PALLET, type bar (K ←)		4T82153
	PALLET, type bar (L ↖)		4T82154
	PALLET, type bar (B ⊕)		4T82420
	PALLET, type bar (V ⊖)		4T82421
	PALLET, type bar (C ○)		4T82423
	PALLET, type bar (Z +)		4T82751
	PALLET, type bar (—)		4T84025
	PALLET, type bar (N ⊜)		4T84069
	PALLET, type bar (P Ø)		4T99564
320	PLATE, spacer: selector separator; nickel silver; 2 11/16'' lg x 2.141'' wd x .065'' thk.	Spaces selector levers, and spaces and tensions selector swords.	4T6689
320	PLATE, top separator	Top separator plate on selector mechanism.	4T83920
316	PLATEN, teletypewriter: rubber; 9 27/64'' lg x 1¾'' OD.	Provides backing for paper	4T83920
308	PLUG, oil: machine thd; steel; ¾'' lg x ½'' dia o/a; knurled head.	Main shaft oil plug	4T74101
317	ROLLER, guide: rear pressure guide	Part of friction paper feed mechanism	4T74491
317	ROLLER, guide: front pressure guide	Part of friction paper feed mechanism	4T74490
316	SCREW, shoulder: eccentric; #6–40 thd	Used in adjusting line feed detent lever	4T74020
319	SCREW, machine: eccentric; flat top binding head; #4–40 thd; .281'' lg w/.250'' lg thd.	Operates trip latch plunger	4T6942
314	SCREW, piolt: Fil H; steel; #6–40 thd; 19/32 lg w/¼'' thd	Locks fulcrum rod	4T74296
312	SCREW, pivot: slotted head; steel; #10–32 thd, ⅞'' lg w/ 11/16'' thd.	Pivots vanes	4T74170
319	SPRING, compression: .0012'' music wire; 3/64'' lg x 9/64'' dia o/a.	Tensions trip latch	4T7602
308	SPRING, compression: .055'' music wire; .740'' lg x .890'' dia o/a.	Tensions main shaft clutch	4T6993
318	SPRING, compression: .011'' music wire; 7/16'' lg x ⅛'' dia o/a.	Tensions inner and outer motor stop pawls on TT–7/FG only.	4T74703
321	SPRING, extension: .027'' music wire; 61/64'' lg x 3/16'' dia o/a.	Resets send-receive break mechanism	4T86873
320	SPRING, extension: .0165'' music wire; 9/32'' lg x ⅛'' dia o/a.	Tensilns selector locking lever	4T78824
318	SPRING, extension: .012'' music wire; 1 7/64'' lg x 15/16'' dia o/a.	Tensions motor stop lever (TT–7/FG only).	4T74988
321	SPRING, extension: .030'' music wire; 1'' lg x 3/16'' dia o/a.	Tensions carriage return and signal bell function levers.	4T74961
321	SPRING, extension: .024'' music wire; 57/64'' lg x 3/16'' dia o/a.	Tensions locking, letters, figures, unshift-on-space, and line feed function levers.	4T74962
316	SPRING, extension: .063'' music wire; 1 7/16'' lg x 13/64'' dia o/a.	Tensions line feed detent lever	4T74710
309	SPRING, extension: .035'' music wire; 1 23/64'' lg x 1 1/16'' dia o/a.	Tensions bell push bar, letters push bar, and figures push bar.	4T55088

10. Typing Unit (Sig C Stock No. 4TBP22/210 and TT–7/FG and TBP93/221 for TT–8/FG)—Con.

Fig. No.	Name of part and description	Function of part	Signal Corps stock No.
315	SPRING, extension: .013″ music wire; 9/16″ lg x 5/32″ dia o/a.	Tensions ribbon reverse pawl	4T4703
314, 315, 321	SPRING, extension: .014″ music wire; 1 5/32″ lg x 11/64″ dia o/a.	Tension pull bar	4T7634
320	SPRING, extension: .020″ music wire; 1″ lg x 7/32″ dia o/a.	Tensions main shaft clutch throw-out lever.	4T7615
320	SPRING, extension: .020″ music wire; .775″ lg x .133 dia o/a.	Tensions selector lever	4T7614
319	SPRING, extension: .018″ music wire; 1 27/64″ lg x 13/64″ dia o/a.	Tensions selector armature	4T7612
319	SPRING, extension: .014″ music wire; 29/64″ lg x 5/32″ dia o/a.	Tensions stop lever	4T7603
311	SPRING, extension: .063″ music wire; 1 45/64″ lg x 5/8″ dia o/a.	Tensions printing bail	4T74015
317	SPRING, extension: .020″ music wire; 47/64″ lg x 11/64″ dia o/a.	Tensions paper finger shaft	4T55063
307	SPRING, extension: .022″ music wire; 55/64″ lg x 7/32″ dia o/a.	Tensions margin bell hammer	4T82442
306	SPRING, extension: .022″ music wire; 1¼″ lg x 13/64″ dia o/a.	Tensions line feed push bar	4T74712
311	SPRING, extension: .024″ music wire; 1¼″ lg x 3.16″ dia o/a.	Tensions spacing pawls	4T74760
310	SPRING, extension: .0185″ music wire; 17/32″ lg x ⅛″ dia o/a.	Tensions spacing stop lever	4T74882
318	SPRING, extension: .010″ music wire; 33/64″ lg x ⅛″ dia o/a.	Tensions intermediate lever	4T84575
314	SPRING, extension: .010″ music wire; 17/32″ lg x 9/64″ dia o/a.	Tensions margin bell pawl	4T82999
311	SPRING, extension: .035″ music wire; 2 3/32″ lg x 21/64″ dia o/a.	Tensions function bail	4T80926
316	SPRING, extension: .016″ music wire; .600″ lg x .150″ dia o/a.	Tensions paper feed pawl	4T80945
302, 314	SPRING, extension: .030″ music wire; 2 3/32″ lg x 3/16″ dia o/a.	Part of ribbon oscillator and feed roll mechanisms.	4T74700
306	SPRING, extension: .056″ music wire; 2 11/32″ lg x 17/64″ dia o/a.	Tensions shift detent lever	4T74704
	SPRING, helical: .010″ music wire; ⅝″ lg x .130″ dia o/a.	Tensions break lever	4T35-70
309	SPRING, helical; extension type; .035″ music wire; 1.670″ lg x .257″ dia o/a.	Tensions carriage return operating lever	4T76296
310	SPRING, motor: .020″ clock spring steel; ⅜″ wd	Carriage return spring	4T74272
310	STRAP, carriage: blk cotton webbing; 9⅞″ lg x 1 1/32″ wd x 3/32″ thk o/a; ring at ea end.	Pulls type bar carriage to left margin when carriage return is operated.	4T74359
308	WASHER, flat: wh felt; ½″ ID x 1 11/64″ OD x 9/64″ thk.	Friction clutch for printing and function bail cam.	4T74800
316	WASHER, flat: felt, wh; 9/16″ ID x 1¼″ OD x 1/16″ thk	Part of platen friction assembly	4T76084
308	WASHER, flat: leather, 3/16″ ID x ⅜″ OD x 1/16″ thk	Part of main shaft oil plug	4T74100
308	WASHER, flat: felt, wh; ½″ ID x 1 5/16″ OD x 9/64″ thk.	Part of friction clutch for main shaft spacing gear.	4T74085
306	WASHER, leather: cup-shaped; 3/16″ ID x 1 11/32″ OD x .032″ thk.	Part of dash pot to absorb shock of carriage return.	4T74033
308	WASHER, flat: felt; ½″ ID x 1 1/16″ OD x 1/16″ thk	Oil retainer on selector cam sleeve	4T72563
308	WICK, oiling: 3/32″ dia x 3/16″ lg	Aids in lubricating main shaft	4T89881
311	WICK, oiling: wh wool; 1 9/64″ lg x ⅛″ OD	Lubricates printing and function bail shaft.	4T94693
311	WICK, oiling: ⅜″ lg	Lubricates printing and function bail shaft.	4T4812

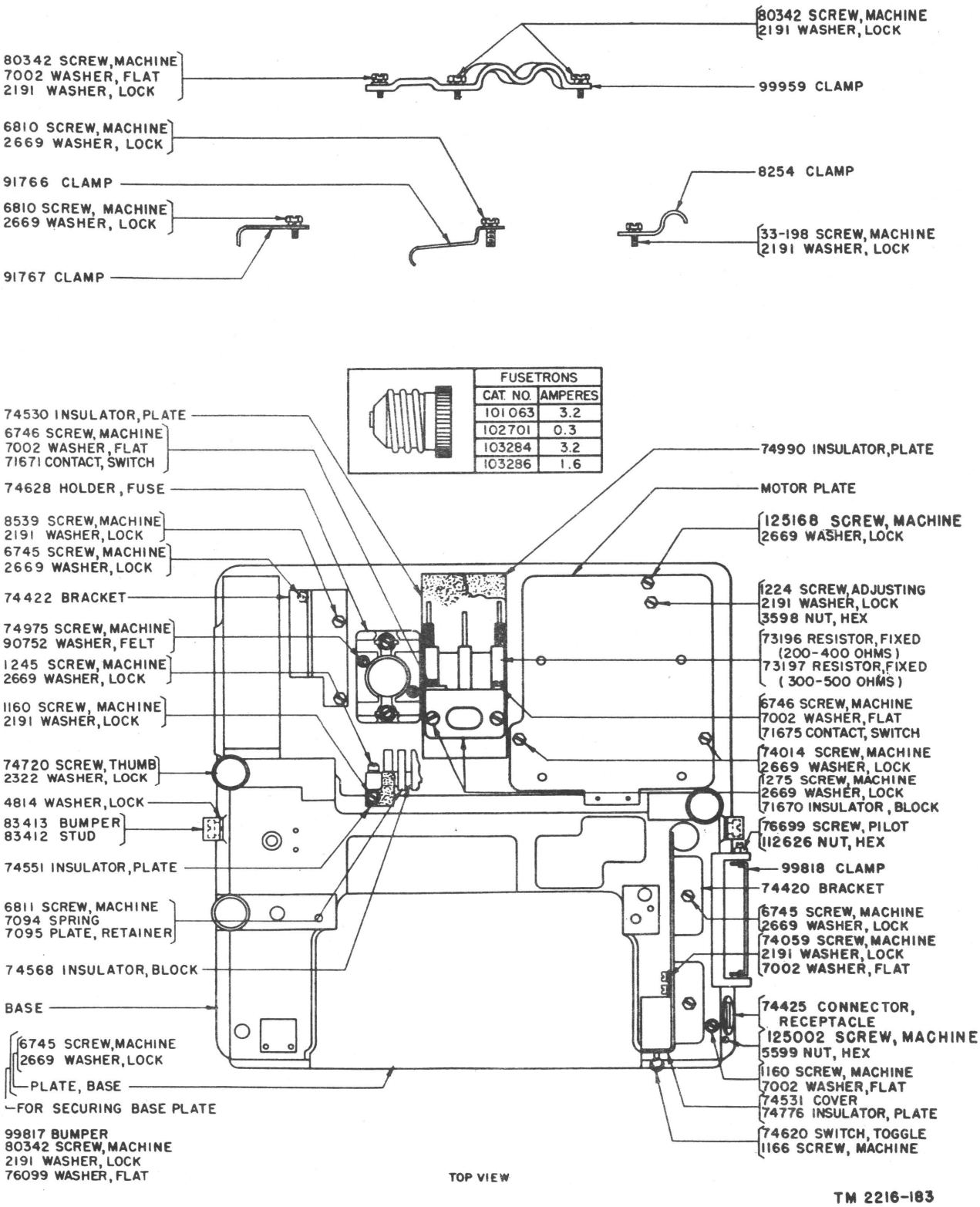
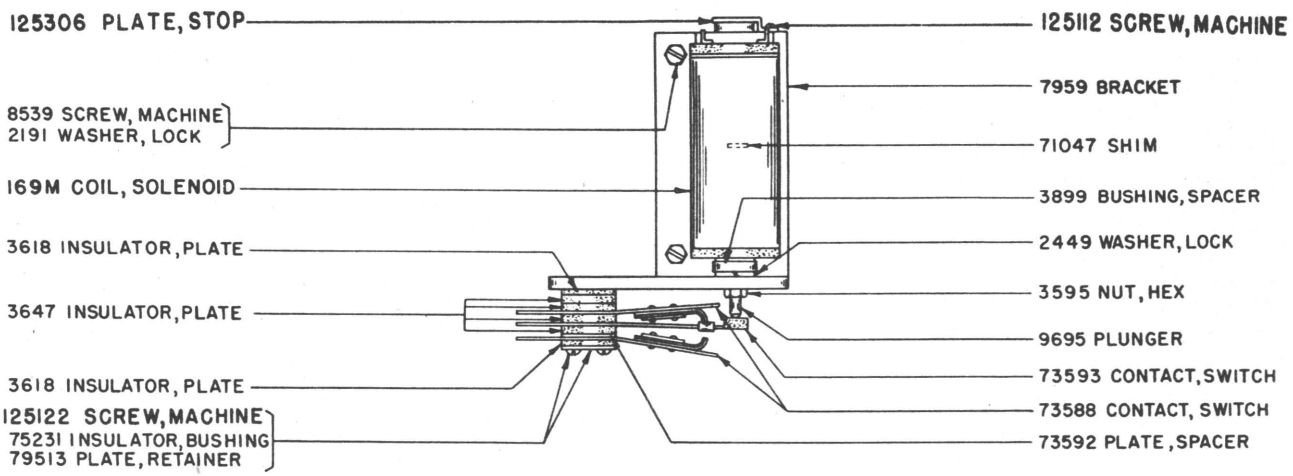
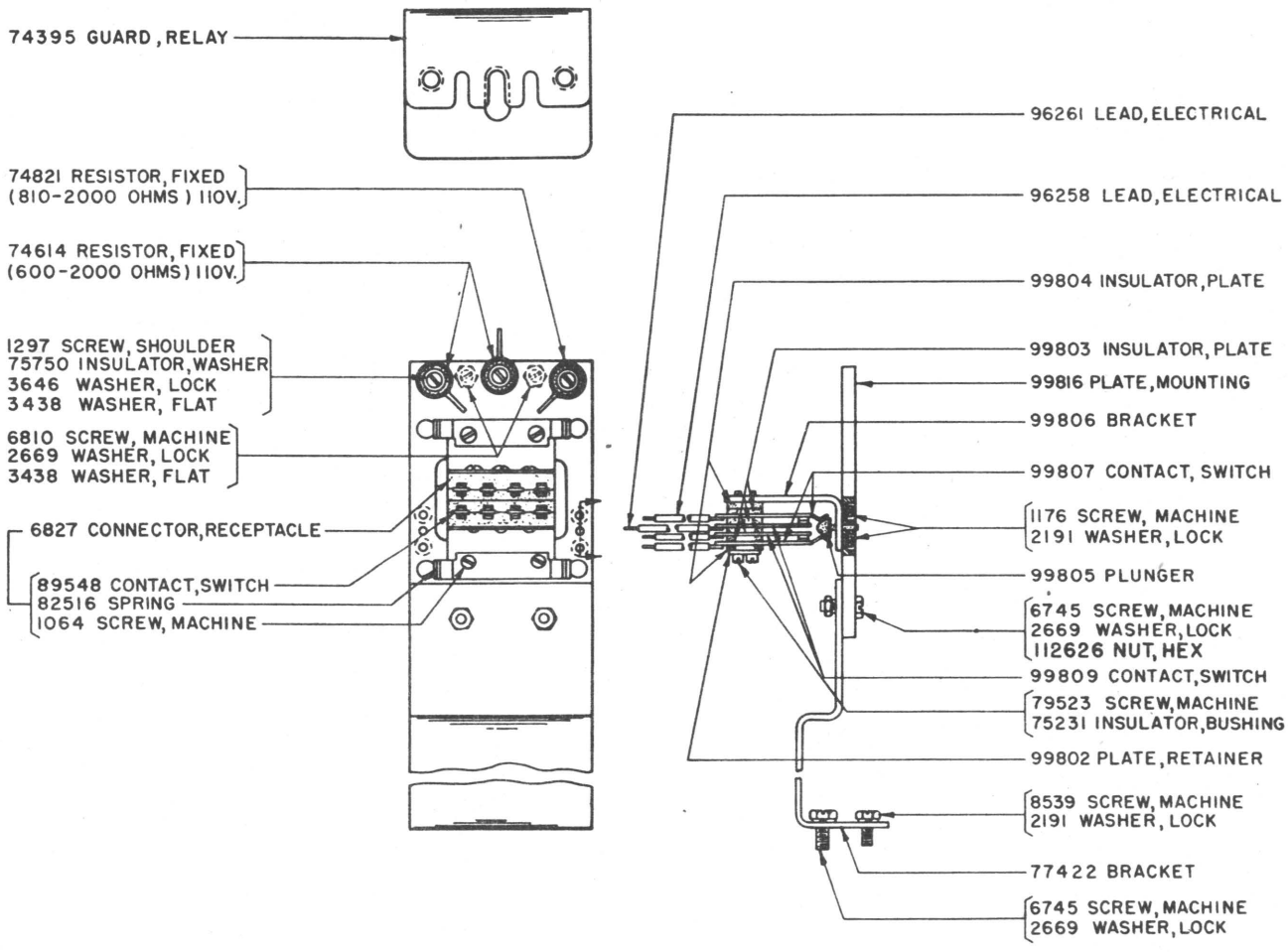


Figure 292. Base, parts identification.



72484 RELAY, SOLENOID: MOTOR CONTROL



LINE RELAY BRACKET PARTS

TM 2216-184

Figure 293. Motor control and relay bracket assembly, parts identification.

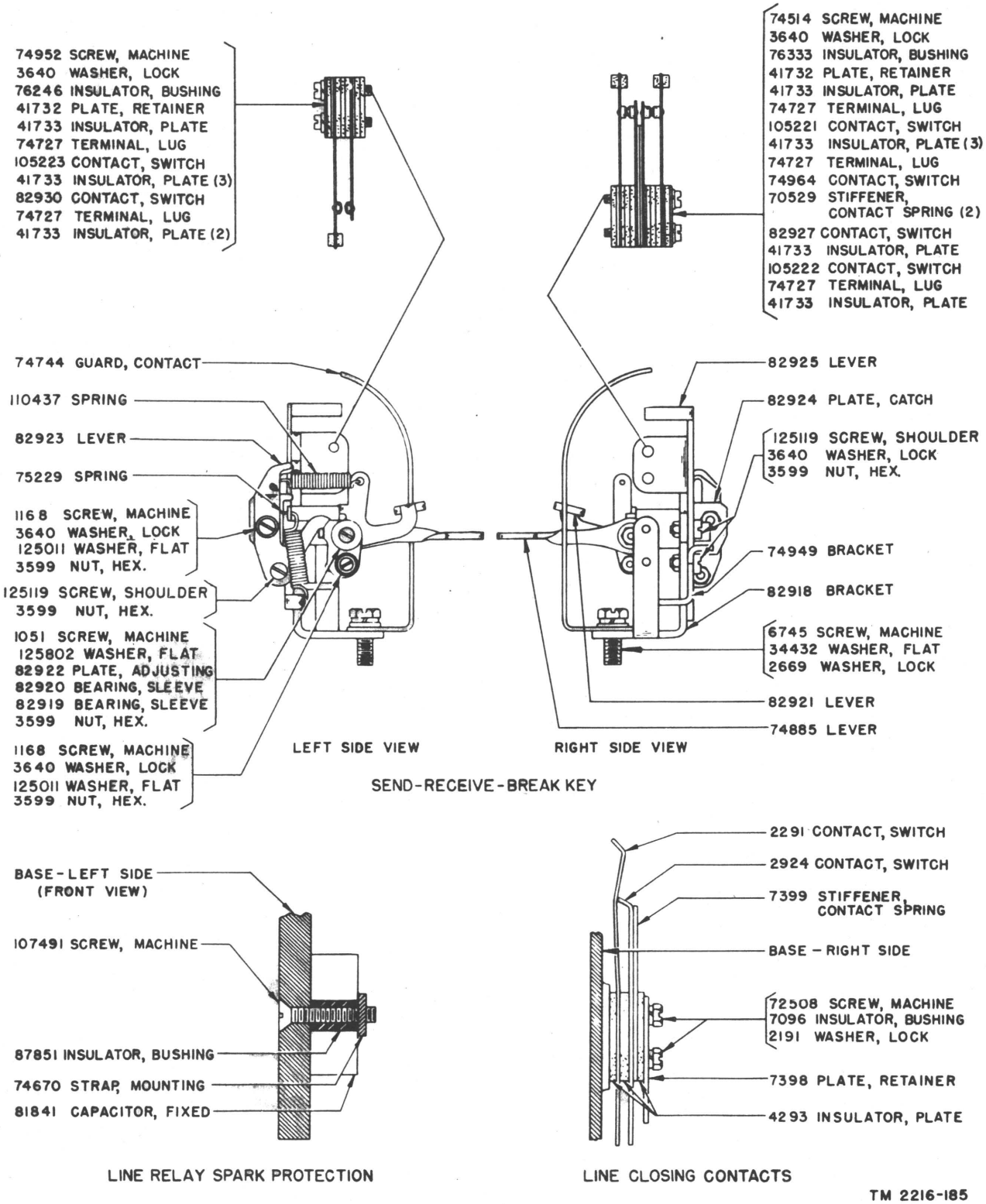
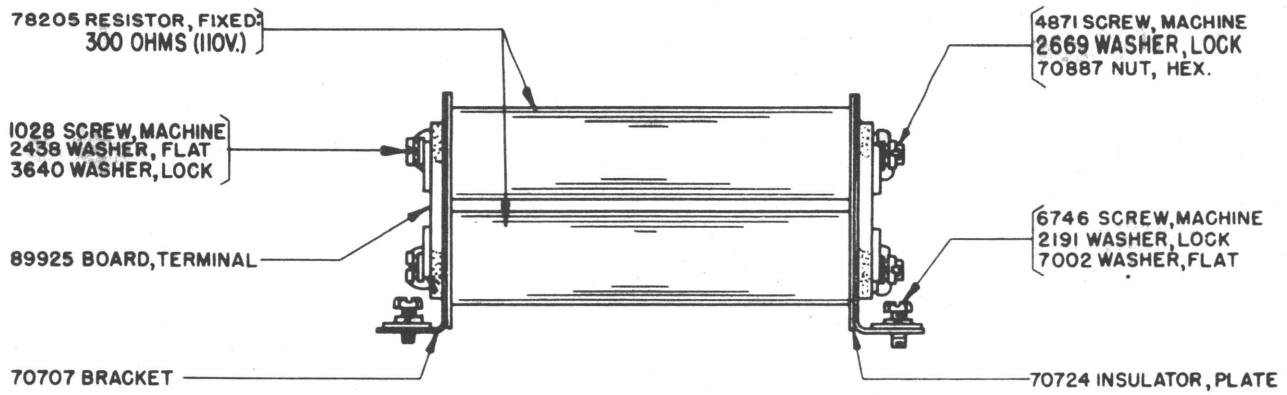
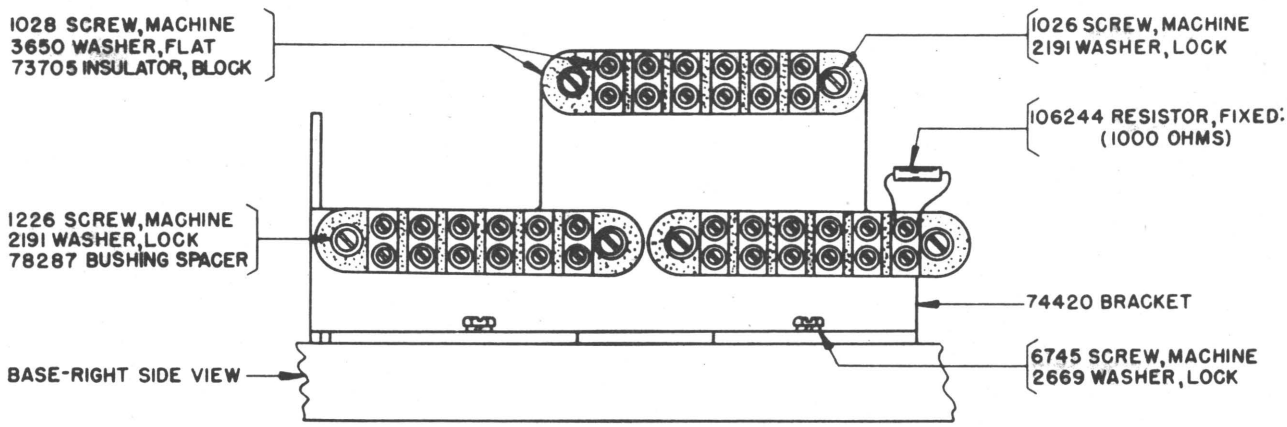
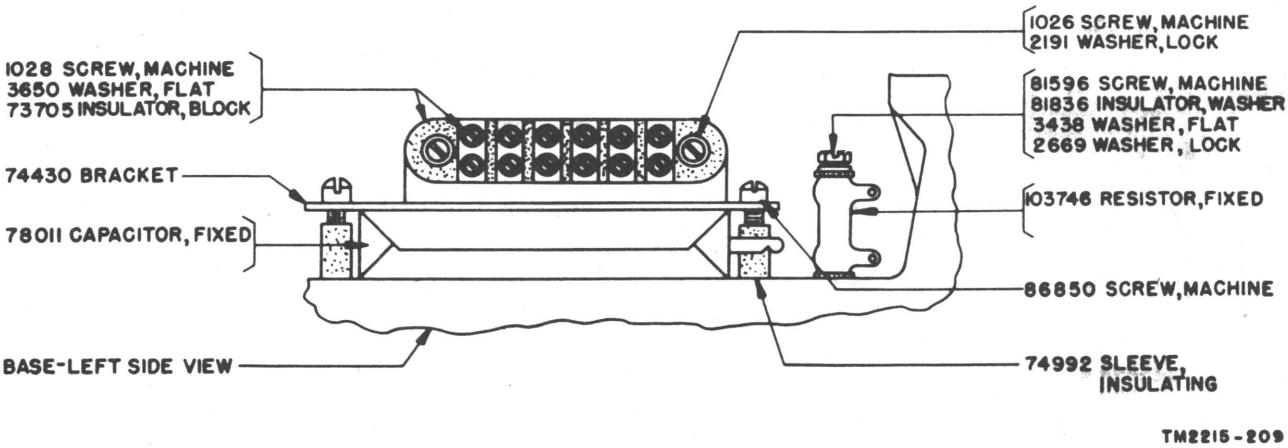


Figure 294. SEND-REC BREAK key assembly, line relay spark protection, and line closing contacts, parts identification.



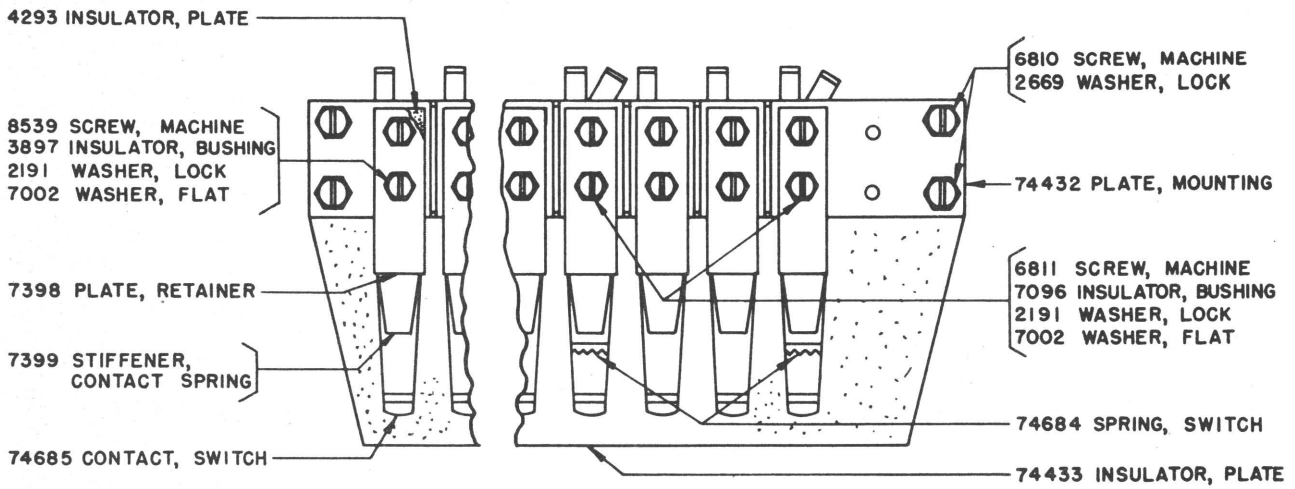
78206 RESISTOR PARTS, (ASSEM) 150-300 OHMS (110 V.)



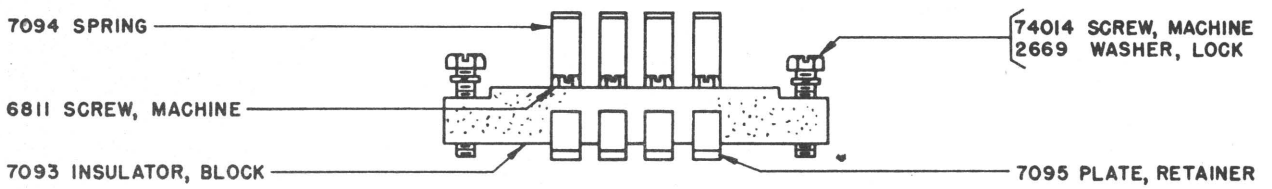


TM2215-209

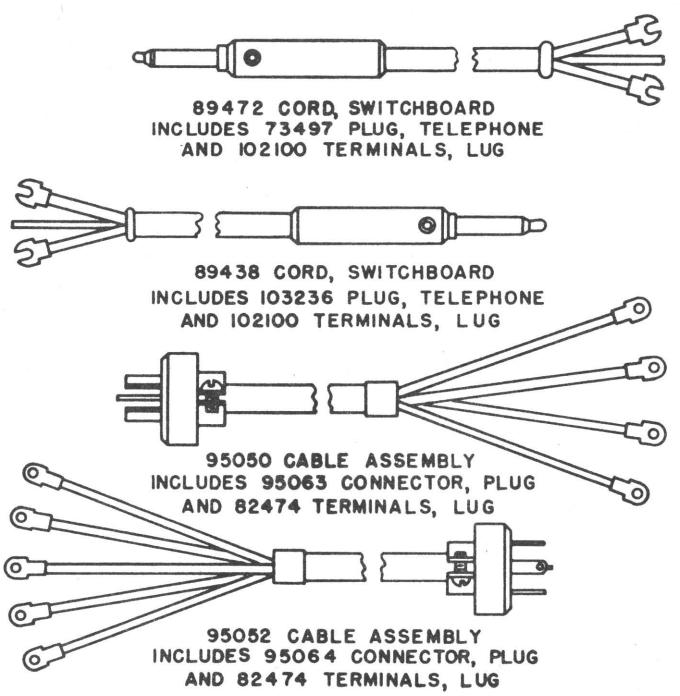
Figure 295. Resistor assembly and base terminal board assembly, parts identification.



KEYBOARD CONNECTOR PARTS



MOTOR UNIT CONNECTOR PARTS



TM2215-210

Figure 296. Base connectors to motor and perforator transmitter, and cord assemblies.

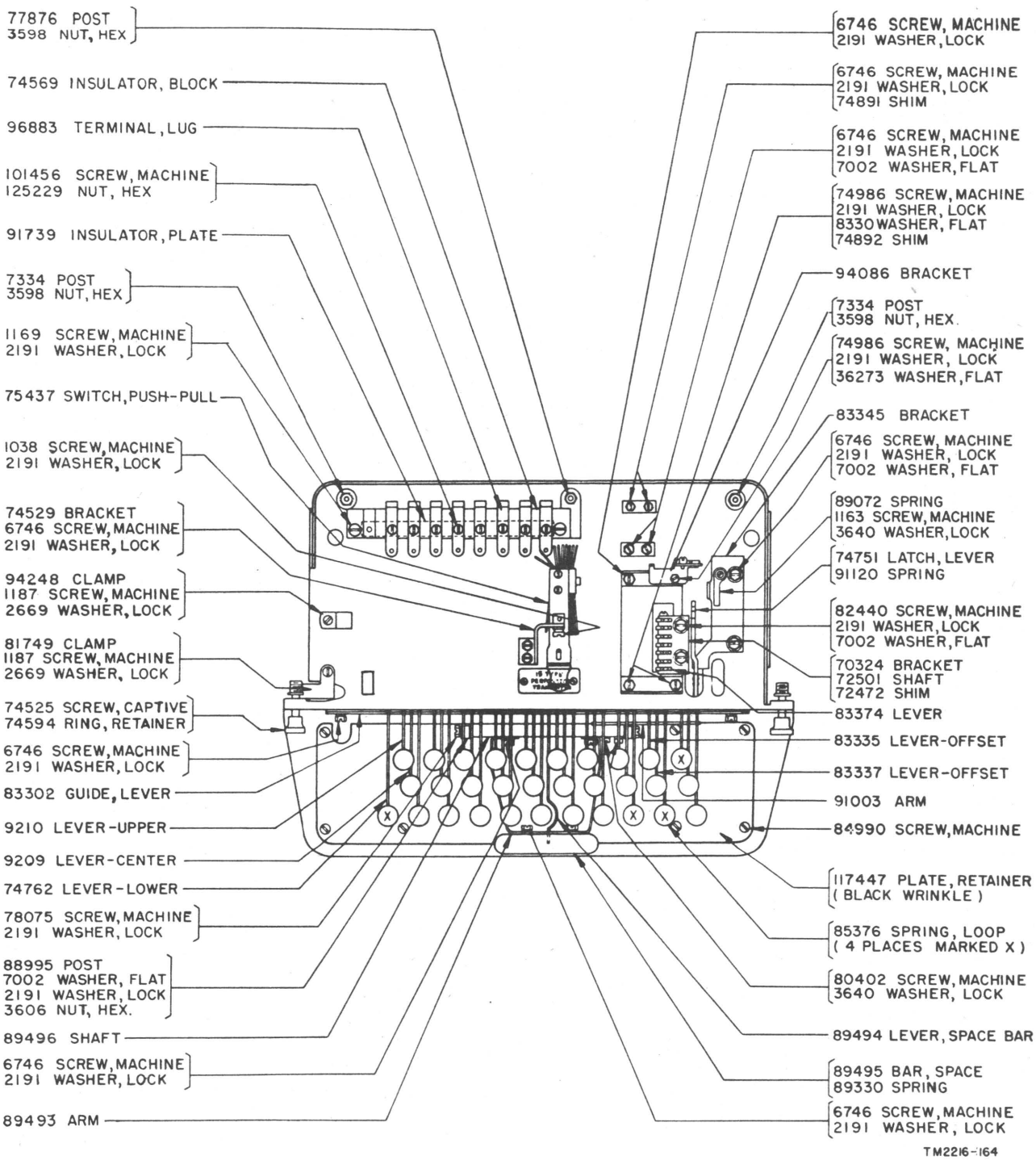


Figure 297. Keyboard, parts identification, top view.

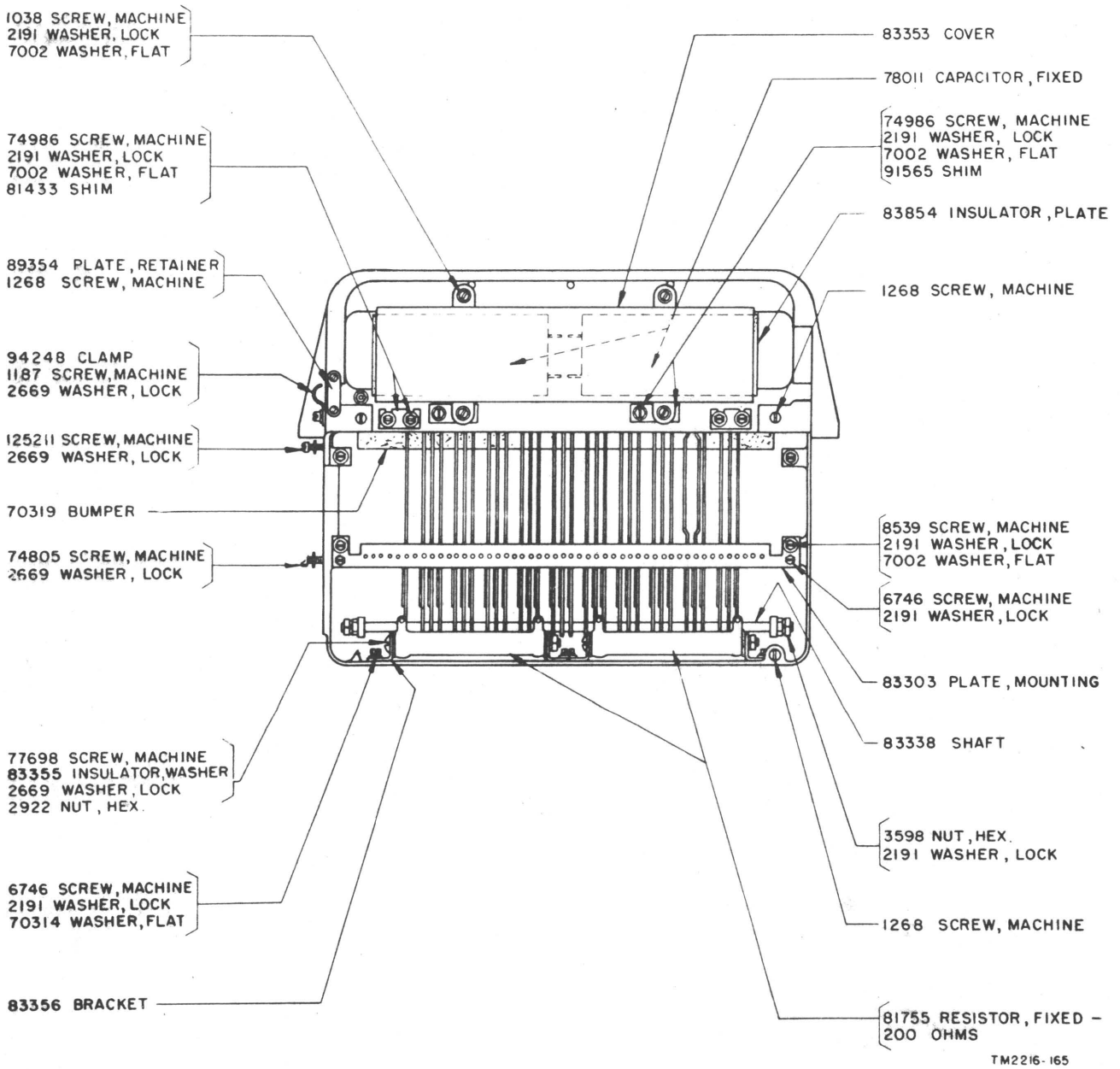


Figure 298. Keyboard, parts identification, bottom view.

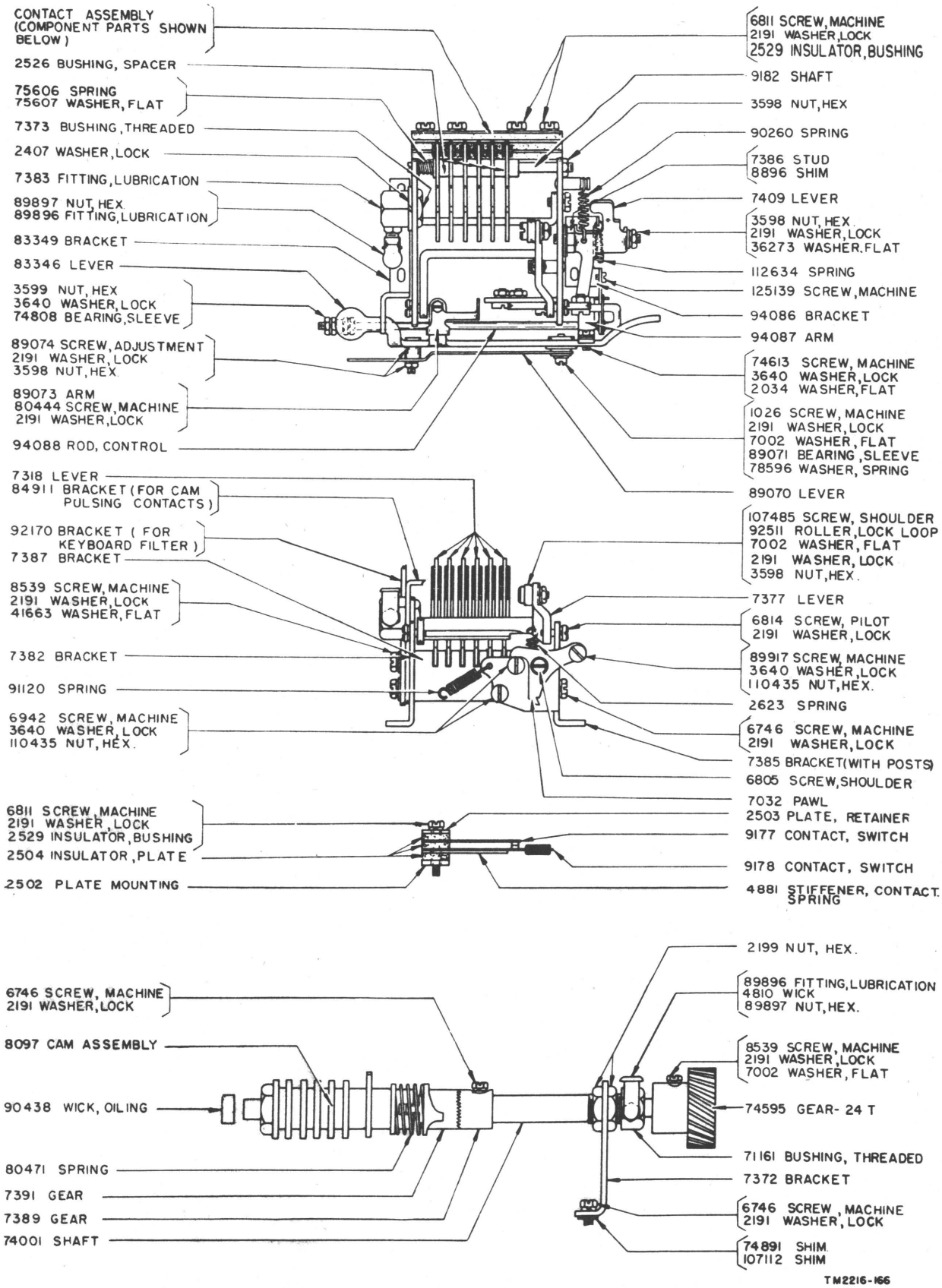
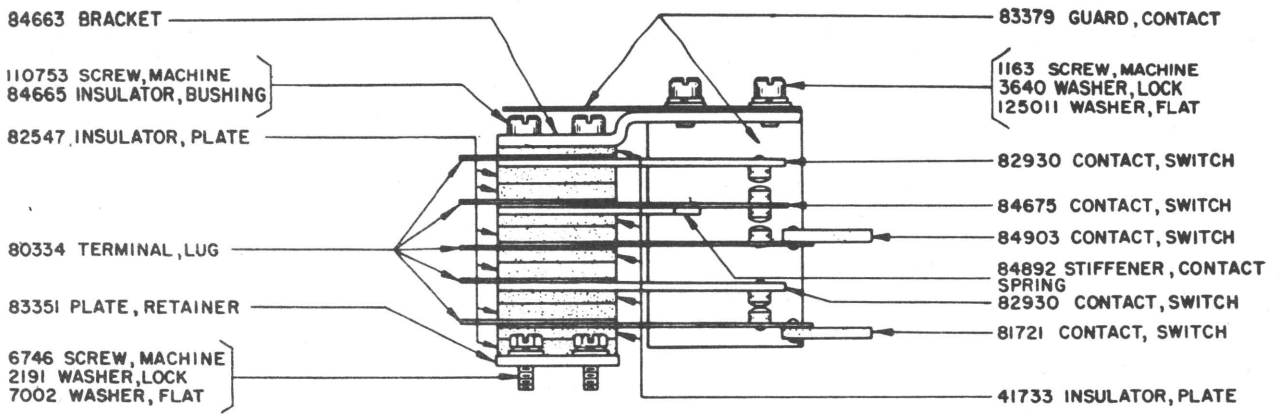
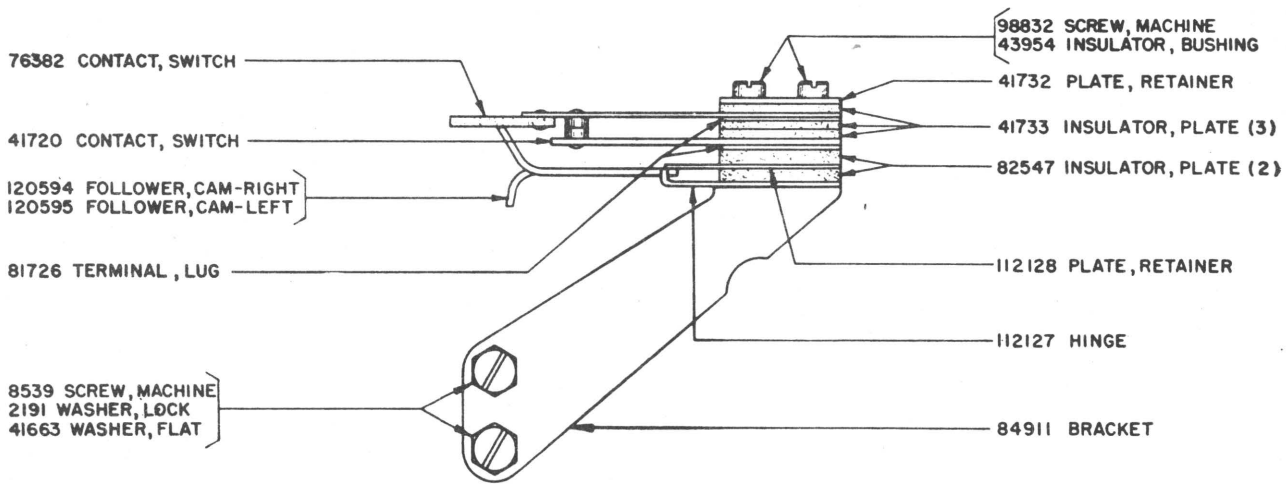


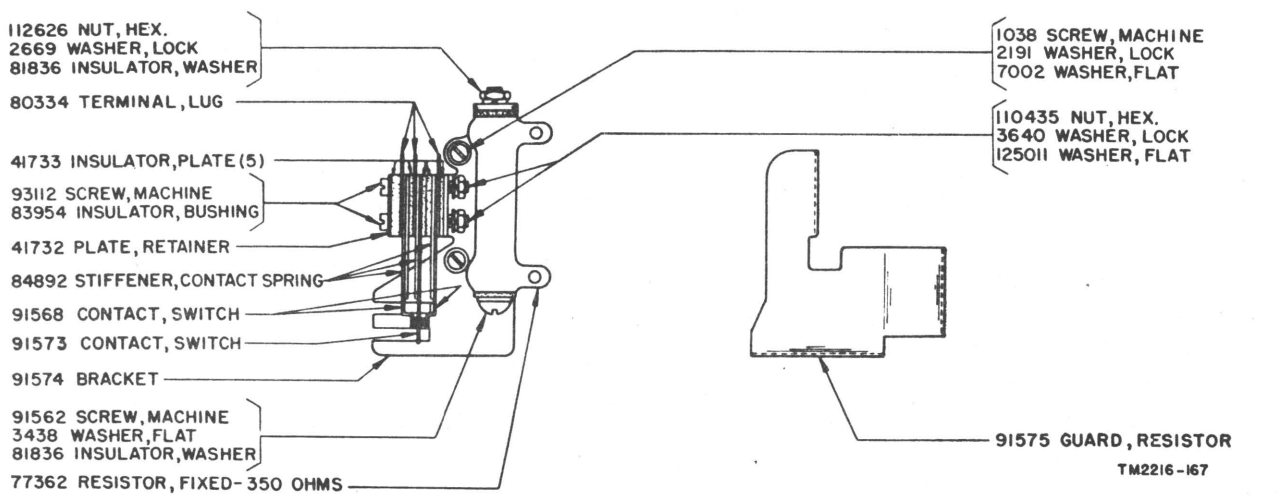
Figure 299. Keyboard transmitting mechanism, parts identification.



84904 CONTACT ASSEMBLY, SWITCH



89974 CONTACT ASSEMBLY, SWITCH



91571 CONTACT ASSEMBLY, SWITCH

Figure 300. Perforator control, cam pulsing, and counter control contact assemblies, parts identification.

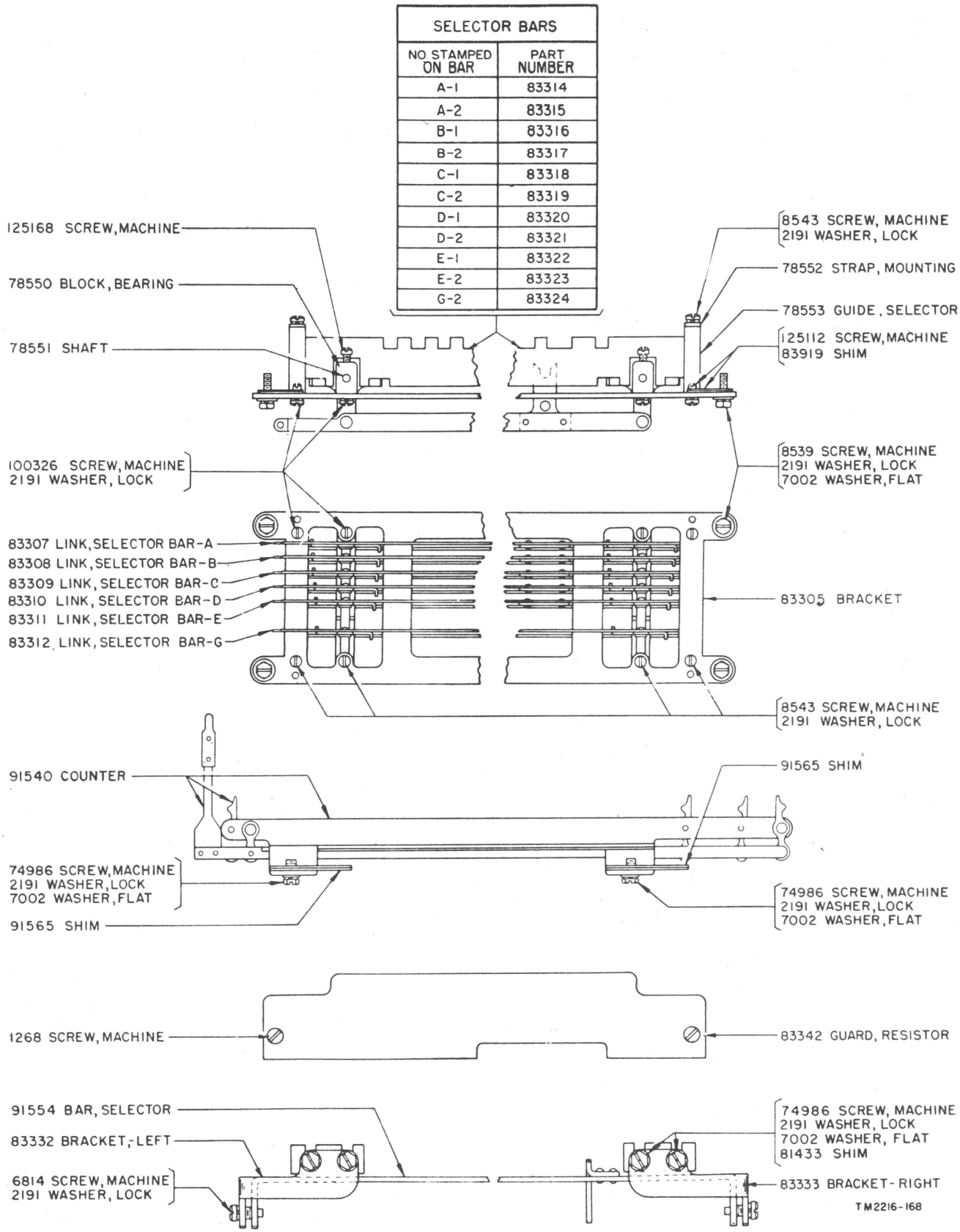


Figure 301. Selector bars and selector bar links, parts identification.

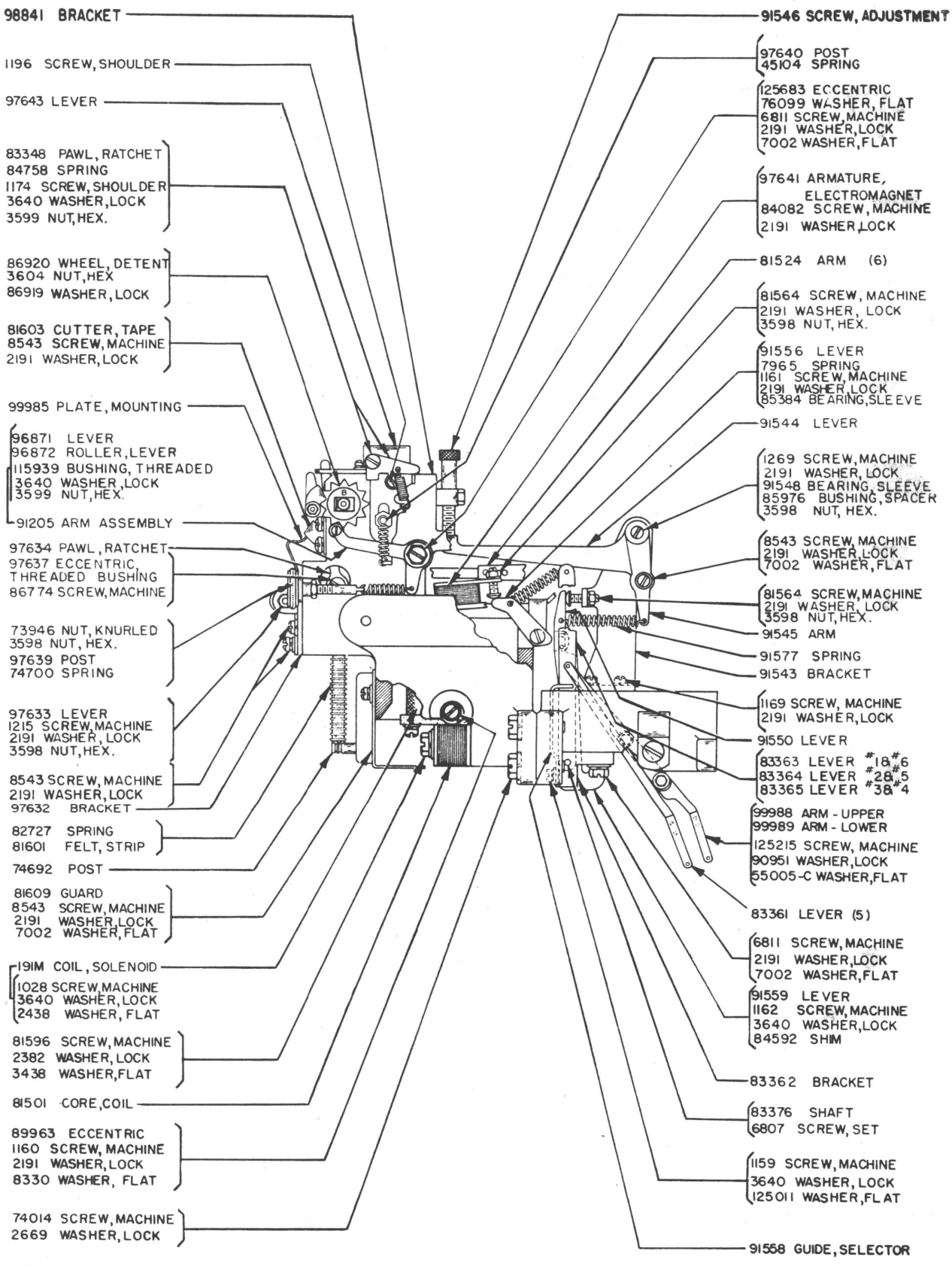


Figure 302. Perforator mechanism, parts identification.

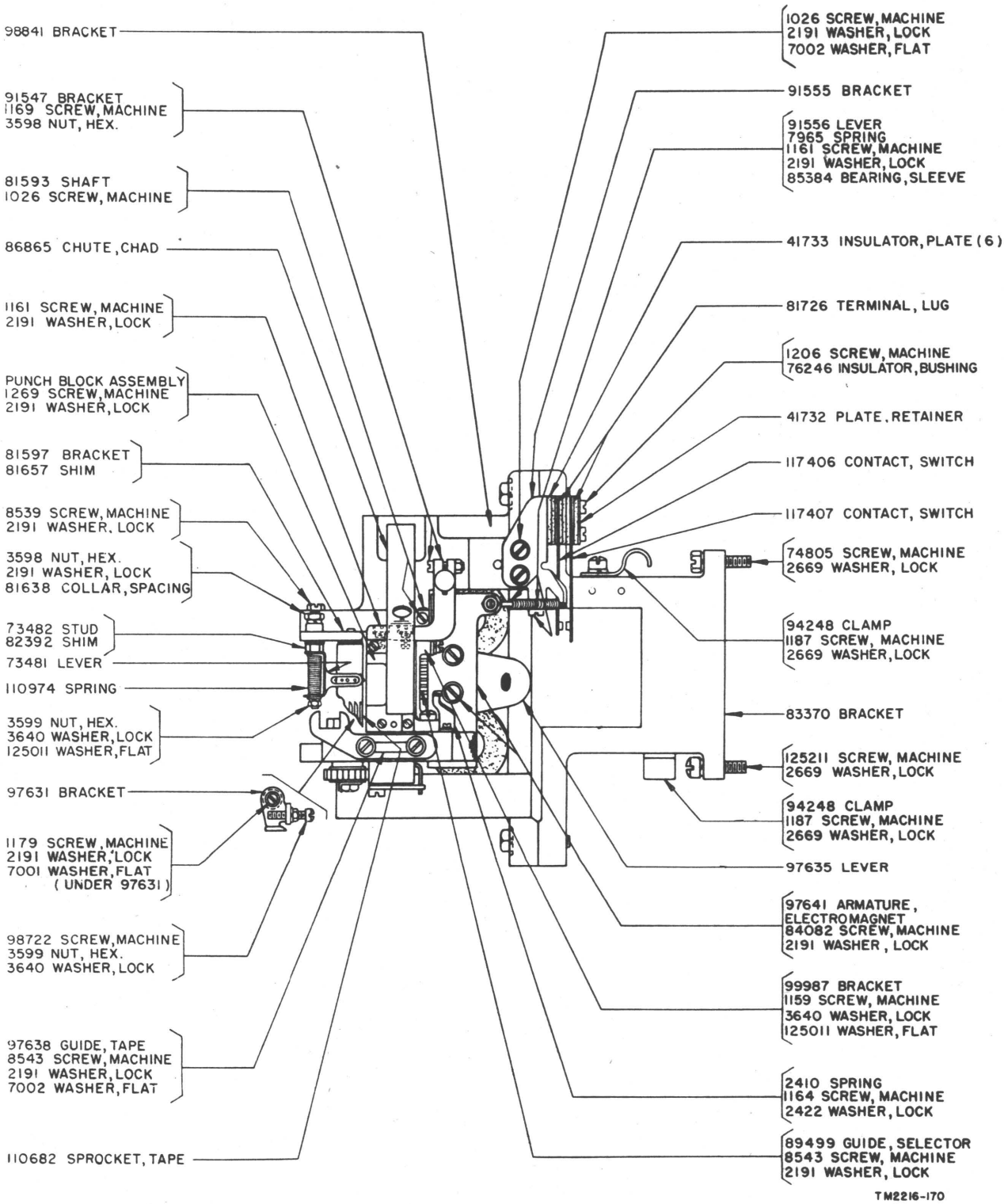


Figure 303. Perforator mechanism, parts identification.

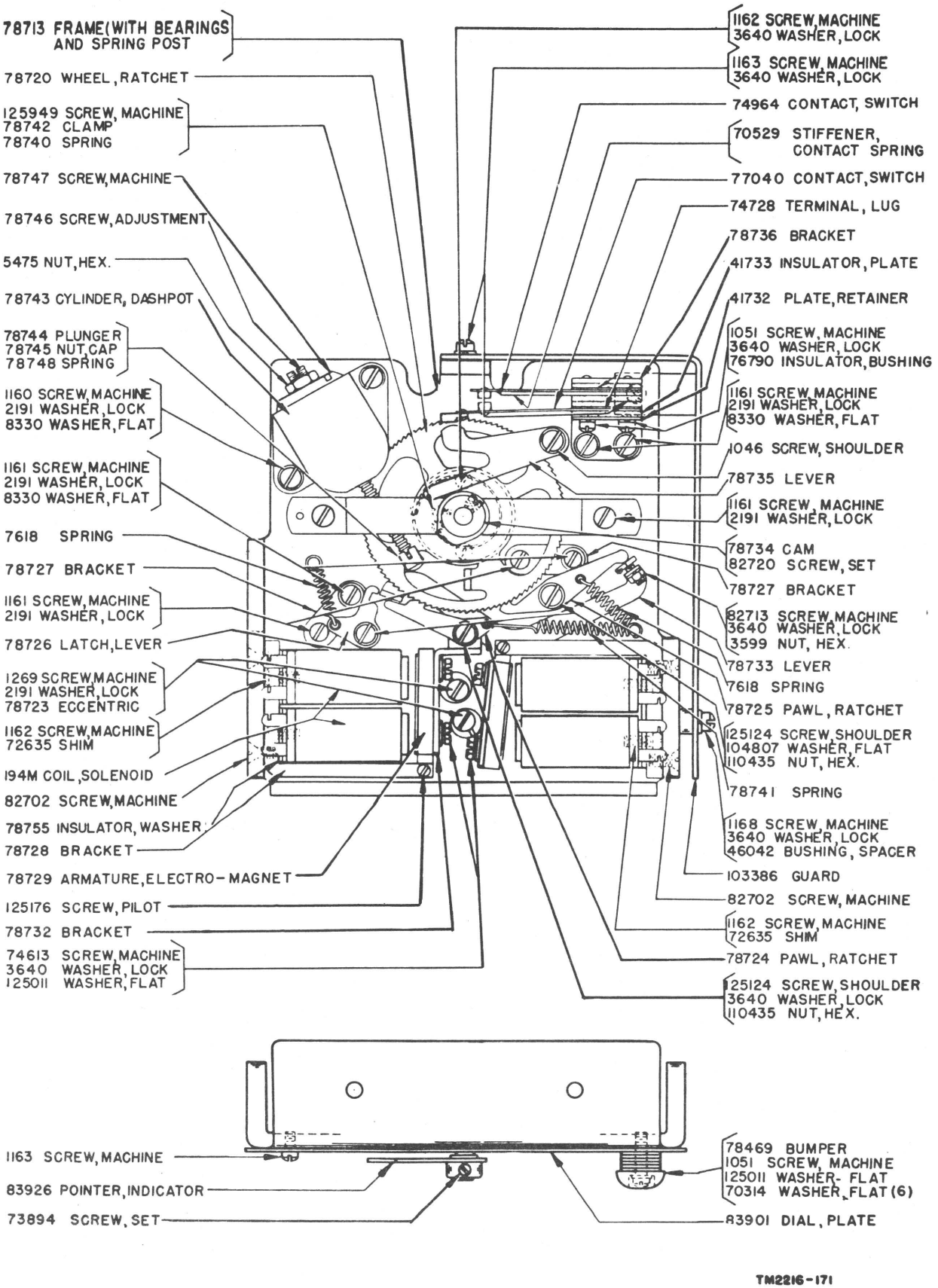


Figure 304. Counter mechanism, parts identification.

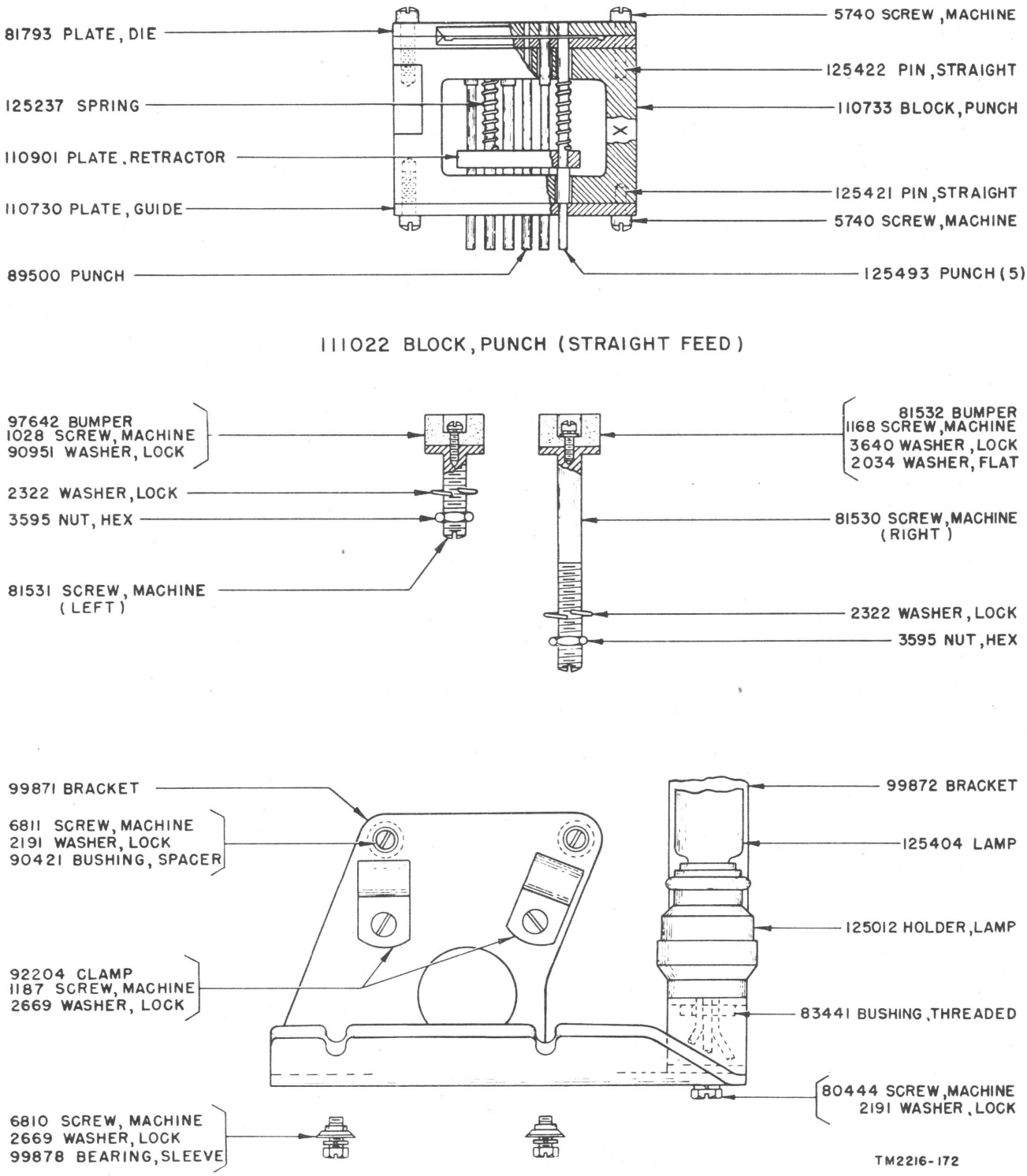


Figure 305. Punch block and counter mounting bracket, parts identification.

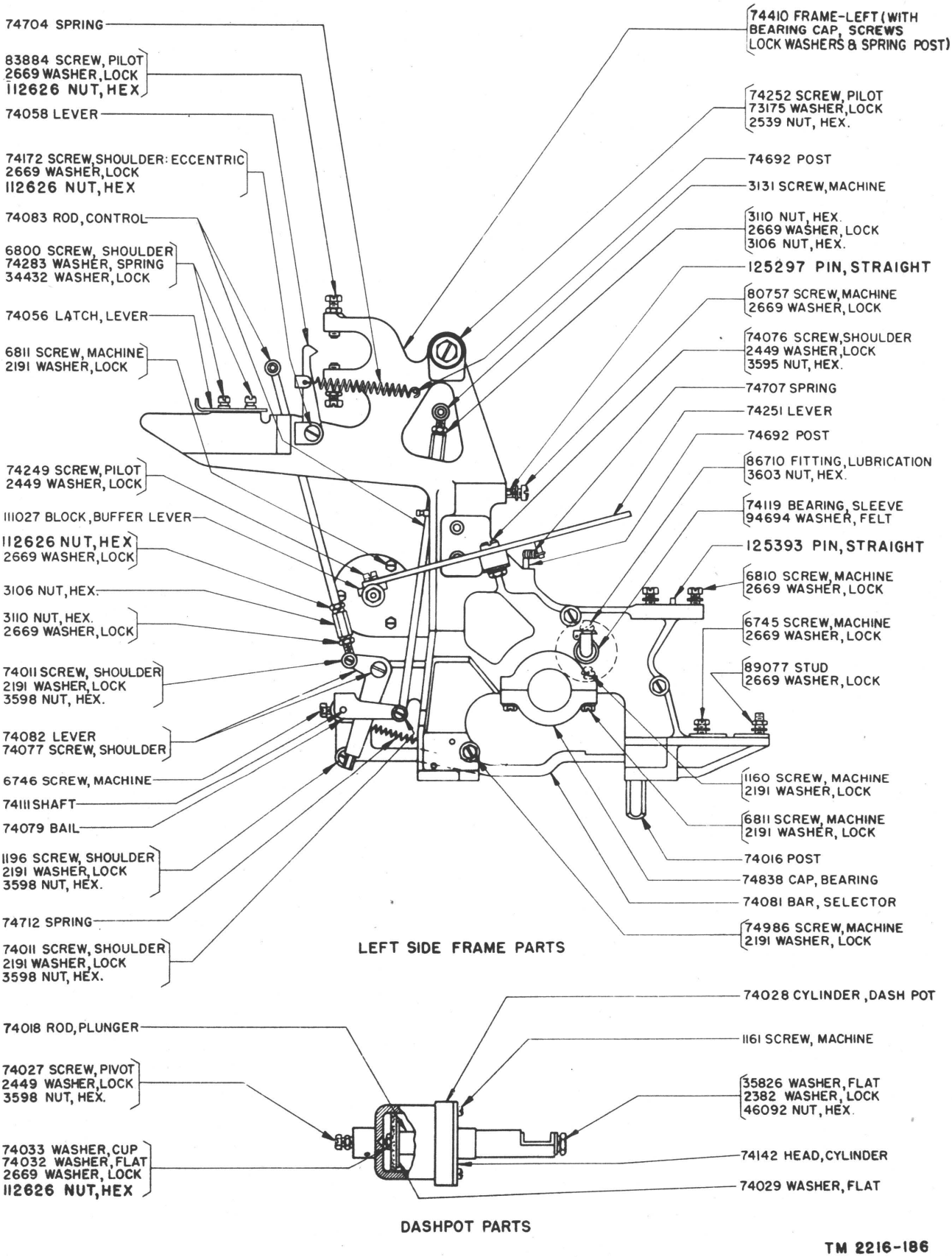


Figure 306. Frame assembly (left side) and dash pot assembly, parts identification.

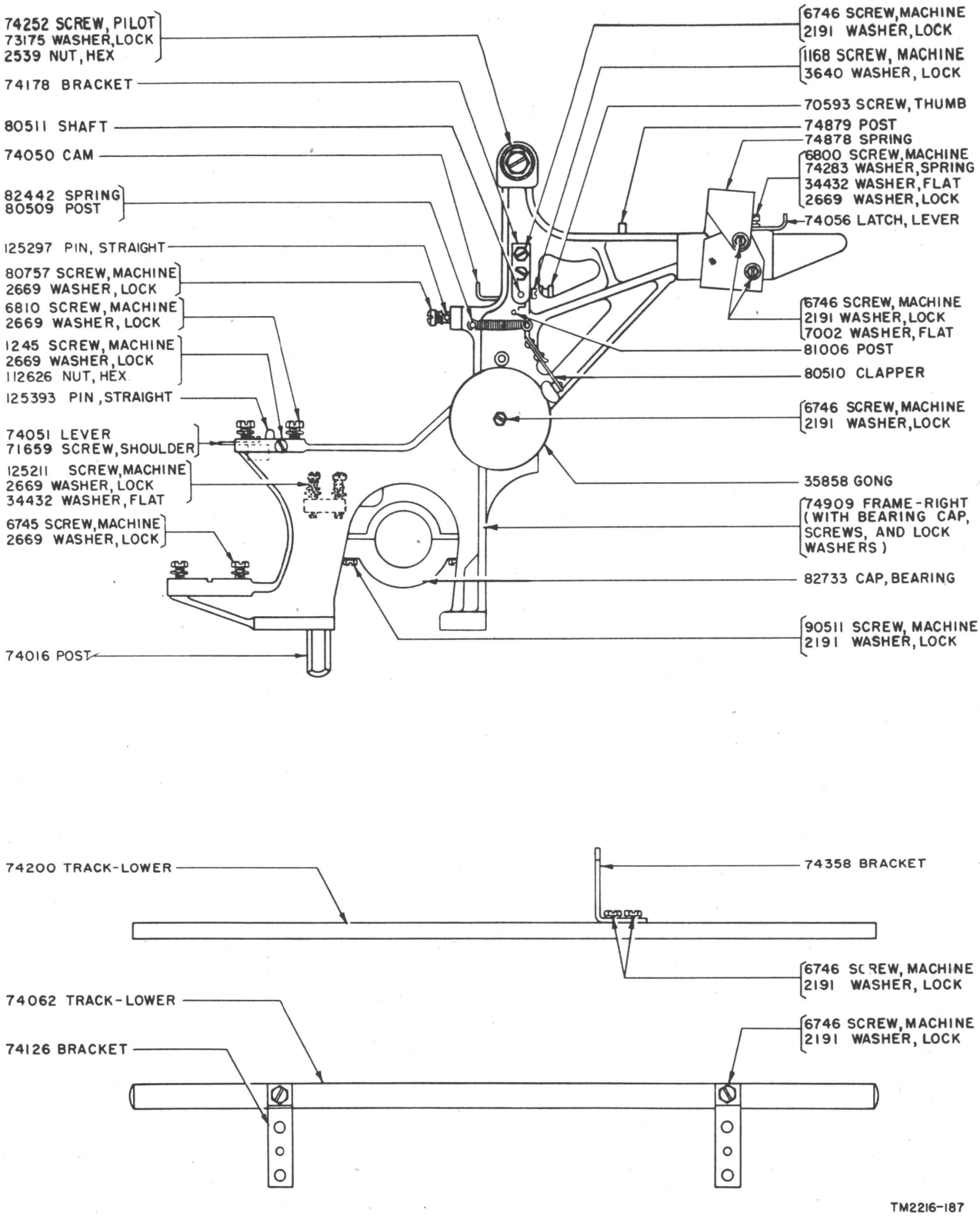


Figure 307. Frame assembly (right side) and carriage tracks, parts identification.

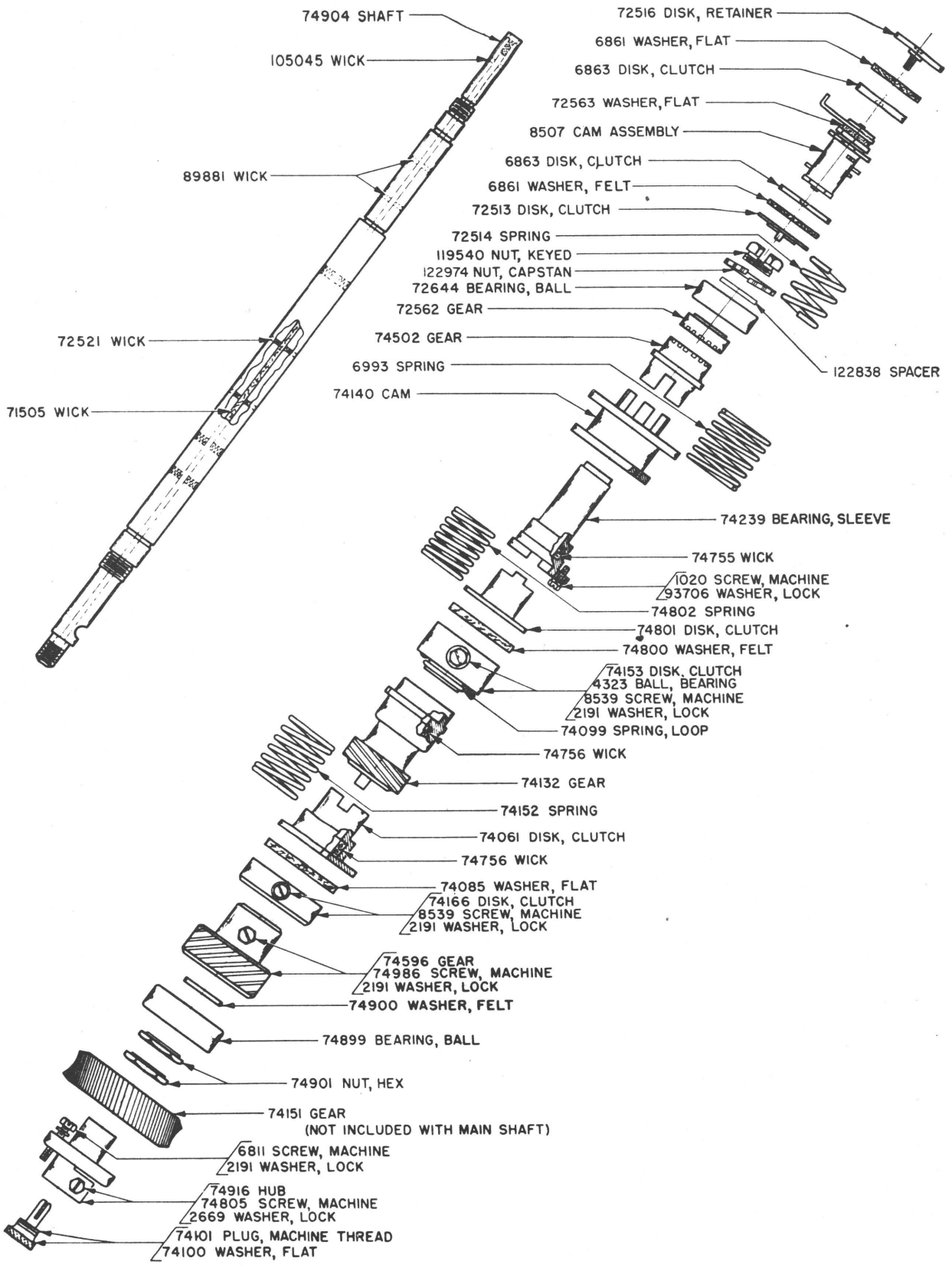


Figure 308. Main shaft assembly, parts identification.

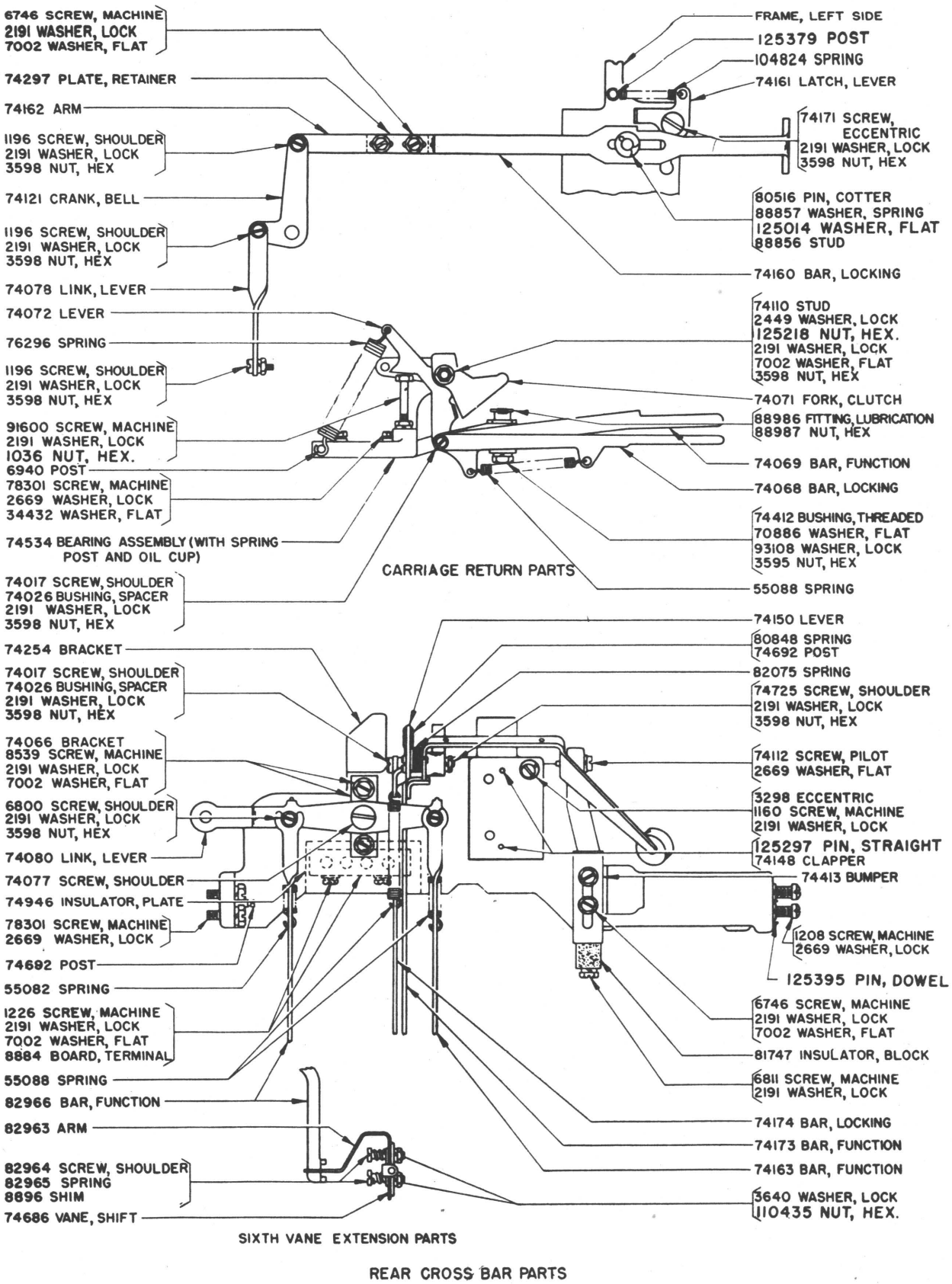
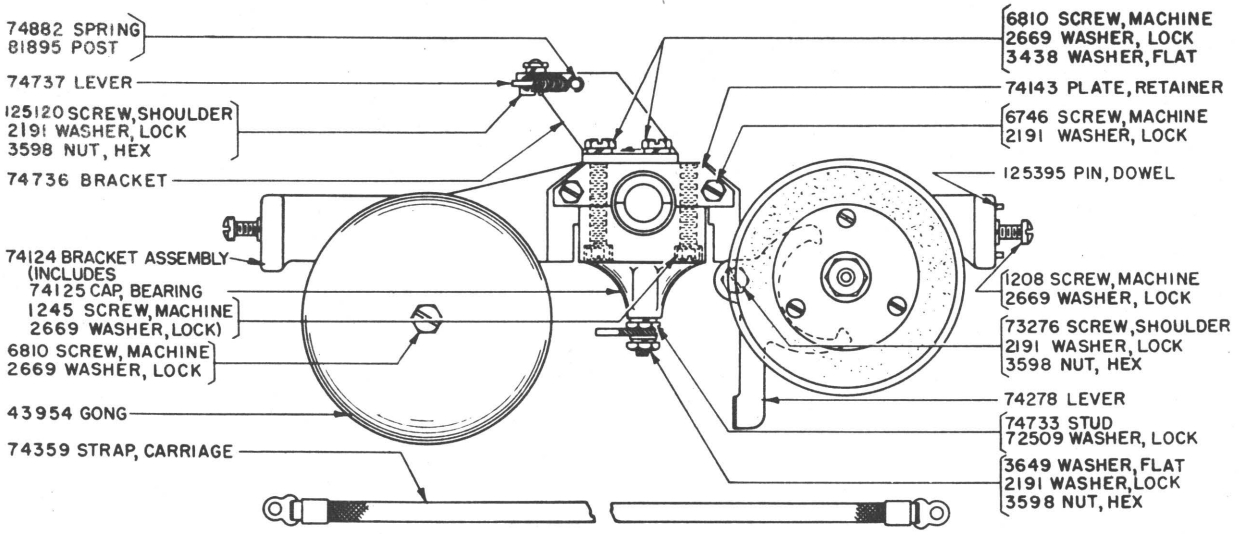
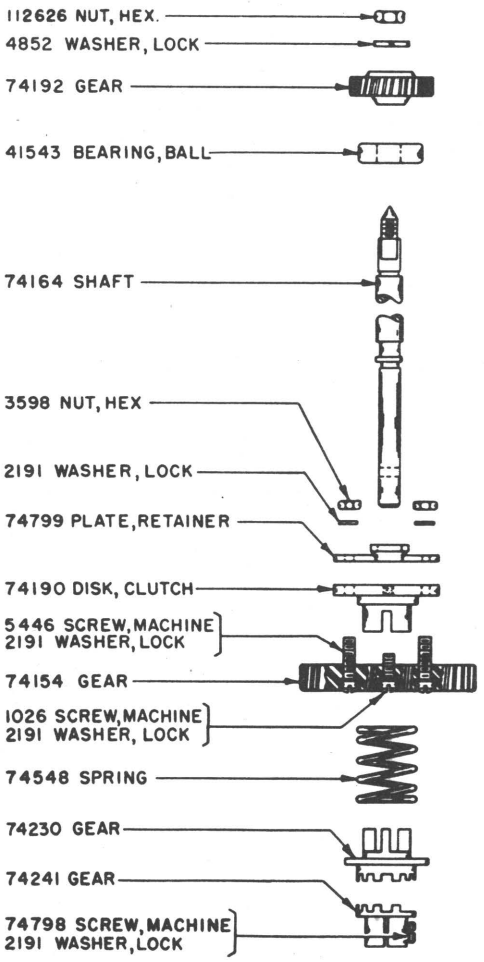


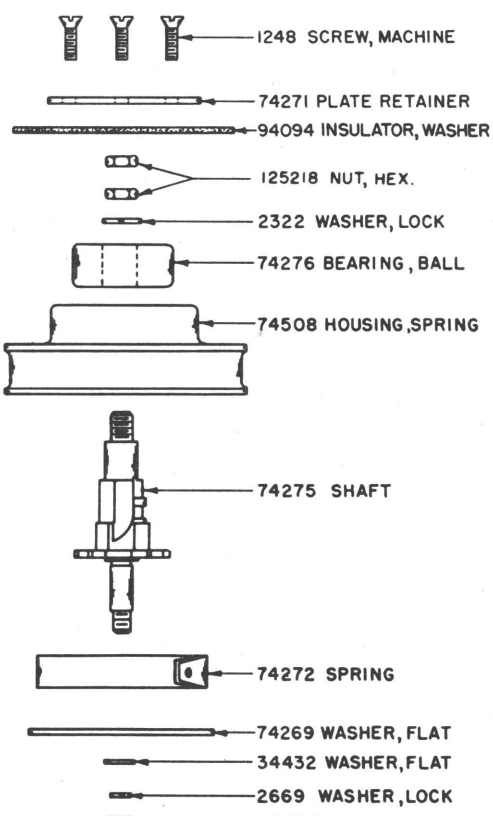
Figure 309. Carriage return and rear cross bar, parts identification.



SPACING CROSS BAR PARTS



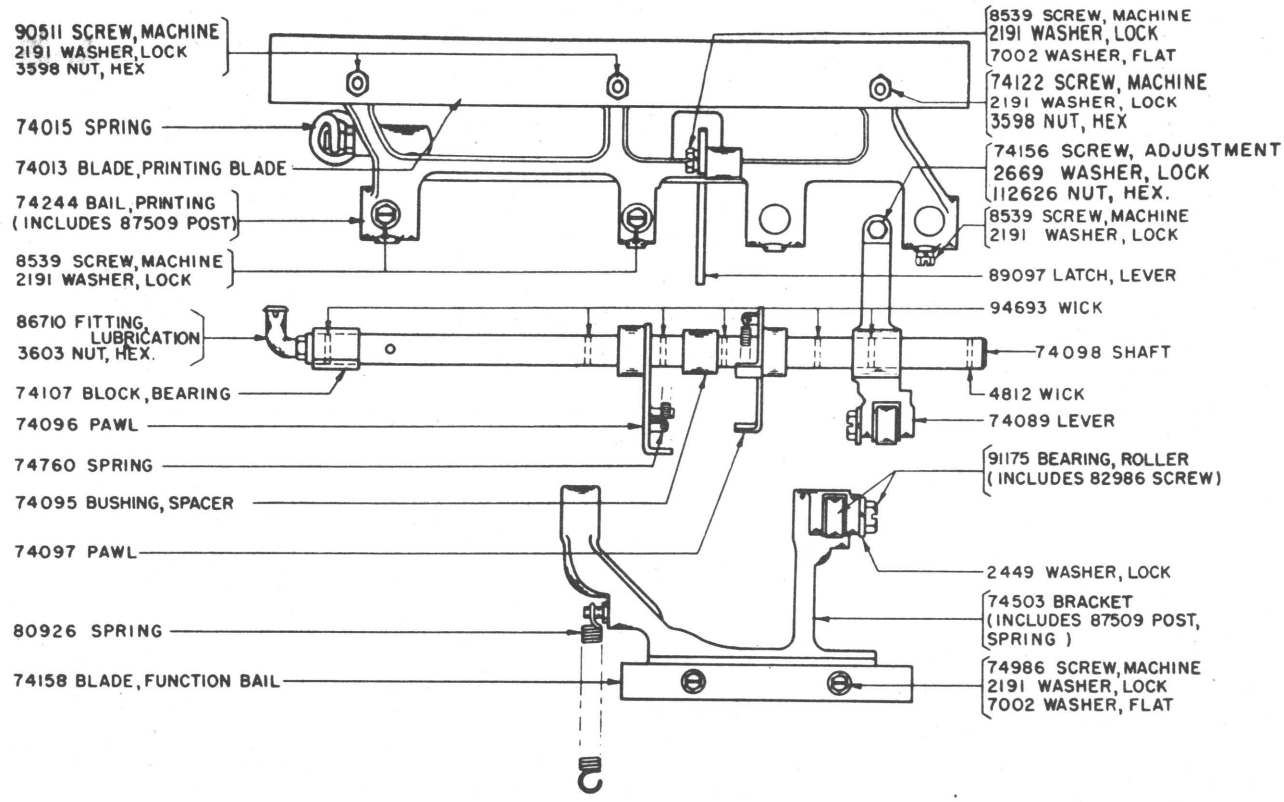
SPACING SHAFT PARTS



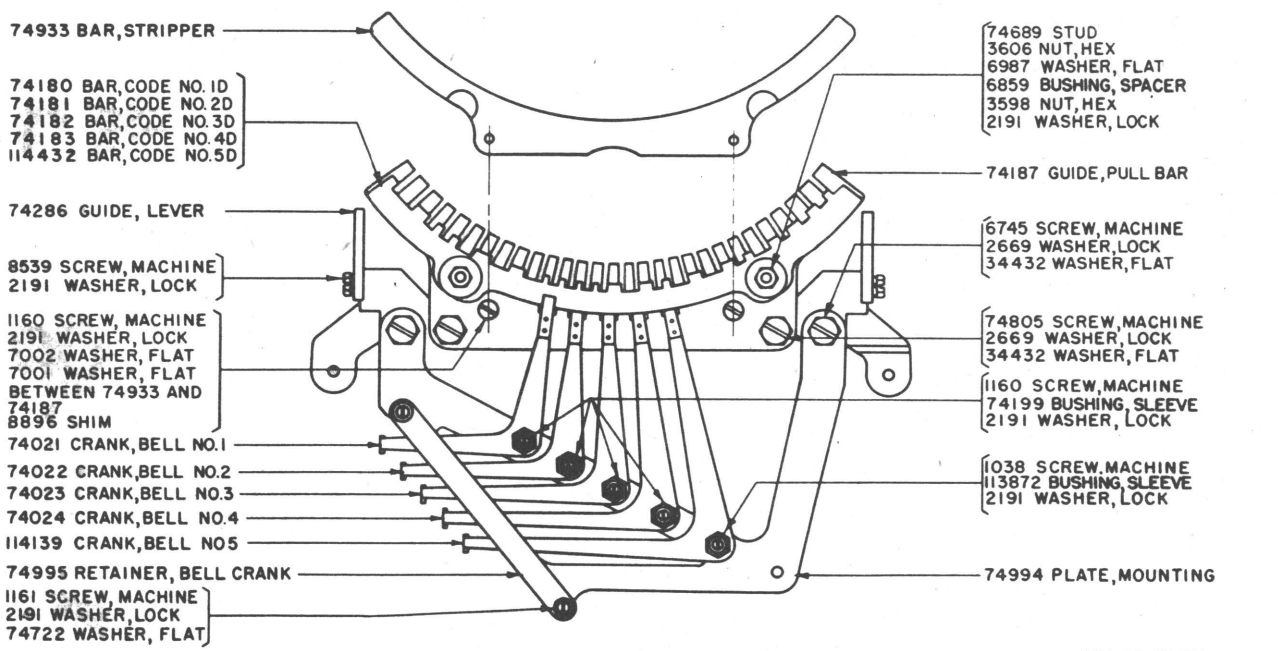
SPRING DRUM PARTS

TM 2216-190

Figure 310. Spacing shaft, upper cross bar, and spring drum, parts identification.



PRINTING AND FUNCTION BAIL PARTS



CODE BAR AND BELL CRANK PARTS

TM 2216-191

Figure 311. Printing, function bail, bell cranks, and code bars, parts identification.

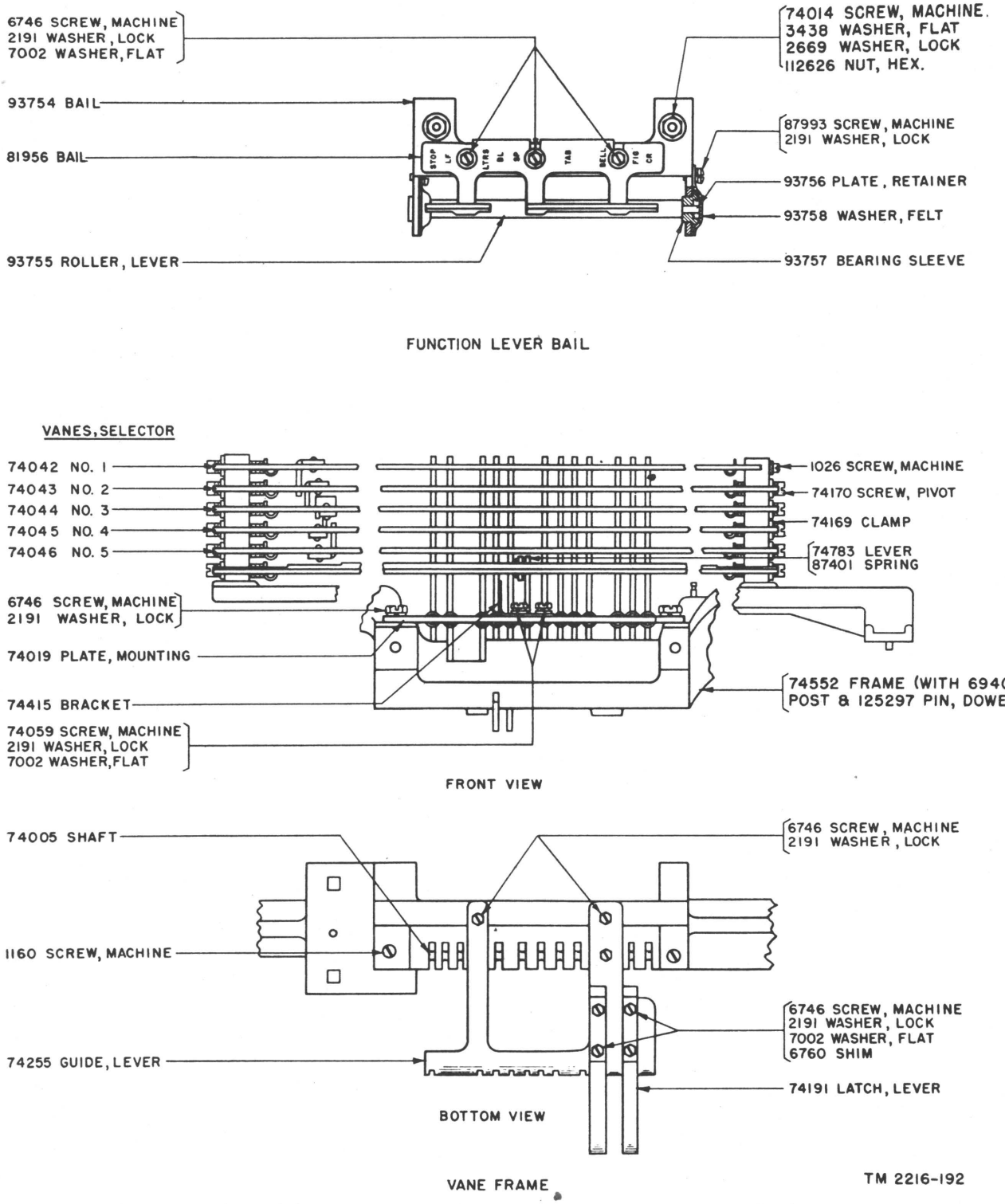


Figure 312. Vane frame and function lever bail, parts identification.

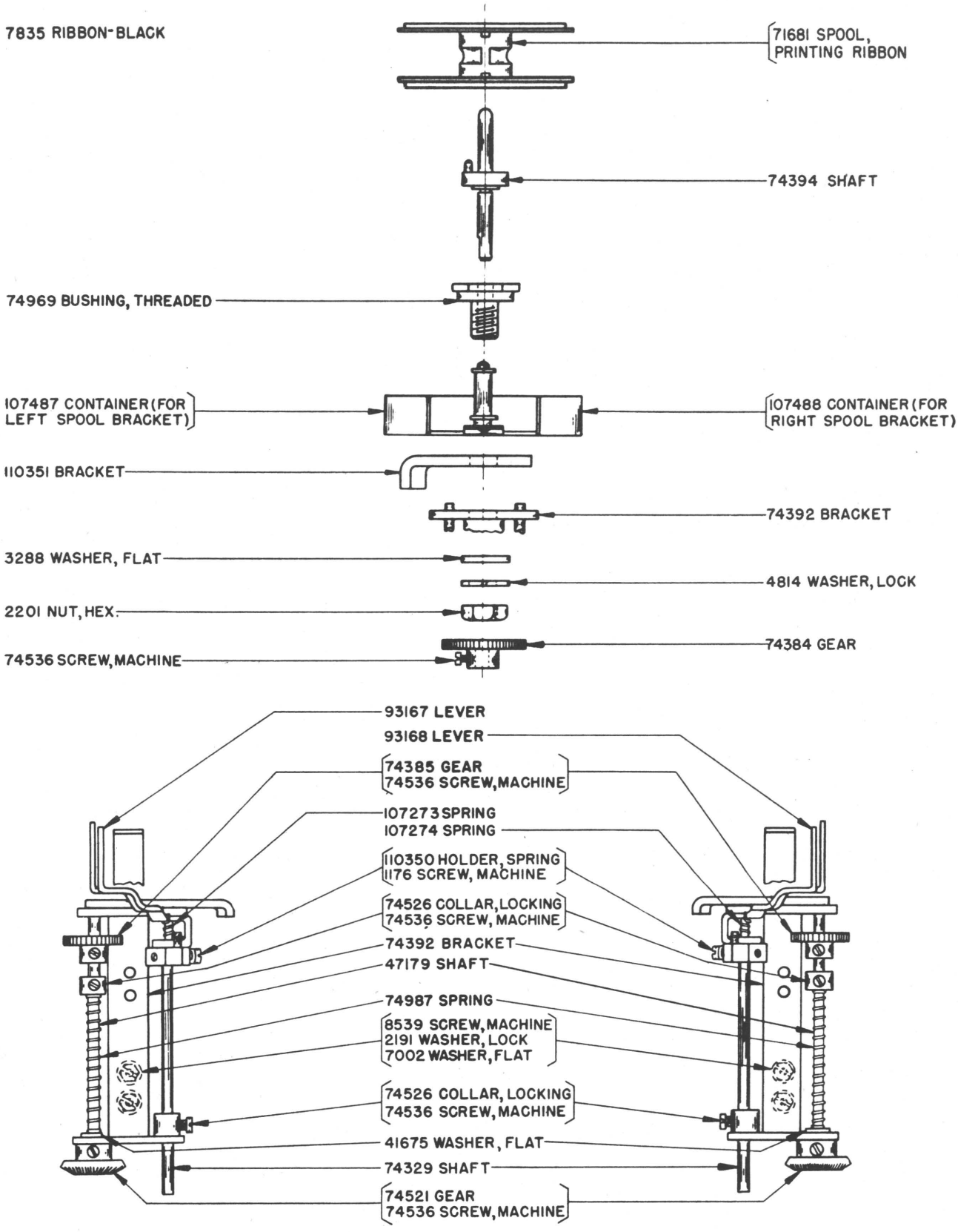


Figure 313. Ribbon feed mechanism, parts identification.

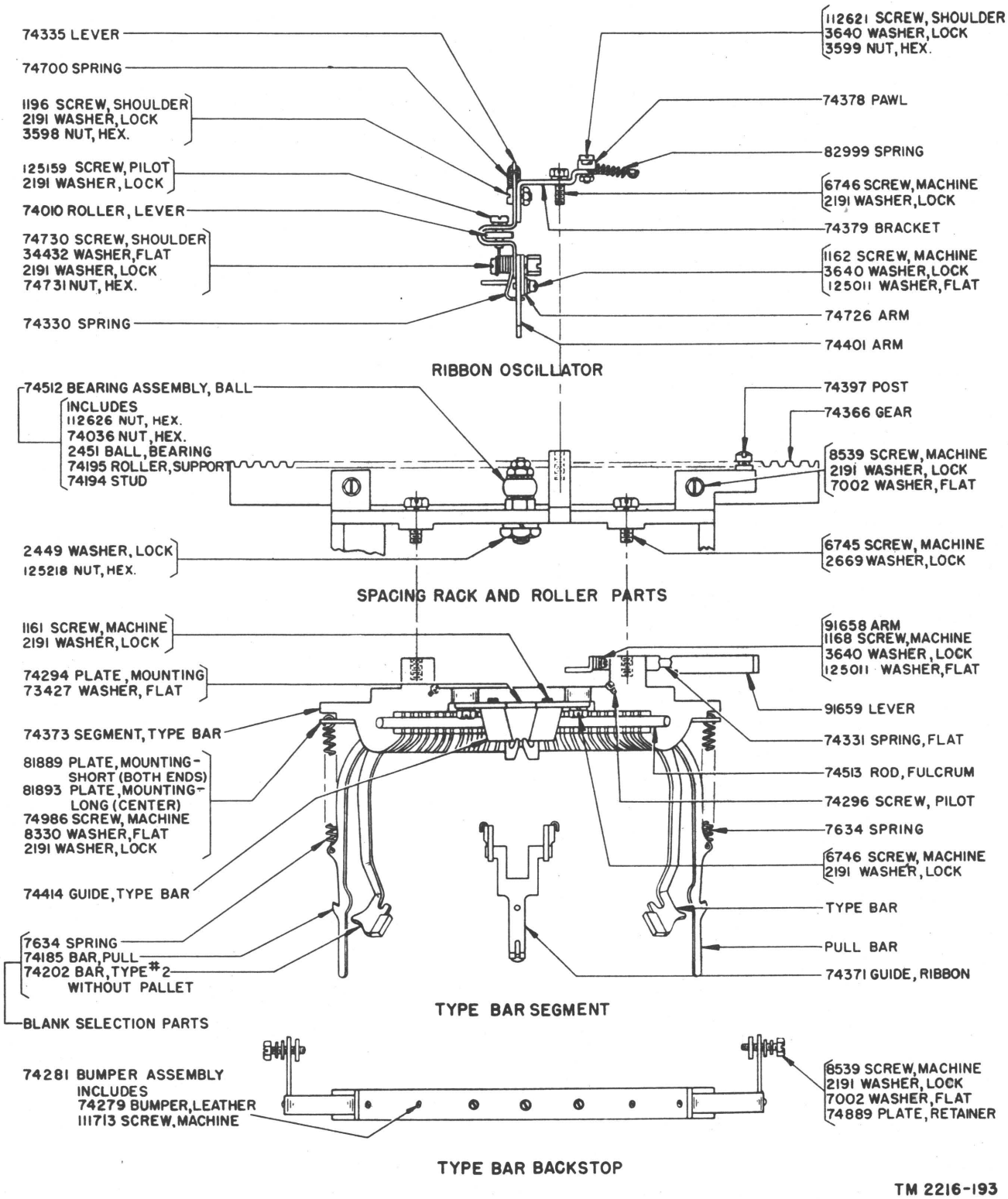


Figure 314. Type bar carriage, (top), parts identification.

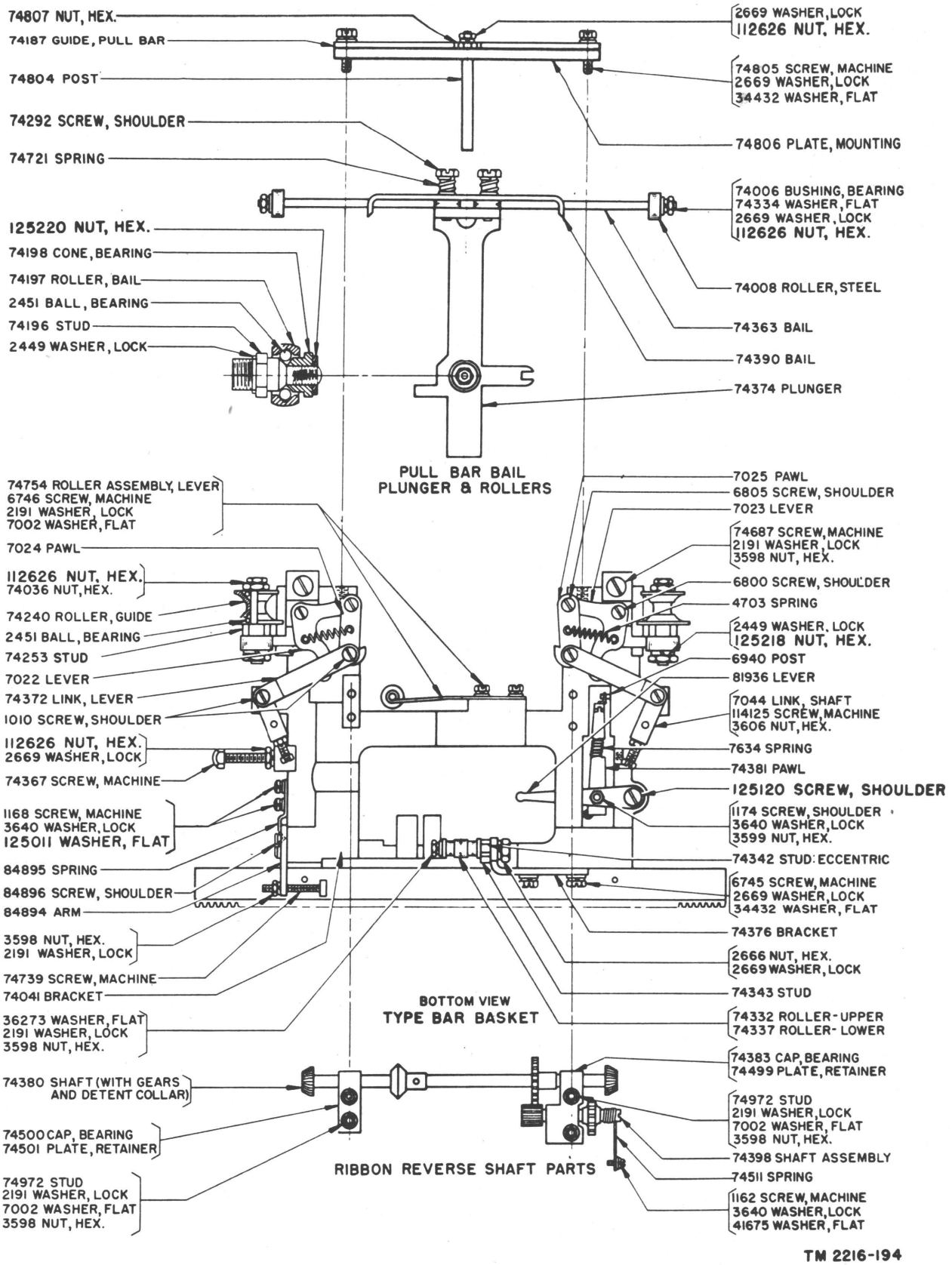


Figure 315. Type bar carriage (bottom), parts identification.

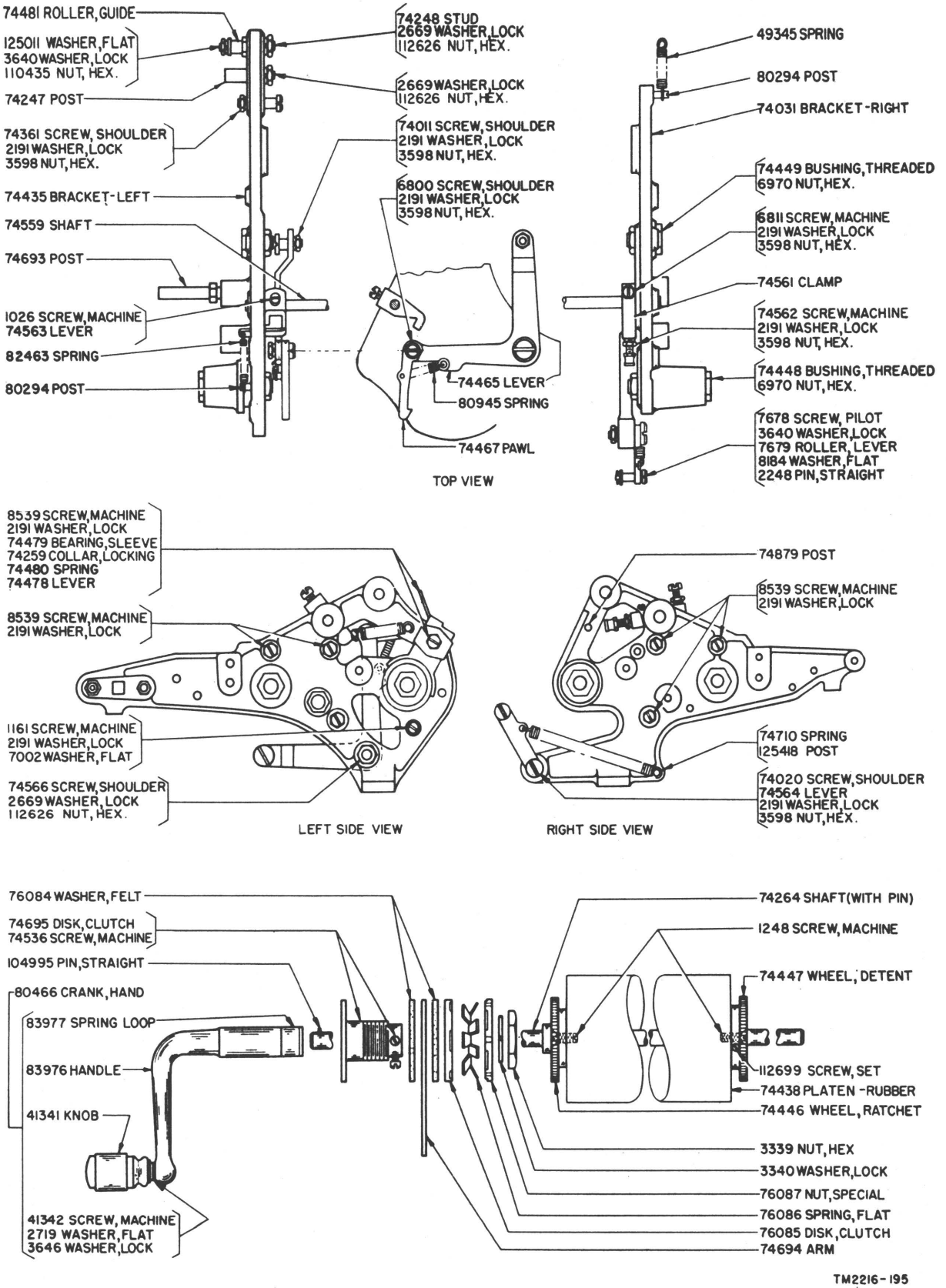


Figure 316. Platen assembly, parts identification.

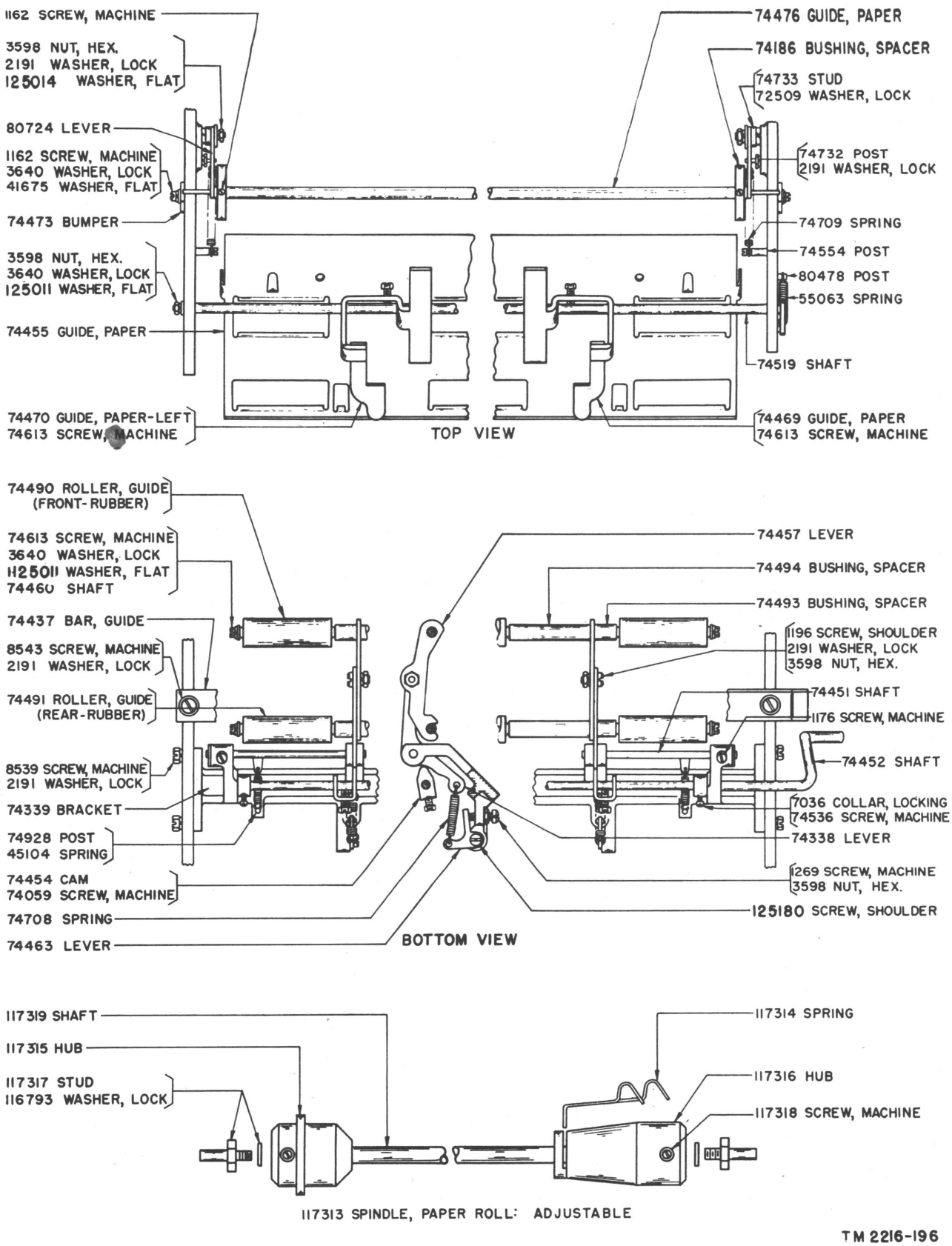


Figure 317. Platen assembly and paper roll spindle, parts identification.

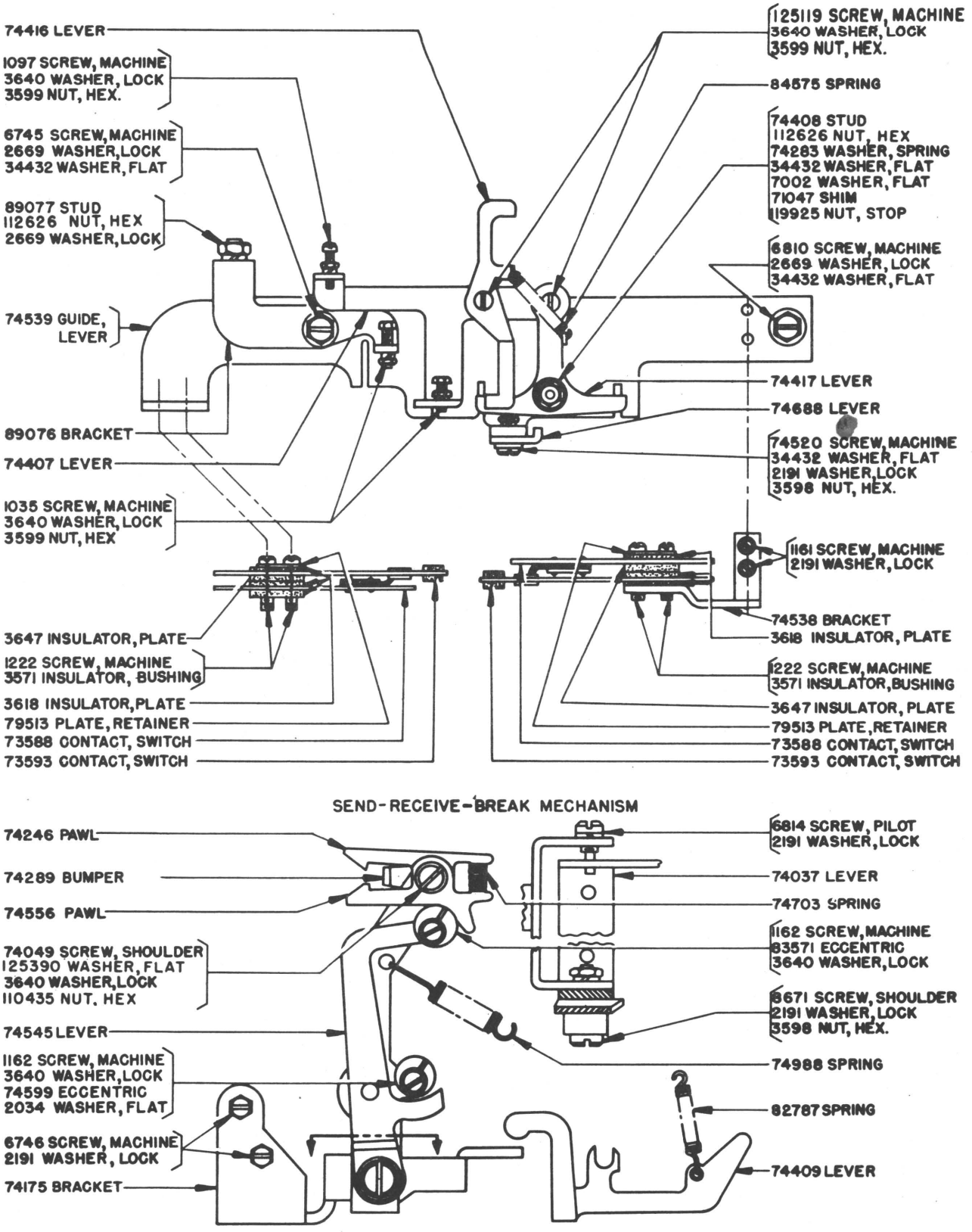


Figure 318. Motor stop mechanism, parts identification.

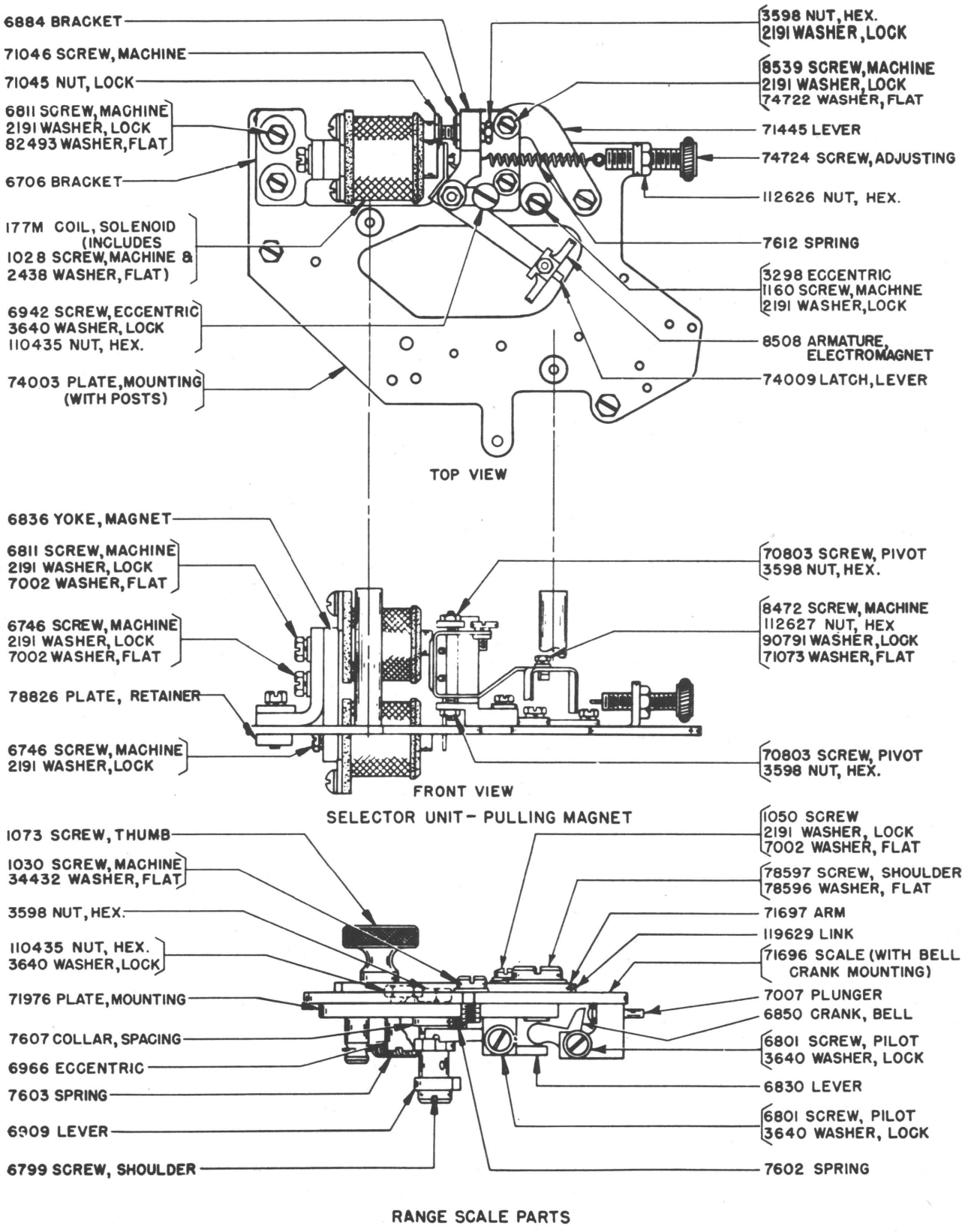


Figure 319. Selector unit and range scale assembly, parts identification.

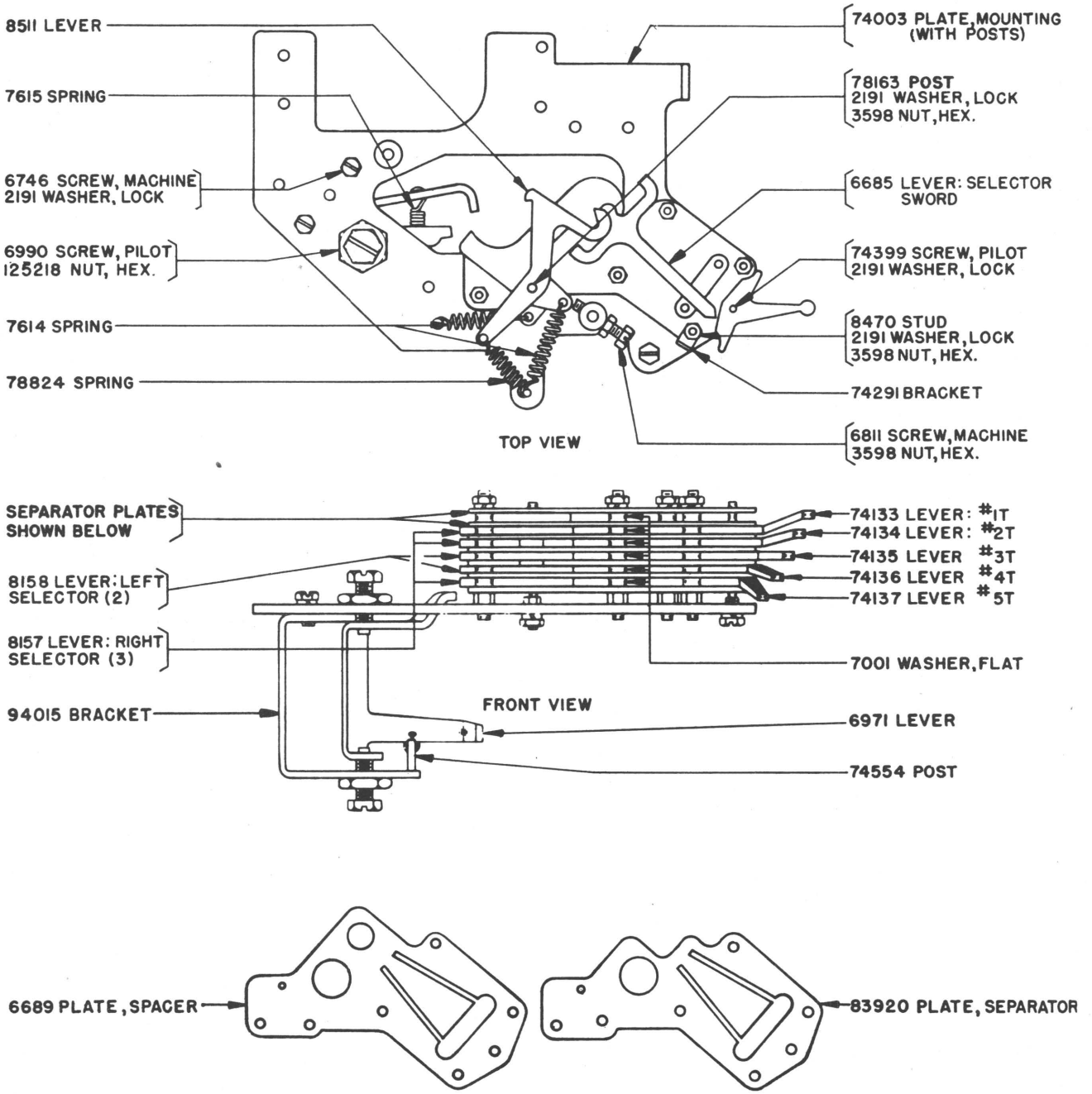
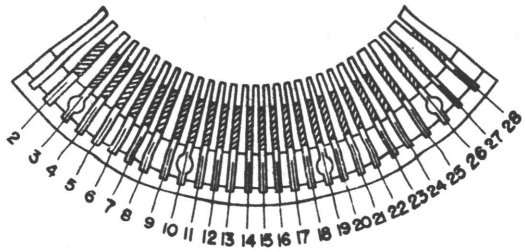


Figure 320. Selector unit assembly, parts identification.



NOTE

CHECK CAREFULLY THE POSITION OF PULL BARS IN THE SEGMENT AND THE ARRANGEMENT OF THE TYPE PALLETS ON THE TYPE BARS. IF THESE DIFFER IN ANY WAY WITH THE ARRANGEMENT SHOWN ON THIS PAGE, THE FOLLOWING PARTS SHOULD BE ORDERED BY NAME. FOR EXAMPLE ORDER:-

TYPE PALLET----------(A-)
TYPE BAR 17 (WITH PALLET)---------(A-)
SPRING CUSHION KEYTOP----------(A-)

NUMBER OF POSITION IN SEGMENT	PULL BAR CATALOG NUMBER	PULL BAR SPRING CATALOG NUMBER	TYPE BARS (WITHOUT PALLETS) CATALOG NUMBER	TYPE BARS (WITHOUT PALLETS) NUMBER ON BAR	TYPE BARS PALLETS CATALOG NUMBER	TYPE BARS PALLETS DESCRIPTION	TYPE BARS (WITH PALLETS) CATALOG NUMBER	TYPE BARS (WITH PALLETS) NUMBER ON BAR	SPRING CUSHION KEYTOPS CATALOG NUMBER	KEYTOPS DESCRIPTION
1										
2	74185 USED IN ALL POSITIONS	7634 USED IN ALL POSITIONS	74202	2	84025	-	84734	2	89413	-
3			74203	3	74303	Z "	74643	3	78970	Z "
3			74203	3	82751	Z +	84735	3	89422	Z +
4			74204	4	74304	K (	74644	4	78956	K (
4			74204	4	82153	K ←	84736	4	89420	K ←
5			74205	5	74305	B ?	74645	5	78947	B ?
5			74205	5	82420	B ⊕	84737	5	89425	B ⊕
6			74206	6	96559	P Ø	102985	6	99564	P Ø
7			74207	7	74307	Y 6	74647	7	78969	Y 6
8			74208	8	74308	M •	74648	8	78958	M •
9			74209	9	74309	U 7	74649	9	78965	U 7
10			74210	10	74310	L)	74650	10	78957	L)
10			74210	10	82154	L ↖	84738	10	89421	L ↖
11			74211	11	74311	H £	74651	11	82607	H STOP
11			74211	11	82151	H ↓	84740	11	89418	H ↓
12			74212	12	74312	O 9	74652	12	78960	O 9
13			74213	13	74313	I 8	74653	13	78954	I 8
14			74214	14	74314	N ,	74654	14	78959	N ,
14			74214	14	84069	N Φ	84742	14	89426	N Φ
15			74215	15	74315	E 3	74655	15	78950	E 3
16			74216	16	74316	T 5	74656	16	78964	T 5
17			74217	17	74317	A -	74657	17	78946	A -
17			74217	17	82147	A ↑	84743	17	89414	A ↑
18			74218	18	74318	J '	74658	18	78955	J '
18			74218	18	82152	J ↙	84745	18	89419	J ↙
19			74219	19	74319	R 4	74659	19	78963	R 4
20			74220	20	74320	D $	74660	20	78949	D $
20			74220	20	82148	D ↗	84746	20	89415	D ↗
21			74221	21	74321	C :	74661	21	78948	C :
21			74221	21	82423	C 0	84747	21	89423	C 0
22			74222	22	74322	F !	74662	22	78951	F !
22			74222	22	82149	F →	84749	22	89416	F →
23			74223	23	74323	W 2	74663	23	78967	W 2
24			74224	24	74324	G &	74664	24	78952	G &
24			74224	24	82150	G ↘	84750	24	89417	G ↘
25			74225	25	74325	V ;	74665	25	78966	V ;
25			74225	25	82421	V Ⓘ	84752	25	89424	V Ⓘ
26			74226	26	74326	Q 1	74666	26	78962	Q 1
27			74227	27	74327	X /	74667	27	78968	X /
28			74228	28	74328	S '	74668	28	78980	S BELL
									78972	FIGS.
									78973	LTRS.
									78976	CAR. RET.
									78978	LINE FEED
									78971	BLANK

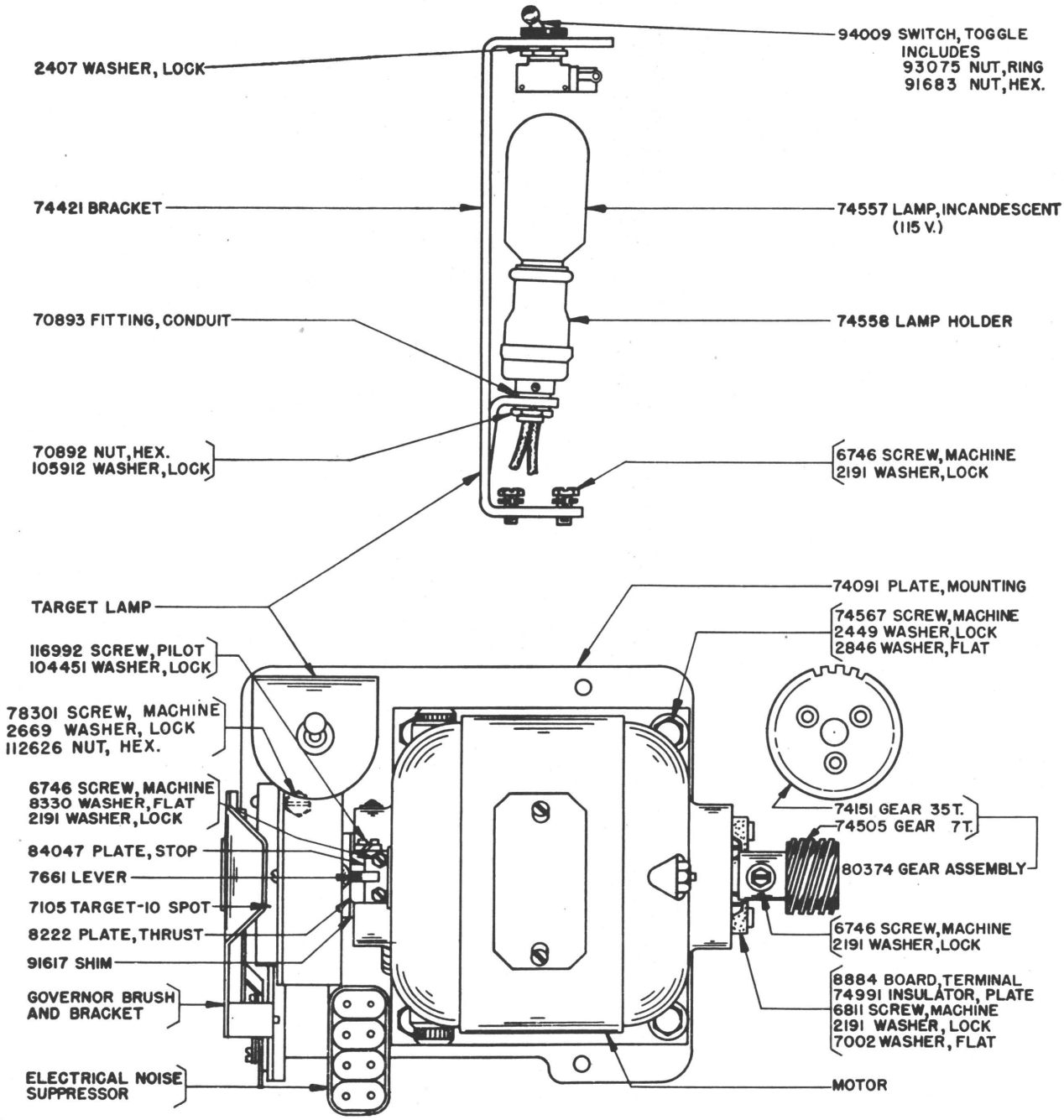
FUNCTION LEVERS

CATALOG NUMBER	POSITION USED	FUNCTION PERFORMED	SPRING	CODE SELECTION	STAMPING
74040	1	LOCKS VANES	74962	NOTE 1	1
74131	2	CARRIAGE RETURN	74961	- - - 4 -	2
84927	2	CARRIAGE RETURN IN "LETTERS" POSITION ONLY	74961	- - - 4 -	S2
74128	3	SHIFT TO "FIGURES" POSITION	74962	1 2 - 4 5	3
74138	4	BELL ON "FIGURES" "S"	74961	1 - 3 - -	4
74109	5	RESETS SEND-RECEIVE BREAK MECHANISM	86873	NOTE 2	5A
74932	7	SUPPRESSES PRINTING & SPACING ON "BLANK"	87402	- - - - -	7A
84060	7	SUPPRESSES PRINTING & SPACING ON "BLANK" IN "LETTERS" POSITION ONLY	4708	- - - - -	7B
74130	9	SHIFT TO "LETTERS" POSITION ON SPACE	74962	- - 3 - -	9
74039	10	OPERATES SEND-RECEIVE BREAK MECHANISM ON "BLANK" SIGNAL	74705	- - - - -	10
74129	11	SHIFT TO "LETTERS" POSITION	74962	1 2 3 4 5	11
74127	12	LINE FEED	74962	- 2 - - -	12
84928	12	LINE FEED IN "LETTERS" POSITION ONLY	74962	- 2 - - -	12A
82271	13	MOTOR STOP ON "FIGURES" "H"	82788	- - 3 - 5	13D

NOTE 1 - OPERATES ON ALL COMBINATIONS NOTE 2 - OPERATES ON ANY PRINTED CHARACTOR

TM2215-229

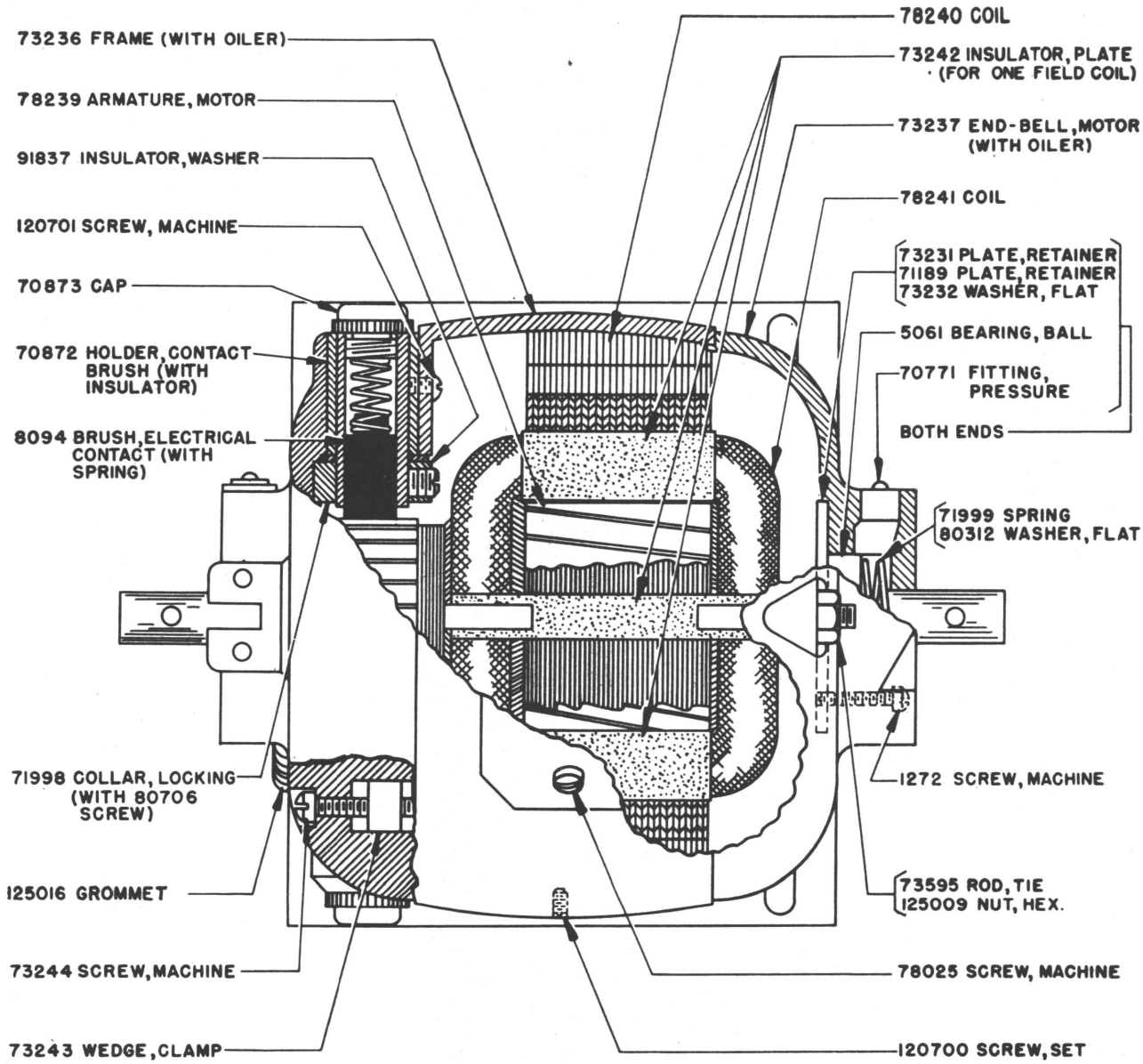
Figure 321. Pull bars, type bars, keytops and function levers, parts identification.



MU-27 MOTOR UNIT

TM 2216-200

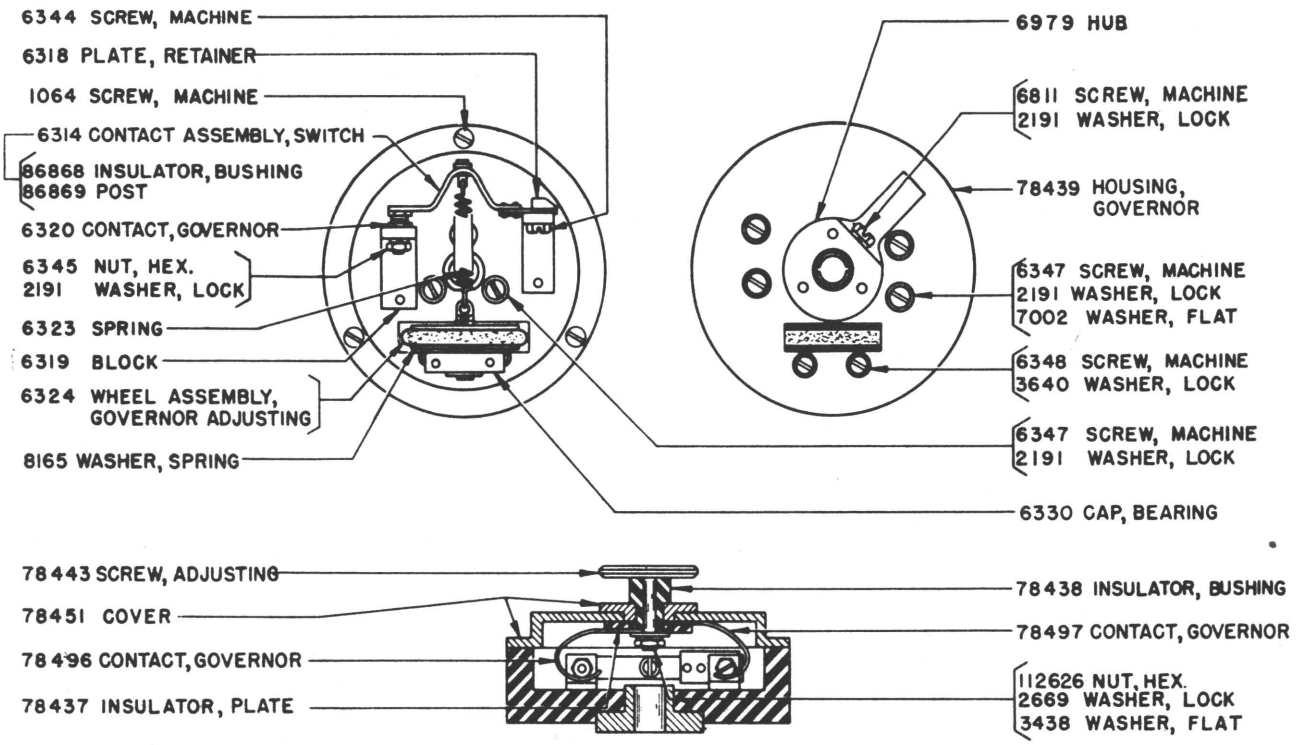
Figure 322. Motor unit, parts identification.



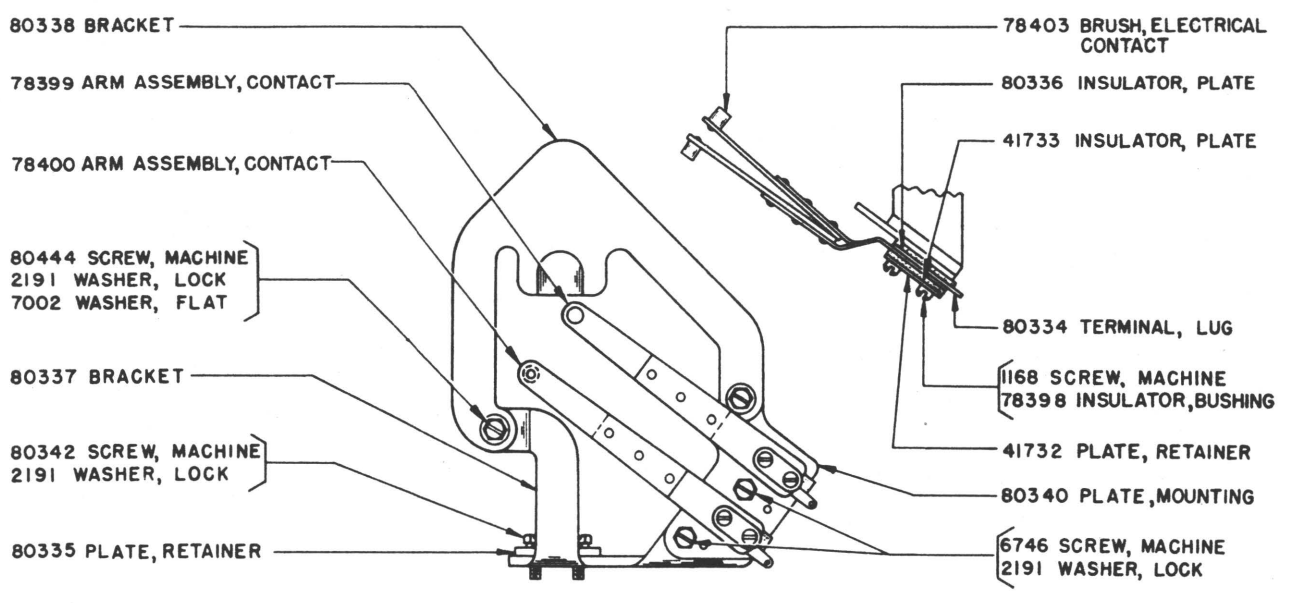
77953 MOTOR, A.C.

TM 2216-201

Figure 323. Motor, parts identification.



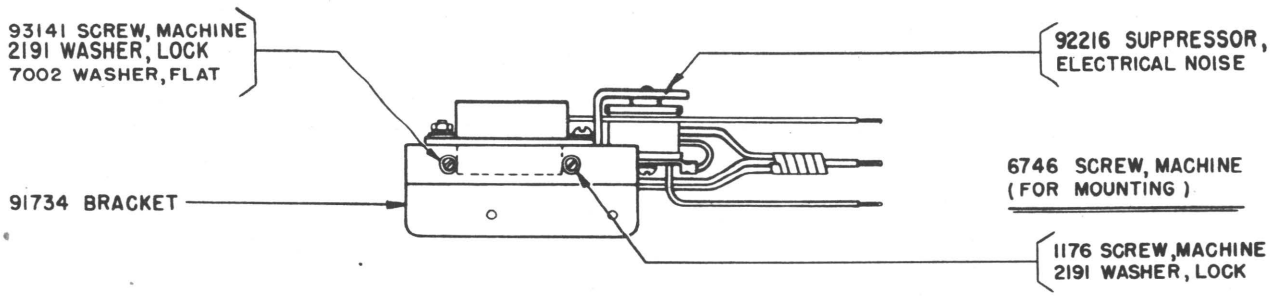
80352 GOVERNOR



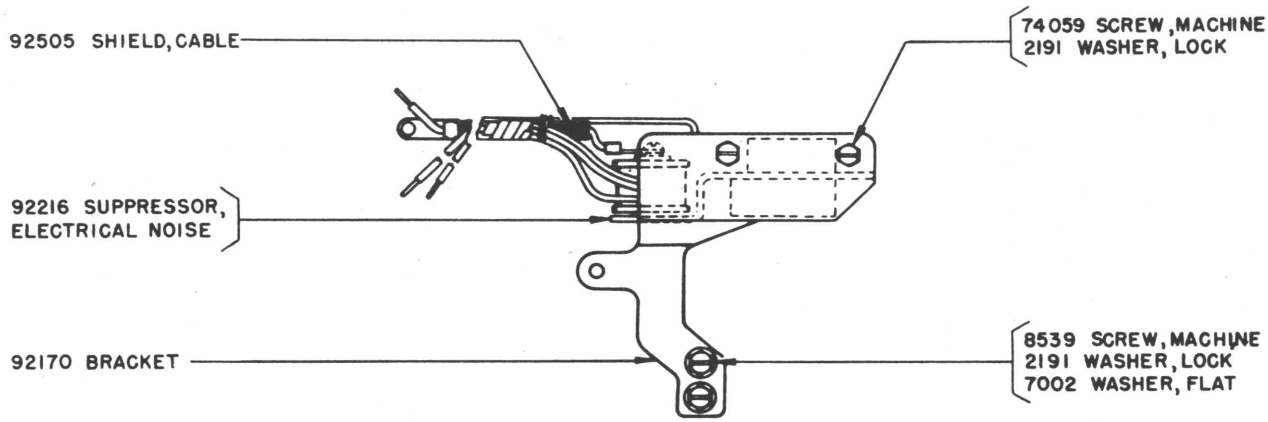
80341 BRACKET ASSEMBLY

TM2216-202

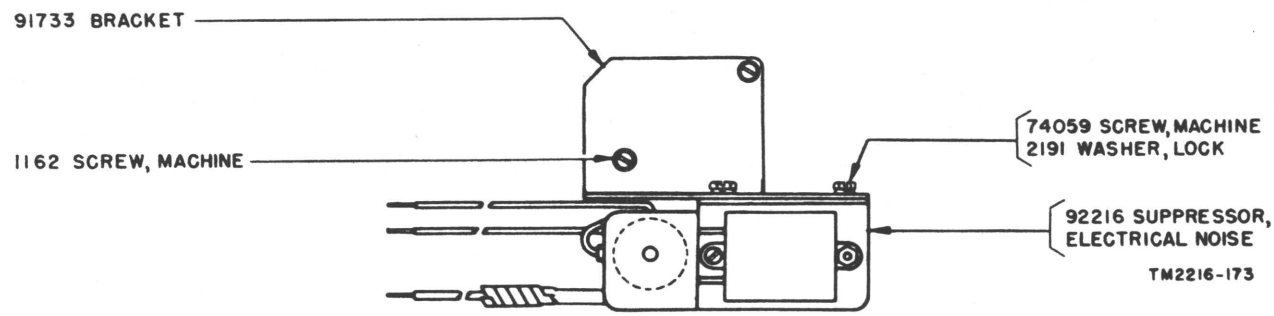
Figure 324. Motor governor, parts identification.



92224 SUPPRESSOR, ELECTRICAL NOISE
(CAM PULSING CONTACTS)

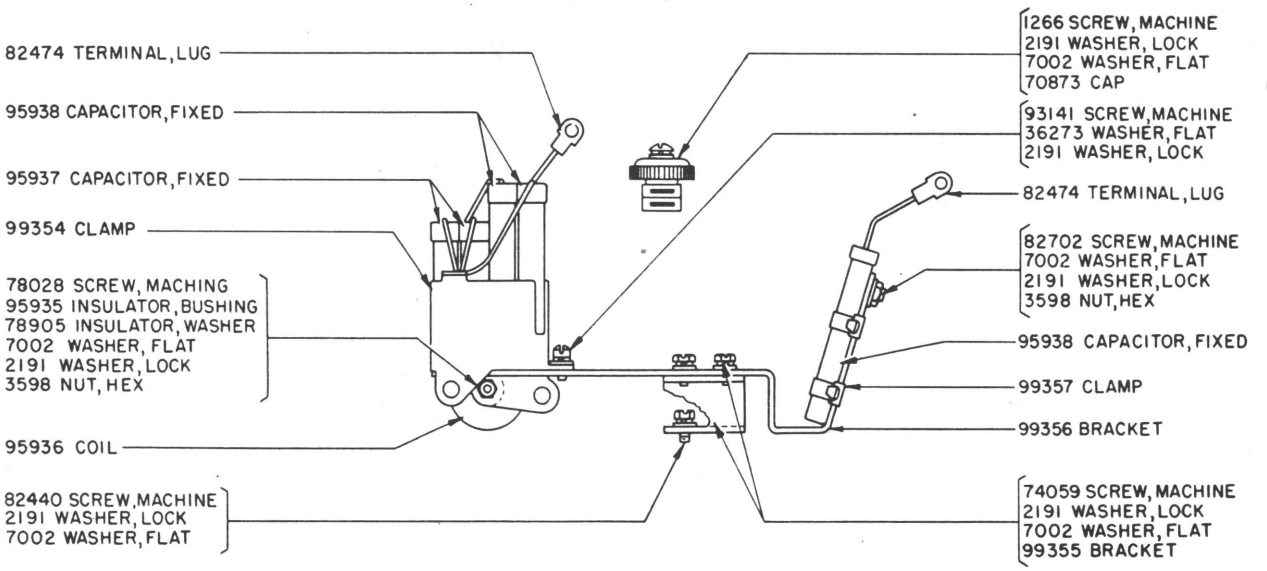


92222 SUPPRESSOR, ELECTRICAL NOISE
(KEYBOARD TRANSMITTING CONTACTS)

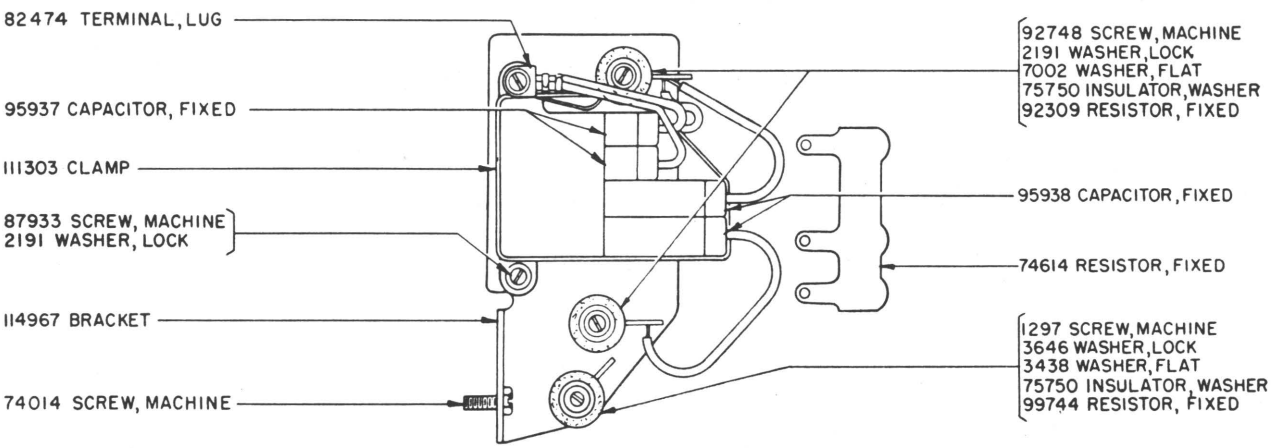


92225 SUPPRESSOR, ELECTRICAL NOISE
(PUNCH MAGNET)

Figure 325. Electrical noise suppressor assemblies, parts identification.



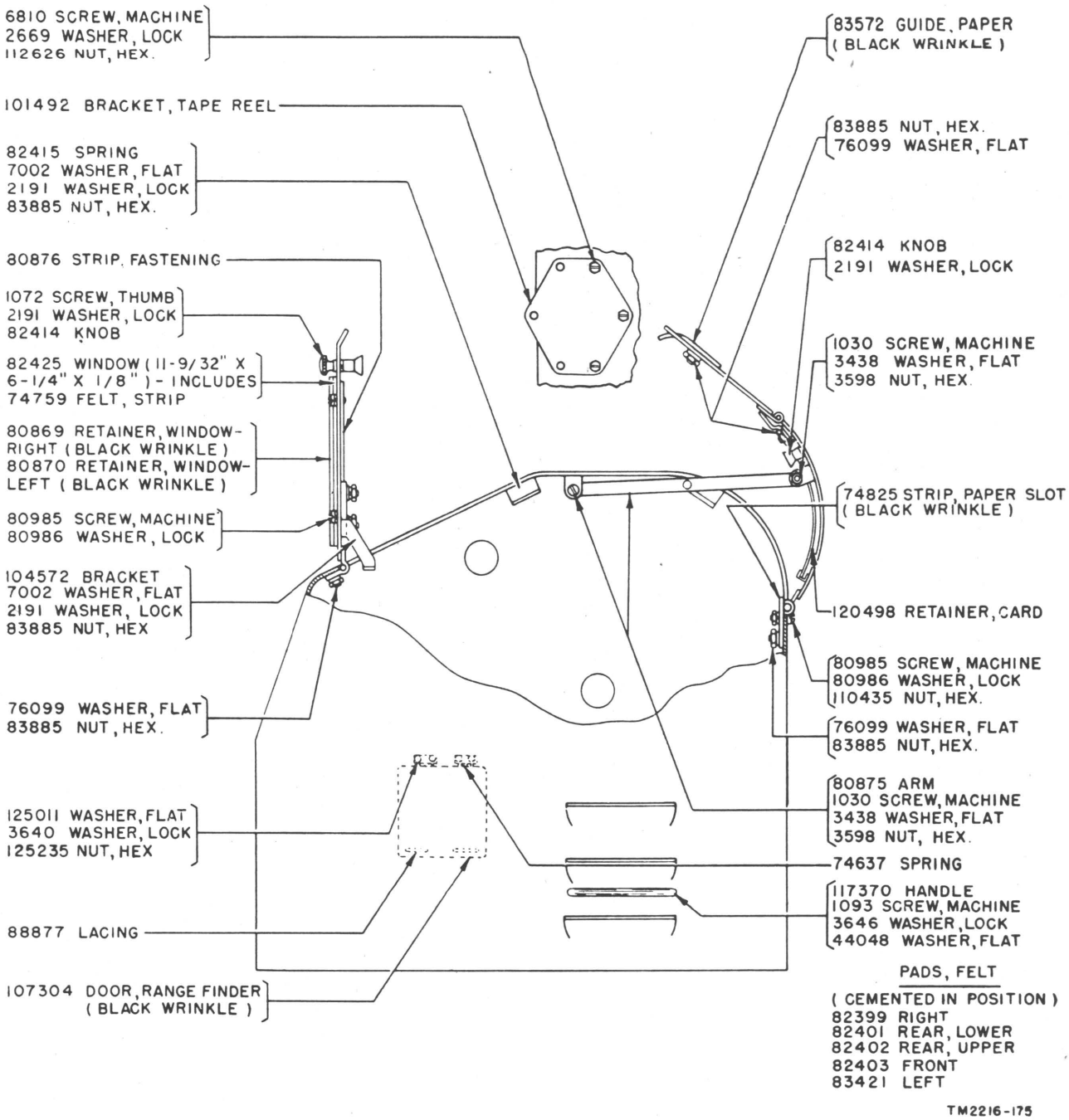
99250 SUPPRESSOR, ELECTRICAL NOISE
(MOTOR UNIT)



114966 SUPPRESSOR, ELECTRICAL NOISE
(LINE RELAY)

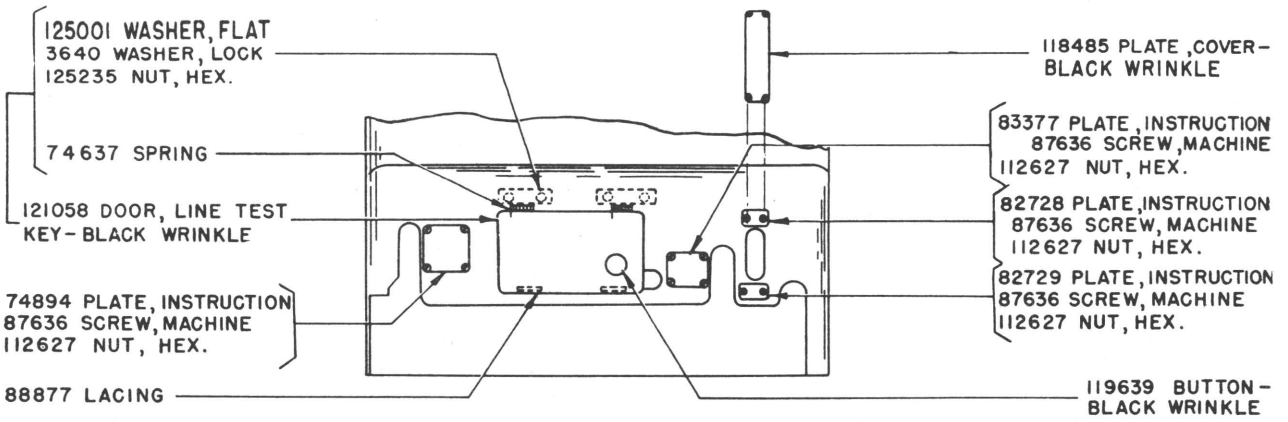
TM2216-174

Figure 326. Electrical noise suppressor assemblies, parts identification.

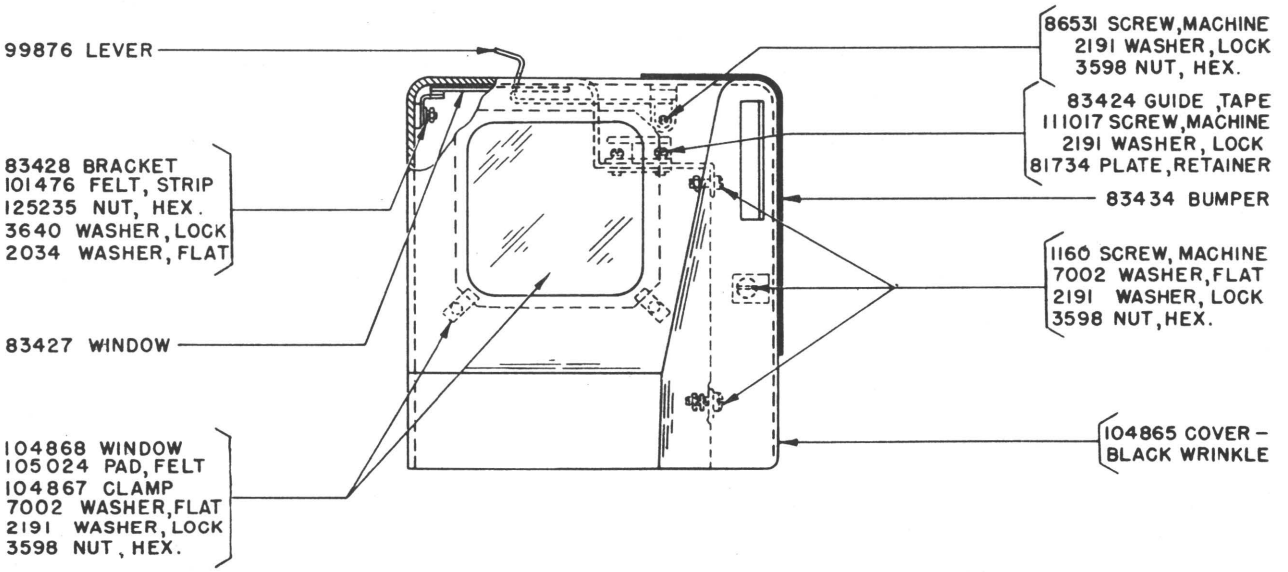


PEXC200 COVER-BLACK WRINKLE
(INCLUDES 117750 PERFORATOR AND COUNTER COVER)

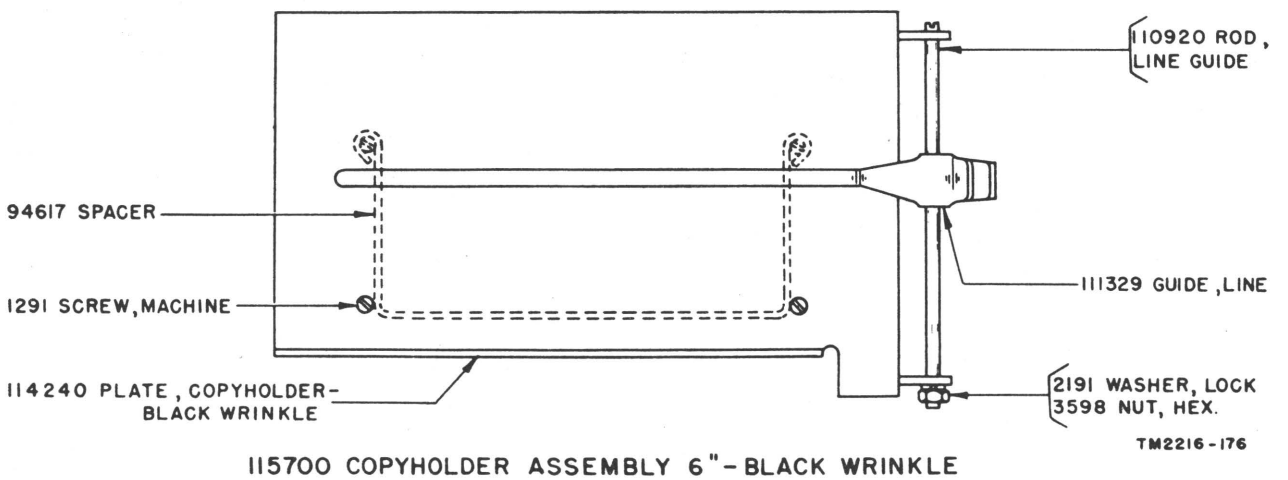
Figure 327. Cover assembly, parts identification.



FRONT VIEW OF COVER

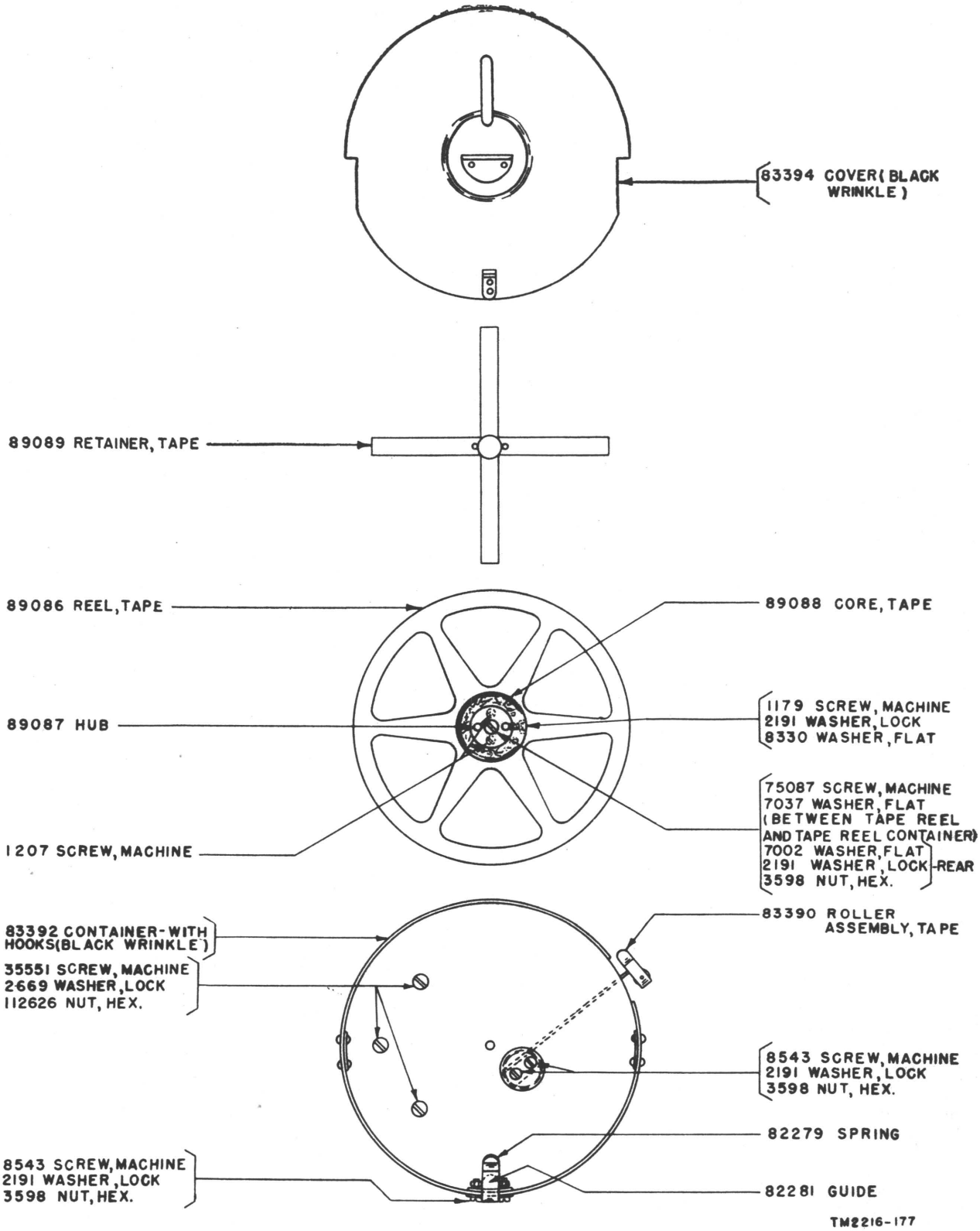


117750 PERFORATOR AND COUNTER COVER - BLACK WRINKLE



115700 COPYHOLDER ASSEMBLY 6"-BLACK WRINKLE

Figure 328. Copy holder and perforator counter cover, parts identification.



115726 TAPE CONTAINER
(BLACK WRINKLE)

Figure 329. Tape container, reel and cover, parts identification.

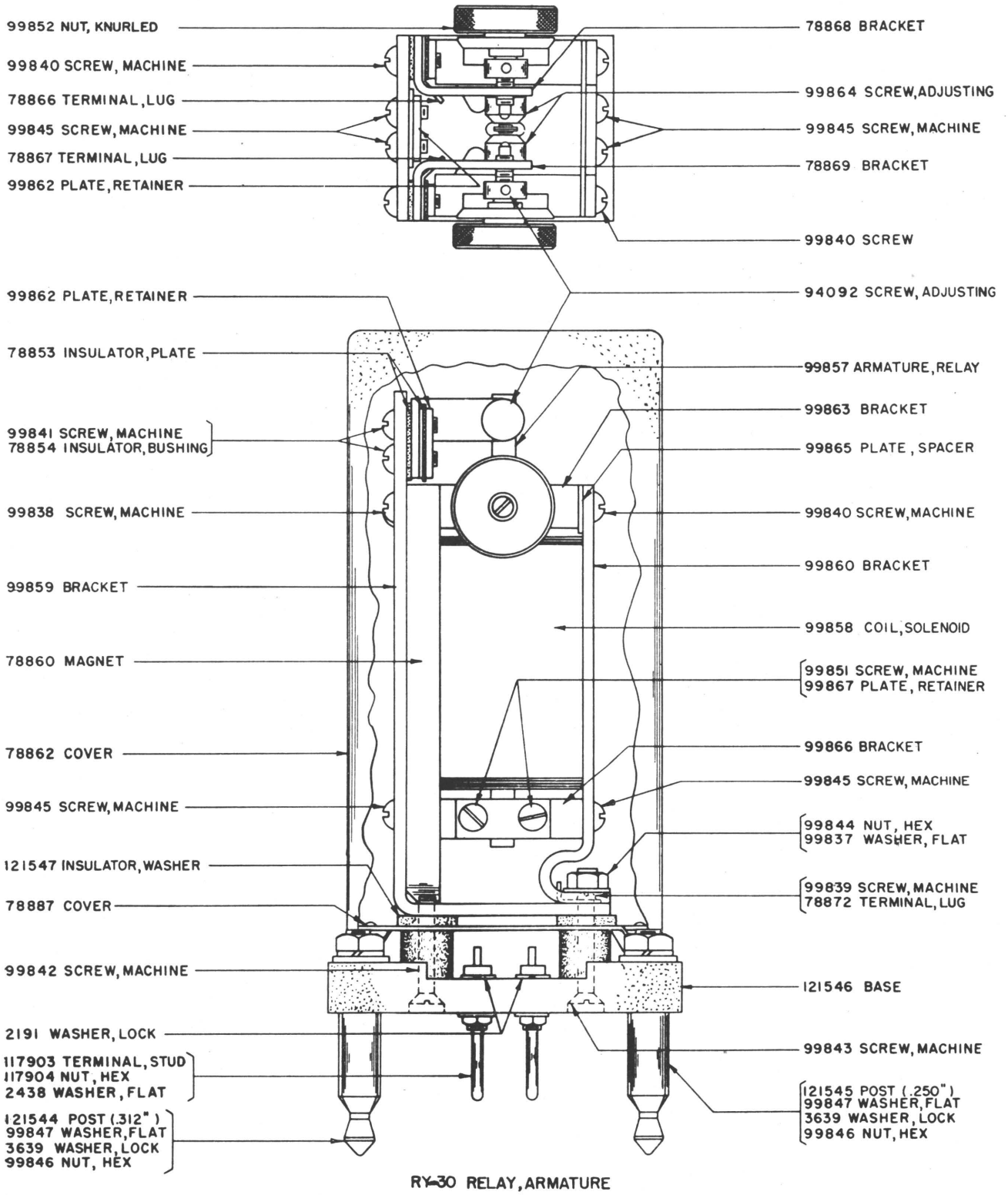
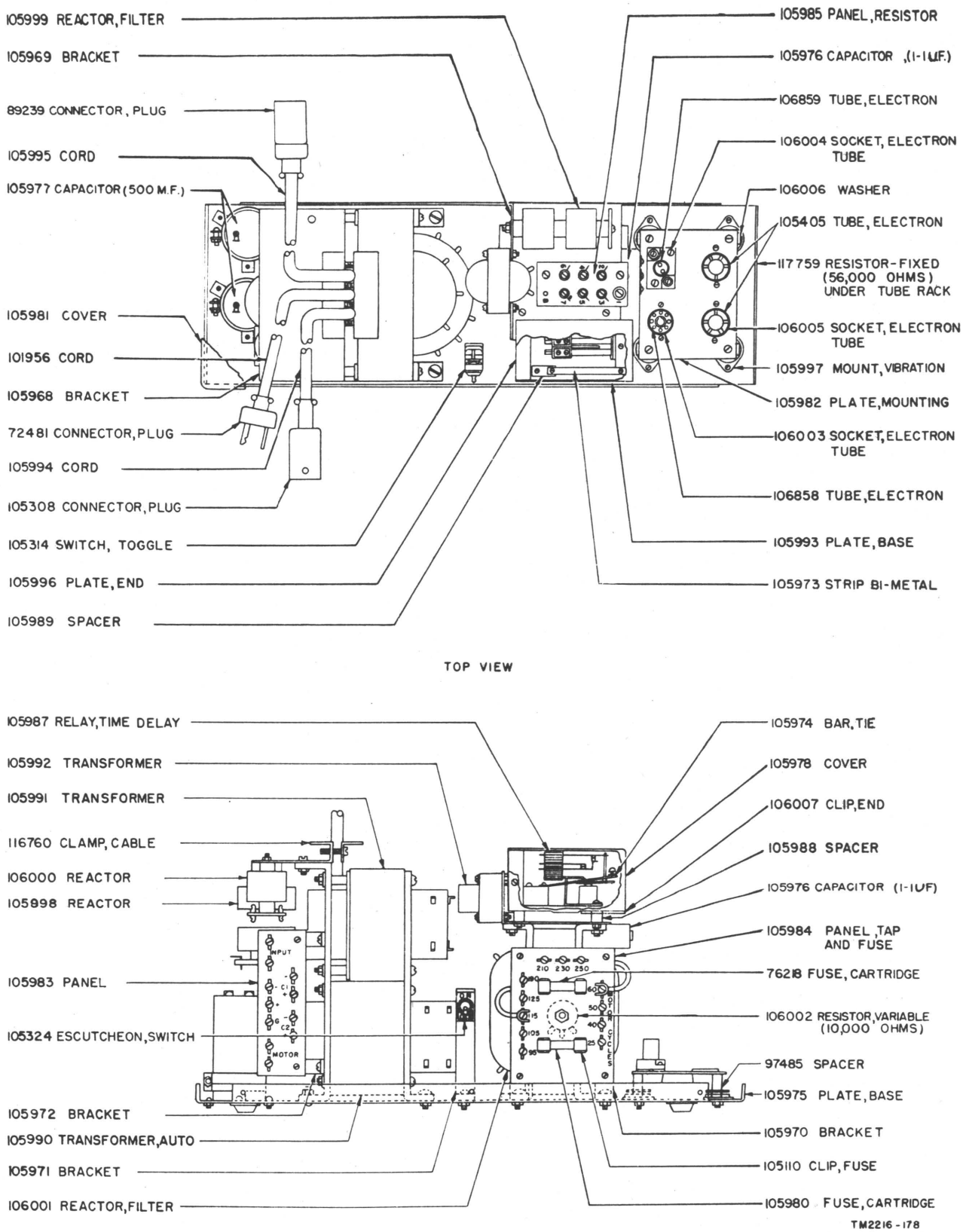


Figure 330. Line relay, parts identification.



REC 30 POWER SUPPLY

Figure 331. Power supply unit, parts identification.

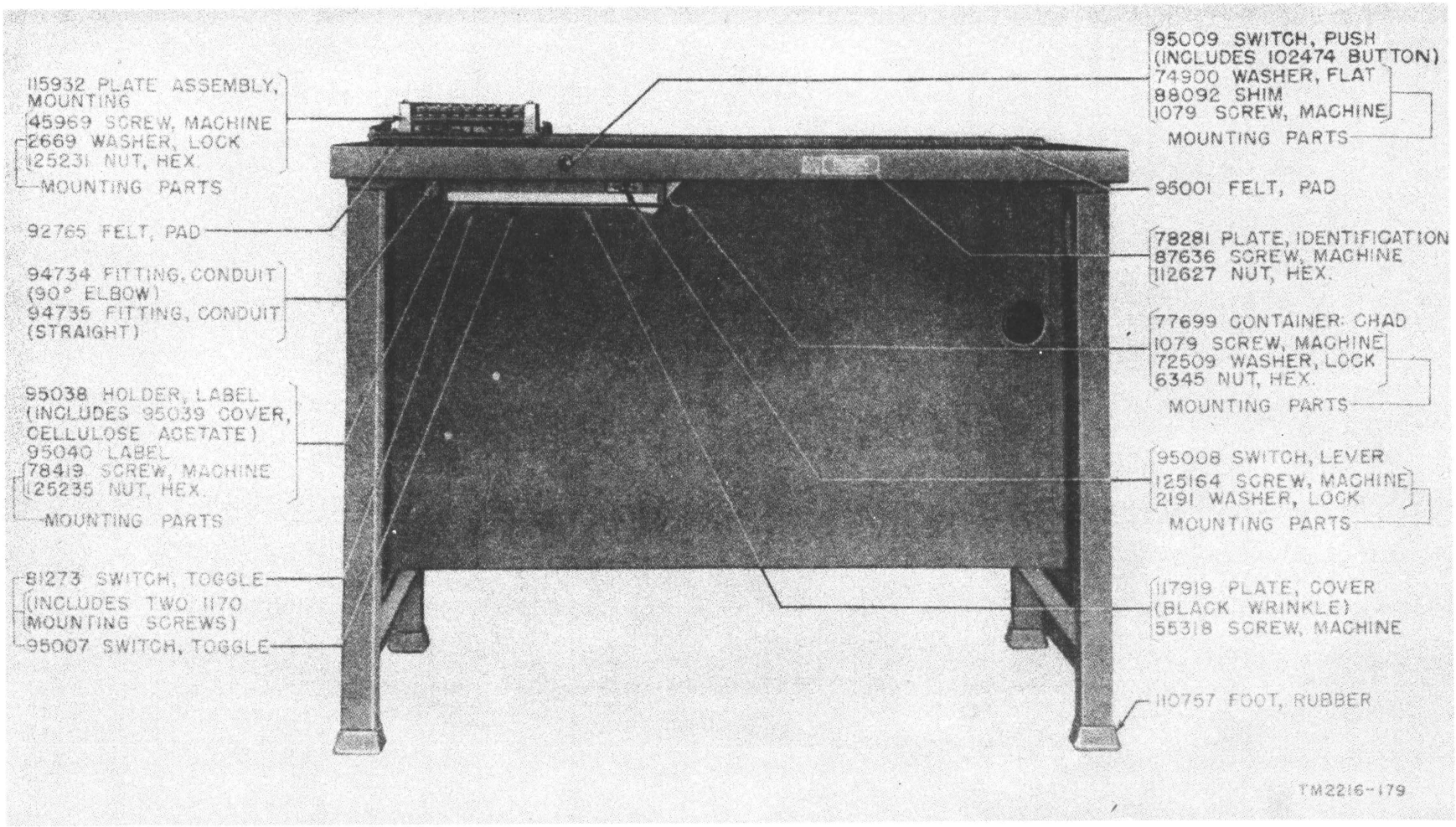


Figure 332. Table, parts identification, front view.

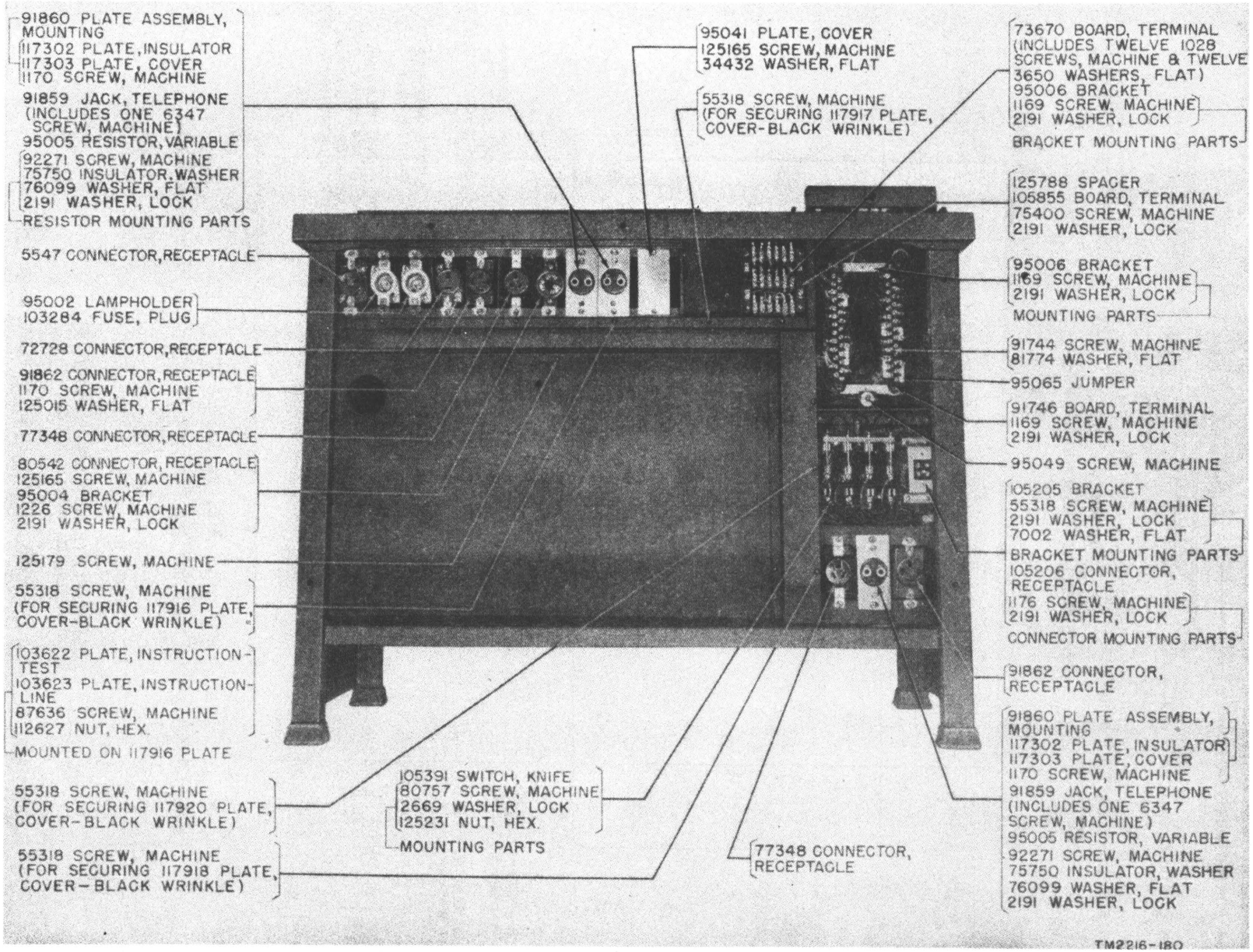


Figure 333. Table, parts identification, rear view.

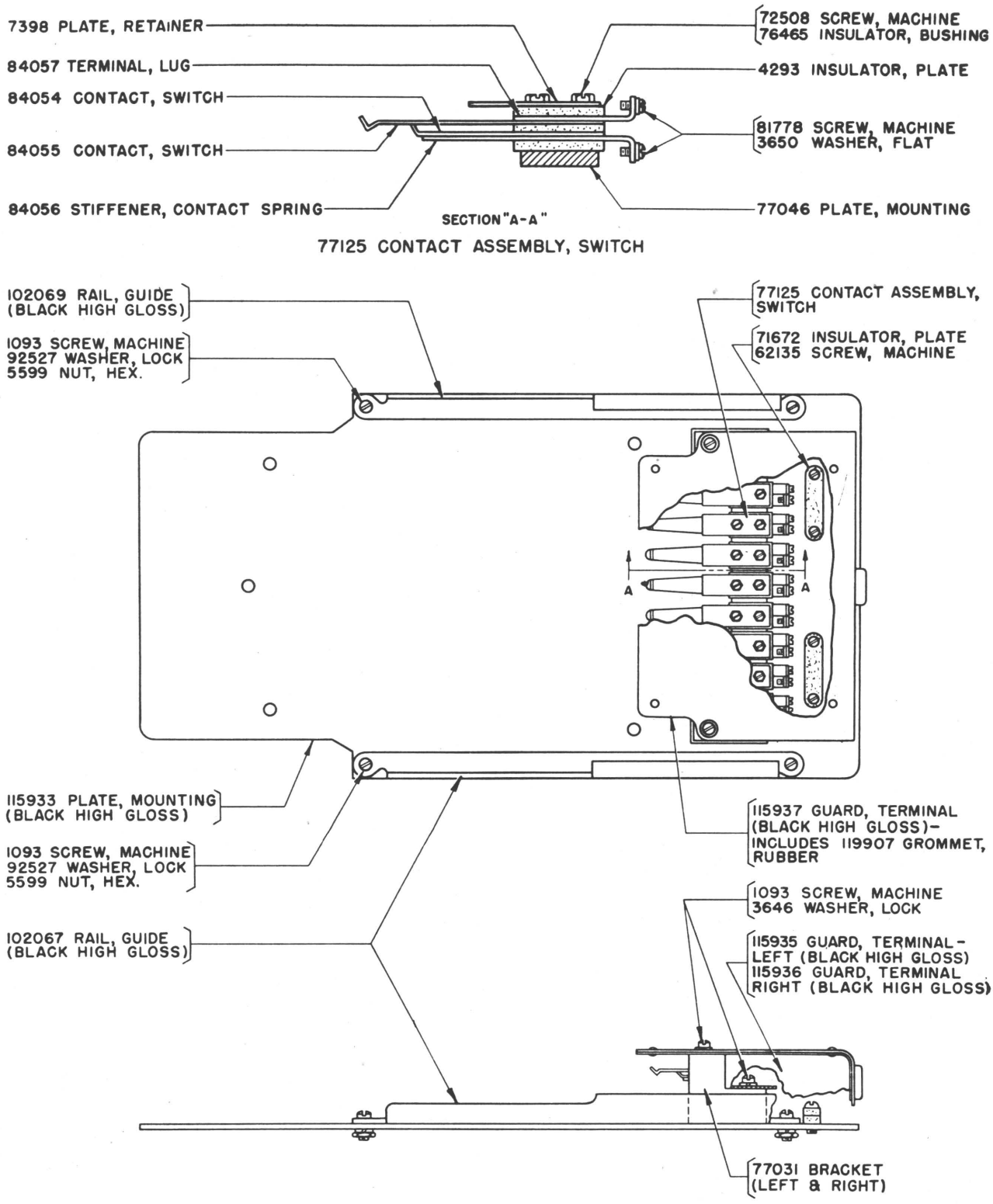


Figure 334. Transmitter distributor mounting plate assembly, parts identification.

APPENDIX III

INTEROPERATION OF BRITISH AND AMERICAN TELETYPEWRITERS

1. Introduction to Joint Military Operation of Teletypewriters

a. GENERAL. Joint military operations involving British and American forces in the same general area may require the interconnection of their teletypewriter systems. (The British use the term teleprinter rather than teletypewriter.)

b. FEATURES. The principal features of British teleprinter equipment which affect the operation of American teletypewriters are described in paragraph 2 of this appendix. The changes which must be made in the adjustment for operation of Teletypewriter TT–7/FG to permit interconnection with British teleprinters are discussed in paragraph 3 of this appendix. Teletypewriter TT–8/FG normally is used in systems which are not interconnected directly with British teleprinters.

2. Features of British Equipment Compared With Teletypewriter TT–7/FG

(fig. 335)

a. SELECTING CODE. The British teleprinter uses the same five-unit, start-stop selecting code as the American teletypewriters.

b. CHARACTER DIFFERENCES. There are very few differences in the keyboards of the two teletypewriters. In the lower case, there are no differences and the keys have the same relative position on the keyboards. In the upper case, there are diferences in D, F, G, H, J, S, V, and Z operations as listed in the following table:

Keyboards			
Lower case		Upper case	
American	British	American	British
D	D	$	Who are you
F	F	!	%
G	G	&	@
H	H	STOP	£ (pound symbol)
J	J	'	Bell
S	S	BELL	'
V	V	;	=
Z	Z	"	—

c. PRINTING. American teletypewriters select and print each character in the same operating cycle. The British teleprinters, however, do not print a character until the succeeding one is being received, with the result that a character is always stored in the teleprinter. The length of the line typed by the British teleprinter is 70 characters which cannot be changed; therefore the change must be made in the American teletypewriter.

d. TRANSMITTING. The teleprinter ordinarily transmits polar impulses compared with the neutral impulses transmitted by Teletypewriter TT–7/FG. Teleprinters are equipped with an automatic send-receive mechanism. When any keyboard key is depressed, the circuit is put in the transmitting position, and, as soon as the character has been sent, the circuit returns automatically to receiving position. Therefore, the machine is always in the receiving position except when a key is depressed.

e. ANSWER-BACK FEATURE. Some teleprinters are equipped with a special answer-back feature. When the upper-case D is operated, the teleprinter receiving it automatically sends back its code station call.

f. SIGNAL BELL. A signal bell is not standard equipment on the British teleprinter. However, an attachment can be added to the teleprinter so that when upper-case J is operated a contact is closed to operate an external signal bell.

g. MOTOR CONTROL. The British teleprinters are not designed for remote electrical motor control. These teleprinters have a timing device which, when the line remains marking for a period of approximately 90 seconds, automatically stops the motor. To restart the motor, it is necessary to open the line.

h. SPEED DIFFERENCES.

(1) *Standard American speed.* American equipment normally operates at 368.1 operations or characters per minute. This is equivalent to approximately 61 wpm. The length of the signaling code for each character is 7.42 units in

204475 O—52——26

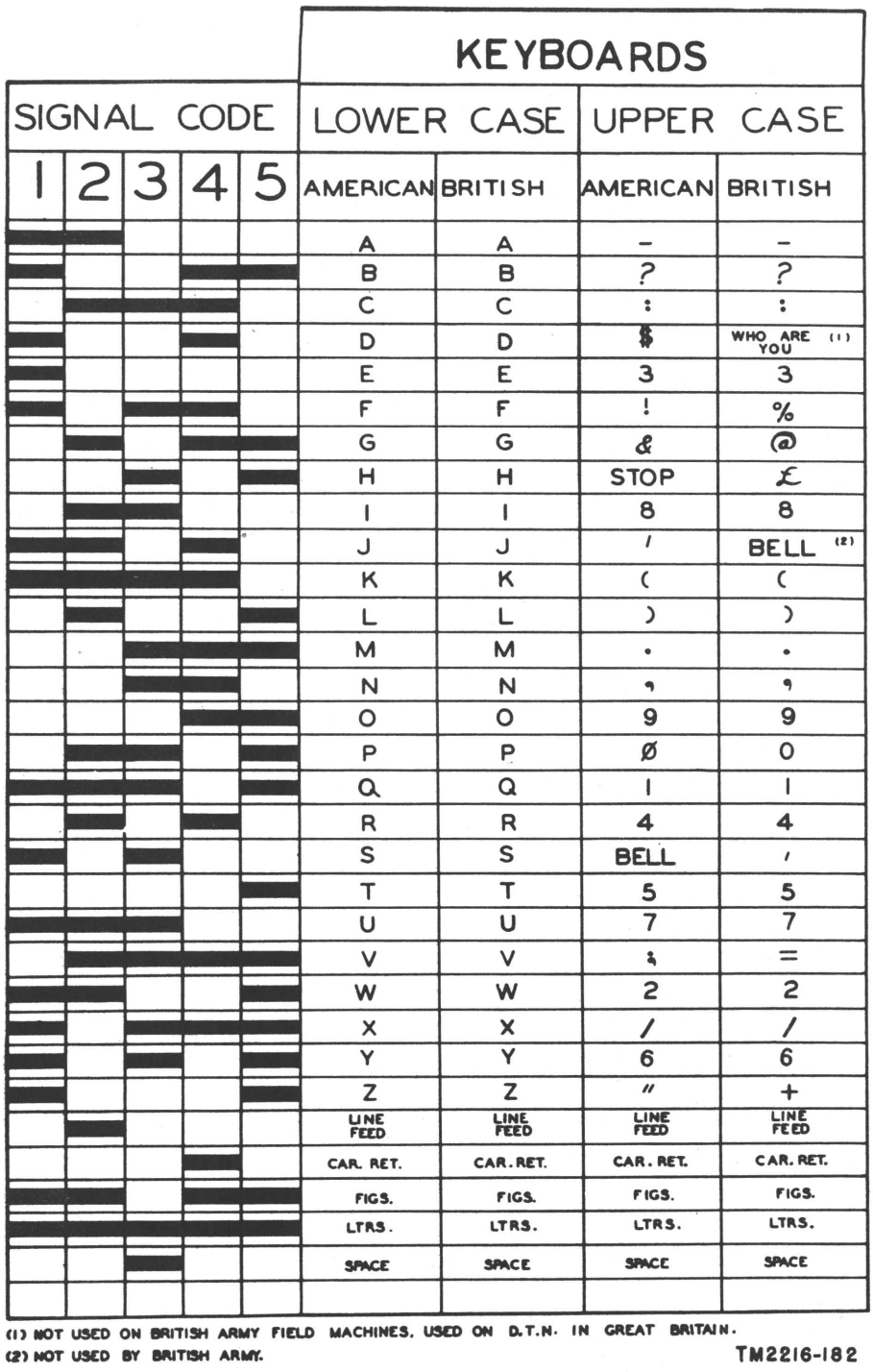


Figure 335. Five-unit code relationship to standard American and British keyboards.

which the start and five selecting impulses are each 1 unit in length, while the stop impulse is 1.42 units in length.

(2) *Standard British speed.* The teleprinter motor is a 24-volt d-c governed shunt motor designed to operate at 3,000 rpm and does not have provision for easily adjusting the speed to 2,740 rpm corresponding to the normal American speed of operation. British teleprinters normally operate at 400 opm or approximately 67 words per minute. The length

of the signaling code for each character is 7.50 units, in which the start and five selecting impulses are each 1 unit in length, while the stop impulse is 1.50 units in length.

(3) *Summary.* Since the British speed is 400 opm, it is necessary to adjust the American equipment to operate at 404 opm, to correct for the differences in length of the character signaling codes. Thus, if the British equipment transmits 7.5 unit characters at the rate of 400 opm, it will be necessary for the American equipment to transmit 7.42 unit characters at the rate of 404 opm.

3. Changes Necessary in Teletypewriter TT–7/FG

The information in this paragraph contains only the necessary mechanical changes needed to modify the American teletypewriter for interoperation with British teletypewriters. See the related teletypewriter set or system manual for information on installation and operation of American and British equipment connected in the same teletypewriter system. No internal electrical changes are involved.

a. Speed. It is necessary that all machines on a network be adjusted to an equivalent number of opm. The American machine must be speeded up to 404 opm by increasing the motor speed. A speed indicator vibrating at 96.19 vps is used for this adjustment. The procedure for adjusting to the new speed is the same as that used with the regular tuning fork. See paragraph 19*b* for instructions on adjusting the motor speed. When the speed of American equipment (368 opm) is increased to operate with British Creed equipment (404 opm), it may be desirable to increase the tension of the armature spring on the teletypewriter receiving mechanism by approximately ½ ounce, if such increased tension results in improved operating margins.

b. Length of Typed Line. It also is necessary to change the number of characters per line on the American machine to correspond to the British line of 70 characters. This is done by resetting the right margin adjusting screw. A corresponding adjustment must be made on the end-of-line indicating bell, so it will ring on the 64th character.

c. Unshift-on-Space Feature. The unshift-on-space feature (par. 121) of the American teletypewriter must be made inoperative because the British machines are not equipped with such a feature. This concludes all of the mechanical changes necessary for interoperation.

APPENDIX IV

GLOSSARY

Note. The following glossary contains explanations of the technical terms used in this manual.

Battery.—The term *battery* normally is used when referring to a group of dry cells or storage cells. In teletypewriter communication, it is common usage to refer to any d-c source used in the production of teletypewriter signals as battery.

Bias.—The effect on the length of telegraph signals produced by the electrical characteristics of the line and equipment. If the received signal is longer than the signal sent, the distortion is called marking bias; if the received signal is shorter than the signal sent, the distortion is called spacing bias.

Capacitor.—A device for inserting the property of capacitance into a circuit; two or more conductors separated by a dielectric.

Function.—The term *function* refers to an operation performed by a teletypewriter such as CAR RET, LINE FEED, FIGS (shift), LTRS (shift), motor stop, bell, etc., that normally is not associated with a printed character.

Fuse.—A wire, bar, or strip of fusible metal inserted as a safety device in an electric circuit. When the current increases beyond the rated strength of the fuse, the metal melts and thus the circuit is broken.

Fusetron.—A fuse equipped with an overload feature. A fusetron will take a starting load up to 50 percent in excess of the rated value for a short period before blowing. The fusetron has a base connection similar to that of a fuse.

Governor.—An automatic attachment to a motor for controlling the speed of rotation.

Ground.—The contact of a conductor with the earth; also the earth when used as a return conductor.

Jack.—A receptacle which, in combination with a plug, provides a device by means of which connections readily can be made in electrical circuits.

Key.—A hand-operated device for the rapid opening and closing of a circuit or circuits.

Mark impulse.—In neutral operation, the term *mark impulse* refers to the closed circuit signal, and the term *space impulse* refers to the open circuit signal. In other than neutral operation, the term *mark impulse* is applied to the circuit condition which produces the same result in the terminal equipment that a mark impulse produces in neutral operation. Similarly, the term *space impulse* is applied to the circuit condition which produces the same result in the terminal equipment that a space impulse produces in neutral operation.

Neutral operation.—The term *neutral operation* refers to the system whereby marking signals are formed by current impulses of one polarity, either positive or negative, and spacing signals are formed by reducing the current to zero or nearly zero.

Operations per minute.—The term *operations per minute* refers to the number of functions performed or characters printed per minute. The equipment goes through one complete cycle of operation for each function performed or character printed.

Polar operation.—The term *polar operation* refers to the system whereby marking signals are formed by current impulses of one polarity and spacing signals by current impulses of equal magnitude but opposite polarity.

Rectifier.—A device for changing ac to dc.

Space impulse.—See mark impulse.

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