

Premax Antenna Manual

A Comprehensive and Authoritative Treatment of Antenna
Design, Construction and Use . . . For Amateur, Public and
Commercial Installations . . . Covering Vertical and Beam
Antennas and Their Mountings.

No. H4R—Revised 1946 Issue

Price, 25 cents

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ANTENNA MANUAL

No. H4R
Revised 1946 Issue

TABLE OF CONTENTS

	Page		Page
Antenna Data and Commercial Tables	19	"J" Antennas for Police Frequencies	20
Antennas, Their Design and Uses	1	"J" Type Antennas	3
Beam Antennas	12	Matching Two Telescopic Units	20
5 meter diagrams	14-15	Pitchfork Antennas, Full Electrical Control	6
10 meter diagrams	8-13-14-15-16-17	Pitchfork Antennas, Multi-Control	6
20 meter diagrams	2-13-15-16-17	Pitchfork Vertical Antennas	4
Commercial Tables	19	Pitchfork Antenna at W2USA	5
Determining Dimensions of Elements for Extended Double Zepps	6	References for Additional Data	18
Dimensions for 10 and 20 Meters	19	Rotary Beam Antennas	13
Extended Double Zepp Antennas	7	Rotary Beam Antenna on New York Journal American Building	17
Extended Double Zepp Tuned Feeders	8	Single Element Bi-Directional Beam Antenna	16
Fixed Rotary Beam Antennas	4	Table of Gains	19
Fixed Rotary Beam Antenna Base	7	Tuning Rotary Beam Antennas	11
Fixed Rotary Beam Antennas in Commercial Service	20	Vertical Antennas	9
Fixed Rotary Beam Antenna Tuning Assembly	7	2 1/2 meter diagrams	4-5-6
Framework for Rotary Beams	12	5 meter diagrams	4-5-6-7-8-9
General Suggestions for Care of Antenna	18	10 meter diagrams	4-5-6-8-9-11
"Hairpins" in Tuning Rotary Beam Antennas	11	20 meter diagrams	3-4-5-6-9
Hi-Q Vertical Antennas	11	40 meter diagrams	9
Horizontal Beam Antenna Dimensions	19	W8JK Type Antenna at W2USA	3
		Wood Frames for Rotary Beam Antennas	12

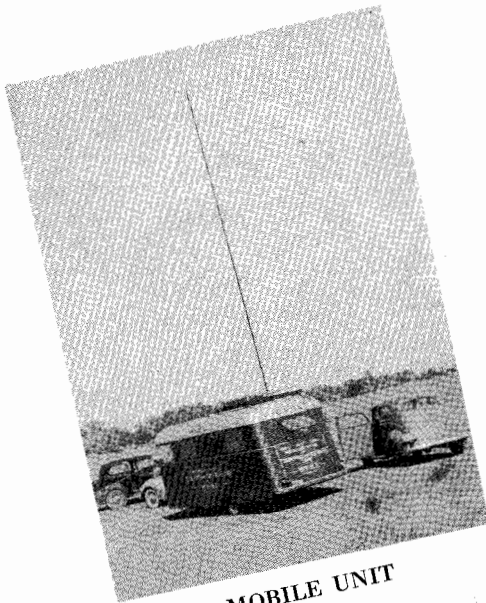
PREMAX PRODUCTS

DIVISION OF CHISHOLM - RYDER CO., INC.

NIAGARA FALLS, N. Y.

ANTENNA MANUAL

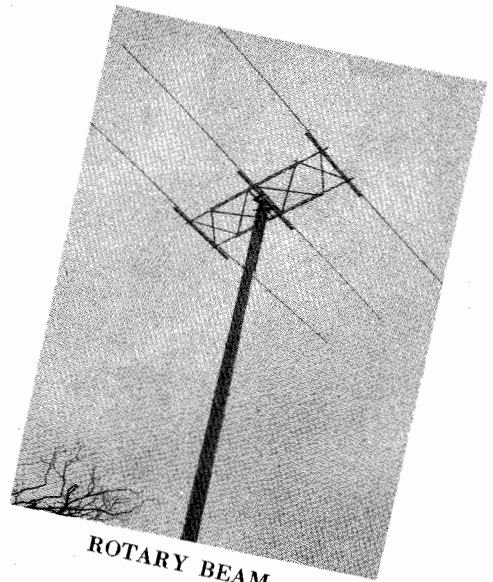
A Technical Compilation of Horizontal and Rotary Beam Arrays, Police, Marine and Commercial Installations



MOBILE UNIT



MARINE PHONE



ROTARY BEAM

Premax Tubular Metal Antennas and Elements are the development of well known and widely accepted Premax antenna designs which had their origin many years ago for use in the standard broadcast bands. When the swing started from cumbersome and often unsatisfactory wire arrays to vertical antennas and radiators, Premax pioneered the development of many types of antennas for amateur as well as commercial installations. The tubular metal type of antenna was introduced in both fixed and adjustable forms and immediately became universally popular because of its adaptability to the peculiar conditions existing in any locality.

The lightness and extreme strength and conductivity of Premax Antennas and Elements, coupled with their low cost, enabled experimenters to go a long way in the development of the multi-element rotary beam.

With the first appearance of the Premax Antenna Manual in 1940, several new and revolutionary types of Antennas and Elements were introduced. New uses for existing units were described. For the first time, really high, self-supporting antennas were made available at prices within the reach of the average amateur.

The lightness and extreme strength of Premax Antennas and Elements have been demonstrated time and again . . . first in the installation at the New York World's Fair where five special duraluminum radiators engineered by Premax withstood two of the worst ice and sleet storms in the history of New York City. These radiators . . . though placed 85 feet above the ground . . . withstood wind velocities of over a hundred miles per hour.

With the advent of World War II, the entire facilities of Premax . . . both engineering and manufacturing . . . were devoted to the supplying of antennas for the armed forces. Premax production became about 97% military radio. Of this total, about 75% represented Premax designs, either standard units adapted to military use or special designs developed by Premax and adopted by the military services. An additional 15% represented equipment on which Premax cooperated in the design, leaving only about 10% representing parts or equipment made to customers' specifications.

The first military contact with the military picture was in October, 1940, when the Navy Department adopted a standard PREMAX Monel Antenna, No. MM-425, for use on destroyers but in the consultation with Navy at Washington, Premax

suggested strengthening the unit for this application rather than using the standard design. In order to provide quick delivery, we developed the USM-525 Monel Antenna as a modification of the Standard MM-425. This new design, adopted for the emergency, was recognized as not entirely suitable for the severe use it would have to meet in combat and we began the design of an entirely new antenna, later known as USM-325. This design became standard on all destroyers and was exclusively furnished by Premax in cooperation with Superior Tube Company, manufacturers of Monel tubing.

In August, 1941, Premax obtained its first large war contract consisting of Monel Antennas and Mountings for the Coast Guard, and this was later increased by another contract for similar units. These were specially developed Monel Antennas and insulator mountings which were required to meet rigid specifications and were submitted to a long series of tests at the Coast Guard Station in Washington before approval. They were used on small reserve boats which the Coast Guard requisitioned for patrolling inland and coastal waters.

In 1942, at the request of the Navy Department in Washington, a stainless steel antenna, Premax No. SM-725, Navy No. 66053, was developed by Premax for use on PT boats and landing craft and this unit became standard for all such installations. The design was required to withstand wind pressures of 90 miles an hour with minimum deflection under severe rolling of such small craft. Premax made over 10,000 of these special antennas.

During 1942 Premax also designed, at the request of the Navy Department, two heavy aluminum antennas, Premax Nos. USA-128 and USA-135, Navy Nos. 66046 and 66047, for use on battleships and aircraft carriers. These antennas were quite different from anything which had previously been made and had to be designed to withstand strains of 60 miles per hour, a ship rolling of 30 degrees, with a deflection at the top of the 28 or 35-foot antenna not exceeding six feet. The Premax design was completely acceptable and was adopted as a Navy standard for all large warships. Premax was the exclusive manufacturer and made about 2,000 of these units.

Premax also designed and produced on a sub-contract for the Air Corps, a special light-weight aluminum antenna for use by paratroopers. This consisted of 16 sections completely telescoping to a length of 29 inches for carrying, and extending to 35 feet for use.

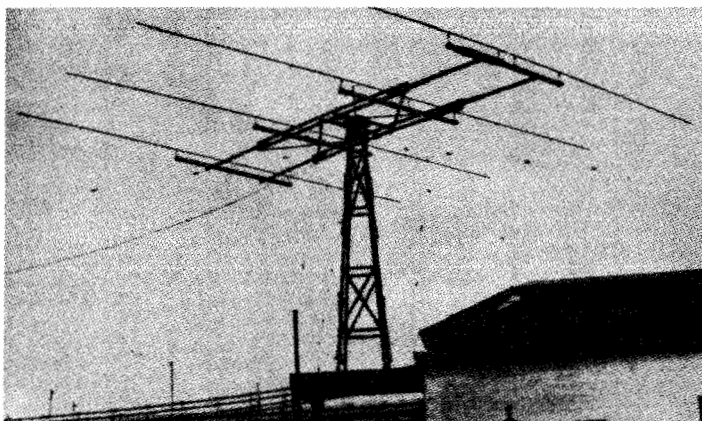


FIG. 1—Premax rotary beam array on top of the New York Journal-American building is relied upon to furnish short wave dispatches from the belligerent European countries to the newspaper. See special letter on page 17. Full details for building and tuning this beam appear on page 11, QST, November, 1939. (Photo by S. P. McMinn, W2WD.)

Premax cooperated in the design of and later produced a special antenna for installation in buoys, the antenna being erected by gas pressure. Several hundred of these antennas were produced and we were working on a much larger contract which was terminated at the conclusion of the war. This device, however, is to be continued in some quantity yet to be determined and Premax has been asked to assist in continuing the developments.

Today, Premax Antennas are known favorably in every part of the world. Experience gained through its contact with the military forces will permit Premax to offer new types of antenna equipment that is beyond the experimental stage . . . equipment that has met the rigorous tests on land, on seas and in the air.

In the field of amateur radio, Premax boasts an imposing list of satisfied users. The first member of the Century Club to be admitted as a result of radio telephone contacts was Frank Carter, W2AZ. He made his 100th contact using the Premax rotary beam, described in QST for October, 1938. Another 20-meter beam was designed by Carter—a full wave W8JK, vertical, rotary—and was set on top of a wooden pole at his station at Oceanside, N. Y. That single antenna proved better than three horizontal beams of the same dimensions, set up between the tops of three poles so as to cover all directions as thoroughly as possible. That particular type of beam with an electrical rotating control was duplicated for W2USA at the New York World's Fair. Used in conjunction with a National 600-watt transmitter, signals from that beam were heard in all parts of the world.

Premax mechanical and radio engineering have gone a long way in making the multi-element rotary beam antenna practical. In addition to providing rigid, yet very light, telescopic elements suitable for practically any type of an array, Premax has designed suitable frame towers and supporting frame works for rotary beam arrays which can easily be built from the sketched plans.

At the time the first Premax technical bulletin was distributed, there was very little information available, regarding multi-element antennas. Not only that, but also there was very little material to be had for making such aerials. In addition to the information which the bulletin gave on suitable antenna structures, it provided, for the first time, a reasonably complete bibliography, of the art. Most of the technical information which that bulletin contained is now to be had elsewhere, notably in the A.R.R.L. Antenna Book, as well as the Radio Antenna Handbook.

For that reason, most of the theory of operation is left out of this treatment of the subject, except for the description of those new antenna designs, which have not yet been described elsewhere and which are thought to have such wide applications to both commercial and amateur communication.

Special technical information, in connection with the design and construction of commercial, police, marine or other special

service, can be made available to those interested. Full information regarding this service may be had on request.

It is thought that the very complete information which may be had from the accompanying illustrations, formulae, dimension tables and other data, is sufficient to permit almost anyone to secure the particular type of beam which is needed to accomplish a given result. In nearly every case, the rotary beams have been horizontal. In order to secure the greatest benefit from them, it is generally necessary to rotate them, unless, of course, they are to be used in a single direction. Even then, there are occasions when the rotary type may be used to advantage, by setting it up, aiming it at the desired station and then fixing it in that position.

For certain classes of service, very definite improvement may be secured, by the use of vertical arrays, so arranged that the elements remain fixed but the direction of transmission and reception may be controlled by switches, located in the transmitting station itself, or by switches which control relays placed near each of the vertical elements. This form of direction control is not new, but it has not had the application it deserves. Definite advantage of the system has been taken by many of the leading broadcasting stations, for the past few years, in controlling their field patterns, so as to more adequately cover their regular service area, as well as to prevent wasting power in undesired directions. The use of two elements for this kind of work has become rather common, since Dana Griffin, W2AOE, described a simple method of applying it, in QST for October, 1935. A study of the same sort, with figures on theoretical gain, etc., by Nick Stavrou, W2FDN, was published in QST for May, 1938. A system for using three verticals to obtain four directions, was described by Arthur H. Lynch, W2DKJ, in QST for January, 1939. A method for using three vertical elements to obtain twelve different directions was given in QST, for January, 1940, by James Arnold, W6QCC.

All the methods, covered up to this time, have been suggested for use on a single frequency, most of the work having been done in the 14 megacycle amateur band. The method described by Lynch proved to have certain advantages over the others, in that it occupied less space for setting it up and it showed a greater gain, in any direction, over the other methods. One of the Lynch type aerials was set up for 14 megacycle operation, at the N. Y. World's Fair. It was placed immediately above a counterpoise. It was found to show a marked gain over

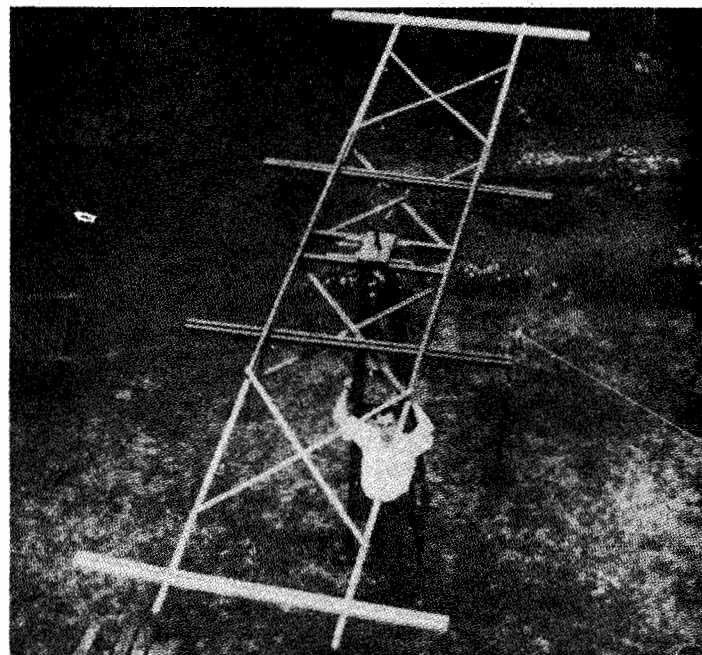


FIG. 2—THE PREMAX EXTENDED FRAME TAKES FORM. This frame was originally designed to take a four-element, 20 meter beam and was to be used at W2USA. However, it was actually installed on the roof of the New York Journal-American building as shown in Fig. 1. The light-colored cross braces have been found to be unnecessary. James Tynan, W2BRI, who has done some remarkable work with a similar four-element array and who actually installed and tuned this one, is shown raising the entire frame off the ground.

an ordinary half wave antenna and was found to have a very broad pattern. By the addition of a duplicate assembly, and the use of tuned feeders, fitted with suitable adjusting apparatus, within the station itself, a new system which has all the advantages of the former methods, in addition to providing this improvement over a very wide band of frequencies, is provided.

In addition to providing gain in any desired direction, on practically any frequency, other distinct advantages of this system include possibility of greater gain in all directions when all the elements are fed at the same time; transmission or reception on two widely separated frequencies at the same time; as well as frequencies which are close together; full advantage of existing counterpoises (metal roofs are to be found in many city locations) without requiring a large surface for erection.

Most satisfactory multi-frequency operation is obtained by disposing the elements, with eighth wave spacing for the lowest frequency to be used, or the frequency for the most important service. Adjustments for both higher and lower frequencies are made in the station itself and considerable gain over an ordinary antenna will be found if the adjustments are made properly. Any given set of adjustments may be recorded and the antennas tuned to them by the simple expedient of setting the dials at the proper markings.

This new type of antenna system is ideal for those locations where multi-band operation is desired and where the advantages of a rotary antenna system are impossible because of lack of space or similar considerations. Suitable methods for setting up this new type of antenna system will be found in the accompanying drawings. (Figs. 5 to 13)

FOUR WIRE TRANSMISSION LINES

The manner in which two spaced transmission lines are run through the same insulators for the simplification of installation is clearly indicated in the drawings. It will be seen that

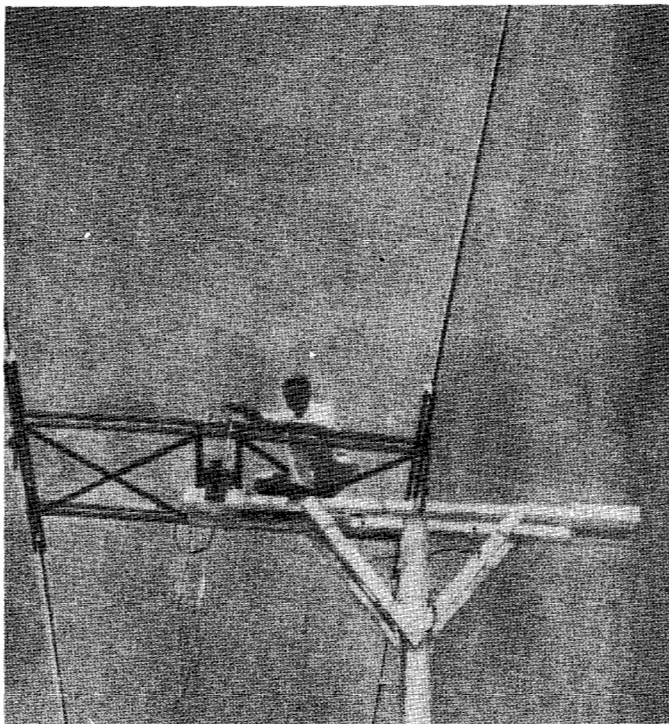


FIG. 3—Mr. Arthur H. Lynch, W2DKJ, managing director of the W2USA radio club at the New York World's Fair, designed all the antenna systems which were used at that station. The beam shown here is a standard W8JK type, electrically controlled from the operating position, nearly a block away. Premax Corulite elements, and a Fig. 46 Frame are used. Electrical details of this type of beam will be found in Fig. 47 in the section of the Handbook devoted to rotary beams. (Photo by Sam Laine, W2BKU.)

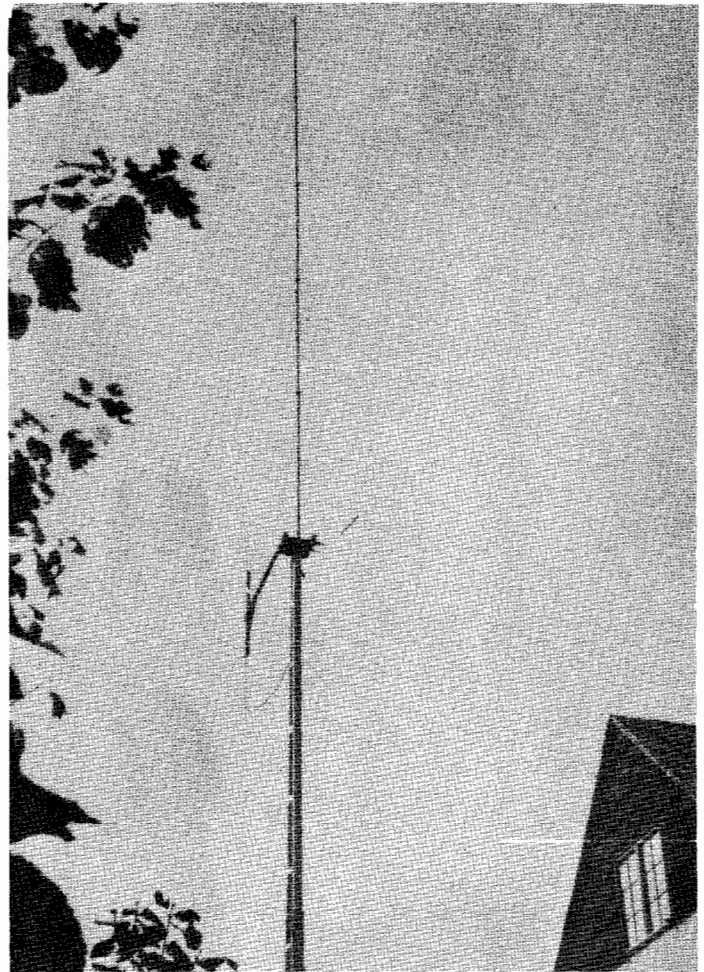


FIG. 4—Premax Aluminum Vertical forms 20 meter "J" antenna at Station W2CLA, Garden City, N. Y. Dr. Lawrence J. Dunn, W2CLA, is the former Director of the Hudson Division of the A. R. R. L., former Chief Radio Aide to the Chief Signal Officer of the U. S. Army, and a very active radio man. He has been using the antenna shown here for some time, and with great satisfaction. The quarter-wave matching stub is brought down the mast on insulators and its lower end is fed with a low impedance concentric line. This antenna has been subjected to some very severe wind and sleet storms. The same size vertical could be used as a quarter-wave antenna on 40 meters. Antennas of this nature have many commercial and government applications.

one pair of wires feeds the beam which gives two main directions of transmission, while the other pair of wires feeds the beam which has its main axis in a direction (two directions, actually) 90 degrees away, or at right angles. By suitably feeding both beams, simultaneously, coverage in all directions is obtained.

The rings for the four wire transmission lines are very simple to make from celluloid, polystyrene or other similar, light, easily-machined, fairly tough material, which has good insulating properties and is reasonably non-hygroscopic.

If the distance between two adjacent wires is known, it is very easy to make a line which will have any desired impedance by using the size indicated in published tables, provided, of course, the wire size is sufficient to carry the line current without heating. The difference in impedance, resulting from running the two lines through the same spreaders is negligible.

Impedance, itself, is of little actual importance in this type of antenna system, for it is automatically compensated for, when the line is tuned to resonance. Actual dimensions of the antenna system may vary greatly, from those which have been indicated, for the reason that they, too, are varied electrically and brought to the proper electrical length, when the transmission line is properly tuned.

PREMAX FIXED "ROTARY" BEAM COVERS ALL FREQUENCIES AND ALL DIRECTIONS—AN ENTIRELY NEW DEVELOPMENT

*A Summarized Version of a Very Effective Array, made by Mr. Lynch Especially for Premax—
For Full Details, See His Article in Q S T for August, 1940*

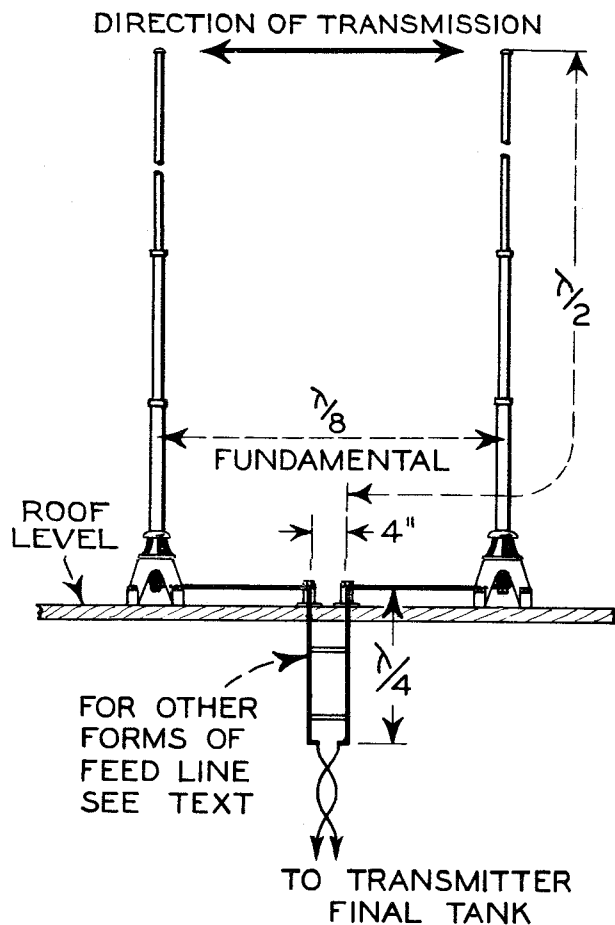


FIG. 5—THE "PITCH FORK" VERTICAL ANTENNA. In this type of antenna, two vertical units, spaced but $\frac{1}{8}$ wave length apart, fed by a low impedance transmission-line and a $\frac{1}{4}$ wave matching stub, provide a figure 8 field pattern, in the two directions in line with the radiators. The radiators are shorter than a half wave length, by the amount between their base and the point of attachment to the quarter-wave stub. This type of beam is considerably better, in the two directions it covers, than any single half-wave radiator. Furthermore, the field pattern is broad enough to permit coverage of reasonable intensity in all directions, except those two which are at right angles to its axis.

This type of beam may be used on any single frequency, by making dimensions conform to the data on the drawing. If made for the middle of any one band, it may be used throughout the band, but it can not be used with satisfaction on several bands.

"We recently installed one of your Aluminum Radiators on our cruiser, and the results obtained have been most satisfactory. We were caught out in a rather bad blow with the mast fully extended. In spite of the fact that it was not guyed, it withstood the force of the wind and the motion of the boat without any trouble."—T. A. Canty, Baltimore, Md.

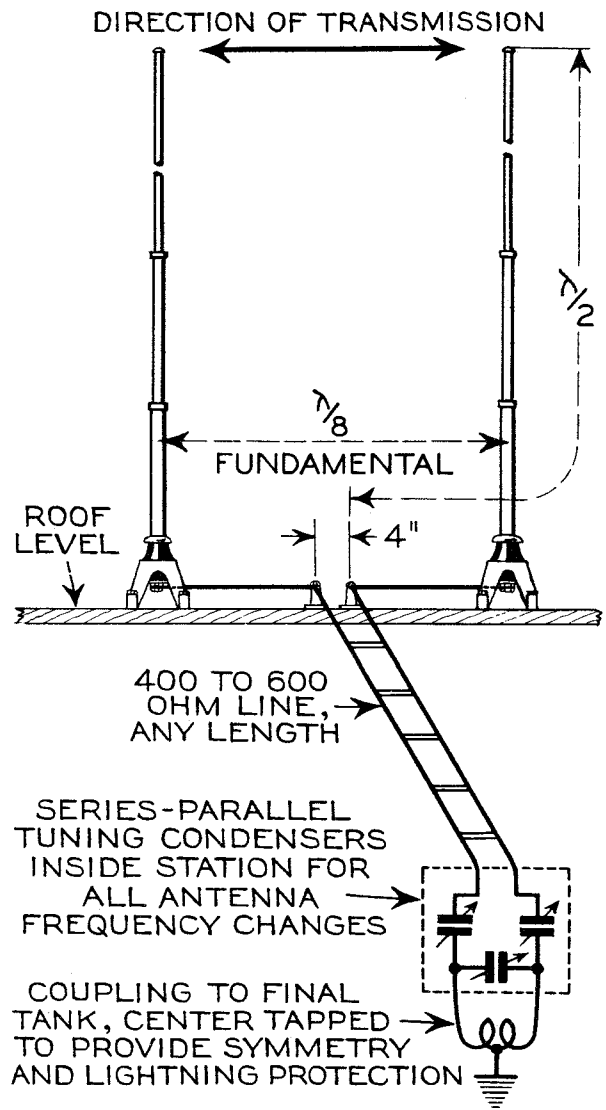


FIG. 6—THE ALL-BAND PITCHFORK. By replacing the low-impedance line and the quarter-wave, phasing section with a tuned transmission line, the same form of antenna may be used advantageously on almost any frequency, if the tuning of the line is done precisely. All the tuning apparatus may well be located within the station. As is indicated in the drawing, the center of the coupling to the final tank, may be grounded as protection against lightning; this grounding also provides better symmetry, in the system.

In determining the dimensions, the antenna should be designed for the lowest frequency on which it is to be used. 14 megacycles is as low as is practical for best results.

Such a system will perform satisfactorily on any HIGHER frequency. Because the line is tuned, it may also be used on lower frequencies, but its efficiency falls off as the frequency is lowered.

"Results have been excellent with my Premax Rotary beam, having worked lots of DX that I did not consider possible heretofore."—Howard Self, Fort Worth, Tex.

PREMAX ANTENNA MANUAL

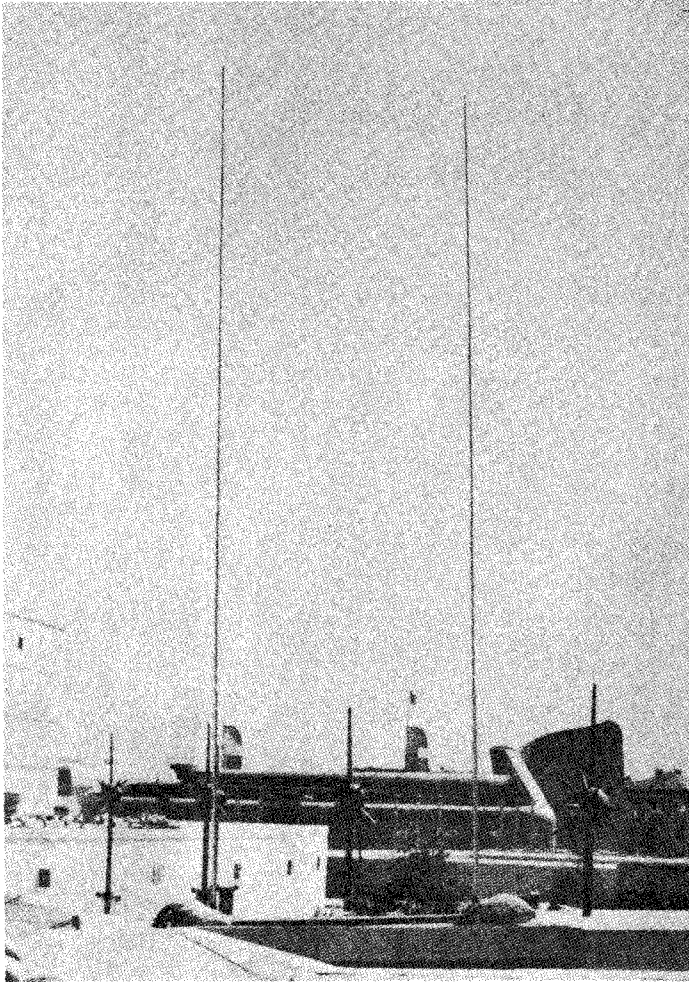


FIG. 7—PREMAX 20 METER "PITCH-FORK" BEAM AT W2 U.S.A. WORLD'S FAIR, NEW YORK. Set on a platform, immediately above the "metallized" roof of the Communication and Transportation Building, World's Fair, New York, this antenna was used for months. Though it was set up to transmit best in an east and west line, it was heard with great satisfaction throughout South America and Canada.

The stream-lined duralumin radiators provide great rigidity and they move around surprisingly little, even during strong winds. Full details for the wooden mounting platform are given in Fig. 13. The famous General Motors Building is in the background and the two towers further back are on the Chrysler Building. (Photo by K. T. Hill, W2AHC.)

taneously for covering all directions, by some such arrangement as shown in Fig. 11.

The illustration above is typical for the flat-roof houses such as are common in most cities.

Where the beams are to be set up on peaked roofs, two alternatives of more than ordinary simplicity suggest themselves. If two peaks are available at right angles to each other, the antennas may be set directly on them. By using the new Premax Wall Brackets type WB-1, the vertical elements may be attached to the side of the building, instead of using the platform on the roof. Suitable stand-off insulators between each pair of elements simplify the running of the feed lines.

Terminal assemblies of the varieties shown in Figs. 9, 10, 11 and 12 would work out well with this system.

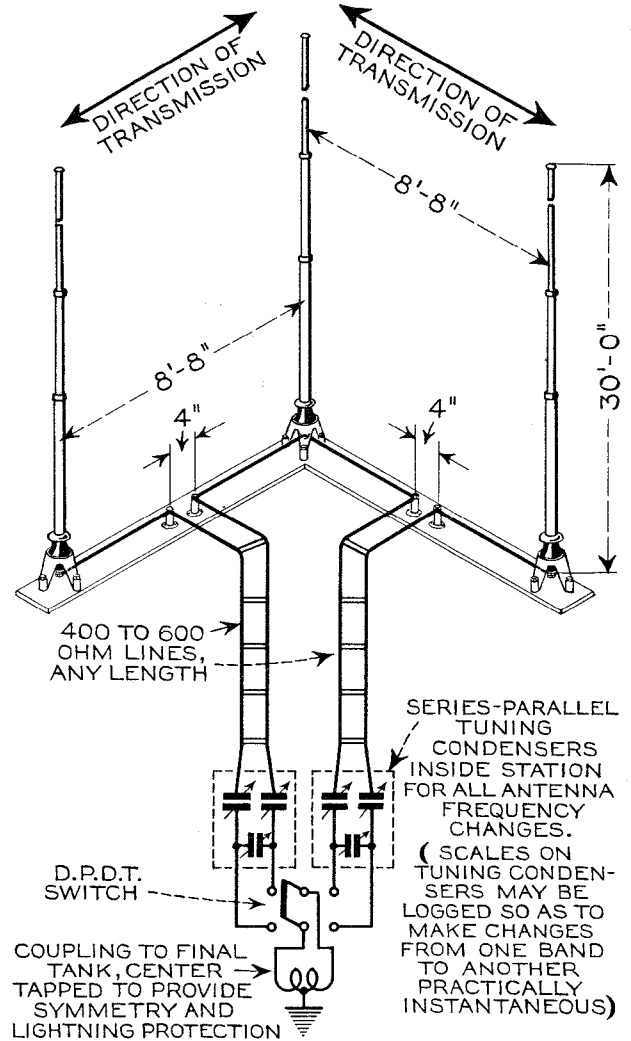


FIG. 9—Space and expense may be conserved by using three elements as shown here, instead of the four shown in Fig. 8. However, there is always the possibility of reaction between the transmission lines themselves, as well as from the third element. In tests made to determine the extent of this reaction, it has been found to be negligible, except when the two antennas are on the same frequency or one of its harmonics. This difficulty is removed very simply by detuning the one not in use. All tuning equipment may be located within the station.

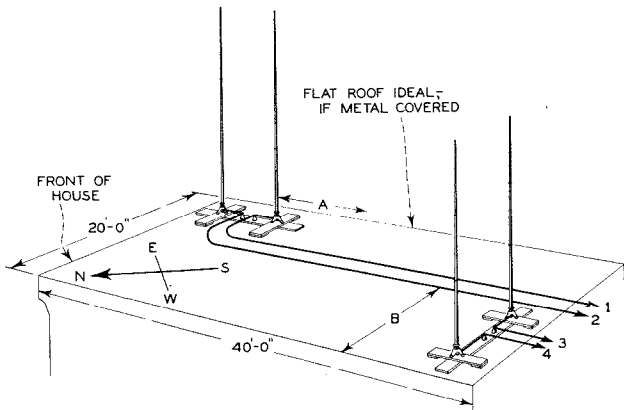


FIG. 8—THE PREMAX FIXED "ROTARY" BEAM SYSTEM WITH VARIABLE FREQUENCY. Here we have two of the beams shown in Fig. 6. They are set up at right angles and any distance greater than a half-wave length apart. The lines coming from them should be kept a reasonable distance apart if they are to be used on the same frequency. By using the tuning system shown in Fig. 9, the antennas may be tuned to the same or to different frequencies and operated at will. They may be operated simul-

Here's a comment from a user of Premax Elements which we believe tells the whole story. It comes from W5EYZ in Fort Worth, Texas.

"I believe that the money spent for a Premax Beam will mean more clean QSO's for any amateur than many times that amount spent on the transmitter itself."

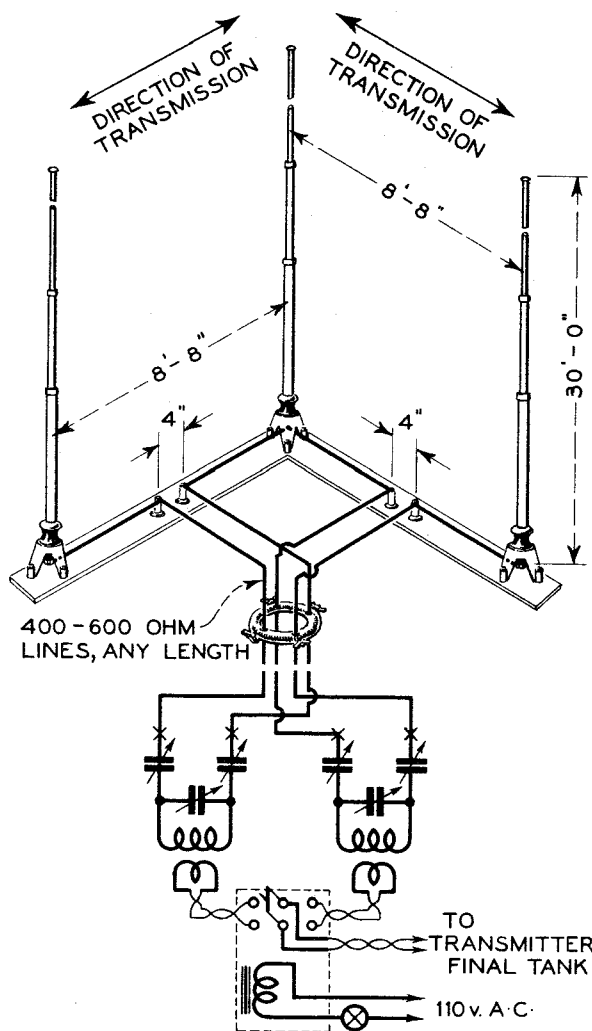
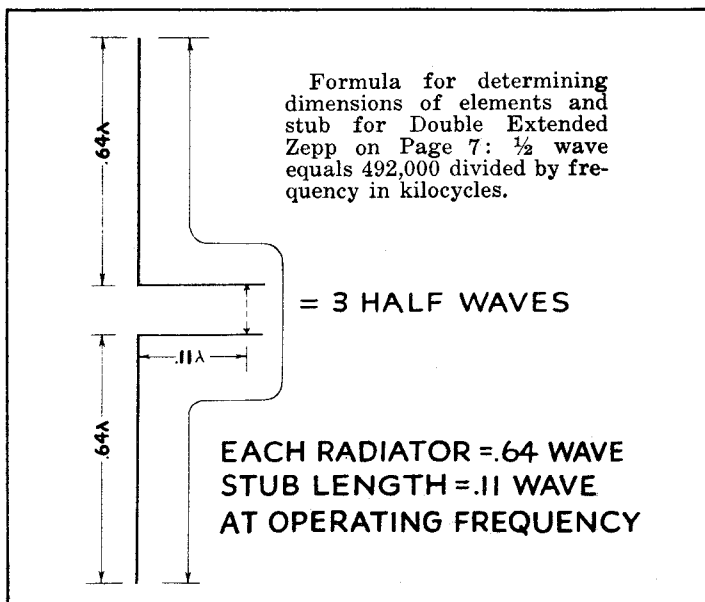


FIG. 10—VARIABLE FREQUENCY IS PROVIDED BY SERIES-MULTIPLE TUNING OF BOTH "PITCHFORKS." The essential difference between the terminal arrangement shown here, and that in Fig. 9, is found in the use of the D.P.D.T. a.c. relay which replaces the knife switch and the manual control. X marks the spot for the insertion of meters used for tuning the beam for the desired frequency.



"... to tell you how pleased I am with my Premax Corulite Rotary (W8JK) beam antenna. Since installing the beam I have worked more real DX and heard more Asiatics than ever before on any antenna I ever had. Worked: J2KG, J8CG, J3FK, F18AC, ZS1BG, CX2AJ, ZS5DE, ZS2BV, CR7AJ, XU8NR, and many other good ones. I just wanted to tell you how pleased I am, and to tell you 'You've got something there!'—W1APA, G. F. Williams, Bridgeport, Conn.

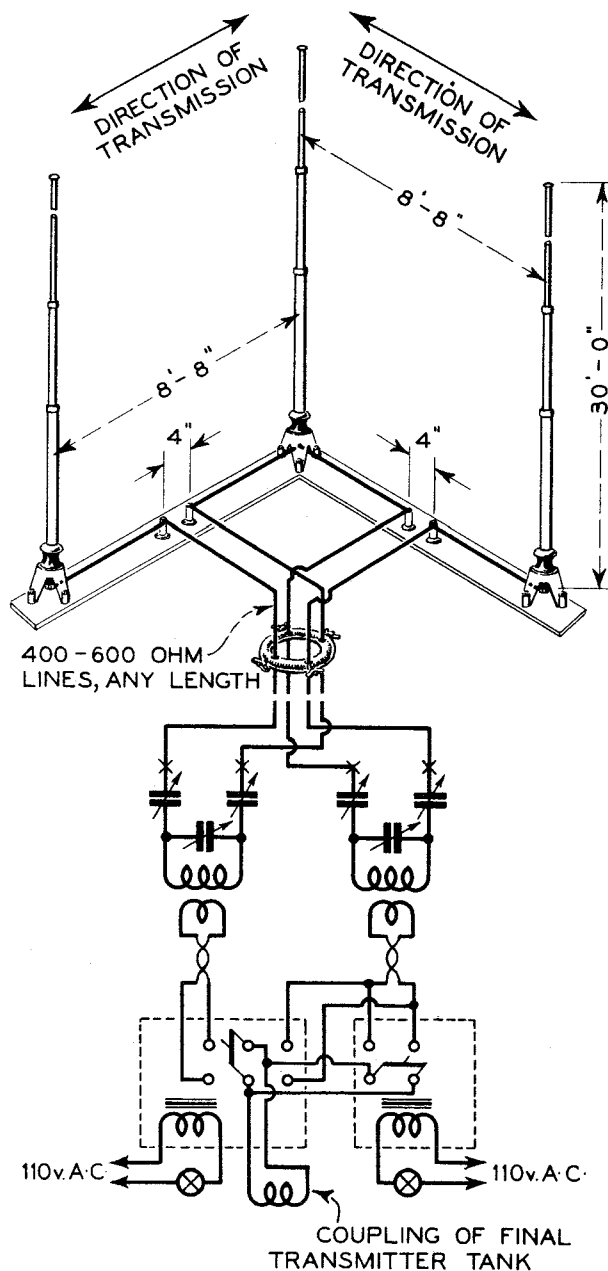


FIG. 11—FULL ELECTRICAL CONTROL. By the use of two a.c. relays, one D.P.D.T., and one D.P.S.T., we provide an elaboration of the system shown in Fig. 10. In this set-up not only are we able to switch from one antenna to the other, but when we desire to transmit in all directions simultaneously, that is made possible by throwing the second antenna in multiple with the first one by the use of the second relay.

PREMAX ANTENNA MANUAL

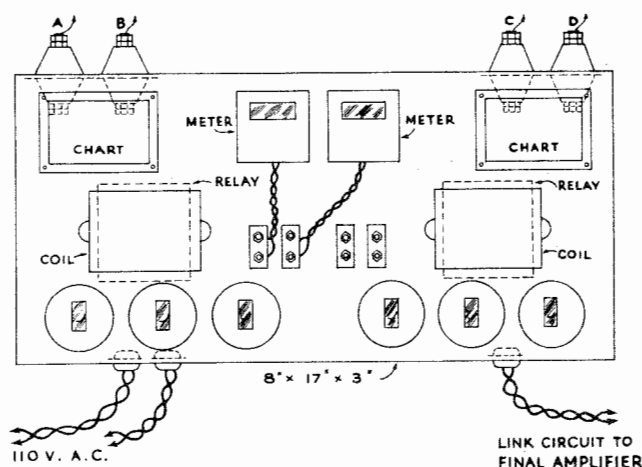


FIG. 12—STATION TUNING ASSEMBLY FOR FIXED "ROTARY" BEAM. Where the fixed "rotary" beam is to be a permanent arrangement, the use of terminal tuning equipment, which is neat, simple to adjust and is self-recording, is well worth while. Such a layout is given here.

A steel, heavy-duty chassis provides room for all the equipment. Beneath the surface we mount the variable condensers, the two relays, and do all the wiring.

On the front outside surface we mount the meters, plug-in coil sockets, chart frames and the insulated banana jacks which take the plugs attached to the meters. The variable condenser dials are also on the front panel. Dial locks, used to hold these dials in the desired positions, may be used to advantage. The feed-through insulators should be taken through the upper surface of the panel and kept reasonably well apart.

If both antennas are to be used together, the settings for a given frequency will be found to change a little and a third chart, which could be placed below the meters, would be an advantage.

Suggested parts list for the tuning assembly is given below:

THE FIXED "ROTARY" BEAM ANTENNA PARTS LIST FOR TERMINAL TUNING UNIT

- 1 Heavy duty, steel chassis, 17" x 8" x 3", National.

- 4 Hollow, cone type bushings, type XS-1, National.
- 4 Terminal Assemblies (for insertion of meter plugs) type FWJ, National.
- 4 Dual banana pin assemblies (two for meter plugs; two for shorts, when meters not in circuit) type FWF National.
- 4 Single hole mount variables, 50 mmf., type SS-50 National. (Condensers with higher breakdown rating if system is used on high power).
- 2 Single hole mount variable condensers, 30 mmf., type SS-30, National.
- 3 Chart frames, 2 1/4 x 3 1/4 inches, type A, National.
- 6 Dial knobs (0-10), type HRO, National.
- 6 Dial locks, for above dials, type ODL, National.
- 2 Plug-in coil sockets, with stand-off insulators, type XB-16, National.
- 2 Center-linked, plug-in coils for each band used, type AR-16, National.
- 1 D.P.D.T., 110 volt a.c. relay, Ward-Leonard.
- 1 D.P.S.T., 110 volt a.c. relay, Ward-Leonard. (Only used if both beams are to be used simultaneously.)
- 2 Thermo-couple meters, 0-1 mil. (with suitable shunts, if power is used Triplet).
- 2 S.P.S.T. toggle switches, G.E.
- 3 Rubber grommets, with 3/8" holes.

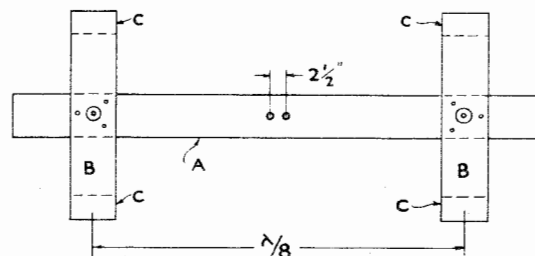


FIG. 13—BASE FOR PREMAX "PITCHFORK" AND FIXED "ROTARY" TYPE BEAMS. Simple supporting framework for use with any of the vertical beams may be made by following the dimensions given here. It is suggested that bags of sand, as shown in Fig. 7, be used.

FOR 20 METER FUNDAMENTAL:

A — 3" x 10" x 10' 0"

B — 3" x 10" x 4' 0"

C — 3" x 10" x 5' 0"

FOR 10 METER FUNDAMENTAL:

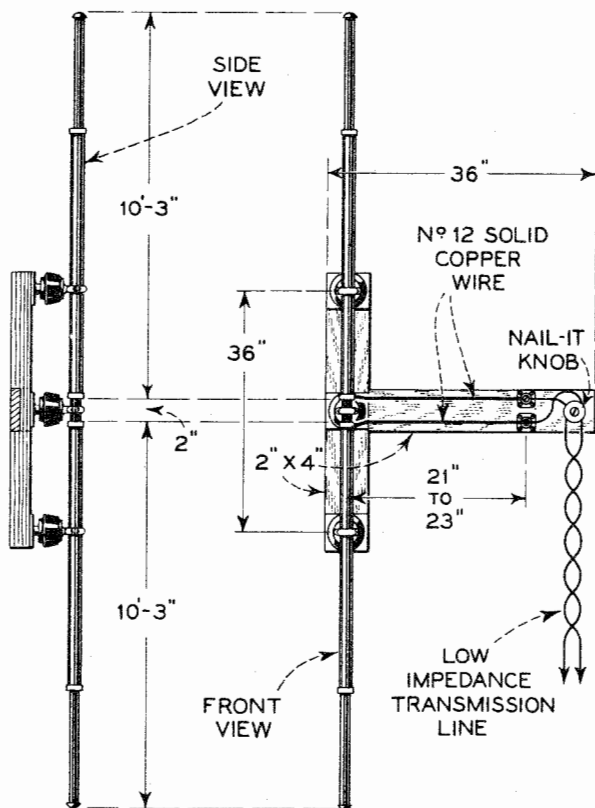
A — 2" x 4" x 6' 0"

B — 2" x 4" x 2' 0"

C — 2" x 4" x 4' 0"

THE EXTENDED DOUBLE ZEPP ANTENNA

*Can Be Used Vertically or Horizontally—
Provides Great Gain Over Two 1/2-Waves In
Phase, But Takes Very Little More Space*



A most informative article, giving the basis for the design and the reasons for the use of the extended double-Zepp antenna, appeared in QST, for June, 1938. It was written by Hugo Romander and was based on information secured from Mr. A. Alford, of the Engineering Department of the International Telephone and Telegraph Co. Using that information as a starting point, Frank Lester, W2AMJ, designed a most practical vertical antenna, for use on the 5 meter amateur band. The simplicity of the system resulted in many operators putting it up and in every instance they have been more than pleased with the results.

There have been several instances where the results produced by the double-zepp have been markedly better than those produced with more elaborate types of arrays. No doubt, the reason for the improvement could be found in the simplicity of adjustment and sure-fire performance of the former.

The double-zepp, by the way, is a common name, applied to two half-waves, in phase, with a quarter wave matching stub, or a tuned transmission line. The extended double-zepp is simply the carrying of the two half-waves to longer lengths, with a corresponding shortening of the matching section. The result is the separation of the radiating portions of the two radiators which brings about the added gain.

Two half-waves, in phase, under normal conditions, will

FIG. 14—This is a composite diagram illustrating the use of the new Premax, double-extended zepp antenna as used at W2USA. For use on frequencies lower than 5 meters, such as police, forestry service, and similar bands, the elements may be extended to the desired lengths and the arm which carries the matching stub, at right angles to the antenna, will have to be lengthened.

When used in a horizontal plane on the lower frequencies, additional gain and marked directional properties are made possible by the use of the Premax Corulite Elements and the Premax Fig. 46 Frame. This application will be fully understood by reference to QST article mentioned in above text.

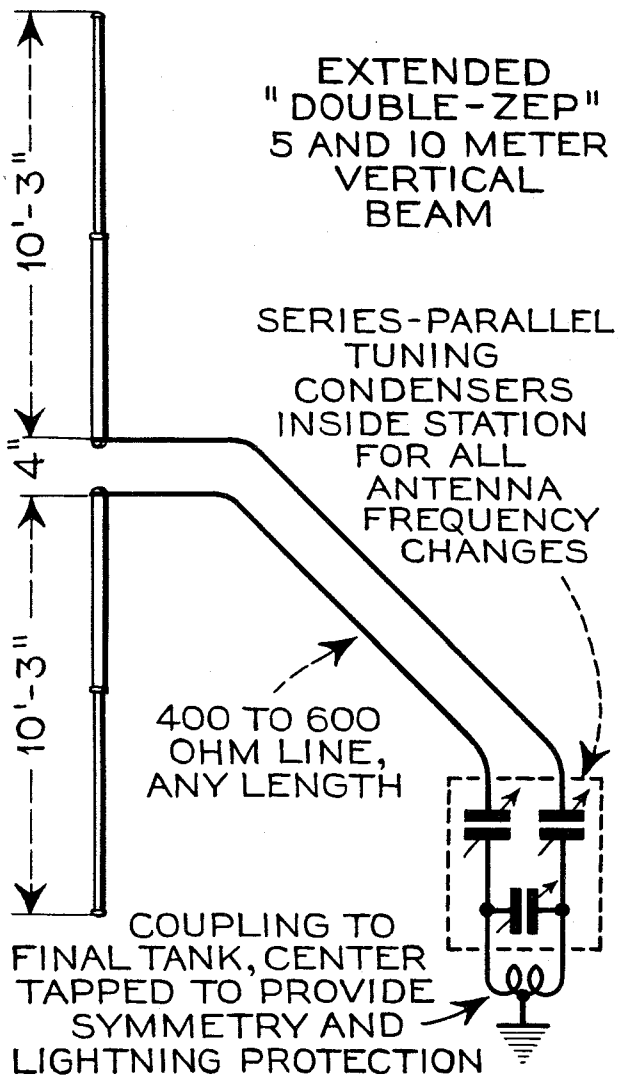


FIG. 15—DOUBLE EXTENDED ZEPP WITH TUNED FEEDERS. Where the antenna is to be used over a considerable band of frequencies, it may be desirable to provide tuning of the line as indicated here. By the use of three condensers both series and multiple tuning are made possible so as to take care of any line regardless of its length. A slight rearrangement of the terminal equipment, shown in Fig. 12, would make a nice set-up for tuning this type of antenna.

show an improvement over a single half-wave, of approximately 50%; the extended, double-zepp, when properly adjusted, will show approximately 100% gain.

A Premax, extended, double-zepp has been in continuous use at W2USA, at the Communication and Transportation Building, World's Fair, New York, ever since that station has been on the air.

Not in the least limited to 5 meter operation, this form of antenna may be used to good advantage in securing greater general coverage in all directions on any frequency, when it is set up in a vertical position. When used horizontally, it has bi-directional properties, considerably more marked than those of the single half-wave antenna or two half-waves, in phase.

In order to enable all to take advantage of the advantages to be had from this simple form of antenna, Premax now provides a unit which is extremely sturdy and which, by the simple expedients of extending the radiators and the matching stub, may be used over a wide range of amateur and commercial services.

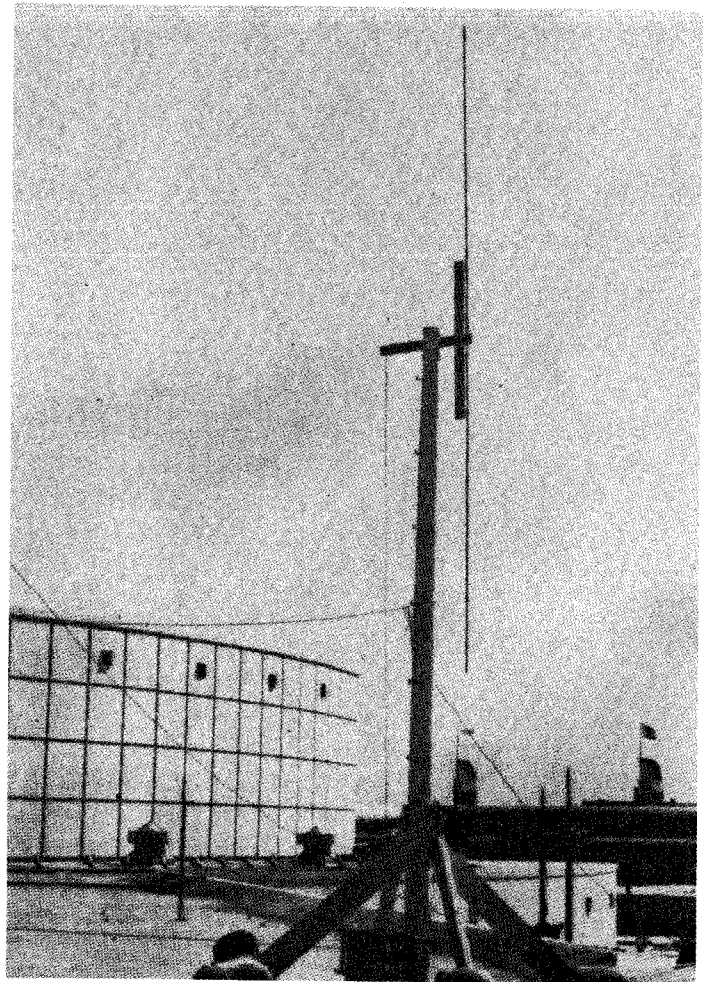


FIG. 16—Premax Corulite 5-Meter Extended Double Zepp at W2USA, World's Fair, New York. (Photo by K. T. Hill, W2AHC, Director Hudson Division, A.R.R.L.).

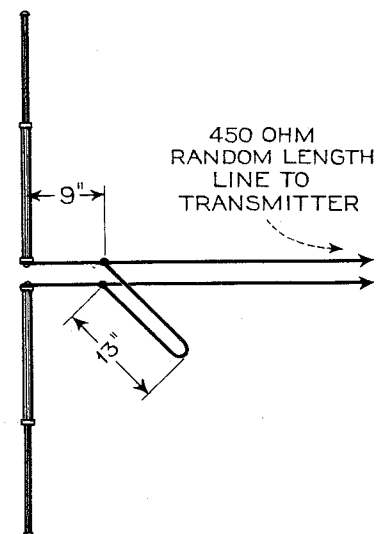
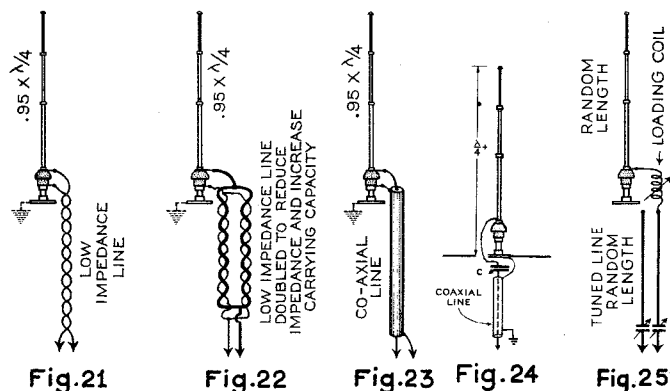


FIG. 17—This arrangement is bound to be an improvement over that of Fig. 14 and 15 even if the co-axial line were to be used instead of the twisted pair. By the adjustment of the hair-pin stub it is possible to provide a line which will radiate little or nothing. If the line is taken away from the antenna at right angles for a considerable distance, it will have less and less effect on the radiation pattern.

24 PRACTICAL IDEAS FOR USING PREMAX VERTICAL UNITS

In addition to the more elaborate antenna systems, in which two or more vertical units are employed to provide directivity and increase in signal strength in desired directions, the following simple cases will be found of great value where simplicity of erection is desired.



FIGS. 21, 22, 23, 24 and 25 show the use of Premax Verticals in typical quarter-wave "macaroni" fashion. The impedance at the base of a quarter-wave antenna, fed in this manner, is approximately 35 ohms. Most of the twisted pair type of transmission line, which is commercially available, has an impedance of 75 to 115 ohms. Such a line, when used as in Fig. 21, would introduce considerable loss, particularly if the line was a considerable length. By doubling the line, as shown in Fig. 22, the impedance is cut in half with beneficial results.

Co-axial lines of almost any desired impedance are now available, and the arrangement shown in Fig. 23 is certainly to be desired. In addition to its other advantages, such a line may be grounded at various points along its length as protection for those who might come in contact with it, particularly if high power is being used. Grounding the line also gives some protection from lightning.

By making the vertical portion of the antenna slightly longer than a quarter of a wave length and inserting a variable condenser as shown in Fig. 24, it is possible to use the same antenna over a rather wide band of frequencies without sustaining the loss which the off-resonance condition of other systems would produce when they are operated at a frequency other than that for which they have been made.

While a co-axial line is indicated, any other feed line may be used in the same manner.

Premax 16-foot radiators may be used as above for wave lengths up to 20 meters (14 megacycles).

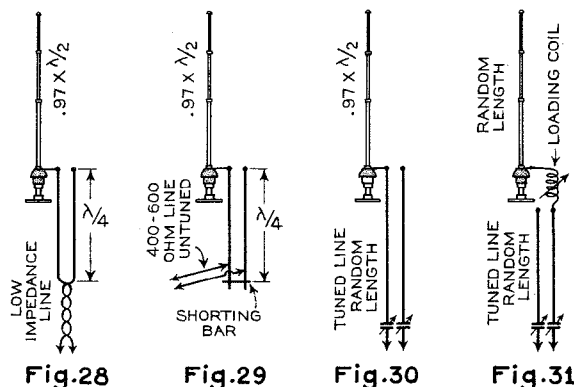
Premax 35-foot radiators may be used as above for wave lengths up to 40 meters (7 megacycles).

Even lower frequencies may be used if suitable loading is provided, as shown in Fig. 25. This is the method used on many marine ship-to-shore radiotelephone installations where comparatively short radiators are used on low frequency on small private craft.

to 20 meters. Many commercial uses will be found to require lengths which will be well within these limits.

Figure 26 is fed with a twisted-pair transmission line. There are several such lines commercially available which have approximately the correct impedance for this use. 72 ohms is generally considered to be the impedance at the center of such an antenna, which is frequently called a doublet, or di-pole.

In Fig. 27, a co-axial line of correct impedance is suggested. It has the same advantage in this case as indicated in connection with Fig. 23.



Figs. 28, 29, 30 and 31 show the use of Premax radiators, in what is generally considered a "J" arrangement. Here, the vertical element is a half-wave, rather than a quarter-wave, as indicated in the other figures.

For this use, it will be noted that we use a quarter-wave matching stub, to bring about an impedance match between the transmission-line and the antenna, proper.

It will be observed that the actual radiating portion of this sort of antenna must be twice as long as is the case for the quarter-wave arrangements. For this type of operation, the radiators must be the same length as the combined length of the radiators in Figs. 26 and 27.

The most popular form of the "J" type antenna, is shown in Fig. 28, though many of the more modern installations are made with co-axial transmission-line replacing the twisted pair. There is little difference in performance, if suitable lines are chosen. However, the co-axial line always has the advantages previously mentioned.

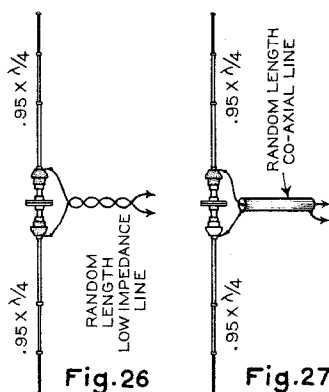
From the stand-point of actual efficiency, on a definite frequency, the arrangement, shown in Fig. 29, is better than any of the other types. Its superiority increases with frequency—that is, its superiority over the other types.

Where we desire to cover a wide range of frequencies, using the same vertical radiator, the arrangement shown in Fig. 30, is well worth while. In connection with the half-wave antenna, it has much the same effect as the arrangement which Fig. 24 provides with the quarter-wave antenna.

It will be noted that Fig. 31 is essentially the same as Fig. 25. It is repeated more for convenience than anything else, as it refers to antennas which are a half-wave rather than a quarter-wave long. The use of the tuned, loading coil enables us to extend the frequency range of the system considerably.

In general, it is thought that half-wave radiators may be used to better advantage than quarter-wave units. The use of the former, however, is limited by the physical dimensions.

"Results from a two-element array at W5CVW are 72 countries, WAC, the first three days the beam was in use." (Array consists of a two-element rotary built with Premax units, and is on Frame Fig. 46, mounted atop of wood tower.)



FIGS. 26 and 27 show the use of two quarter-wave radiators set opposite each other, forming a simple half-wave antenna. They may be used either in vertical or horizontal arrangement. If used vertically, they will emit with equal intensity in all directions; if arranged horizontally, they will send out a signal in the form of a figure eight. The line of radiation will be at right angles to the line of the antenna in this case.

In the simple forms, without loading, the longer Premax radiators may be used up to 40 meters and the shorter units up

Figs. 32, 33, 34, 35 and 36 illustrate the use of two-half wave radiators, in phase. By this arrangement, it is possible to increase the radiation of a given transmitter by approximately 50%. Arrangements of this nature may be either horizontal or vertical. If vertical, and suitably raised above ground, the average improvement, in all directions, over a single half-wave antenna, of the same general type, will be about the 50% indicated. If used in a horizontal arrangement, the signal pattern will continue in the form of a figure eight, as with Figs. 26 and 27, but the pattern will be in the form of an elongated 8, narrowing at the sides and extending about 50% further in the two directions, at right angles to the axis of the antenna. Figs. 32, 33 and 34 are identical, except for the difference in the forms of transmission lines, employed, as previously outlined and for which the same considerations apply as in Figures 21 and 25.

Quite a combination of effects may be had from the use of the system, shown in Fig. 35. Depending upon the lengths of the radiators, with relation to the operating frequency, it may be operated as a single half-wave antenna, at a given frequency and as two half-waves, in phase, at twice that frequency.

Fig. 36 indicates a method for obtaining a duplicate of any of the arrangements in Figs. 32, 33 and 34, in which the feed line is attached to the antenna, proper, through a matching-stub, at the antenna base, rather than in the center. Any of the previously described lines may take the place of the twisted pair.

As a rule, the center-fed system is to be preferred, as it provides better symmetry.

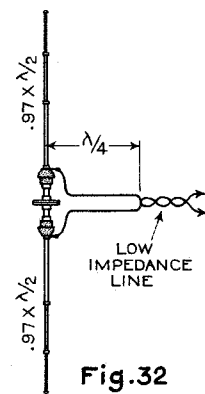


Fig. 32

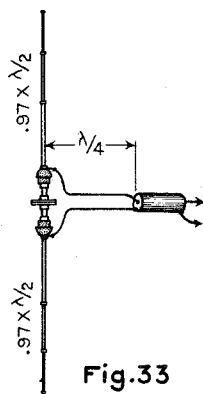


Fig. 33

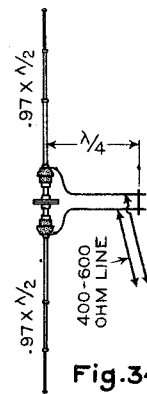


Fig. 34

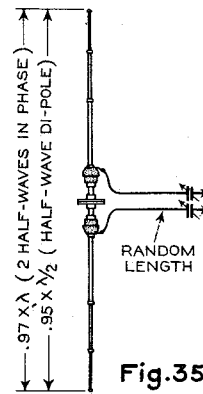


Fig. 35

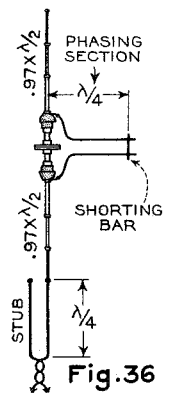


Fig. 36

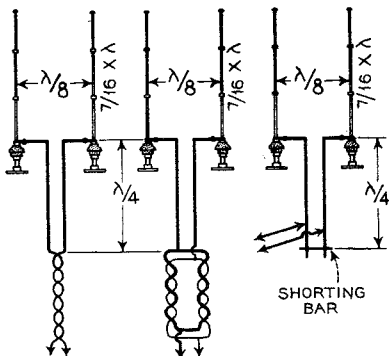


Fig. 37 Fig. 38 Fig. 39

Fixed "Rotary" Beams. Except for the differences in their transmission-lines, as outlined, previously in connection with other antennas, these three figures are identical.

Figs. 37, 38 and 39 indicate the use of two vertical radiators, in what has come to be called a "pitch-fork" type of beam. Beams of this type will show a marked improvement in two main directions, over the simple, half-wave antenna. Their pattern is in the form of a figure 8, with the line of radiation taking the same line as the axis of the assembly. Beams of this nature are very simple to adjust. They are very effective and an entirely new use for them is presented with greater detail, in the section of this bulletin devoted to

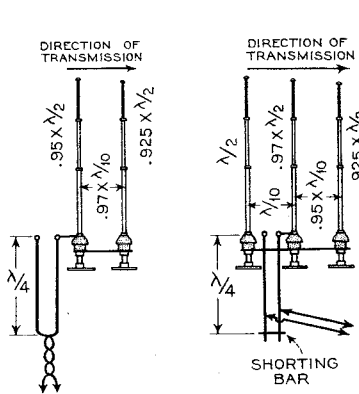


Fig. 40

Fig. 41

wave spacing, between the elements, because the beams would then be easier to tune and they could be used with reasonable gain over a wider range of frequencies.

Figs. 40 and 41 indicate the use of a single, driven element, around which an additional element or two are swung, to provide the gain, in the desired direction, which the use of beam antennas brings about. It will be seen that 1/10 wave length spacing has been suggested. That has been done for the reason that it conserves space and produces an arrangement which is not too cumbersome. On some of the higher frequencies, such as used for frequency modulation, television, and the amateur bands above 56 megacycles, it would be desirable to use quarter-

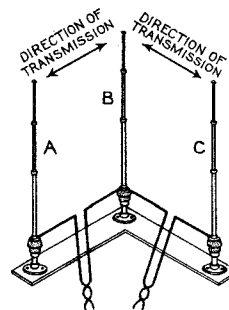


Fig. 42

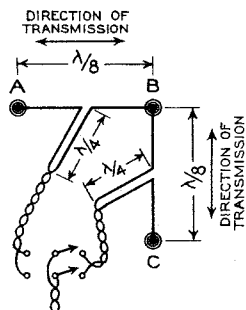


Fig. 43

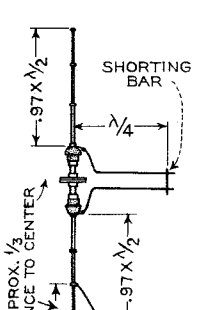


Fig. 44

Figs. 42 and 43 illustrate the method of using three vertical elements, in a double "pitchfork" arrangement, for covering all directions, without the necessity of altering the position of the elements, themselves. Where operation is confined to a single narrow band of frequencies, this arrangement eliminates the need for four verticals, such as is described elsewhere in this bulletin. The other arrangement is better.

Fig. 44 shows the use of a single-wire feed, instead of the various systems of feed, which have been shown previously. While it is a satisfactory method of feeding an antenna, under certain circumstances, it does not make for the symmetry of the other systems. In this case, the single-wire feed has been used with two half-waves, in phase and the diagram might well be considered in the group illustrated in Figs. 32 to 36. However, since, the same sort of feed system may be applied to almost any form of antenna, it has been thought that it is better to show it separately.

"You may be interested in knowing that had it not been for installing one of your Rotary Beams here, I would never have won the 1939 DX Marathon for phone stations.

"In the last four months of 1939 I worked 28 new countries that I had not worked before. This alone should be proof enough how well your equipment works if properly installed.

"I cannot find words to express my admiration for the Premax Rotary Beams; all I can say is that they are by far the best antenna I have ever used.

"For the more serious minded amateur that would like to work more stations and have more complete QSO's, I heartily recommend Premax Rotary Beams."—
Louis C. Bremer, W3LE, Baltimore, Md.

PREMAX TEN-METER HI-Q VERTICAL ANTENNA

A simple ten-meter Vertical which is easy to erect on a chimney, or practically anywhere, will be found very desirable for operators who have very little space available for installation. The results obtained with this array have been so gratifying that many operators who are working on ten-meters will desire to duplicate it.

The Premax Ten-meter Hi-Q Vertical requires one Premax 30 foot Vertical Mast and one 12 foot, together with a chimney bracket or other mounting. Where this vertical is to be attached to a chimney top, the ease with which it may be done is shown in Fig. 45 (left). In this instance the installation is made with the Premax Chimney Bracket No. CB-1. The dimensions indicated in the drawing are those for 28,500 KC, which is the low frequency end of the ten-meter phone band. Lower frequencies such as the c.w. portion of the ten-meter band can be secured by extending both the telescopic units to the desired length. Correct lengths for higher frequencies are possible by collapsing the masts to the required length.

Another method of installation is shown in Fig. 45 (right), where the array is installed on top of the chimney or on a parapet or fire wall. In this instance the regular Premax Parapet Support No. PS-18 with special brackets is used.

The transmission line is approximately 600 ohms and attached at a point two feet above the shorting bar. The idea is then to extend the shorter vertical to one-quarter of a wave length and to extend the longer vertical to one-quarter of a wave length above the shorting bar and then 97% of a half wave length above the quarter-wave point. This provides a self-supporting quarter-wave matching stub of a very high "Q" and a vertical radiator which is self supporting and well into the clear.

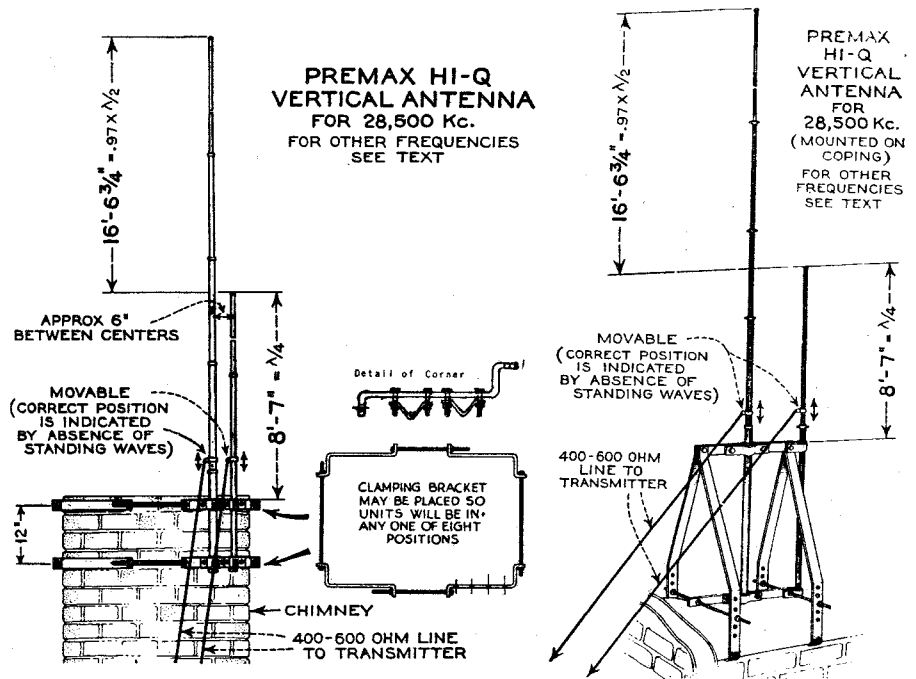
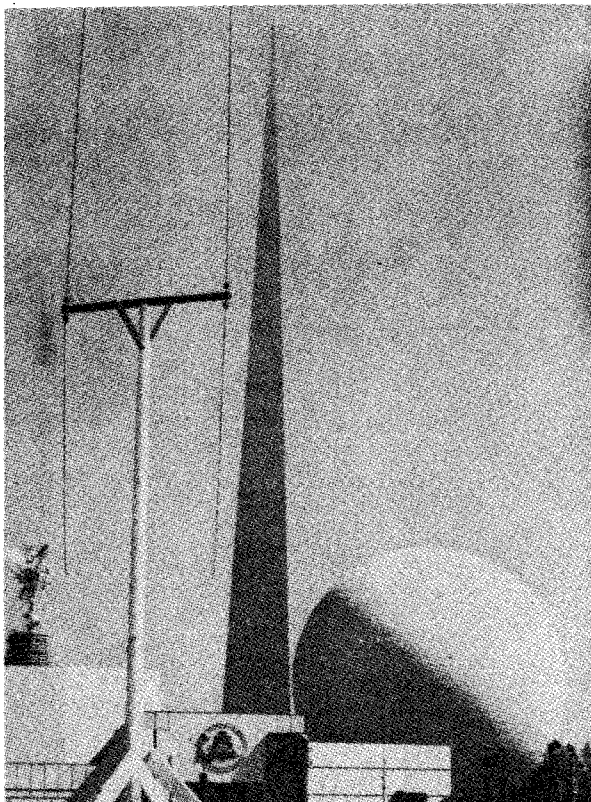


FIG. 45—In the above diagram, the Hi-Q Vertical Antenna is shown mounted on a chimney at the left. The supports are provided by the use of the Premax Chimney Bracket. At the right, the same arrangement is shown mounted on a parapet or fire wall by means of the Premax Parapet Support. An antenna of similar type for commercial application is described and illustrated on page 20.



10 meter Premax full wave W8JK type beam at W2USA, World's Fair, New York. The Trylon and Perisphere, theme center of the Fair, to the right, and the American Telephone and Telegraph building, topped by the gold figure, to the left. (Photo by Kenneth T. Hill, W2AHC, director Hudson Division, A.R.R.L.)

The Use of Premax "Hair-pins" In Tuning Rotary Beams

The physical length of elements comprising various types of antenna arrays have, in the past, been thought to require extremely delicate adjustment. In fact, the performance of a definite antenna can, to a large extent, be improved or ruined by these adjustments. As the number of elements is increased, the difficulty of making the adjustments at the outside ends of the elements is also increased.

This difficulty is thoroughly eliminated by the use of Premax "hairpins." They are inserted between two halves of each of the elements and they may be slid up or down so as to provide a variation in the overall length from tip to tip of the element, without making any adjustments in the two halves of the element itself. In other words, the physical length is measured from the outside end of one element through that portion of the "hairpin" that is in use to the outside end of the other half of the element. By this method it is possible to have all of the elements set at a single physical length and the variation in their electrical length may be provided by the "hairpins." Similarly, the variation from one end of a given band to another may be obtained by a similar adjustment.

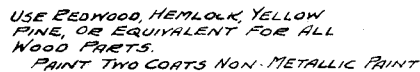
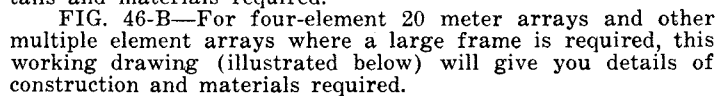
When final adjustment is arrived at, the "hairpins" should be soldered permanently in position in the lugs provided on the elements.

Diagram illustrating the chassis dimensions and components for a scissor lift truck:

- 8'-8"±** FOR 10 AND 20 METER BI-DIRECTIONAL
- 6'-11"±** FOR 20 METER UNI-DIRECTIONAL
- Dimensions: 3'-4" and 7'-0"
- Labels: A, B, C, D, E, F

near yellow pine or equal, are:

- A—1 wood center block 8" x 12" x 1½"
- B—1 Bakelite block 4" x 8" x ¾"
- C—2 main supporting members 1½" x 1½" x 3' 6"
- D—4 cross members 1½" x 1½" x 9' 0"
- E—4 antenna supports 1½" x 1½" x 7' 0"
- F—4 trussing units 1½" x 1½" x 5' 5"



TWENTY DESIGNS FOR BUILDING PREMAX ROTARY BEAM ARRAYS

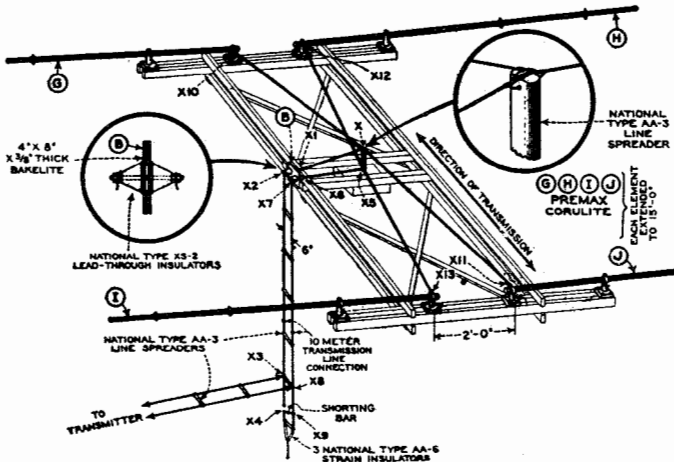


FIG. 47—FAMOUS W8JK BI-DIRECTIONAL BEAM. One of the most satisfactory rotary beams ever designed. It is very easy to adjust. Can be operated on both 10 and 20 meter bands without making any change in the feed line; it being necessary only to open or close the shorting bar on the matching stub. Because it is bi-directional, the need for complete rotation with feed line complications is eliminated.
Uses four Premax Units No. 618-M—Frame Fig. 46.

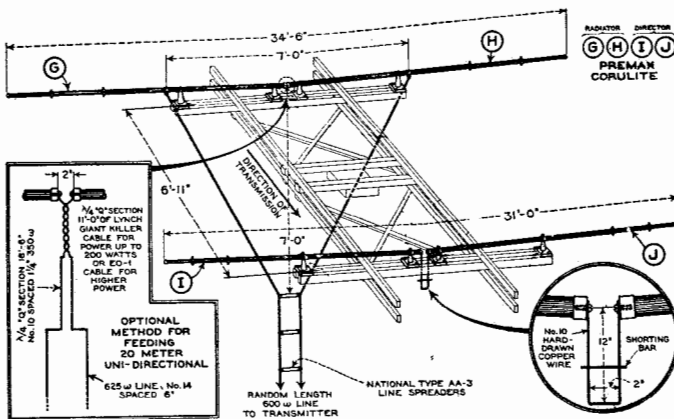


FIG. 48—20 METER UNI-DIRECTIONAL, HIGH-GAIN, CLOSE-SPACED ARRAY. (Use for commercial services obtained from formula.) Where uni-directional properties are required, the arrangement shown here may be utilized to extremely good advantage. In this type of beam we have a radiating element, fed by a 600-ohm line which is attached to the radiating element by means of a Delta type transformer. The other element which is shorter than the radiator acts as a director. Several methods for feeding the driven element are illustrated in other figures, and one alternative method is illustrated here. In addition to providing uni-directional properties, this type of beam produces a considerable gain over the type shown in Fig. 47.
Uses four Premax Units No. 618-M—Frame Fig. 46.

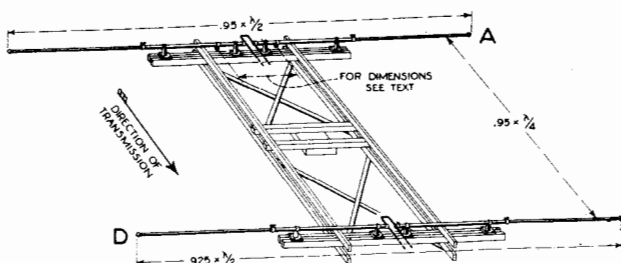


FIG. 49—10 METER, UNI-DIRECTIONAL ARRAY WITH QUARTER WAVE SPACING. This type of antenna has an

advantage over the close-spaced array in that it is much easier to tune to resonance. It will be noted, however, that the spacing between the elements is even greater than the spacing for the 20 meter beam shown in Fig. 48. The "hair-pin" method of tuning all Premax elements is used to excellent advantage in this type of array. Any of the various methods for feeding the driven element may be used.
Uses four Premax Units No. 108-M—Frame Fig. 46.

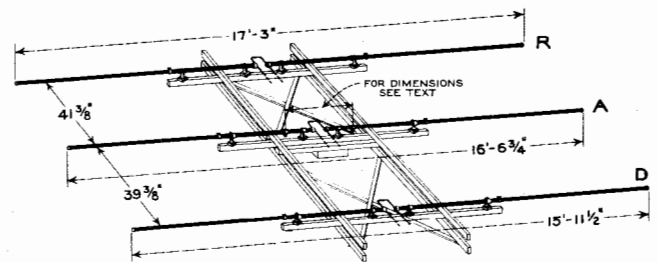


FIG. 50—10 METER, THREE-ELEMENT, CLOSE-SPACED ARRAY. When close spacing (approximately 1/10 wave length) is used between the elements it is possible to have more room on the standard Premax framework with three elements than with but two, where the arrangement in Fig. 49 is used. The introduction of the third element makes the beam much sharper; provides much greater gain and reduces interference from undesired directions when used for reception. It has the disadvantage of being more difficult to tune and is efficient over a narrower frequency range. The dimensions for this type of beam have been worked out by L. M. Cockaday and they may be followed with only minor adjustments being necessary for any frequency within the 28-30 megacycle range. The method for feeding the driven element "A" is similar to that employed in Fig. 48. However, any of the alternate methods may be employed.
Uses six Premax Units No. 108-M—Frame Fig. 46.

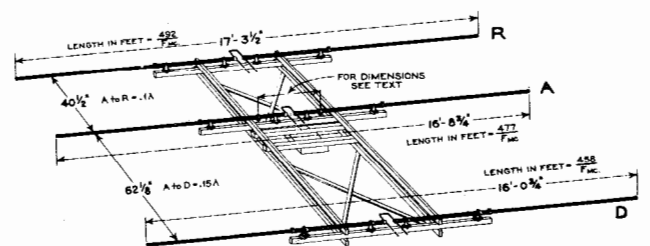


FIG. 51—Except for the difference in the length of the elements as well as their spacing, the arrangement shown here is very similar to the three element array shown in Fig. 50. The same number and size elements will be required for this beam as for Fig. 50.

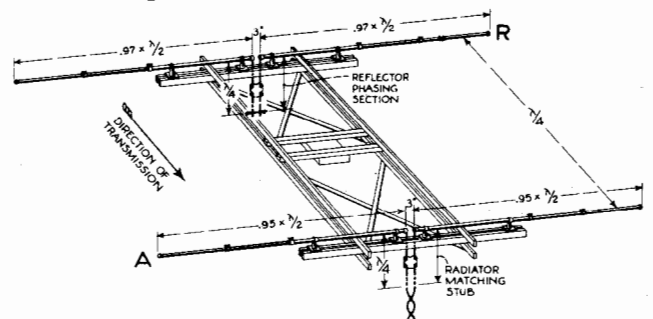


FIG. 52—10 METER, FOUR HALF WAVES IN PHASE, QUARTER WAVE SPACING. This beam may be made to have a practical gain which is as good or even better than the beams which have three elements and close spacing. It has the distinct advantage over any of the other types of being very

easy to tune to resonance. In most cases the units may be set according to the formula and the beam set in operation without adjustment of any kind.

The approximate dimensions for the units "A" and "R" for 30 megacycle operation are 15' 6" and 16' 7" each respectively. The distance between them would be 8' 2½", while the stubs would be 8' for the antenna elements proper, "A" and 8' 2½" for the reflectors.

By alternating the dimensions according to the formula, an excellent beam for reception of television or frequency modulation may be provided.

Uses four Premax Units No. 108-M—Frame Fig. 46.

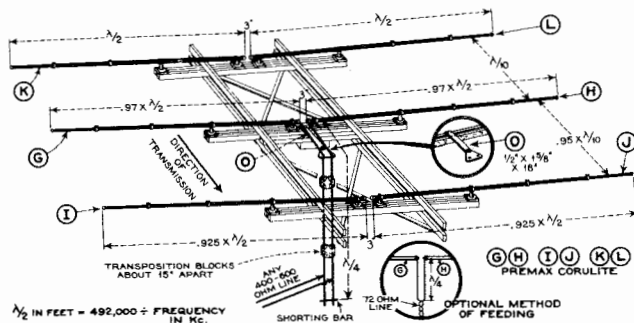


FIG. 53—10 METERS, SIX HALF WAVES IN PHASE, CLOSE SPACING. There are many services in which a beam of this nature may be used to advantage. For instance, in testing it, three stations, each approximately 1500 miles distant, delivering the same order of signal strength and each being separated from the other by 15 degrees of arc, were tuned in. When turned in the direction of one, there was no interference from either of the others. Similar improvement in transmitted signals from the testing station were also reported.

The disadvantages include difficulty of tuning accurately—and, without such tuning, the additional elements may introduce loss instead of gain—narrow band of frequencies over which there is a marked improvement; beam (electrical in this case) is so narrow that accurate aiming is required. This last, of course, is a distinct advantage for receiving. Beams like this are excellent for point-to-point commercial service.

Uses six Premax Units No. 108-M—Frame Fig. 46.

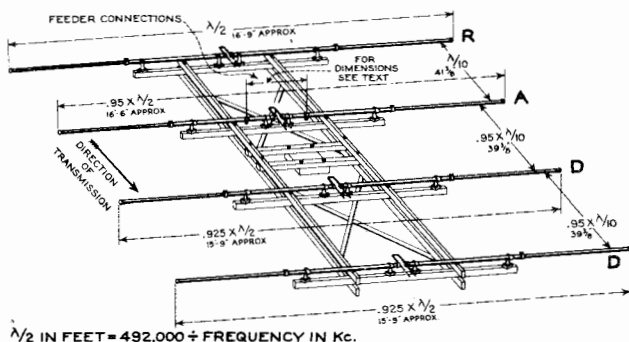


FIG. 54 — 4 HALF WAVES, 10 METERS, WITH SLIGHTLY ALTERED FRAMEWORK. By making the longitudinal sections of the Standard Premax Beam Frame a little longer, it is easy to provide room for four ten meter elements with close spacing. This type of beam, with full details for a simple method of tuning it, will be found in QST for November, 1939.

This form of beam, although originally intended for low angle, long distance amateur work, is ideal for use on some of the higher frequencies, for frequency modulation, television and facsimile reception. It may be used to excellent advantage on both ends of relaying service. Full mechanical details for the frame are given in Fig. 46-A.

Uses eight Premax Units No. 108-M.

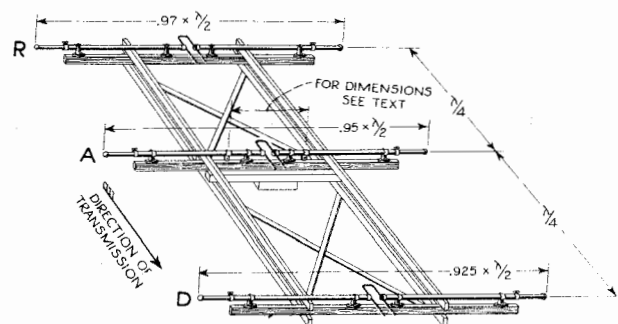


FIG. 55—5 METERS, 3 HALF-WAVE ELEMENTS, QUARTER-WAVE SPACING. Some of the best long-distance operation on the five meter band has been accomplished by the use of horizontal, multi-element antennas. The standard Premax Beam Frame, Fig. 46, without any additions, is suitable for use with this type of array. There are a lot of advantages to be had from using the quarter-wave spacing, such as simplicity of tuning and greater frequency range for the same setting.

The "Delta" method of feed is shown, but any other method may be employed.

The advantage of the Premax "hair-pin" method of adjusting the various elements to proper length becomes more and more apparent as we go to these higher frequencies.

Beams of this type are ideal for many kinds of commercial services.

Uses six Premax Units No. 104-M—Frame Fig. 46.

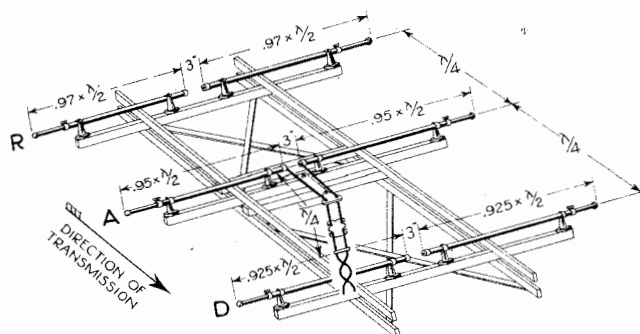


FIG. 56—5 METERS, 6 HALF-WAVES, IN PHASE, QUARTER-WAVE SPACING. It is doubtful that any more efficient and compact 5 meter array could be conceived which would be as easy to adjust for best performance as this one. While it is shown with a quarter-wave matching stub, for the driven element, fed by a twisted pair, any other form of feed system may be employed. No doubt an open wire line, if it is free from standing waves, would be even better than anything else. Of course, a good co-axial line could be used.

Since quarter-wave spacing is used, the adjustment of the beam is not too difficult and the overall dimensions are such that it can be set up almost anywhere, even where space is very limited. It provides extremely high gain and remarkable front to back ratio. By following the formula given on the diagram, similar beams may be set up for many of the commercial services. Because the elements themselves are large with relation to spacing, this form of beam is highly efficient.

Simplification of adjustment and even greater efficiency could be obtained if quarter-wave phasing sections, such as shown in Fig. 52, were used in between the "R" and "D" elements.

Uses six Premax Units No. 104-M—Frame Fig. 46.

"I am very happy to tell you that the (Premax) Beam is far beyond my expectations. I cannot for the life of me understand why there should be so much difference between two antennas, but I am well content to let it remain as it is without worrying too much about the 'why' of it."—E. L. Melton, Kansas City, Mo.

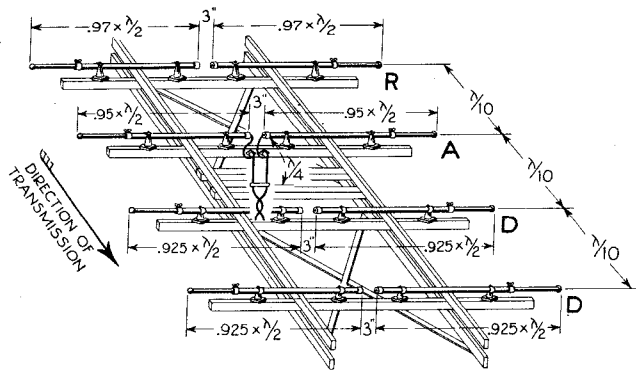


FIG. 57—5 METERS, 8 HALF-WAVES, IN PHASE, CLOSE SPACING. This beam is made with $1/10$ wave spacing. It is extremely sharp and can be made to have tremendous gain and front-to-back ratio. While it has great possibilities for various commercial relaying services, it is doubtful that it will find much amateur use. Like the array, described in Fig. 56, it would be easier to adjust if phasing stubs were used between the various parasytically excited elements.

For some of the commercial relaying services such as television, frequency modulation, and facsimile, this form of beam is excellent.

Uses eight Premax Units No. 104-M—Frame Fig. 46.

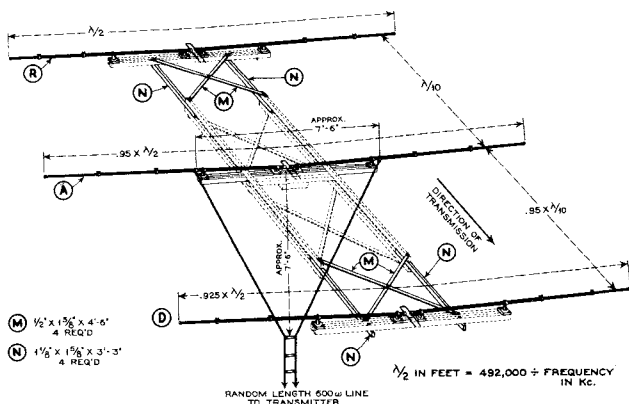


FIG. 58—20 METER, 3 ELEMENT, CLOSE-SPACED, UNI-DIRECTIONAL ARRAY. By the addition of the simple extensions shown above, the original Premax Frame, Fig. 46, is made suitable for the 3 element array.

This particular type of array, even though the elements are close-spaced, is made easier to tune than those which have been suggested in the past because of the precise adjustment which is secured by using the "hair-pins."

The "delta" feed and spaced transmission line have been found to be ideal. They make it rather a simple matter to eliminate standing waves.

Any other feed system may be substituted however.

Many commercial organizations have begun to use beams of this type in place of "rhombics" which for the same order of performance would require considerable acreage.

Uses six Premax Units No. 618-M—Frame Fig. 46 with extensions MN.

TWO-BAND ROTARY BEAM For 10 and 20 Meter Operation

Attention is called to an article by Fred D. Rowe, W6FK, and Max P. Fisher, in RADIO for June, 1940, describing a very ingenious and thoroughly practical idea for a two-band rotary beam which is well worth consideration.

A slight modification of the Premax Frame, Fig. 46-A, in the Manual, would work out excellently for this arrangement. Premax Units No. 108-M for the 10 meter and No. 618-M for the 20 meter will take care of the element requirements.

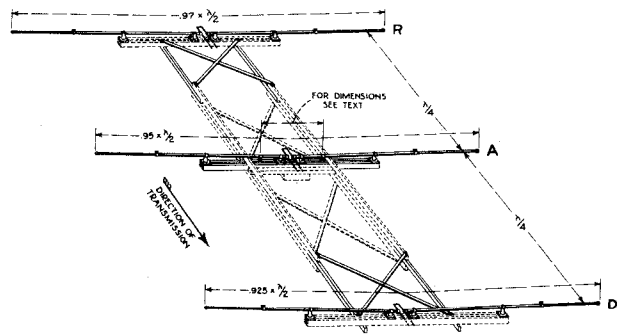


FIG. 59—10 METERS, 3 ELEMENTS, QUARTER-WAVE SPACING. Where space is available it will be found that this form of beam will have great advantage over those which use close-spacing, such as illustrated in Figs. 50 and 51. It is easier to tune; will hold its tuning better and it may be used with good performance over a wider band of frequencies for any given fundamental frequency.

It's suitable for any commercial use where the frequency is above 30 megacycles, such as frequency modulation, television, facsimile, and certain forms of relaying.

Uses six Premax Units No. 108-M—Frame Fig. 46, with extensions as indicated.

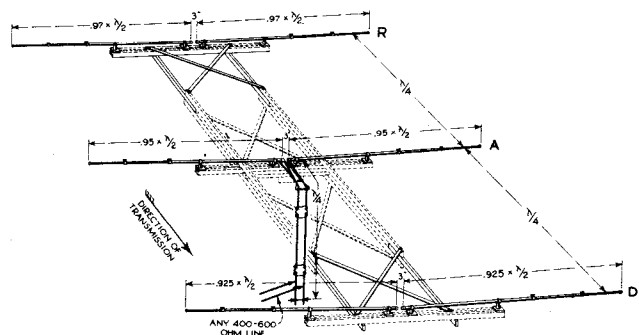


FIG. 60—10 METERS, 6 HALF-WAVES, IN PHASE, QUARTER-WAVE SPACING. The quarter-wave spacing of the elements, which is made possible by the use of the extended frame, provides an array which is vastly superior to the arrangement shown in Fig. 53, although the same number of elements are employed. This beam will cover a wider frequency range for a given setting; is easier to tune; will stay in tune better.

Excellent results will be obtained from this beam if the elements are simply set up according to the formula without any tuning. However, tuning will show a definite improvement. If the final degree of performance is desired, quarter-wave matching stubs, as shown in Fig. 52, can be used between the two reflectors, "R" and directors "D."

It is doubtful that a more practical beam for the frequency range which this one can be made to cover could be devised.

Excellent for any commercial service above 30 magacycles. Uses six Premax Units No. 108-M—Frame Fig. 46, with extensions as indicated.

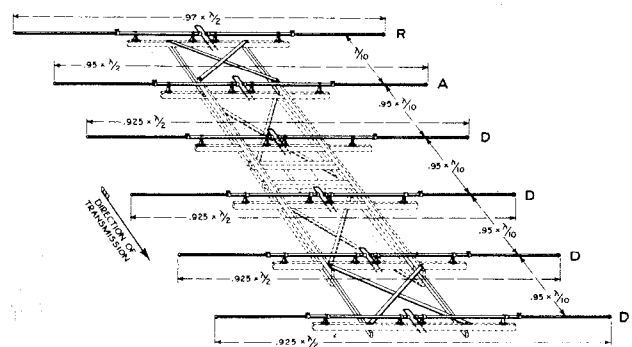


FIG. 61—10 METERS, 6 ELEMENTS, CLOSE-SPACED ARRAY. The overall width of this array is just half of that

shown in Fig. 59. The theoretical gain is somewhat higher and it presents much less surface to the wind.

It is much more difficult to adjust and will operate over but a very narrow band of frequencies once it has been tuned.

This type, however, does lend itself to certain point-to-point services where space is an important factor.

Any form of feed system may be used, but simplicity would seem to indicate the "delta" match and open-wire transmission line.

Uses twelve Premax Units No. 108-M—Frame Fig. 46, with extensions as indicated.

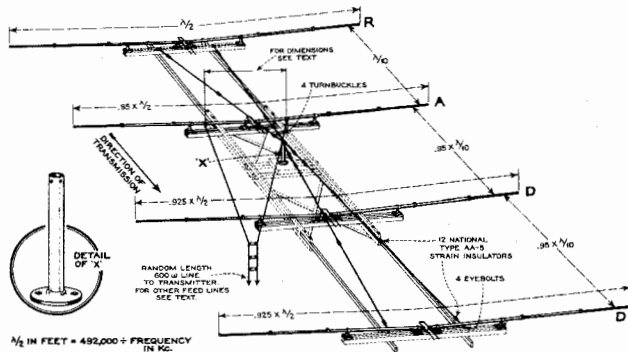


FIG. 62—20 METERS, 4 ELEMENTS, CLOSE SPACING. This beam is capable of remarkable performance. It was designed by Arthur H. Lynch for use at the radio station, W2USA, World's Fair, New York. Instead, however, it was set up on the roof of the N. Y. Journal-American Building, where it is used by Tom Brooks, Radio Editor of the paper, for receiving broadcasting from Europe. It withstood several bad windstorms, as well as the most severe sleet storm which New York has had in years.

It has reduced man-made interference greatly; provided an unbelievable gain in signal strength and, on one occasion, it made possible the reception of a complete speech direct from London when one of the large broadcasting companies took the speech off the air with the explanation that it was not being received because conditions were too bad.

World-wide coverage has been secured by James Tynan, W2BRI, with a beam of the same type (using a ladder frame) which is only 33 feet above the ground.

Full details for building, feeding and adjusting this beam will be found in Mr. Lynch's article in QST, November, 1939.

Beams of this nature are ideal for commercial point-to-point service where tremendous tracts of land would be required to secure the results which this form of unit makes possible on long-range service.

Uses eight Premax Units No. 618-M—Frame Fig. 46-B.

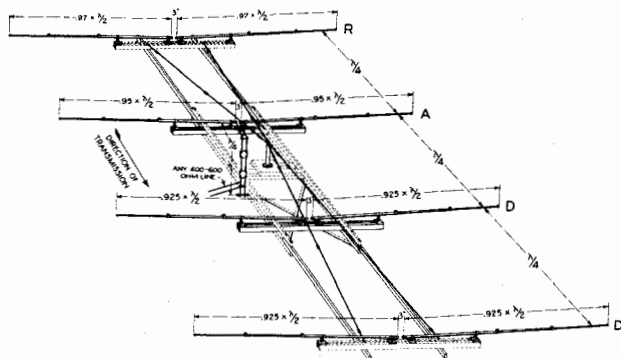


FIG. 63—10 METERS, 8 ELEMENTS, QUARTER-WAVE SPACING. In connection with Fig. 59, we said that it is difficult to conceive of a more practical arrangement than is shown there, but it may be that for some particular services the beam illustrated here will be more desirable. Certainly it is capable of remarkable gain, while it is very light and is actually quite small of dimension for the remarkable directivity it makes possible.

Accuracy of tuning may be obtained by introducing stubs, as shown in Fig. 52, between the reflector and the director elements.

Uses eight Premax Units No. 108-M—Frame Fig. 46-B.

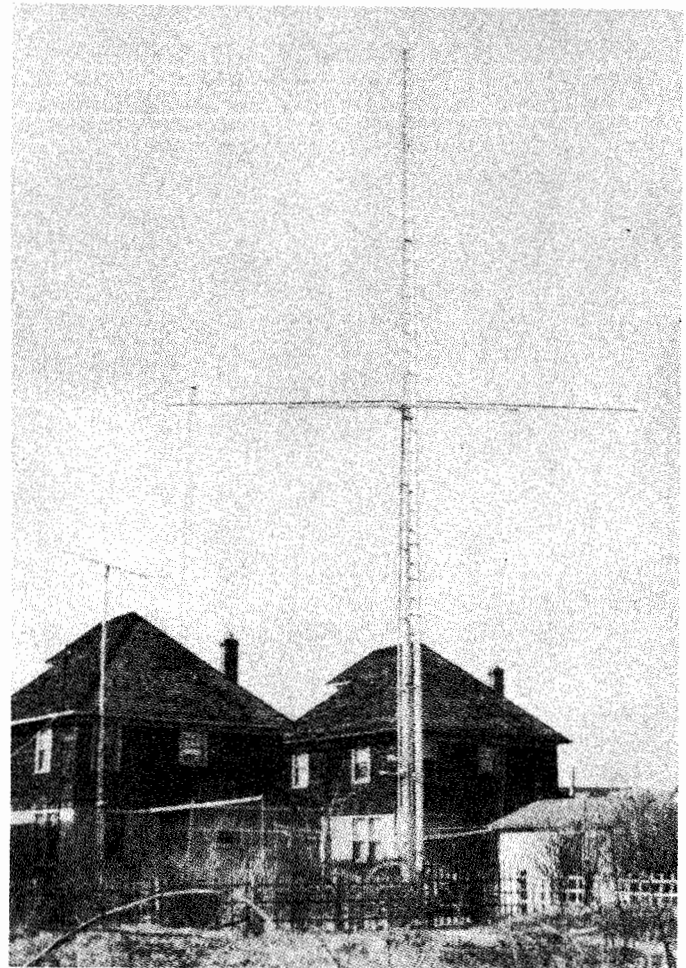


FIG. 64—SINGLE ELEMENT, BI-DIRECTIONAL BEAM. With so much attention given to the more elaborate arrays, we are very likely to overlook the possibilities of the single element rotary beam. There are occasions when it can be used to great advantage.

Two such antennas are shown in this picture. The one to the left, extending just above the roof, is for 10 meters and the larger one, hung from brackets on the forward mast, is for 20 meters.

The large antenna, between the masts, is 4 half-waves, in phase, commonly called a "lazy-H."

This group of aerals is at the station owned by Dorothy Hall, W2IXY, Springfield, L. I. For its contacts with Pitcairn Island and, more recently, for its regular schedules with the Byrd Expedition in Little America, this station is famous. On a recent occasion, when all attempts to contact the expedition, using the larger antenna, were without avail, switching to the single element rotary brought good signals and carried very good signals out.

During the last annual ARRL DX Contest, the 20 meter rotary antenna provided excellent contacts with XU8AM at Shanghai, China; KA4LH in the Philippines; PK4LZ, Java; K7GFC Alaska; K6NYD and K6PLZ Hawaii, KF6JEC Canton Island in the South Seas; K6NYD operating as KE6 Portable on Puka Pinnacle Reef, a tiny island in the South Seas; CP2AC Bolivia; YS1MS Salvador; ZP6AB Paraguay; and it is worthy of note that contacts were not possible with any of these points using the larger antenna.

A similar antenna which has given very satisfactory results

on the 10 meter band may be seen extending directly above the roof of the house.

This type of antenna can be duplicated by using Premax Units No. 108-M or 618-M.

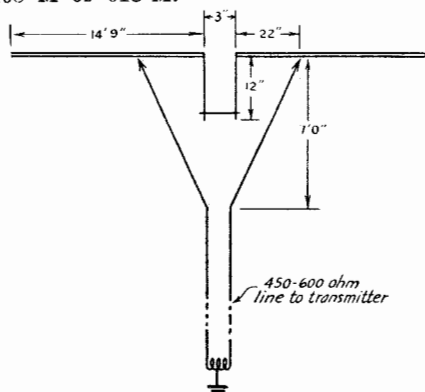


FIG. 65—IDEAL FEED SYSTEM FOR SINGLE ELEMENT, HALF-WAVE ANTENNAS. The field pattern of a single half-wave antenna, when it is horizontal, takes the form of a figure 8 with the radiation at right angles to the axis of the antenna. Therefore, such an antenna is bi-directional, requiring only 180 degrees of rotation for coverage in all directions. Feed line troubles, of the nature which are introduced when full rotation is required, are eliminated. It is for this reason, as well as for the simplification of adjustment which the entire combination brings about, that the method shown here is suggested.

Dimensions of the delta matching system, for 14,250 kc. Slight adjustment of the taps on the antenna element may be necessary to eliminate standing waves. The coupling coil at the transmitter may be grounded at the center to reduce lightning hazard.

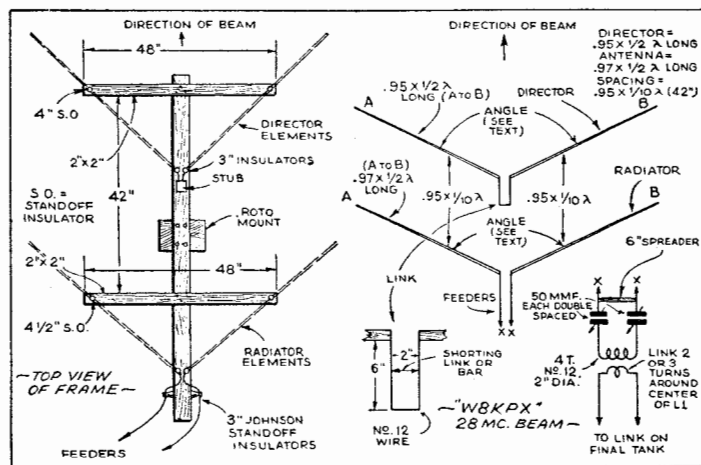


FIG. 65-A — A COMPACT 28 MC. ROTARY BEAM by Harry D. Hooton, W8KPX, 104 Washington St., East, Charleston, W. Va. (Courtesy of Radio and Television).

With the introduction of the new lightweight, adjustable elements for directive antennas, the erection of almost any type of 14 or 28 mc. horizontal "beam" has now become a more or less simple and inexpensive operation.

As the drawing shows, the antenna really is a two-element affair using a half wave radiator with a half wave parasitic director placed directly in front of it. The spacing between the two elements is close—approximately one-tenth wavelength or about 42 inches. The radiator and reflector elements are not placed in a straight line as in the conventional arrangement, but are pulled back at the centers to assume a double "V" position as indicated. Extensive experimental and test transmissions have been made using this antenna and the results indicate that the directive properties of the array are not very much affected until the "V" is closed beyond a certain angle—possibly 60 or 70 degrees. This means that the antenna can be made quite compact and still retain its efficiency.

Full details for the design and construction of this interesting antenna appear in Radio and Television for June, 1940.

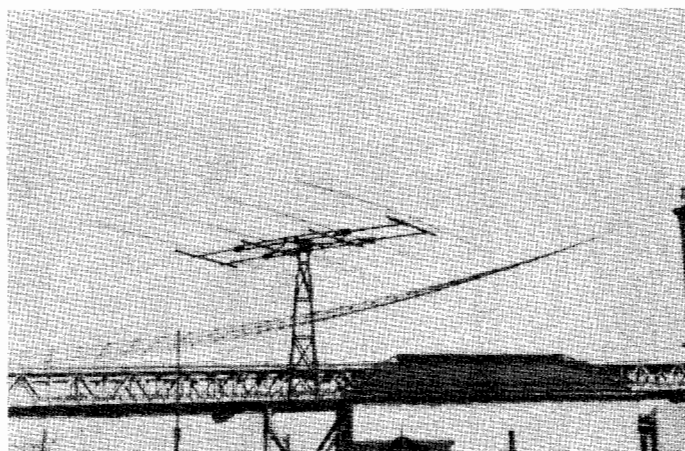
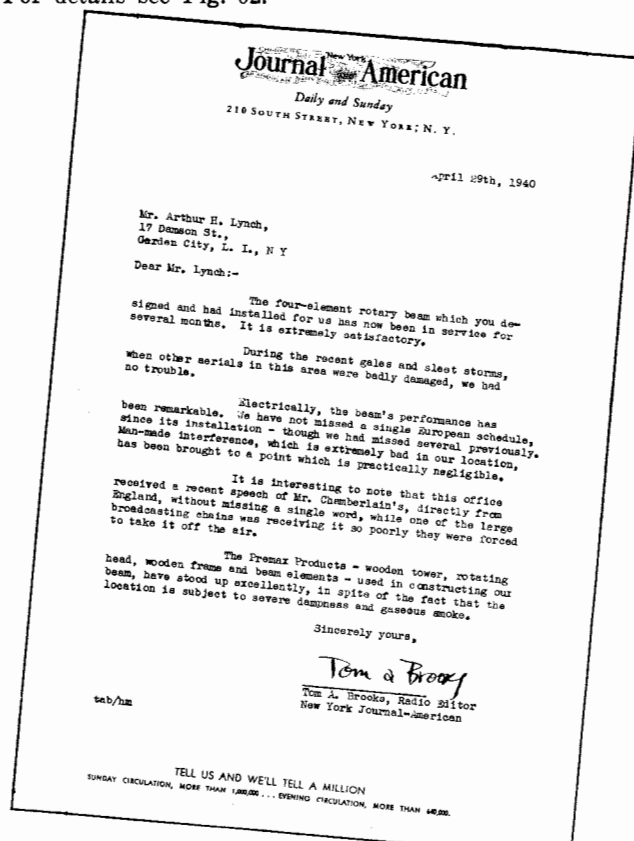


FIG. 66—WATCHING THE WAR WITH A PREMAX BEAM. Tom Brooks, famous Radio Editor of the N. Y. Journal-American, wanted to be sure to get all the information from Europe direct, so he arranged to have a Premax beam installed. The satisfaction which the antenna is giving is indicated by his letter, reproduced here.

The Historic Brooklyn Bridge is in the background. For details see Fig. 62.



NOTE

In mounting elements on rotary beam frames, it is desirable to make the outer standoff insulator at least two inches higher than the center insulator. This serves to counteract the normal sag in the extended unit. This elevation may be accomplished by using standoff insulators of different heights, or by inserting a small wood block beneath the outer insulator.

SUGGESTED REFERENCES FOR ADDITIONAL DATA ON ANTENNA DESIGN AND FEEDING

- "Small But Effective Flat-Top Beams," Kraus, Radio, March and June, 1937.
These are the first of a whole series of articles, on compact, multi-element arrays, which have been a very valuable contribution to the art.
- "Directional Antennas," Brown, Proceedings, I.R.E., January, 1937.
Possibly no single article on antennas is more quoted. It is used as the basis for many excellent designs. Technical and practical.
- "Match and Mismatch," Seeley, QST, November, 1937.
The application of the theories which make for good multi-element antenna design and feed systems are generally shrouded in mystery, from which two main bugaboos emerge, namely: "standing waves" and "impedance match." This article goes a long way toward dispelling those vagaries.
- "The Bi-Square Array," Smith, Radio, April, 1938.
A perfectly practical form of beam. Much of the technical information, given in this article may well be applied to other antennas.
- "How Long Is a Quarter Wave Length," Hawkins, QST, November, 1937.
Information which has been difficult to locate elsewhere and which is very helpful in determining the proper feed system for almost any case.
- "Matching Stubs With Remote Switching," Willoughby, Radio, February, 1938.
Good, practical information, which may well be used in connection with any type of antenna, used for operation on more than one band.
- "Why Some Beams Don't Work," Conklin, Radio, January, 1938.
A wealth of practical information, based upon experience. Can be used to avoid some of the pitfalls which should be obvious but, generally, are not.
- "Effect of Average Ground on Antenna Radiation," Conklin, Radio, March, 1938.
The subject of "grounds" has been almost as badly neglected as antennas themselves. It is no less important, as this article makes clear.
- "The Compact Uni-Directional Array," Roberts, Radio, January, 1938.
Any article by this author is bound to be full of practical information. This one, which describes what has come to be known as the "plumbers' delight" beam—because it is all made of pipe fittings—is well worth reading and digesting.
- "A Rotable Mast For Beam Antennas," Roberts, Radio, April, 1938.
A practical, though rather elaborate system for rotating an array, along with its mast. Various forms of feed lines, of the continuously rotatable are discussed. Many of the ideas may well be applied to simpler masts.

GENERAL SUGGESTIONS

GIVE YOUR ANTENNA A CHANCE against the weather. A few simple, protective measures will pay dividends in longer life and more dependable performance.

STEEL RUSTS, wood parts check and weaken, soldered and mechanical joints corrode when exposed to the alternate action of sun and rain, heat and cold. The most advanced methods of protection will not avail indefinitely.

PREMAX ELEMENTS are prepared in the most practical manner possible to provide basic protection against rust and corrosion while maintaining the necessary electrical and mechanical factors. The cadmium plating applied on steel units corresponds with U. S. Bureau of Standards specifications for exposures of one to five years or more under average climatic conditions. It must be remembered, however, that some atmospheres are considerably more severe in corrosive action than others. Sea air, for instance, commonly considered highly corrosive, is not nearly so injurious to most metals as industrial atmospheres where the high sulphur content combines with moisture to form highly corrosive sulphuric acid.

Depending on your location, therefore, your antenna will be subject to greater or less corrosive action which will affect both its stability and its performance. A few simple precautions will do much to prolong its life.

- 1—Protect all electrical connections, such as clamp contacts, cable joints, etc., with a wrapping of tape or coating of weatherproof paint or cement. Keeping out moisture, keeps out corrosion.
- 2—Paint all wood parts thoroughly, preferably before assembly, using a vegetable base rather than a metal base paint.
- 3—After all adjustments are made, paint the entire beam, elements and all, with a good weatherproof paint or enamel. Then check it occasionally, especially in Spring and Fall, to halt any starting corrosion and put your antenna in shape for bad weather ahead.

An hour or so of prevention is worth a week or two of wrestling with poor DX due to corroded, high resistance contacts.

- "Directing Stuff At Things," Herbiveaux, Radio, April, 1938.
A common sense discussion of the various ways in which beams may be used to advantage.
- "Characteristics of Horizontal Antennas," Grammer, QST, Nov., 1936; March, 1937.
This author (now the Technical Editor of QST), like Roberts, tempers his theory with an eye to practicality. His articles are extremely sound and generally contain much information which is not confined to the subject discussed. Substantial information of that nature is disclosed in this article.
- "Simple Directional Arrays Using Half Wave Elements," Stavrou, QST, May, 1938.
An understanding of the fundamentals which this article discloses will be helpful in beam design, of practically any kind.
- "Directional Transmitting Systems," Sterba, Proceedings I.R.E., July, 1931.
One of the most complete treatises on multi-element arrays ever published. Now very difficult to secure. Well worth the trouble, though much of the fundamental information has been repeated by other authorities.
- "All-Around 14 mc Signal Squirter," Mims, QST, December, 1935.
Possibly no one author has done more to popularize beam antennas, for amateur operation. This is the basis for many of the later, practical applications, by the same author. Very helpful information.
- "New Ideas in Rotable Antenna Construction," Whitney & Whitney, QST, May, 1938.
Substantial information concerning rotating mechanisms, in particular and mast and antenna design, in general.
- "The Extended Double Zepp Antenna," Romander, QST, June, 1938.
Excellent material, which is only now coming into its own. Many of the ideas, first suggested in this article, are now getting enthusiastic endorsement.
- "The Three Element Array," Giora and Dawley, Radio, November, 1938.
Design, construction and operation of the close-spaced, 3 element array, by authors who have done much to popularize its use.
- "Rotary Flat-Top Beam Antennas," Kraus, Radio, December, 1937.
The description of what was probably the most popular beam ever used on the 20 meter band, by an author of more than ordinary ability.
- "Thoughts on Rotary Beam Antennas," Lynch, QST, October, 1938.
Description of a type of framework which may be used with many different types of rotary beams and which has, since, become very popular. Many practical mechanical and electrical suggestions are included.
- "2-Meter Rotary Beam Works Wonders," Secor, Radio & Television, October, 1938.
Some of the mechanical features of this beam would find application in present-day facsimile and other ultra-high-frequency services.
- "Ultra High Frequency Terminations," Timms, Electronics, August, 1935.
Particular reference is made to co-axial feed systems for several of the simpler forms of antennas.
- "Continually Rotable 28 MC Beam," Neuenhaus & Schreiner, QST, March, 1938.
Excellent discussion of the increasingly-important matter of suitable feed systems for beams which are to be continuously rotatable.
- "Practical Design of Close Spaced Uni-Directional Arrays," Smith, Radio, June, 1938.
Excellent material which may well be applied to multi-element beams, regardless of frequency. Reference material worth keeping.
- "Feeding Vertical Antennas," Lynch, QST, January, 1939.
A very complete and practical discussion of a subject, which up to the time had been given very little attention. As more and more vertical antennas are being used this article is thoroughly worth digesting.
- "The Co-Axial Vertical Radiator," J. J. Long, QST, January, 1939.
An excellent application of the "factory-whistle" type of co-axial antenna, for amateur and commercial application. The foundation on which several excellent, later designs have been based.
- "Three Element Close Spaced Array," Radio, March, 1939.
- "Simple Vertical Antennas"—Covers low and high frequency application, as well as "top-loading," Ferrill, Jr., QST, February, 1939.
- "A Coupling System for the Close-Spaced Antenna-Director," Mobley, QST, April, 1939.
- "A 'Double-Barrelled' Antenna System," covering two band operation with a non-resonant line. Swift, QST, April, 1939.
- "Checking Beam Antennas with the S-Meter," including tables for converting meter readings to decibels for signal-strength comparison, Taylor, QST, April, 1939.
- "End-Seal for Co-Axial Lines," Burton, QST, May, 1939 (Hints & Kinks Dept.)
- "Rotating the Rotary," with simple gearing and electrical control system, Williams, QST, July, 1939.
- "The Two-Band Three-Element Rotary," Schroeder, QST, August, 1939.
- "A Few Feeder Considerations," considering losses in tuned lines and adjustment of flat lines, Goodman, QST, September, 1939.
- "More Thoughts on Effective Antennas," with proven designs for verticals and horizontals, for 14—56 m.c. and full details for constructing and tuning 4 element arrays, Lynch, QST, November, 1939.
- "Link Coupling for the Rotary Antenna," Burke, QST, November, 1939, with practical ideas which may well be applied to Premax Products.
- "The Triangle Antenna," selects 12 directions with 3 vertical radiators, suitable for single-band operation, Arnold, QST, January, 1940.
- "Feeding a Multi-Element Array," with simple practical information for using a 600 ohm line, Alsop, Radio, March, 1940.
- "Top-Loaded Verticals," with information which may well be applied to the various Premax products, Kennedy, Radio, April, 1940.
- "A Feed System for the Four-Element Beam," W. B. Thompson, W8OKC, Radio, May, 1940.
Uses single and double quarter-wave lengths of EO-1 cable into quarter-wave 400-ohm matching line, into 600-ohm transmission line.
- "New Dimensions for the Extended H-Beam," Editorial, Radio, May, 1940.
This type of beam can be used either horizontally or vertically.
- The A.R.R.L. Handbook.
- The Radio Antenna Handbook.

ANTENNA DATA AND TABLES

GAIN is generally considered to be the improvement in a given direction, (two directions, in the case of bi-directional beams), over the results to be obtained from the use of a given "reference" antenna. In most discussions of the subject, the reference antenna is considered to be a single half-wave unit, operating under theoretically ideal conditions.

BEAM applies to antennas in two distinct ways; it indicates the electrical propagation characteristics of the antenna, as we think of the beam from a search-light; it has, also, come to designate the entire mechanical structure which is used to produce the radio beam.

MEASUREMENT of "gain" is made in several different ways, but all bring about very much the same result. The most common method of expressing gain is the "decibel." Various tables for converting decibels into power, and vice versa, as well as the many other factors which have to do with the measurement of antenna performance, are to be found in the various antenna handbooks.

FRONT-TO-BACK RATIO generally refers to the relation between the power radiated from the front of an antenna, as compared to the power radiated to the rear. Like gain, it is generally expressed in decibels (db). This ratio is thought to be a rough estimate of the effectiveness of the beam, or "array," as multi-element beams are called. This ratio finds its most common application to horizontal antennas. Most horizontal beams, properly adjusted, show an improvement, in the desired direction, with a corresponding diminution of signal in the undesired directions, as the number of elements is increased.

Where the beam is used for receiving, the ratio is equally important, as it is an indication of greater acceptance in the desired direction and rejection in the undesired directions. Suitable beams, for receiving, reduce interference from undesired stations, located in other directions than the desired station, even though they happen to be on the same frequency. Furthermore, their use results in a marked reduction in man-made interference.

ELEMENT, in most antenna discussions, refers to a single half-wave portion of the array. For instance, two-half waves, in phase, form a two element beam; a driven antenna with a director and a reflector—regardless of their spacing—forms a three element beam, or array; if another director is added, it becomes a four element beam, etc.

PARASITIC ELEMENTS are those which do not have energy fed to them directly from the transmitter, but rather absorb their actuating energy from the element which is so fed. When they are suitably disposed, with relation to the driven element, they produce the effect which is most easily understood by thinking of the reflector as a mirror behind a light and the director, or directors, as the lens or lenses, placed before a light, to produce a light beam.

MATCHING SECTIONS are those portions of any antenna system which are used to produce a similarity of impedance between the antenna and the transmission-line which is used to feed it. For most practical purposes, any of the commercially available transmission-lines, whether they be twisted pairs or of the co-axial variety, may be attached to the bottom of a quarter-wave matching stub. With the higher impedance lines, such as 400—600 ohms, it is better to locate the shorting bar at the base of the stub and raise the line up the stub, to a point where the standing waves, on the line, are at minimum, or disappear.

PHASING SECTIONS are those portions of an antenna system which are employed to bring several elements in phase. They are, generally, a quarter-wave long. However, as they comprise two sides, the sum of the two sides is actually a half wave-length. Most phasing sections, used on the higher frequencies, are made of wire which is stretched out. There is no reason why they can not be a coil and condenser combination which can be tuned to the same electrical length, as the phasing stub. In fact, that is general commercial procedure, on some of the lower frequencies.

TABLE OF GAIN
PRODUCED BY ADDITIONAL ELEMENTS*

Elements	Gain over single half-wave	Front-to-back ratio
2	4 — 5 decibels	10 — 15 decibels
3	6 — 7 decibels	15 — 25 decibels
4	7 — 9 decibels	20 — 30 decibels

*So many factors enter into the actual determination of the gain of any antenna system, that the figures can only be considered as a rough approximation. Under certain conditions, especially where suitable tuning of the

array is not accomplished, additional elements may bring about a loss. The possibility of such loss is reduced where quarter-wave spacing is used rather than the close-spacing, though the latter has a decided advantage in reducing the overall physical dimensions of the array.

HORIZONTAL BEAM DIMENSIONS

The lengths and the spacing between the elements of any multi-element array will vary with its final height above ground, as well as with its nearness to surrounding objects. Therefore, such dimensions may be considered only as a starting point. The final adjustment may result in elements of a length considerably different from the tables which are generally given.

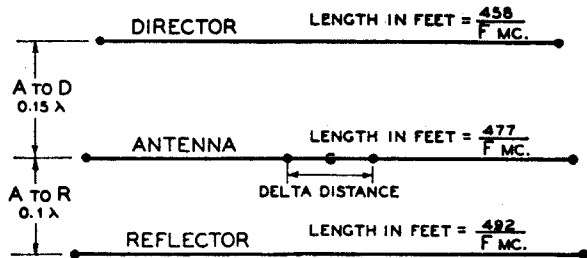


Fig. 78

Copyright by Radio

A Top View of the Elements of the Array Make It Perfectly Clear
How the Elements Are Oriented in Space

In connection with the selection of lengths and spacing for such beams, where Premax Products are to be used, the process of tuning is reduced to a very simple matter. By selecting lengths, from the tables, or from the formula, covering the particular case, which will be suitable for the SHORTEST wave length (the HIGHEST frequency), for the band to be covered, the additional length, required for any other portion of the band is obtained by the use of the "hair-pin," while maintaining the efficiency of the beam.

In addition, slight differences in separation between the elements, as suggested by the various tables, are also compensated for, by the adjustment of the hair-pins, over a reasonable range of frequencies, such as a megacycle or even two.

If this data is used for the determination of the beam element lengths and spacing, for a given frequency, the lengths should be slightly shorter than the figures resulting from the formula, to permit the hair-pins to bring the elements up to suitable electrical length. The data, given in this formula, is suitable for determining the figures for any close-spaced array, regardless of the frequency on which it is to be used. Little, if any, change will be noted where 1/10 wave spacing is used between the antenna and director, instead of the 0.15 wave length spacing shown.

Distance between the director shown and additional directors will also be the same and the director lengths, where more than one are used, will all be the same.

CALCULATING DIMENSIONS FOR 10 AND 20 METER BEAMS — BEAMS FOR ANY OTHER FREQUENCIES EASILY FIGURED

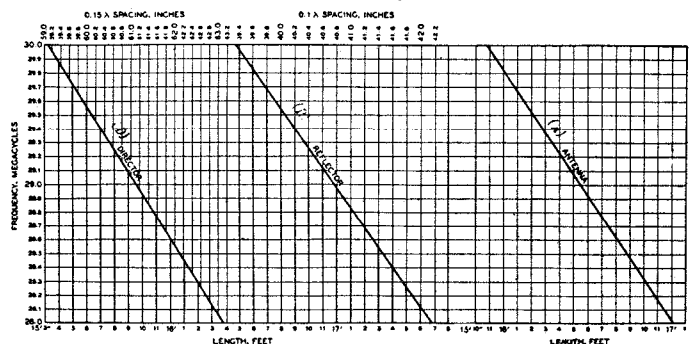


Fig. 79 is a reproduction of the chart developed by the previously mentioned authors in "Radio," and it will simplify the determination of the suitable lengths and spacing for the three elements as well as their correct distance apart. In this connec-

tion it should be remembered that the distance between elements should be measured between the outside surfaces—not between centers. That accounts for the total overall dimensions in the accompanying sketch. (Fig. 78.)

The method of using the chart in Fig. 9 is as follows: First, decide upon the frequency of operation and draw a horizontal line across the chart at this point. At the point where this line crosses the line marked "D," follow downward to the bottom abscissa where the length of the director will be found in feet and inches. Then, travel upward from this same point of intersection to the top abscissa to determine the value of the 0.15 wave-length spacing from director to antenna in feet. Now, travel out the chosen frequency line to its intersection with the "A" line. Travel downward from this point to the bottom abscissa to determine the antenna length. Then, travelling again out the frequency line, follow downward from the intersection of this line with the original line marked "R." Reading along the bottom will be found the reflector length in feet and inches. Now, the last figure, reflector-to-antenna spacing, can be found by reading upward from the last intersection point to the top abscissa again where this spacing will be found in feet and inches.

The values found by use of the chart in Fig. 79 can be taken as quite accurate in most cases. If desired, the beam may be installed using the figures as given with no alterations. Many have done so and obtained excellent results.

For convenience in determining lengths and spacing for the amateur 28-30 megacycle band, the accompanying chart is of value. For determining dimensions for the 14 m.c. band, it is but necessary to divide the frequency and multiply the dimensions by 2.

For use in determining dimensions for the 56-60 m.c. band, the frequency is multiplied and the dimensions are divided by 2.

The same procedure is followed for the 2.5 meter (112-116 m.c.) band, but the factor is 4, instead of 2.

Telescoping radiators and matching sections, both of which are self-supporting, coupled with simplicity of assembly on existing structures, make for better transportation and more rapid and cheaper installations. Premax has developed a combination of products, for this service which produce excellent results. The drawings indicate the manner in which the assembly is set up, on either parapet or chimney.

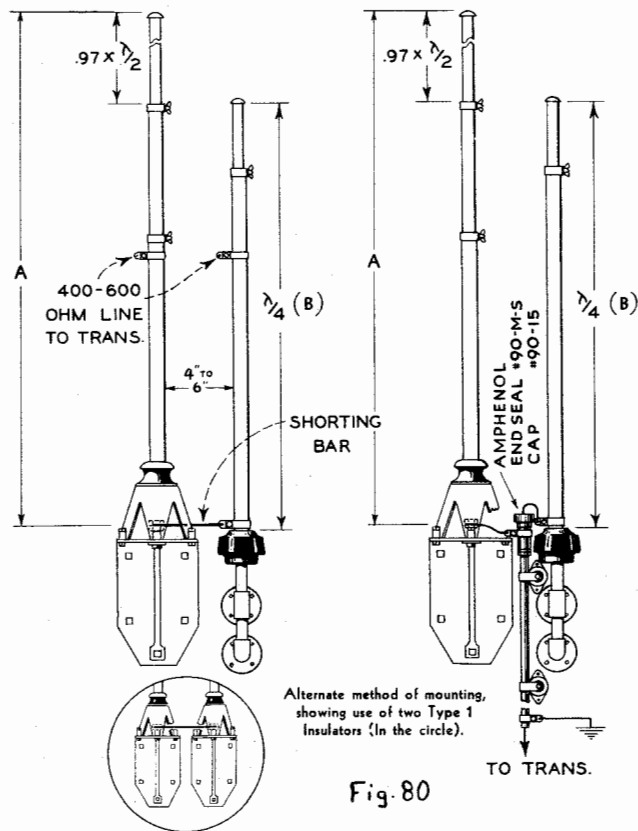


Fig. 80

Where it is possible to attach the two telescopic units, which go to form the antenna and matching stub, directly to the side of the building, that may be done by the use of two of the new Premax Wall Brackets, No. WB-1.

TABLE OF DIMENSIONS

FREQUENCY	Ft.	Ins.	Ft.	Ins.
KC				
32,300	22	1 1/4	7	7 1/4
32,340	22	1	7	7 1/4
32,380	22	0 1/2	7	7
32,540	21	11 1/2	7	6 3/4
32,580	21	11	7	6 3/4
32,700	21	9 3/4	7	6 1/2
32,740	21	9 1/2	7	6 1/4
32,780	21	9 1/2	7	6
32,820	21	9	7	6
34,180	20	10 3/4	7	2 1/2
34,220	20	10 1/2	7	2 1/4
34,260	20	10	7	2 1/4
34,420	20	9	7	1 3/4
34,460	20	8 3/4	7	1 3/4
34,620	20	7 1/2	7	1 1/4
34,660	20	7 1/4	7	1 1/4
34,700	20	7	7	1
36,700	19	5 1/2	6	8 1/2
36,780	19	5	6	8 1/4
36,820	19	4 3/4	6	8 1/4
36,940	19	4	6	8
36,980	19	3 3/4	6	8
38,340	18	7 1/2	6	5
38,380	18	7 1/4	6	5
38,420	18	7	6	5

"J" ANTENNAS FOR THE POLICE FREQUENCIES

For use in the ultra-high frequency band, assigned for the police use, the Premax Hi-Q "J" Antenna is ideal. It is rigid, easy to install and, because both the antenna unit and the matching-stub are self-supporting, there is no need for the usual insulating material being introduced between them. As a result of the large diameter of the elements themselves, the efficiency of the entire system is improved. Antennas, of this type, are suitable for use with any kind of transmission-line, from the twisted-pair to the open-wire types.

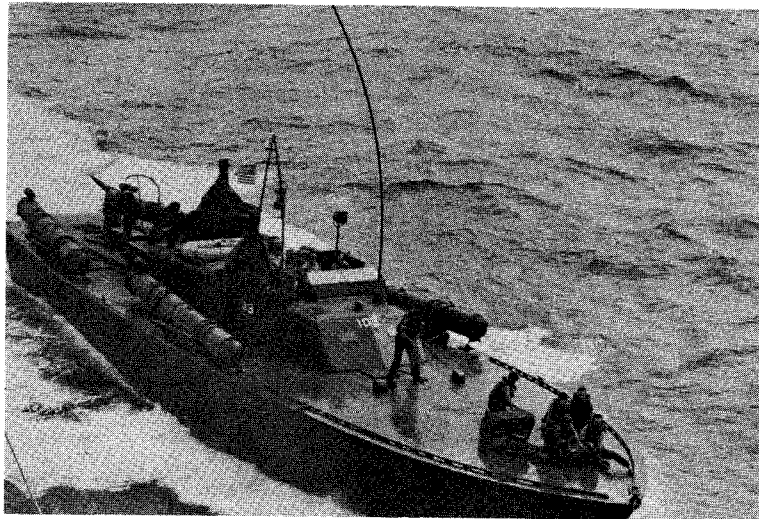
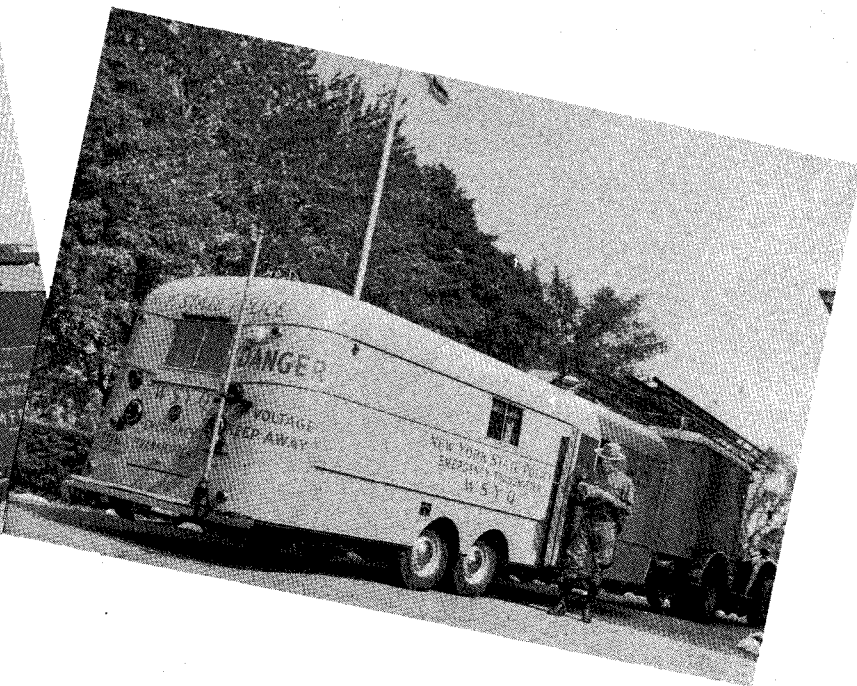
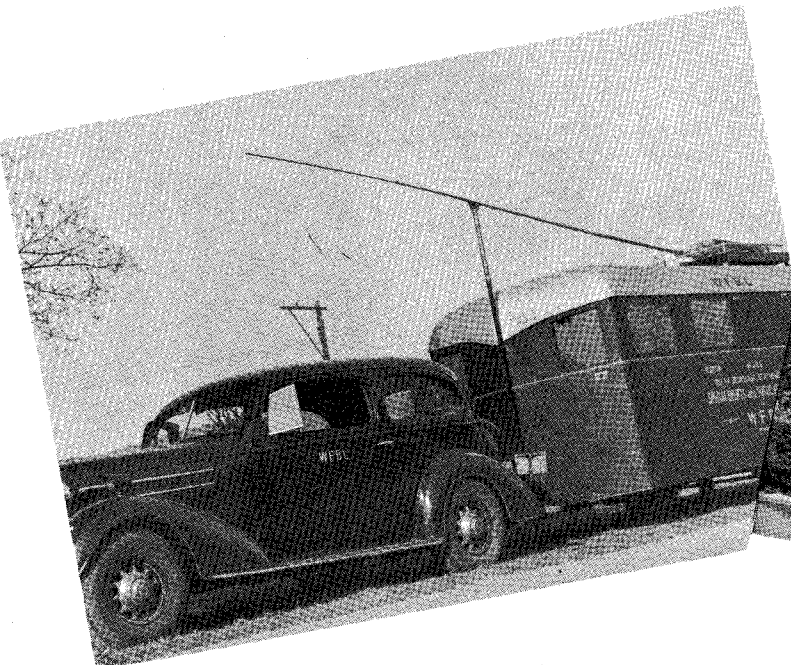
The formula, for determining the length of the radiating unit, as well as the matching stub is based on the following figures. The actual radiating portion of the larger vertical unit is .97% of a half-wave length, at that frequency. The latter, when a shorting-bar is used, is measured above the shorting bar. The total length of the radiator, therefore, is the length of the matching stub, above the shorting bar, plus the figure derived from the formula (.97% x half-wave, at operating frequency). Thus, we derive the following table:

	30 m.c.	30 m.c.	35 m.c.	40 m.c.
Length of stub, above shorting bar	8' 1 1/2"	7' 0"	5' 3 1/2"	5' 3 1/2"
Length of radiator, above stub	15' 7 3/4"	13' 9 3/4"	9' 6"	9' 6"
Total length, above shorting-bar	23' 9 3/4"	20' 9 3/4"	14' 9 3/4"	14' 9 3/4"

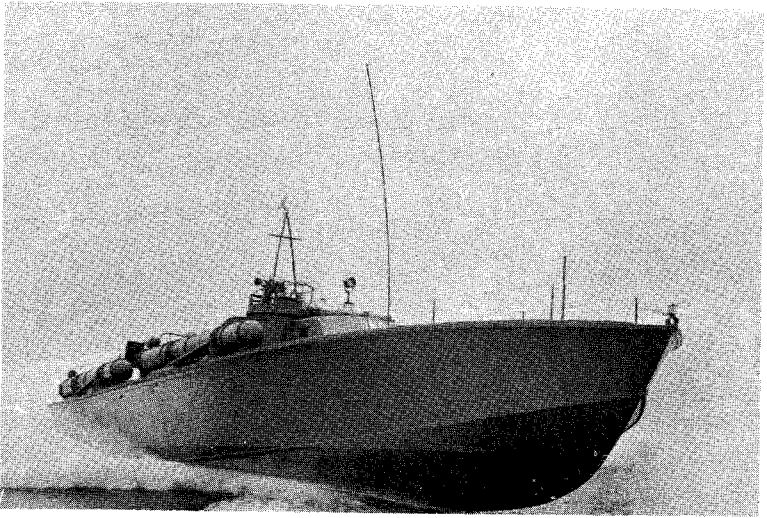
Where low-impedance lines, of the twisted pair or co-axial types, are to be used, the chimney and parapet types of mounting are not recommended, but the two telescopic units, which in combination, go to make up the "J," should each carry their own supporting insulators (Premax, Type 1, for the longer unit and Premax, Type 2, for the shorter one) and the low-impedance line is attached directly to the base of each of the units. IMPORTANT NOTE: The metal portion of the longer unit actually extends right through the larger type insulator, Type 1, so the connection should be made under the lower nut, at its base. The smaller insulator, Type 2, should be mounted sufficiently lower than the larger one to have the bottom of the element which it supports (the metal does not go through this insulator) level with the nut, at the base of the larger insulator.

PREMAX FIXED "ROTARY" BEAMS IN COMMERCIAL SERVICE

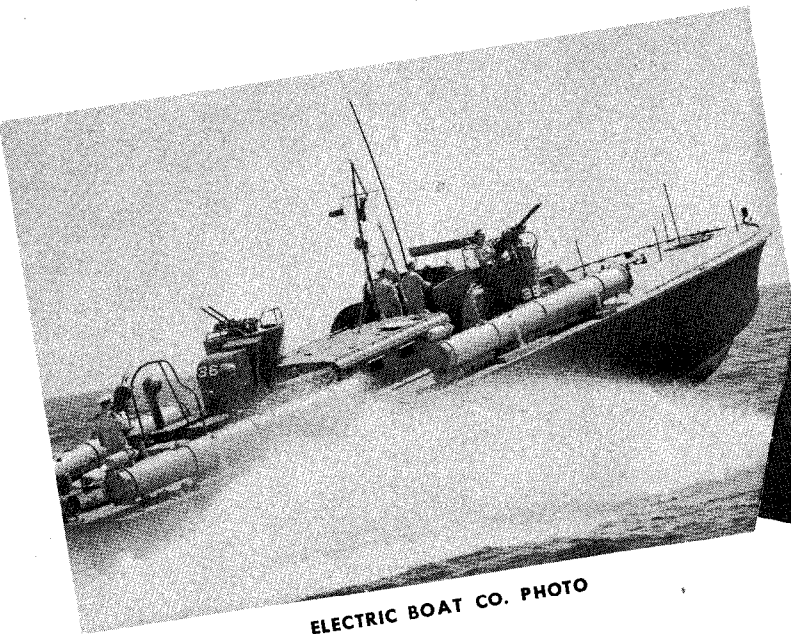
From the figures which have been given for the police and the forestry services, in connection with the "J" type of antenna, it is a very easy thing to secure the figures which would be suitable for the system which is known as the fixed "rotary" beam system and which can be made to give much greater efficiency in four main directions, with no loss of signal in the less favored directions. It will be seen that two distinct pairs of radiators, a reasonable distance from each other, are used. The dimensions for the matching stubs will be exactly as shown in the two tables above. The height of the two radiating elements, which are used to make each pair, or each "pitch-fork," are LOWER, by one quarter the length of the matching stub. In other words, the basis for the formula remains the same, but the length of the radiating element is measured from the point where the matching stub is connected, at the center of the assembly, and includes the piece of wire which extends out to the insulator.



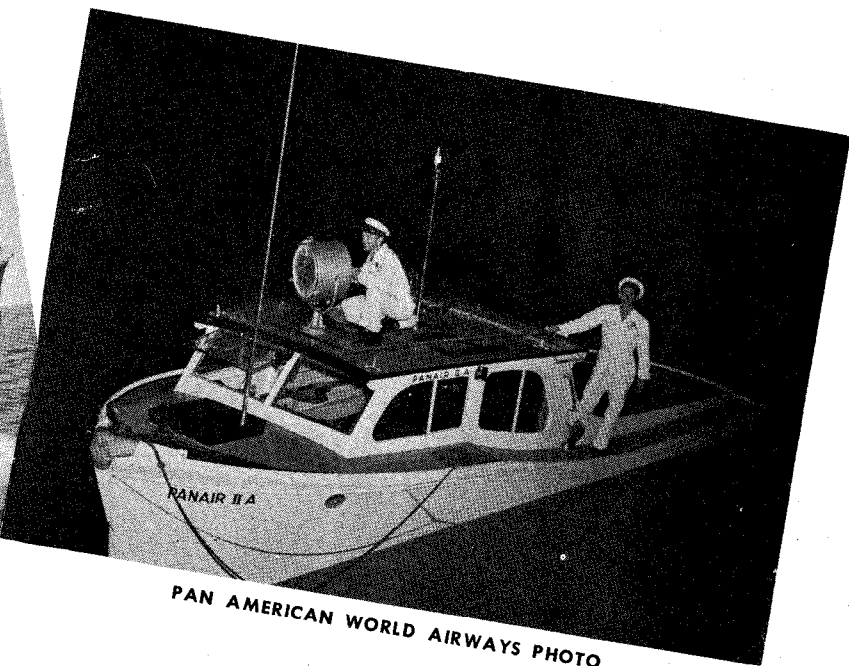
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