G-E Electronic TUBES

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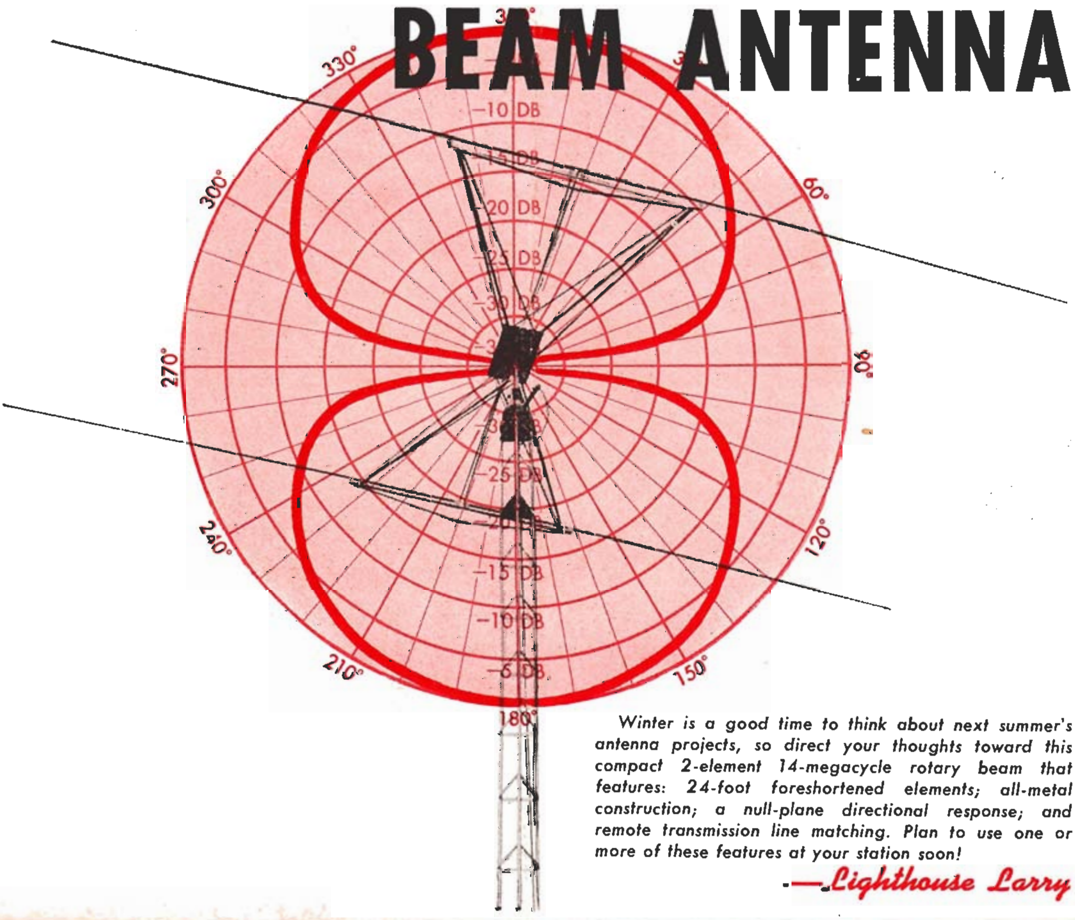
THE DIRECTIONULL BEAM ANTENNA



Winter is a good time to think about next summer's antenna projects, so direct your thoughts toward this compact 2-element 14-megacycle rotary beam that features: 24-foot foreshortened elements; all-metal construction; a null-plane directional response; and remote transmission line matching. Plan to use one or more of these features at your station soon!

—*Lighthouse Larry*

CONTENTS

THE DIRECTIONULL BEAM ANTENNA

BEAM BACKGROUND

Modern design makes a big difference in this 1957 version of a beam antenna that has been quite popular for more than twenty years. The radiation pattern, shown in Fig. 1, is bidirectional, with a power gain of between 4 and 5 decibels over a tuned dipole. When the elements are made from low-resistance conductors, the over-all length may be reduced to about 24 feet with practically no sacrifice in performance as compared to full-length 14-megacycle elements. Aircraft construction principles keep the total weight below 25 pounds when the beam is constructed from the materials specified in the PARTS LIST.

Even though this antenna has about the same power

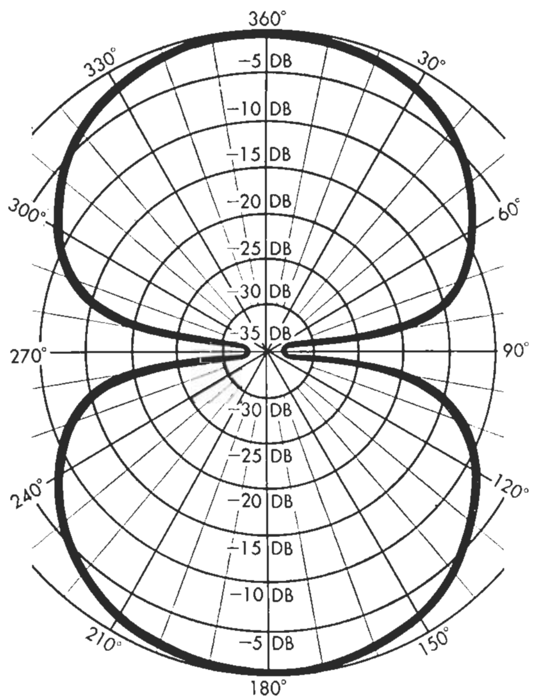


Fig. 1. Measured polar plot response pattern of this antenna. Actual gain at the outside circle is between 4 and 5 decibels over a tuned dipole.

gain as a well-tuned two-element parasitic beam, it is used in a different manner to take advantage of the sharp nulls shown on the radiation pattern. When receiving, the antenna is turned so that interfering signals are placed in this null. Since the width of the main lobes in the pattern is about 70 degrees at the half-power points, the transmitted signal from the beam will be stronger than that from a dipole antenna even when the beam is aimed more than 40 degrees off the station being contacted.

The construction will be covered later, but first, a word about this antenna's history is in order. The original design dates back to the middle 1930's and was known as the *end-fire* or "8JK" beam. During that era, the antenna elements usually were constructed from heavy copper wire stretched between wooden spreader bars. It was then either strung up horizontally between fixed supports like an ordinary flat-top antenna or else suspended vertically so that it could be rotated. The method of feeding power to the original end-fire beam was equally simple, usually just a tuned open wire line connected to points "A" and "B" on the schematic diagram of the beam, shown in Fig. 2. When the transmitter end of the feedline was terminated in a conventional antenna tuner, a frequency range of two to one could be covered with almost no change in the basic radiation pattern.

During the past ten years, this antenna has appeared in still another form, known as the Twin Triplex beam. In this version, each of the two elements is a folded dipole made from paralleled conductors. Most antenna handbooks give directional pattern and construction information on the above-mentioned beams.

The *null-plane directional response* pattern is an outstanding feature of the end-fire beam that requires a bit of explaining. This pattern is shaped like two spherical objects just touching each other. An approximation of this pattern may be simulated by placing this page on a flat surface. Next set a ping-pong or golf ball on each half of the pattern of Fig. 1. A small piece of paper inserted vertically between the spheres at the point of contact represents this antenna's *null plane.*

Thus, the actual antenna has very little response to signals arriving from the two directions in line with this null plane, either horizontally or at any other vertical angle. These signals are presented to feedpoints "A" and "B" 180 degrees out of phase and are greatly attenuated. However, signals arriving from other directions are only attenuated slightly, or are received stronger than with a single resonant dipole. The end-fire beam has been deliberately designed to have a bi-directional pattern in order to achieve this useful null plane that remains unchanged over at least a two-to-one frequency range.

If you have ever used a parasitic type beam for receiving sky-wave propagated signals, you may have noticed that signals arriving from directions behind or off the sides of the main lobe sometimes are surprisingly strong. This effect may have been caused by one or more factors. First, the parasitic beam has a *null-point* directional response pattern. The shape of this pattern may be illustrated by holding a soft rubber ball in one hand and pushing a finger horizontally into one side of the ball. The indentation represents the null point at the rear of the beam pattern. The ball surface (and beam pattern) will attempt to assume its normal shape immediately above the indentation. Thus, if the ball were then sliced horizontally at the center and again about 20 degrees above the center, the shape of these slices would be much different. The slice taken above the center would have a much smaller indentation, representing a smaller null at the rear of the beam. From the above example, it can be seen that the parasitic beam will pick up sky-wave signals that arrive from the sides and rear of the antenna much

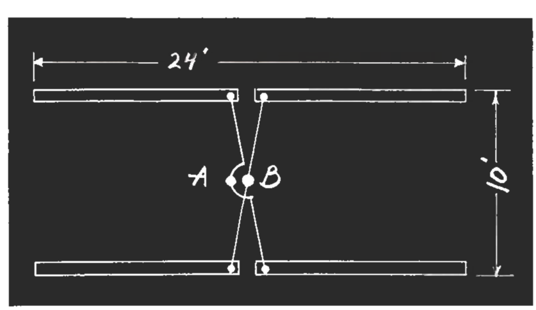


Fig. 2. Schematic diagram of the DIRECTIONULL antenna showing over-all dimensions, phasing line and feedpoints "A" and "B."

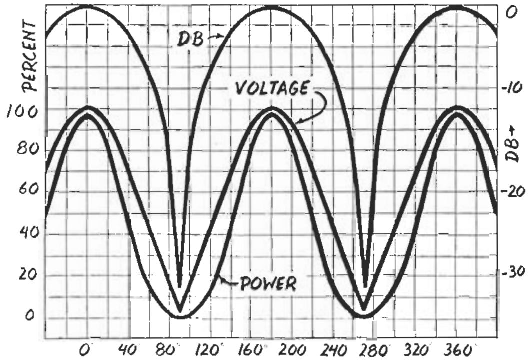


Fig. 3. Rectangular plot response pattern. The "DB" curve illustrates the same data as the polar plot, Fig. 1. Note that the "Power" curve is nearly a sine wave.

better than the response pattern measured in the horizontal plane would indicate.

Second, optimum front-to-back and front-to-side response patterns of a parasitic beam are obtained only over a very narrow frequency range, usually less than 50 kilocycles in the 14-megacycle amateur band. When the antenna is operated at frequencies beyond this narrow band, the response pattern changes rapidly. A classic example of this effect is the usual 50-megacycle parasitic beam having three or more elements. When this antenna is tuned for best results at 50.5 megacycles, the pattern may actually reverse itself when the beam is operated higher than 53 megacycles.

PLOTTING BEAM PATTERNS

Even though each half of the polar beam pattern in Fig. 1 for the DIRECTIONULL antenna is nearly circular, the same data could have been made to appear greatly elongated simply by changing the scale used to plot the pattern. In this way the pattern shape can be altered to produce any effect that an author may wish to illustrate.

The rectangular method of plotting rotary beam antenna response curves, shown in Fig. 3, more nearly illustrates the true pattern, regardless of the scale used for plotting. It is also more handy if you do not have ready access to polar graph paper. The relationship between decibels of attenuation, plus the percentage of voltage and power in the end-fire antenna pattern for all directions, has been plotted on this graph.

ELECTRICAL DETAILS

An end-fire antenna of this type will have two elements that may be from one third to one full wavelength long. The spacing between elements may be from one-tenth to one-quarter wavelength. For this model, an over-all element length of 24 feet was chosen because 12-foot lengths of aluminum tubing are stocked by many aluminum supply warehouses. Each half element should be a single length of tubing at least one inch in diameter with no joints to keep the electrical resistance low.

Since the 24-foot elements are less than one-half wavelength long for 14 megacycles, the normally rather high "Q" of the end-fire beam will be somewhat higher for this antenna. Thus, the current flow in the elements will be high. Also, the RF voltage near the center of each element will be high when much power is fed into the antenna, so good insulation should be used to support the elements.

Both elements are split at their centers and cross connected with the phasing line shown in the schematic diagram, Fig. 2. Even though this antenna could be fed with a tuned line, as mentioned earlier, it is possible to match an untuned line to points "A" and "B." The shortened elements present a capacitive reactance at these points which may be canceled out with an inductive matching stub. On this antenna, a butterfly type split-stator capacitor was connected across the open end of the stub to reduce the over-all length. This capacitor provides an easy method of adjusting the stub for exact feedline impedance matching in all parts of the 14-megacycle band when the antenna is used for transmitting. As shown in Fig. 4, a small 1-RPM clock motor may be coupled to the capacitor shaft for remote tuning from the ham shack. Since the clock motor turns only in one direction, choose a capacitor that is capable of continuous rotation. Matching various types of feedline to the stub will be covered under ADJUSTMENT PROCEDURE.

Fig. 4. Schematic diagram of the matching stub for use with untuned feedlines. The spacing "S" is about 1 inch. For 72-ohm twin lead, dimension "A" is about 18 inches, and "B" is about 6 inches. The over-all stub length is the same for other feedlines, but the tap position may change.

MECHANICAL DETAILS

A rotary beam antenna having insulated elements requires a different construction technique from a "plumber's delight" antenna in which the elements are attached directly to a metal boom. It is desirable to have each pair of element insulators spaced several feet apart to reduce element overhang beyond the outer insulator. Simple steatite pillar insulators having a threaded hole in each end were found to have adequate strength to withstand considerable element deflection. This is important if you live where high winds or sleet storms are encountered. Leakage across the insulators in wet weather is minimized by placing an inverted polyethylene plastic cup over each insulator.

A truss-type design was used for both the element supports and the main boom framework. Each half of the boom is triangular in shape, as shown on page 1, instead of the usual ladder-type boom. This frame is surprisingly strong even when constructed from the relatively soft aluminum angle used on this model.

Two identical frames, as shown in Fig. 5, are constructed and fastened to a 12¼ x 19 x ⅛-inch thick aluminum plate. A standard aluminum rack panel, or any similar semi-hard aluminum plate, is suitable. On this model, a 2-inch pipe flange was bolted to this plate. The antenna was then mounted on a short length of pipe that was clamped atop a standard television antenna rotator. Smaller diameter pipe, 1½ or 1¼ inches, may be used to fit the particular rotator on which the antenna will be mounted.

ASSEMBLY

First, accumulate all items in the MATERIAL LIST and cut the aluminum angles to the lengths shown in the third column of the PARTS LIST. The 7-inch lengths left over from the four 65-inch long part 1 pieces are used for parts 5 and 6. Similarly, the two ends from part 2 are used for the part 7 pieces that attach to the pipe mast.

The frame beam is put together in three steps: first, the element support trusses; second, the boom framework; and third, the elements, phasing lines and matching stub. All main parts in the framework are shown and numbered on the assembly drawing, Fig. 5.

All joints in the boom framework are fastened together with ¼-20 x ¾-inch long aluminum bolts and

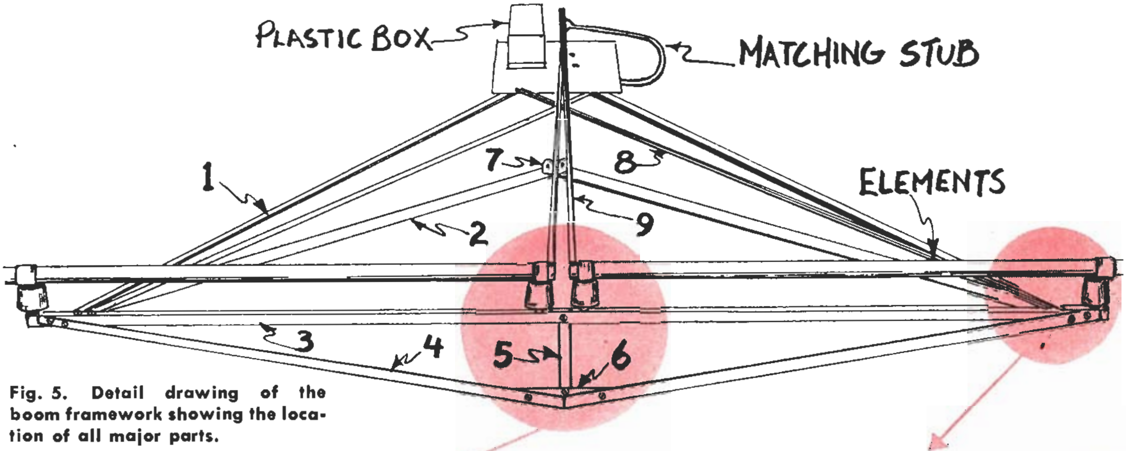


Fig. 5. Detail drawing of the boom framework showing the location of all major parts.

Fig. 6. Detail view at the center of the element support trusses. The element sections are spaced 1¼ inches and the phasing line is fastened to the tubing with a spacing of 2 inches between hole centers.

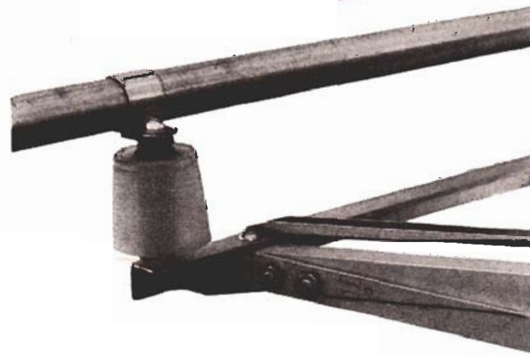


Fig. 7. Side detail view at the corner of the framework, looking from the right side of the boom, showing parts 1 and 2 attached to the element truss.

nuts. Most hardware stores that stock the aluminum angle also have them. Experienced constructors may wish to predrill some of the joint holes, but the possibility of drilling holes in the wrong locations is greatly reduced by following this procedure:

First, align the pieces in each joint properly, fasten with a clamp and drill a ⅛-inch diameter pilot hole through them. Second, remove the clamp and enlarge the hole in the piece that will be next to the bolt head with a 9/32-inch diameter drill. Third, enlarge the hole in the other piece with a No. 6 drill, then thread it with a ¼-20 tap.

As each joint is assembled, the bolt is not tightened completely until the whole framework has been assembled. Then, all bolts are tightened and an aluminum nut is run onto each to serve as a locking device. This will keep vibration from loosening the frame joints. If aluminum hardware is not readily available, galvanized steel bolts and nuts are permissible. With either type of hardware, all joints should be protected with a coat or two of aluminum paint.

ELEMENT SUPPORT TRUSSES

Predrill 9/32-inch diameter holes for the element insulators in the top rib of part 3 ½ inch from both ends and 1½ inches each side of center, as pictured in Figs. 6 and 7. These views also show the following steps. The

MATERIAL LIST

12—6-foot lengths of ¾ x ¾ x ⅛-inch wall aluminum angle (Reynolds aluminum Cat. No. 7).

8—6-foot lengths of ½ x ¼ x 0.020-inch aluminum channel (Reynolds Cat. No. 16 brace for screen frame).

4—12-foot lengths of 1-inch diameter x 0.031 to 0.058-inch wall aluminum tubing, 61ST6.

1—Aluminum plate 12 x 19 inches, ⅛-inch thick.

8—Steatite pillar insulators with threaded holes in ends, ¾ to 1-inch diameter, 2 inches long.

8—Polyethylene drinking glasses 2 inches in diameter.

1—Polyethylene refrigerator box about 5 inches square and 6 inches high.

8—Element clamps made from 0.031-inch thick aluminum, 1 inch wide and 4½ inches long.

1—Capacitor support bracket made from 0.062-inch thick aluminum 1 inch wide and 4½ inches long.

32—¼-20 x ¾-inch long aluminum bolts and nuts.

24—10-24 x ¾-inch long aluminum bolts and nuts.

1—3-foot length of 2-inch steel pipe (2⅜ inches outside diameter). (1½- or 1¼-inch pipe may be needed to fit some rotators).

1—Pipe flange to match size of pipe used for mast.

1—4-foot length of No. 10 copper wire for matching stub.

1—Butterfly split-stator variable capacitor, 6-40-mmf per section, 0.030-inch air gap (Hammarlund BFC-38, or Johnson 50LB15, Cat. No. 167-23).

2—Insulated flexible couplings.

1—4-inch length of ¼-inch diameter brass or fiber shafting.

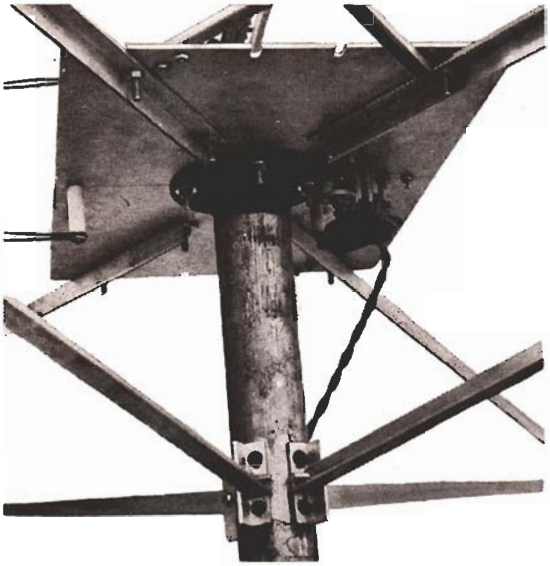


Fig. 8. Bottom view of the aluminum mounting plate showing the braces attached to the pipe mast and matching stub insulator. The clock motor that drives the capacitor is mounted on metal pillars 3 inches from the center of the plate.

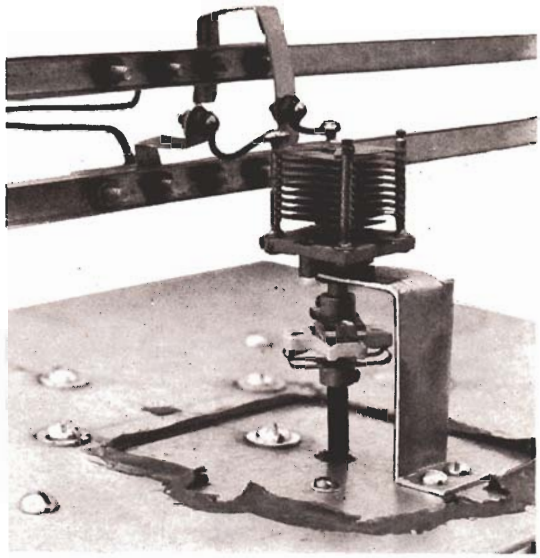


Fig. 9. Detail view of the matching stub tuning capacitor with the polyethylene box removed. The box is fastened to the plate with small angle brackets, then sealed with an aluminum caulking mastic compound used for sealing joints between aluminum gutters.

PARTS LIST

PART NO.	NO. REQ'D	OVER ALL LENGTH	MATERIAL
1	4	65 inches	angle
2	4	67½ inches	angle
3	2	72 inches	angle
4	2	72 inches	angle
5	2	6 inches	angle
6	2	6 inches	angle
7	4	2¼ inches	angle
8	4	63 inches	channel
9	4	63 inches	channel

upper end of part 5 is then fastened to the center of part 3. Cut off both ends of the bottom ribs on the part 4 and 6 pieces as follows: part 4, 1 inch; and part 6, ½ inch. Then fasten the center of part 6 to the lower end of part 5. Next, cut a narrow notch in the center of the side rib on part 4. Bend part 4 so that it fits against part 6, as shown in Fig. 6, with the ends overlapping part 3, shown in Fig. 7. Then fasten part 4 with two bolts into part 6 and two more at each end into the side rib at each end of part 3.

BOOM ASSEMBLY

Locate the center of the 12 x 19-inch aluminum plate and draw four radial lines at an angle of 30 degrees with the long sides. Fasten the pipe flange at the plate's center and drill holes for the capacitor bracket, clock motor and its extension shaft. Lay the plate and the element trusses upside down in their correct positions on a large flat surface, such as a cellar or garage floor.

Trim the top rib of the part 1 pieces to a 30-degree angle, then clamp them 2½ inches from the ends of part 3 on the element trusses. The other ends of part 1 are then laid along the radial lines on the plate with their ends 4 inches from the plate's center, as shown in Fig. 8. Before fastening these pieces to the plate, measure the distance between the element supports on both sides of the boom. These distances should be equal, otherwise the beam elements will not be parallel.

Assemble each part 1 piece to the plate with two bolts, then screw the pipe mast into the pipe flange. Stop in a position at which the pipe is square with the plate, then drill and tap a ¼-20 hole into both flange and pipe for a locking bolt. Draw four lines up the pipe in line with each part 1 piece (the boom is still upside down) and assemble the part 7 brackets to the pipe on these lines ten inches from the plate. Clamp a part 2 piece to each part 7 and assemble, as shown in Fig. 8. Cut off 1 inch of the bottom rib at the outer end of part 2 where they contact part 1, as shown in Fig. 7. Make sure that the entire frame is not warped or twisted, then assemble each part 2 piece to its respective part 1.

Turn the frame right-side up, clamp the part 8 cross braces to part 3 adjacent to each part 1 and assemble with a 10-24 bolt. Clamp the other ends to the plate so that each pair of braces crosses, and fasten them to the plate with two 10-24 bolts. Finally, fasten each pair of braces where they cross with another bolt. The completed framework may be moved outdoors after the matching network is installed, but before attaching the antenna elements.

FINAL ASSEMBLY

The butterfly variable capacitor, C_1, is mounted over the extension shaft hole with a bracket made from 1/16-inch thick aluminum, as shown in Fig. 9. Most small 1-RPM clock motors will need to have a short piece of ¼-inch diameter brass rod soldered to the shaft. Then, the motor is mounted below the plate to protect it from the weather. It turns the capacitor through a flexible coupling and short extension shaft.

A polyethylene refrigerator box about 5 inches square and 6 inches tall was inverted over the capacitor for protection. Short lengths of heavy wire run from the capacitor stators to bolts which pass through the box wall. One-half inch wide aluminum strips connect these bolts to the phasing lines.

Form eight element clamps from sheet aluminum at least 1/32 of an inch thick, as shown in Fig. 7. Drill a 9/32-inch diameter hole in each clamp before it is slipped over an element. Mount the element insulators on part 3 of the element truss, using bolts that match

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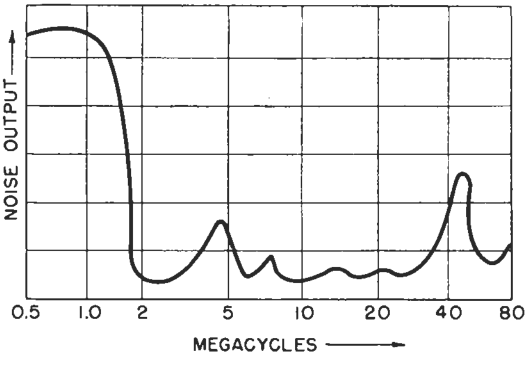
REDUCING FLUORESCENT LAMP QRM

Do nearby fluorescent lamps cause plenty of QRM in the broadcast receivers around your house? Or perhaps even on the amateur bands in your station receiver? That form of interference can be greatly reduced or eliminated if you will observe a few precautions when installing these lamps. The same remedies apply equally to fluorescent lamp fixtures that already are in use.

Well, why does a fluorescent lamp create this interference? Simply because it is essentially a mercury-arc discharge device that is automatically turned on and off 120 times each second when operated on 60-cycle AC power. The mercury arc within the glass tube causes a sputtering or sparking action at the lamp electrodes, thus setting up a series of radio waves. This RF energy is radiated in one or more of the following ways:

1. Direct radiation from the mercury arc.
2. Radiation from the power line near the lamp.
3. Feedback through the power line to the radio.

The intensity of noise generated varies considerably among identical lamps, as well as those of different wattage ratings. In most cases, the total amount of noise produced by a multiple-lamp installation will be very little more than that of the single lamp of the group that produces the most noise. The broadcast frequencies from 0.55 to 1.6 megacycles are most affected by this noise, as the graph below indicates.



This particular curve represents the noise spectrum of a typical 40-watt fluorescent lamp. Lamps having different wattage ratings usually will have peaks of noise output at other frequencies.

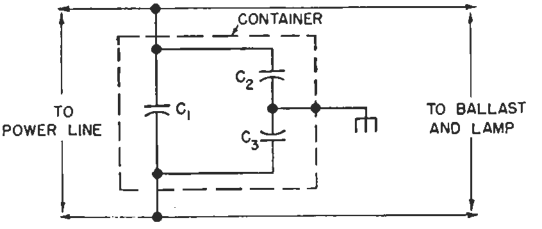
DIRECT RADIATION

The radio energy radiated by a fluorescent lamp usually is dissipated within a few feet and therefore can be controlled by sufficient spacing between the lamp and the radio or its antenna.

If the radio must remain within the bulb radiation range, the following precautions should be taken: (1) Install an antenna that is outside the noise area, connect it to the radio through a shielded lead-in cable and ground the shield. Reducing noise in a radio equipped with a built-in antenna is more difficult. Usually some lamp noise can be canceled out by turning the radio to a certain position. However, some radios of this type are equipped with a separate antenna connection to which the shielded antenna lead-in wire may be attached. (2) Provide a good ground for the radio. Receivers having a "hot" chassis—one that is connected to one wire of the power cord—should have a 0.1-mfd, 600-volt capacitor in series with the ground lead at the chassis.

NOISE FILTERS

The ideal method for reducing both line radiation and feedback is to place a filter at each lamp or fixture. For most household type lamp fixtures, a simple delta-connected capacitor network, as shown below, is sufficient. The capacitors should be connected as close as possible to the line side of each lamp ballast. Typical capacitor values are: C_1, across the power line, 0.02 mfd; C_2 and C_3, 0.002 mfd. The ground connection between C_2 and C_3 should be made to the metal frame of the lamp fixture. All capacitors should have a DC working voltage rating at least four times the power line voltage. Example: 500- or 600-volt capacitors for a 115-volt line.



Commercially-made filters designed especially for fluorescent lamps are made by several firms. Among these, General Electric has two types that use the above circuit. One is the catalog number 25F214, designed for permanent lamp installations. The other, catalog number 25F890, is recommended for portable lamp fixtures. Your local G-E Apparatus Sales office will tell you where they can be obtained. Another type which should be available from most radio parts distributors is the Sprague IF-37.

Direct radiation noise from a fluorescent lamp can be greatly reduced by shielding the lamp bulb. Since many fixtures partially enclose the bulb, complete shielding is possible simply by fitting a piece of aluminum screening across the opening and grounding it to the fixture. Obviously, the screen will absorb some light, and it will be necessary to choose a mesh for maximum reduction of interference and minimum absorption of light.

Don't put up with that hash any longer! Examine these remedies suggested by General Electric's Large Lamp Department—install any necessary filters and shielding—then enjoy more quiet reception on your home and ham shack receivers!

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the threaded hole in the insulator. Trim off the lip of the polyethylene cups to clear part 3 by at least ½ inch and cut 9/32-inch diameter holes in the bottoms. Place a cup atop each insulator, followed by two washers, and clamp the elements to the insulators.

Cut the part 9 phasing line pieces to size, then clamp each one in a vise and twist it to form permanent 90-degree twists in all four pieces. This will place the center of the phasing line in a vertical plane where it attaches to the polyethylene box. Next, clamp each pair of channels together, allowing enough overlap so that the ends may be fastened to the middle of the elements. Join each pair of channels with four 10-24 bolts, and insert the short aluminum strips in both joints as shown in Fig. 9. Also place large soldering lugs for the matching stub under the heads of these bolts.

Assemble the center of the phasing line, adjusting the short aluminum strips for a 2-inch center-to-center line spacing. The ends of the channel strips should be shaped to fit the tubing snugly. Then fasten

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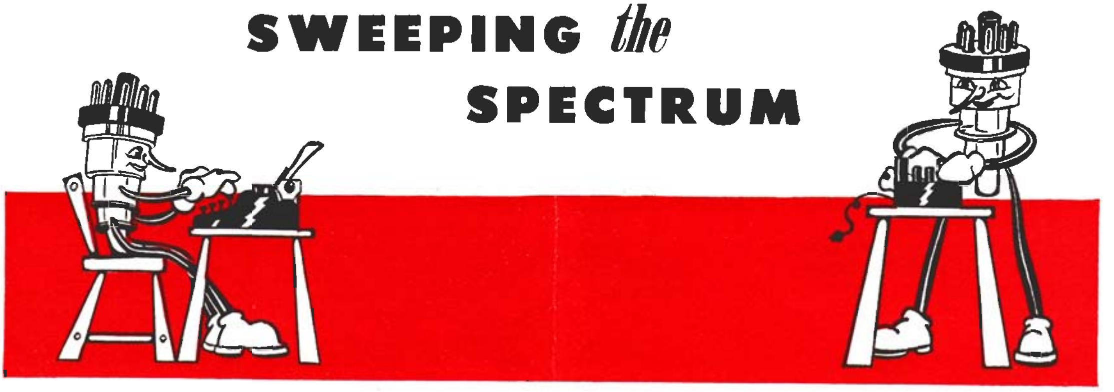
SWEEPING *the* SPECTRUM



Here's some information that you may pass along to your local radio club secretary concerning two types of program material which General Electric will loan to amateur radio clubs, novice radio classes and other groups interested in electronics.

. . . The first is a tape recording of the 1955 Edison Radio Amateur Award presentation ceremony. It's a 25-minute program during which Herbert Hoover, Jr., W6ZH/K6EV, and former FCC Commissioner Edward M. Webster have many kind words to say about Bob Gunderson, W2JIO, the 1955 Award winner. In addition, they toss in a few bouquets about the many fine services with which all radio amateurs serve the public.

. . . As long as he's writing, have him ask me for the catalog of educational and technical motion pictures and slide films that can be shipped to your group from eighteen G-E Film Libraries strategically located throughout the United States. These films are loaned at practically no charge (just return postage). The address to which your secretary may write for films is listed in the back of that catalog.

* * *

While we're on the subject of club programs and tape recorders, there are many ways which a tape recorder can be used to advantage at many club meetings. Our local club recently put on a "CW MAN'S NITE," during which tape recorded code messages and other information was played back to the audience. The recording even demonstrated how a CW traffic net operates from start to finish and included a step-by-step voice narration.

. . . Thanks to all those generous radio club paper editors and secretaries who send me each issue of their club paper or bulletin. I read them all thoroughly and am amazed at the commercial appearance of some publications. The boys who man the editorial and production staffs of these papers really deserve a big vote of thanks from the membership which they serve. We swap G-E HAM NEWS with these radio clubs and will be glad to do the same in exchange for copies of your own club paper.

. . . Aside from the usual news about coming club programs, gossip columns and ARRL bulletins, some clubs report the activities of each group within the club, such as: DX, VHF, traffic, emergency Civil Defense, etc. One type of feature which I heartily endorse are technical articles describing simple, handy electronic gadgets that the local boys have dreamed up. So if you have developed a little black box that makes life easier around your ham shack, give your club paper editor the gruesome details.

. . . Many clubs are conducting radio code and theory training classes for novices, but one club goes even further. According to an item in their club bulletin, the members have rounded up a lot of spare parts, applied some collective elbow grease, and now own a few crystal-controlled CW transmitters for the 3.7, 7.15 and 21.2-megacycle novice bands. When a novice in the area gets his license, they loan him a transmitter until he can get a rig of his own on the air. They say that this gets novices on the air sooner and gives them more CW operating experience in preparation for that 13-word-per-minute general class examination.

. . . A similar system could be set up for loaning simple receivers to those prospective novices who do not have a receiver, but who may wish to take advantage of code practice now being transmitted by many amateur stations. Again, the more fruitful junk boxes in your club could be raided for parts to build a few of the simple receiver designs that have been described in amateur radio journals lately. Bring up this worthwhile subject for a club project at your next meeting.

. . . If you have any other schemes for keeping your club officers busy, send them in and I'll pass them along in this column.

* * *

I have just answered several letters from fellows who wish to build the "HAMSCOPE" (see G-E HAM NEWS, Vol. 11, No. 5, September-October, 1956, for details) around other types of cathode ray tubes that have been lying idly in their spare parts boxes. In some cases, these tubes have the cathode connected internally to one side of the tube heater.

The original circuit diagram on page 3 of that issue must be changed slightly to utilize these tubes. The separate cathode on the 3KP1, pin 3, was connected to the arm on the "INTENSITY" potentiometer through a 1-megohm current limiting resistor. The circuit should be changed as follows: First, the end of that 1-megohm resistor should be removed from pin 3 and connected to one side of the cathode ray tube heater. Second, the lead from the control grid, pin 2, to the voltage divider network should no longer be connected to the heater circuit.

Still another big question is: Can a 5-inch cathode ray tube be used in this circuit? And the answer is—Yes!—if at least 1000 volts is applied across the voltage divider network. The higher the voltage, the brighter the pattern on the tube screen will be.

* * *

That supply of the G-E HAM NEWS SECOND BOUND VOLUME is dwindling fast, so if you wish to have a copy, an order for it should be placed soon. They have been going so fast that our bindery has really worked to keep up with the demand. In case you haven't seen previous announcements, all thirty G-E HAM NEWS issues printed from 1951 through 1955 have been bound into a 250-page book having stiff black leatherette, gold-stamped covers. A handy cross-indexed listing of all information in the book also is included. The cost?—$2.00, postpaid.

—*Lighthouse Larry*

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them to the elements with 10-24 bolts, placing the nut inside the end of the tubing.

The matching stub is shaped from a single length of No. 10 wire with an initial spacing of one inch. Solder the open ends to the soldering lugs on the phasing lines. Support the closed end on a small steatite pillar insulator if a balanced feedline will be used, as shown in Fig. 8. However, if you plan to use coaxial cable, shape the matching stub so that the first few inches from the closed end are close to the aluminum plate and ground this end to one of the pipe flange bolts shown in Fig. 8.

ADJUSTMENT PROCEDURE

Since the element lengths need not be adjusted, final tuning is done in two simple steps. First, the matching stub is resonated in the 14-megacycle band with a grid-dip meter. Second, set the feedline at a position on the stub that results in a minimum standing wave ratio on the line. These adjustments may interact, so each should be repeated a few times. Tuning should be done at the height at which the beam will be operated for best results, although an initial adjustment may be made with the antenna only a few feet off the ground.

Set capacitor C_1 to maximum capacity and check the resonant frequency of the stub with the grid-dip meter. If the stub resonates below 14 megacycles, spread the stub wires further apart or, conversely, move them closer together if the resonant frequency is too high. Then, assuming that a balanced feedline will be used, attach that line as indicated in Fig. 4. Again check the stub's resonant frequency and readjust it to 14 megacycles if a change in the tuning was noted.

Next, connect a standing wave ratio meter and stable source of 14-megacycle RF energy to the other end of the feedline. Measure the standing wave ratio on the line, then shift the position of the feedline on the matching stub for a minimum reading. Turn off the RF energy source, again check the resonant frequency of the stub with the grid-dip meter and adjust the conductor spacing if necessary. Recheck the standing wave ratio on the feedline and change its position on the stub for a minimum reading. Repeat each step until the lowest standing wave ratio is measured with the stub resonant at 14 megacycles.

Now, shift the RF signal source to about 14.3 megacycles and again measure the standing wave ratio on the feedline. Then, apply power to the clock motor through a push-button switch and see whether the standing wave ratio decreases as capacitor C_1 turns toward minimum capacity. It should be possible to measure a very low standing wave ratio throughout the 14-megacycle band simply by rotating the capacitor, once the feedline is matched to the antenna. The components have been chosen to handle the output from a full "gallon" plate modulated transmitter on this band when the beam is tuned.

The antenna may be fed with coaxial cable by following these steps: First, ground the matching stub as previously described. Next, skin about three inches of the coaxial cable, twist the braid into a single conductor and seal the cable's end with plastic electrician's tape. Solder the coaxial cable braid to a large soldering lug and fasten it to the aluminum plate where the pillar insulator is shown. Then tap the inner conductor of the coaxial cable onto one wire of the matching stub about 5 inches from the closed end for 52-ohm cable, and 6 inches for 72-ohm cable. Follow the steps outlined for balanced feedlines to obtain a minimum standing wave ratio on the cable.

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