



TABLE-TOP ANTENNAS

Antenna Experiments Performed with One-Tube 420 mc. Rig

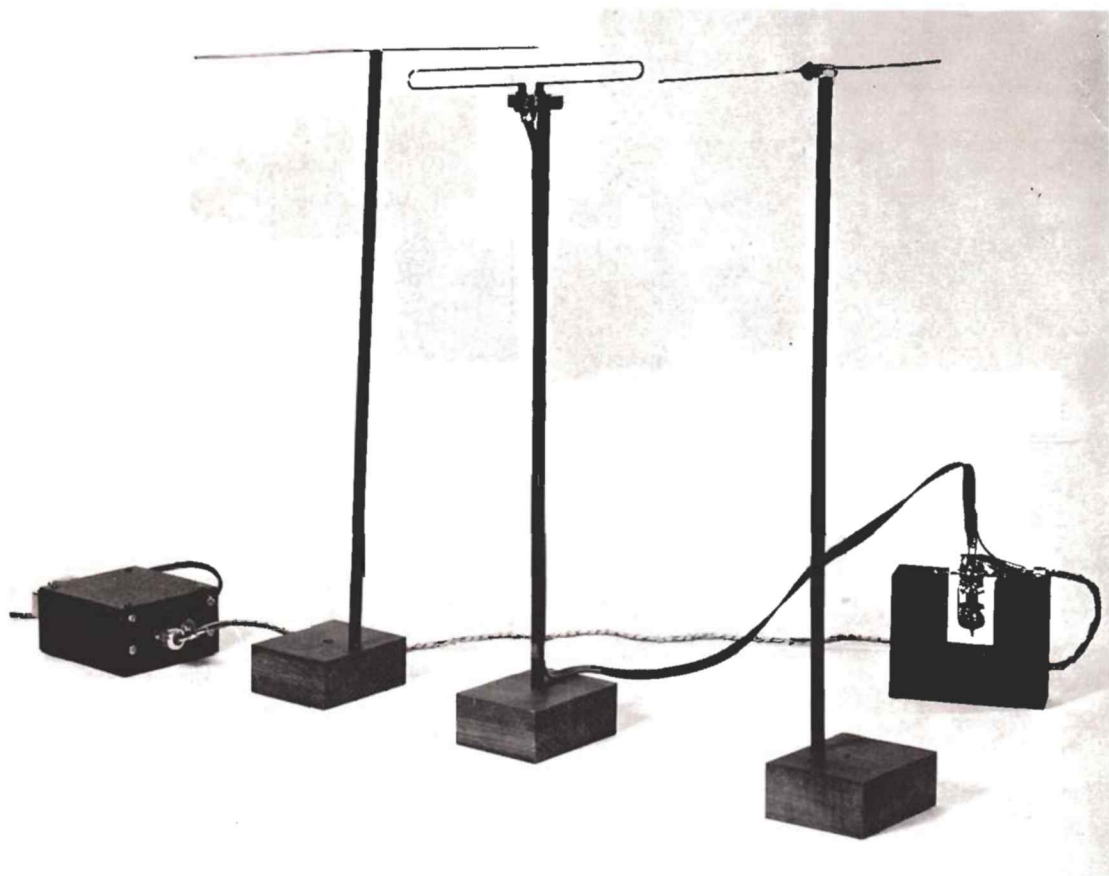


Fig. 1. Table-Top View of the 420 mc. Transmitter Feeding a Three-element Beam

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ELECTRICAL CIRCUIT

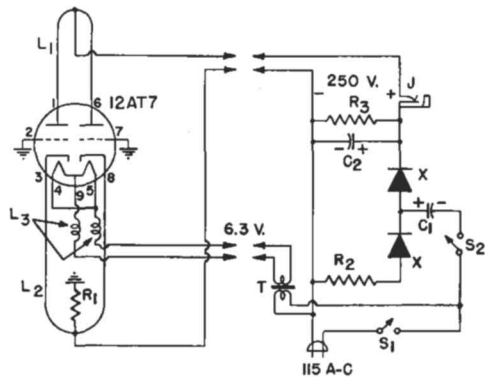


Fig. 2. Circuit Diagram of Transmitter

CIRCUIT CONSTANTS

- C_1 = 16 mf 450 V electrolytic
- C_2 = 8 mf 450 V electrolytic
- J = Closed circuit jack
- L_1 = No. 14 wire, $3\frac{1}{2}$ in. long, bent into "U" $\frac{3}{8}$ in. wide
- L_2 = No. 14 wire, $4\frac{1}{2}$ in. long, bent into "U" $\frac{1}{2}$ in. wide
- L_3 = 8 T No. 18 wire close wound, $\frac{1}{8}$ in. I.D.
- R_1 = 1250 ohm $\frac{1}{2}$ watt
- R_2 = 25 ohm $\frac{1}{2}$ watt
- R_3 = 0.5 megohm $\frac{1}{2}$ watt
- S_1, S_2 = SPST toggle switch
- T = 6.3 volt, 1 ampere filament transformer
- X = Selenium rectifier (G-E 6RS5GH2)

Did you ever want to try out a new antenna without bothering to build up a full-size one for your big rig? This sort of thing is very practical on the high-frequency bands. For example, a wavelength at 420 megacycles is approximately twenty-eight inches. Half-wave antennas are therefore about one foot long.

With this idea in mind a tiny 420-megacycle transmitter was devised. This is shown in detail in Fig. 6. A General Electric 12AT7 tube, a nine-pin miniature socket and one resistor are all the parts required. The matching power supply is similarly compact, as it employs two G-E selenium rectifiers.

Fig. 1 shows the transmitter feeding a folded dipole with 300-ohm twin-conductor cable. The dipole forms the radiating element in a three-element beam. The spacing shown is not necessarily optimum and was arrived at by arranging the elements for the best photographic effect. The right-hand element has a 60-ma pilot lamp in the center, so that this element can also serve as a field strength meter.

By observing proper precautions, the transmitter shown can be connected to a variety of antennas and the approximate directional characteristics and gain of any antenna type determined. An experimental setup of this sort has further uses. Club members can be invited to try out their pet antenna schemes in front of the entire club. Further, amateurs are called upon from time to time to give talks or demonstrations. An inexpensive layout of this sort will form the nucleus for a short talk on antennas, and also demonstrate that the amateur is a technical man, rather than just a person who enjoys producing BCI.

The complete demonstration outfit, referring to Figs. 1 and 8, consists of the trans-

mitter, the power supply and miscellaneous antenna and element supports.

TRANSMITTER

A detail photograph of the transmitter is shown in Fig. 6 and the circuit diagram in Fig. 2. The 12AT7 double triode is a push-pull grounded-grid oscillator. It will be seen that no chassis is used. Instead the metal ring around the socket (a Cinch 53F12617 socket is pictured) is the ground point. Other nine-pin miniature sockets, such as the National XOA-9-C, can be employed. If such sockets do not have a metal ring which can be used as the ground plane, it will be necessary to mount the socket on a small metal plate.

Wiring the transmitter is extremely simple. The two grid lead lugs on the socket are bent over and soldered to the ground plane. No wires are needed. L_1 is bent out of wire and soldered to the two plate terminals. It is soldered in position as indicated in Figs. 1 and 6 and arranged so that it is perpendicular to the plane of the socket. L_2 is similarly made up and soldered to the cathode leads. This inductance is at right angles to L_1 . Resistor R_1 is soldered to the center of L_2 and to the ground point on the socket.

Pin 4 is connected to pin 5 (to permit 6.3 volt operation of the 12AT7) and the two filament chokes (L_3) are connected to the filament terminals. The two chokes are wound over a $\frac{1}{8}$ -inch diameter rod. These are self-supporting because of the stiffness of the No. 18 wire.

The last step is to make a four-wire power cable. This can be any length required. Note that B minus connects to the center of L_2 instead of ground.

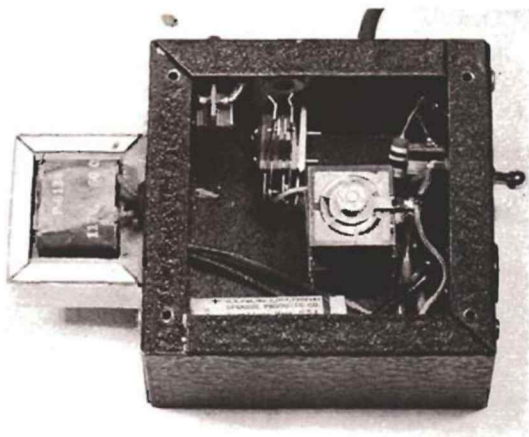


Fig. 3. Power Supply for Table-Top Transmitter

The 12AT7 tube and socket are fastened to a wooden block with wood screws. Fig. 6 shows how two soldering lugs have been used for this mounting. The size of the wood block is given in Fig. 5.

POWER SUPPLY

Fig. 2 gives the circuit diagram for the power supply, and Fig. 3 is a photograph of the power supply with the top cover removed.

The unit is built into a 4 x 4 x 2-inch metal box. This is the type with the two four-inch square removable sides. One of the sides has the two selenium rectifier stacks mounted on it, and the tie points for C_1 and C_2 . The filament transformer is mounted on one side, S_2 and J on the second side, and S_1 and the power output plug on the third side.

The wiring layout is not at all critical, and almost any arrangement may be used. The selenium rectifiers have one terminal which is colored red. This terminal corresponds to the thin bar on the circuit diagram.

Switch S_1 is the filament switch and S_2 is the plate voltage switch. The closed circuit jack (J) is used to measure plate current to the 12AT7.

CAUTION: This power supply does not have an adequate filter for use on low-frequency bands. If a power supply similar to that shown is desired for low-frequency transmitters, a filter circuit should be added.

ANTENNA AND ELEMENT SUPPORTS

In order to achieve results which are accurate, it is necessary to use an antenna system which is well built. The two types of antennas pictured use similar supports. Bakelite rods $\frac{3}{8}$ inch in diameter act as "masts" and wooden blocks are used to sup-

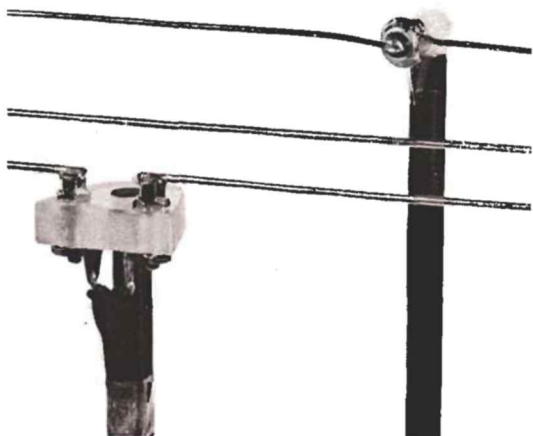


Fig. 4. Detail View of Antenna and R-F Pickup Element

port the masts. These wooden blocks are 3 inches wide, $3\frac{3}{4}$ inches long and $1\frac{1}{2}$ inches thick. Holes $\frac{3}{8}$ inch in diameter are drilled in the blocks at several points, to permit placing the elements close together.

Wood dowels could also be used for the masts. Metal is not recommended. The length of the masts could possibly be important, especially if ground-plane antennas are to be used. Those masts pictured are eighteen inches long. Regardless of the length used, the masts should be of a size that will permit them to be raised or lowered in the wooden blocks so that all antenna elements are in the same plane.

Fig. 4 gives a detail view of the top of the antenna mast, and the top of an element mast. For the antenna, a piece of polystyrene is drilled to fit snugly on the bakelite rod and is also drilled to take two banana jacks. The spacing on the jacks is one-half inch, center to center. The feeder, 300-ohm twin-conductor in this instance, is soldered to the two jacks. The feeder line itself is fastened to the mast with cellulose tape. With this arrangement, it is a simple matter to change antennas.

The same photograph shows how a pilot lamp is fastened with cellulose tape to the other mast. A reflector, a director, or practically any other type of element can be fastened in a similar manner.

Various types of elements and antennas are shown in Fig. 7. A recommended field strength meter is shown as "A." The antenna itself is made of No. 12 bare wire. A sensitive d-c meter, when paralleled with a germanium crystal rectifier and a condenser, is a satisfactory field strength indicator, and when this type of unit is used with a resonant pickup antenna, as shown, extreme sensitivity is obtained.

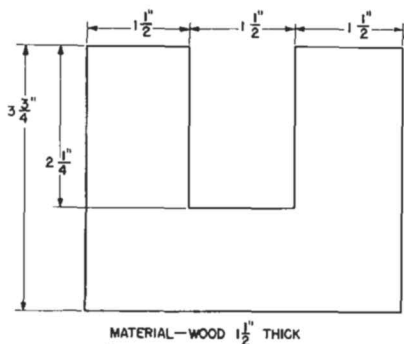


Fig. 5. Layout of Transmitter Mounting Block

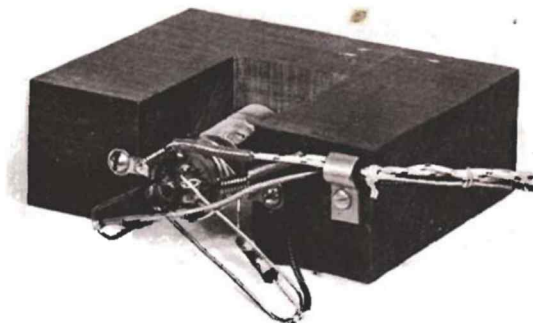


Fig. 6. Table-Top Transmitter

For example, a three-element parasitic beam caused full scale deflection of a 0-50 micro-ampere meter at a distance of approximately twenty feet. With less sensitive meters, the field strength meter will, of course, be less sensitive.

The sketch in Fig. 7B shows a field strength meter using a 60-ma pilot lamp. This is the type with the pink bead, and provides the most sensitive indicator that can be made with regular pilot-lamp bulbs. It is not as sensitive as the meter type of indicator, but the lamp will glow when approximately one foot away from a three-element beam.

A folded dipole is shown in Fig. 7C, and a reflector in Fig. 7D. Both are made of No. 12 bare wire. These dimensions are approximately correct for a frequency of 420 megacycles. Pruning dimensions for maximum efficiency is recommended.

The much-discussed "quad" antenna is shown in Figs. 7E and 7F. The double loop is the antenna, and the single loop is the reflector with the matching stub. A short must be placed on this matching stub and adjusted for maximum forward gain.

The antenna systems described are only two of many types that may be used. Practically any antenna may be made up and tested on this unit.

NOTES AND PRECAUTIONS

If the transmitter is to be used only for demonstration purposes, it is only necessary to make sure that the frequency is within band limits. The easiest way to do this is with Lecher wires. Most handbooks give complete details on the use of Lecher-wire frequency-measuring systems.

If the transmitter is to be used to check gain figures on various types of antennas moderate care must be taken in order not to obtain misleading results. The site selected should be in an area as free from

metal as possible. Keep away from electrical conduit in floors and metal lath in walls. Along this same line, keep your body away from the antenna and the field strength meter.

Direct radiation from the transmitter itself may tend to distort the antenna pattern. If this is the case, shield the transmitter by placing it in a metal box.

Make use of a field strength meter as shown in Fig. 7A. Be certain that the meter is placed in an area free of metal. Do not approach the field strength meter too closely when taking a reading.

If the above precautions are observed, antenna tests may be made in the usual manner. The feeder is coupled to the plate line of the transmitter inductively. If 300-ohm twin-conductor line is used, the two leads may be shorted at one end forming a pickup loop. Cellulose tape is convenient for holding the feeder line to the plate lines. Take care that the feeder line is matched to the antenna. Check this match when making changes in the antenna. Check the input power to the transmitter and keep it constant.

Ground-plane antennas should be very easy to construct. Copper screening will serve as the "ground". One interesting point is that the transmitter can easily be put "below ground". Copper screening can also be used as a ground for any antenna system.

Many interesting experiments can be performed with the transmitter, antenna and field strength meter layout. For example, certain objects can be placed between the antenna and the field strength meter. Some will reflect the r-f energy and others will not affect the meter reading. Those which cause the meter reading to decrease can be used as reflectors and placed in various positions so as to reflect power into the meter and cause the reading to increase. One way this may be done is to use a large reflector, such as a

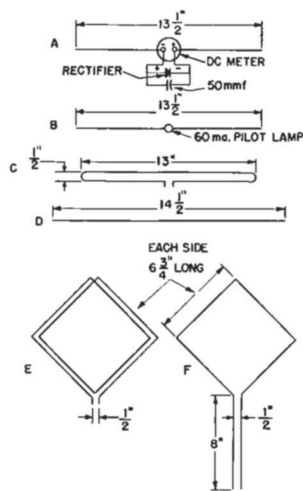


Fig. 7. (Above) Dimensional Details of Various Antenna Systems and Field Strength Meters

Fig. 8. (To left) Table-Top View of a Quad Antenna in Action

sheet of metal, as a simulated Heaviside layer, above and between the antenna and the field strength meter. The number of

stunts such as this which may be done is limited only by the ingenuity of the experimenter.

TECHNICAL TIDBITS

HIGH-FREQUENCY R-F CHOKES

On the higher frequency bands (10 meters and up) the amateur is faced with a double problem. Should he use r-f chokes in the grid or plate or filament circuit, and if so, what type of choke should be used. The question of "shall I use an r-f choke here" is often answered by looking through circuit designs to see if others used a choke in that place in the circuit. On the other extreme, an amateur may decide not to use any chokes because he has experienced trouble with r-f chokes causing parasitics.

This indecision on the part of the average amateur is partially caused because he does not understand how an r-f choke works. Or, if he understands r-f chokes, he may find that the proper choke is not available commercially. The purpose of this article is to explain briefly how r-f chokes operate and to give details on how to build good high-frequency chokes.

OPERATION OF R-F CHOKES

A radio-frequency choke is normally used to provide a d-c path from a point of zero r-f voltage to a point where r-f voltage exists. In Fig. 10A, the r-f choke is in series with the high voltage lead and serves to prevent an r-f current from flowing through

the power supply. Condenser C_1 presents a low impedance path for the r-f current so that the current can return to the cathode circuit of the tube. Fig. 10B shows an r-f choke in a parallel feed circuit. In this case the r-f choke must be designed so that practically no r-f current passes through it, because the r-f current must pass through C_2 to the tank circuit.

What magic property is built into r-f chokes which enables them to pass d-c currents and yet act as effective barriers to radio-frequency currents? Obviously an r-f choke must have inductance, capacitance, resistance or some combination of these three. The answer is found in the word "impedance," which is another way of saying "resistance to radio-frequency current." The inductance, capacitance and resistance which are present in a choke combine in a certain way at certain frequencies and it is this combination that is called impedance.

It is not necessary for an r-f choke to act like a high inductance in order to work properly. Probably the most common r-f choke is the 2.5 millihenry type with four pies. This type is normally used as a series choke on the lower frequency ham bands.

This type of choke has a relatively high impedance which is due to capacitive reactance. Because this

TECHNICAL TIDBITS

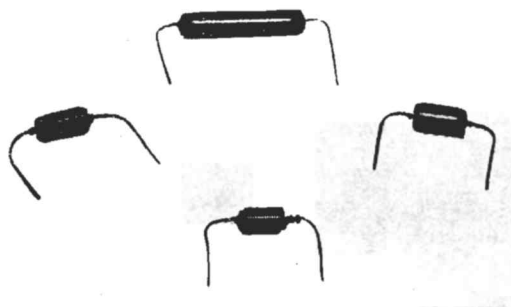


Fig. 9. One-Band R-F Chokes Wound as Described Below

and other types of r-f chokes which cover a large frequency range are subject to resonant points at certain frequencies it is wise to use them only in circuits where they have been tried and found adequate.

In high-frequency circuits, r-f chokes are relatively important. Unfortunately the standard 2.5 millihenry choke will not serve in most cases, so that special high-frequency chokes are desirable. Because the frequency is high, the chokes become simpler to construct. In fact, single-layer windings are desirable.

In addition to their simplicity single-layer r-f chokes have an electrical property which is very desirable. If a choke is designed to be self-resonant at a frequency which is close to the frequency or frequencies of desired operation, the choke will be very nearly a perfect choke in that it will be effectively a pure resistance of a very high value. For example, if a choke is desired for six meter work, it might be designed to be self-resonant at 45 megacycles. This means that at 45 mc the choke will appear to have no inductance and no capacitance. The impedance at 45 mc will be quite high and will appear to consist only of pure resistance.

At higher frequencies the choke will appear to have a very high resistance and some small amount of capacitance. This capacitance may be in the order of a micro-micro-farad. A small amount of capacitance in this order will not affect the operation of the choke.

A review of the above in capsule form shows us that—1) Regular 2.5 mh r-f chokes, designed for operation over a wide frequency range, are generally not too efficient on the higher-frequency bands (10 meters and up). 2) For optimum operation, r-f chokes should be designed for one frequency, especially for the more critical service as parallel chokes, as shown in Fig. 10B. 3) Homemade chokes for low-frequency work would be bulky and difficult to construct, but for high-frequency work single-layer r-f chokes are easy to construct and have the advantage of being almost perfect chokes electrically.

CONSTRUCTIONAL DETAILS

High-frequency r-f chokes may be wound on practically any insulating material, such as wood, bakelite or polystyrene. The exact nature of the insulating material will determine, to some extent, the quality of the completed choke. Generally it is not necessary to go to these materials, as very satisfactory chokes can be wound on ordinary resistors. Fig. 9 shows four such chokes. The upper choke (for 10 meters) is wound on an old style two watt resistor ($1\frac{3}{4}$ inches long and $\frac{1}{2}$ inches in diameter). The two middle chokes are wound on new-style two watt resistors

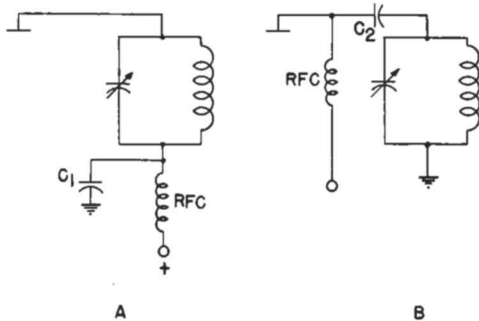


Fig. 10. Illustrating Series and Shunt Feed R-F Chokes

($\frac{1}{16}$ inches long and $\frac{5}{16}$ inches in diameter), while the lower choke is wound on a new style one watt resistor ($\frac{3}{8}$ inches long and $\frac{1}{4}$ inches in diameter).

WINDING DATA

Complete winding data for four high-frequency chokes:

10-11 METER CHOKE—No. 30 enamel wire close wound to cover $1\frac{1}{2}$ inches on an old-style 2-watt resistor ($5/16$ inch diameter).

6 METER CHOKE—44 turns of No. 30 enamel wire wound on new-style 2-watt resistor ($5/16$ inch diameter).

2 METER CHOKE—17 turns of No. 22 enamel wire wound on new-style 2-watt resistor ($5/16$ inch diameter).

1.25 METER CHOKE—16 turns of No. 22 enamel wire wound on new-style 1-watt resistor ($7/32$ inch diameter).

Use only insulated composition type resistors (not wire wound). Use resistors of a high value—one megohm or higher. File a small notch on each end to catch the wire and hold it. The wire can be soldered first to one pigtail, the choke wound, then the wire twisted around the other pigtail, the insulation removed, and then finally soldered.

Do not attempt to make any changes in specifications. Use the proper resistors and the right size enamelled wire. A thin layer of coil cement may be placed on the completed chokes if desired.

The 144 and 220 mc r-f chokes specified above use heavy enough wire so that they may be employed in filament circuits if the current does not exceed one ampere. The 28 and 50 mc chokes are to be used only in circuits where the current is in the order of 0.1 amperes, although they might possibly stand twice this current in amateur service. All of the chokes are suitable for use as shunt-feed chokes.—Lighthouse Larry.

CQ. . . CQ. . .

Most amateurs, when writing to me, remember to include their QTH so that I have a place to address my answer. If you have written to me and not received a reply, perhaps your QTH was missing. Remember to include your address!

Lighthouse Larry

QUESTIONS AND ANSWERS

Do you have any questions about tubes or tube circuits that are of general interest? For each question published you will receive \$10 worth of G-E Electronic Tubes. Mark your letter "Entry for Questions and Answers" and send to Lighthouse Larry, Tube Division, Bldg. 269, General Electric Company, Schenectady, New York, or in Canada to Canadian General Electric Company, Ltd., Toronto, Ontario.

TUBE DATA CALCULATION

Question: When operating a tube at a plate voltage and plate current that lie somewhere between typical values as given in a tube manual, how does one calculate the necessary grid bias voltage to establish the operating point on the tube plate characteristic curve for dynamic conditions?—W2VGF.

Answer: When operation of a tube is contemplated under a set of operating conditions which differ from those published, it is advisable to calculate complete operating conditions. The method of calculation is too lengthy to be explained here, but complete information on this type of calculation is available in the G-E Transmitting Tube Manual.

For these calculations certain conditions of operation are arbitrarily assigned. These are: d-c plate voltage, grid bias voltage, peak grid voltage swing and plate voltage swing. These four values may be obtained in practice by applying them directly or by varying the grid drive or load impedance. Calculations are then made with these data, together with the constant current curve for the tube in question. When the calculations are completed the following will have been determined: d-c plate input power, plate output power, plate efficiency, grid excitation power, grid bias loss and d-c grid current.

It may be that the first set of calculations gives a low plate efficiency in which case it is desirable to recalculate with different assumed conditions until a reasonable efficiency is obtained.—Lighthouse Larry.

GETTER IN TUBES

Question: What is the purpose of the small tray or pedestal situated internally and to the bottom of most tubes?—J. S. Meli.

Answer: Most receiving tubes and low power transmitting use a getter. This is a material that is able to absorb gas which may be present in the tube envelope. It is this getter that is contained in the small tray you refer to.—Lighthouse Larry.

TRICKS AND TOPICS

HOME-MADE COIL DOPE

Sometime ago I made the mistake of constructing a 20 meter beam using polystyrene insulators for element supports. When the wind blew it down, as usually happens eventually, I was left with a big handful of expensive pieces of polystyrene. Not wanting to suffer a complete loss on the investment, I looked for something I could dissolve the remains in, so that I could use it for coil dope. I tried various easily obtainable solvents without success to an appreciable degree (including acetone). As a last resort I tried a little of the carbon tetrachloride, which I had obtained at the local parts house for the purpose of cleaning contacts. It worked quite well. A cubic inch can be dissolved overnight and the coil dope may be made to have any viscosity by adding more or less solvent. I recommend this to anyone who may have broken shafts, insulators, etc., which would have to otherwise be discarded. It makes very fine coil dope. Broken polystyrene shafts may be mended also by softening the ends in carbon tetra-

LOW-LOSS SOCKETS

Question: Is there any advantage in using low-loss tube sockets made of a ceramic or a mica composition material when the tube which is to be used in the socket has a base made of bakelite?—W3JELH.

Answer: When a tube is plugged into a socket, the socket itself adds a loss to that occasioned by the tube base. Recognizing this fact, many experimenters have done away with sockets by connecting leads directly to the tube pins. Going even further, some remove the tube base.

However, the quality of the material the socket is made of is not an all-important factor. Suppose we compare two sockets, made with two different materials, one of which is ten times better (from a loss standpoint) than the other. If the better grade of socket is ten times as thick, so that there is ten times the material to be lossy, then the two sockets are practically identical from a loss standpoint. It is for this very reason that bakelite tube bases are as good as they are. The portion of the base between tube pins is relatively thin, thus reducing the loss in the bakelite to a minimum.

Thus, there is no definite answer that can be made to your question, except to state that the loss incurred in a socket should be as small as possible.—Lighthouse Larry.

TUBE FILAMENT POWER

Question: What consideration should one give to the watts consumed by the filament of a transmitting tube where one has a choice of tubes, some consuming more than others, but all being rated for the same service?—W ϕ HY.

Answer: If you disregard the cost of the filament transformer, this question is relatively easy to answer. However, the comparison should be made only between tubes with the same type of filament, that is compare tungsten filament tubes only with tungsten filament tubes, etc.

The filament power of a tube is a measure of the emission available. Emission is, of course, all important. The greater the filament power, the more emission that is available. This means that a tube with a heavy filament has a reserve of emission, which is helpful in some types of service. Also, this reserve of emission may give increased tube life.—Lighthouse Larry.

chloride. This dope if applied thickly has a tendency to dry slowly and form bubbles. For a heavy application several light coats are recommended—W5LVA. (If the pieces of polystyrene are cut into smaller pieces, they dissolve more quickly.—Eds. note.)

R-F INDICATOR

Here is a trick that should prove invaluable to the 420 mc experimenter. General Electric No. 47 panel lamps are broadly self resonant at this frequency, and may be used instead of a neon lamp, yet in the same manner. If a short length of wire is soldered to the center contact on the bulb, the sensitivity will be improved. Approximately one half inch is sufficient, but will vary slightly with individual lamps and should be determined by experiment. The bulb will give indications in many cases where the power level is insufficient to cause a neon bulb to ionize.—W7BMF. (The G-E No. 47 lamp is a 6-8 volt, 150 ma lamp with a brown bead and a bayonet base. A No. 40 lamp will also work.—Eds. note.)

TECHNICAL INFORMATION

12AT7

GENERAL DESCRIPTION

Principal Application: The 12AT7 is a miniature-type twin triode designed for use as a grounded-grid radio-frequency amplifier or as a frequency converter at frequencies below

Cathodes.....	Coated Unipotential
	Series Parallel
Heater Voltage (A-C or D-C).....	12.6 6.3 Volts
Heater Current.....	0.150 0.300 Ampere
Envelope.....	T-6½ Glass
Base.....	E9-1 Small Glass Button 9-Pin
Mounting Position.....	Any
Direct Interelectrode Capacitances (Approximate)*	
(Grounded Cathode Operation)	
Grid to Plate (Each Section).....	1.45 uuf
Input (Each Section).....	2.5 uuf

approximately 300 megacycles. A center-tapped heater permits operation of the tube from either a 6.3 volt or a 12.6 volt heater supply.

Output (Section Number 1).....	0.45 uuf
Output (Section Number 2).....	0.35 uuf
Grid to Grid (Max).....	0.005 uuf
Plate to Plate (Max).....	0.4 uuf
Heater to Cathode (Each Section).....	2.5 uuf
(Grounded Grid Operation)	
Plate to Cathode (Each Section).....	0.15 uuf
Input (Each Section).....	5.0 uuf
Output (Section Number 1).....	1.6 uuf
Output (Section Number 2).....	1.5 uuf

MAXIMUM RATINGS

	Design Center	Absolute	
Plate Voltage.....	300	330	Volts
Plate Dissipation (Each Section).....	2.5	2.8	Watts
D-C Heater-Cathode Voltage.....	90	100	Volts

CHARACTERISTICS AND TYPICAL OPERATION

CLASS A AMPLIFIER (Each Triode Section)

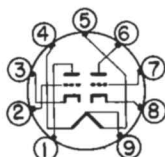
Plate Voltage.....	100	180	250	Volts
Grid Bias Voltage.....	-1	-1	-2	Volts
Amplification Factor.....	54	62	55	
Transconductance.....	4000	6600	5500	Micromhos
Plate Current.....	3.7	11	10	Milliamperes
Grid Bias Voltage**.....	-6	-8	-12	Volts

*Approximate values without external shield.
**Approximate values for 10 microamperes plate current.

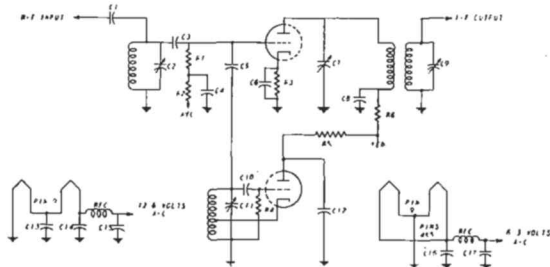
TERMINAL CONNECTIONS

- Pin 1—Plate (Section Number 2)
- Pin 2—Grid (Section Number 2)
- Pin 3—Cathode (Section Number 2)
- Pin 4—Heater
- Pin 5—Heater
- Pin 6—Plate (Section Number 1)
- Pin 7—Grid (Section Number 1)
- Pin 8—Cathode (Section Number 1)
- Pin 9—Heater Center-Tap

BASING DIAGRAM



TYPICAL CIRCUIT FOR CONVERTER OPERATION AT 100 MEGACYCLES



- C₁ = 100 Micromicrofarads
- C₂ = R-F Tuning Capacitor
- C₃ = 25 Micromicrofarads
- C₄ = 1000 Micromicrofarads
- C₅ = 1 Micromicrofarad
- C₆ = 1000 Micromicrofarads
- C₇ = 50 Micromicrofarads
- C₈ = 1000 Micromicrofarads
- C₉ = 50 Micromicrofarads
- C₁₀ = 50 Micromicrofarads
- C₁₁ = Oscillator Tuning Capacitor
- C₁₂ = 1000 Micromicrofarads
- C₁₃ = 1000 Micromicrofarads
- C₁₄ = 1000 Micromicrofarads
- C₁₅ = 1000 Micromicrofarads
- C₁₆ = 1000 Micromicrofarads
- C₁₇ = 1000 Micromicrofarads
- R₁ = 50,000 Ohms
- R₂ = 50,000 Ohms
- R₃ = 2000 Ohms
- R₄ = 10,000 Ohms
- R₅ = 1000 Ohms
- R₆ = 1000 Ohms
- R₇ = 1000 Ohms
- E_b = 100 or 250 Volts

Oscillator voltage applied to mixer should be just sufficient to cause grid current to flow in the mixer section.

Electronics Department



Schenectady, N. Y.

(In Canada, Canadian General Electric Company, Ltd., Toronto, Ont.)