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GUILLOTINE CONVERTER

Covers 6 and 10 Meters Using New G-E Guillotine Coils

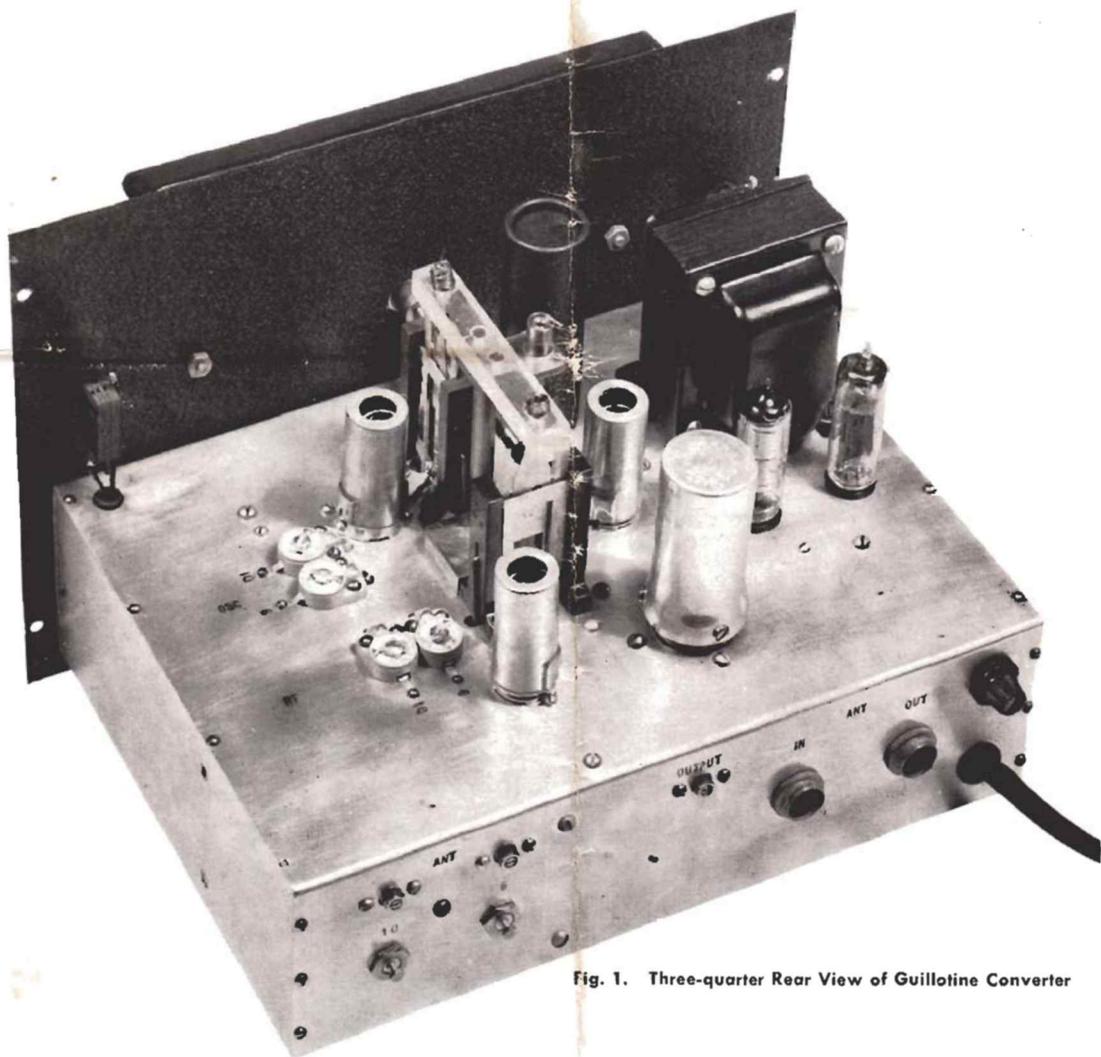


Fig. 1. Three-quarter Rear View of Guillotine Converter

The converter shown in Fig. 1 above employs the new General Electric Guillotine Tuner. This, combined with G.E. miniature tubes, gives a converter which is extremely sensitive on six and ten meters and above all, is very simple to build. Tuning is accomplished without the use of variable condensers, as the Guillotine coil is a high-Q variable inductance.

The tracking problem, usually a tough one for experimenters, is automatically taken care of by the fact that the Guillotine coils are made in two styles, r-f coil and oscillator coil, and designed to operate as a pair.

ELECTRICAL CIRCUIT

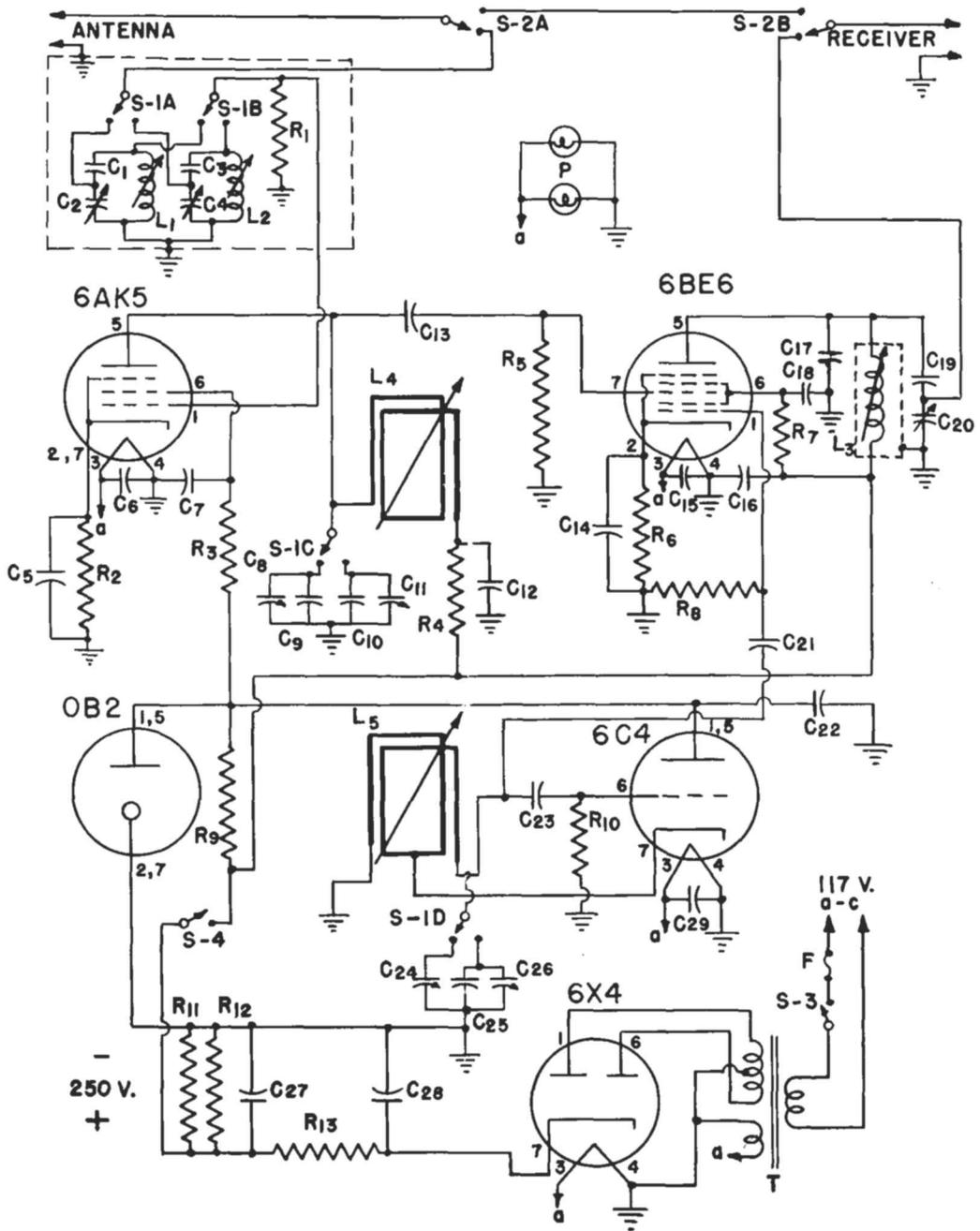


Fig. 2. Circuit Diagram of Guillotine Converter

COIL DETAILS

The three parts of the G.E. Guillotine coil are pictured in Fig. 3. The main portion of the tuner is a heavy, silver-plated, two-turn rectangular coil, rigidly supported between two plastic posts. The "knife" of the guillotine, which moves up and down between the two turns of the coil, is a flat, solid, silver-plated piece. It is guided in grooves

in the plastic posts so that it passes between them without touching. These two pieces are securely fastened to the chassis by a spring clamp.

When the vane is pulled completely out of the coil the converter tunes to its lowest frequency, and as the vane is lowered into the coil, the frequency increases. The inductance of the coil is lowered as the vane moves into it because (1) the

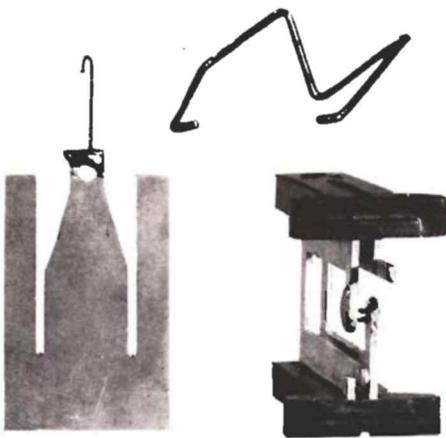


Fig. 3. Detail View of Guillotine Coil

vane acts as a shorted turn, and (2) the vane reduces the mutual inductance between the two turns of the coil. In the Guillotine Converter the total movement of the vane is one-half inch.

Manufactured to precision standards, the Guillotine coil is difficult to duplicate, but the James Millen Mfg. Co. has made special arrangements with the General Electric Company so that these tuners will be available.

CIRCUIT DETAILS

Referring to Fig. 2, the circuit consists of an r-f stage using a G.E. 6AK5 tube, with a G.E. 6C4 as the oscillator tube and a G.E. 6BE6 tube as mixer. A rectifier, 6X4, and voltage regulator tube, OB2, complete the lineup.

The r-f stage input circuit is identical to that used in the "R-9'er" (see G.E. Ham News, Vol.

1, No. 4). Individual tuned coils, one for six and one for ten meters, are switched in by switch S-1A and S-1B. The other two sections of this switch (S-1C, S-1D) change the padding condensers used with the guillotine coils, allowing operation on either 6 or 10 meters.

The remainder of the circuit is typical of high-frequency converters, with the exception of the 6BE6 output circuit. Here again, an "R-9'er" matching circuit is used, even though the output frequency is in the neighborhood of 10 megacycles. The use of this type of matching circuit does away with link coupling, which is sometimes very difficult to adjust properly.

The entire circuit has been designed with one idea in mind—efficiency. The result is a converter which has a measured voltage gain of over 250 (on 6 meters).

The voltage regulator tube need not be used if a d-c voltage with good regulation is available. The power supply shown is compact but need not



Fig. 4. Front-panel View of Guillotine Converter

CIRCUIT CONSTANTS

C ₁ , C ₃ , C ₉ , C ₁₉	= 10 mmf ceramic (Erie Ceramicon)	L ₃	= 19 T #24 wire, 1/2 inch diameter, close wound on permeability tuned form (Millen #74001)
C ₂ , C ₄	= 100 mmf air trimmer (Hammarlund APC-100)	L ₄	= G.E. Guillotine R-F coil (Millen #46812)
C ₅ , C ₆ , C ₇ , C ₁₂ , C ₁₄ , C ₁₅ , C ₁₈ , C ₂₂ , C ₂₉	= .001 mf 400 v mica	L ₅	= G.E. Guillotine Oscillator coil (Millen #46811)
C ₈ , C ₁₁ , C ₂₄ , C ₂₆	= 4-30 mmf ceramic trimmer (Erie TS2A)	P	= Pilot lamps, 6.3 volt, in Millen #10035 dial
C ₁₀	= 160 mmf (100, 50 and 10 mmf ceramics in parallel)	R ₁	= 7000 ohm, 1/2 watt
C ₁₃ , C ₂₃	= 100 mmf ceramic (Erie Ceramicon)	R ₂	= 200 ohm, 1/2 watt
C ₁₆	= .05 mf 400 v. paper	R ₃	= 1000 ohm, 1/2 watt
C ₁₇	= 50 mmf ceramic (Erie Ceramicon)	R ₄	= 5000 ohm, 1 watt
C ₂₀	= 140 mmf air trimmer (Hammarlund APC-140)	R ₅ , R ₈	= 0.1 megohm, 1/2 watt
C ₂₁	= 5 mmf ceramic (Erie Ceramicon)	R ₆	= 150 ohm, 1/2 watt
C ₂₅	= 60 mmf (50 and 10 mmf ceramics in parallel)	R ₇	= 30,000 ohm, 1/2 watt
C ₂₇ , C ₂₈	= 20 mf 450 v electrolytic (Sprague EL220 dual)	R ₉	= 10,000 ohm, 10 watt
F	= 1 1/2 amp fuse	R ₁₀	= 10,000 ohm, 1/2 watt
L ₁	= 8 T #24 wire close wound on slug-tuned coil (Millen #69041)	R ₁₁ , R ₁₂	= 0.1 megohm, 2 watt
L ₂	= 16 T #30 wire close wound on slug-tuned coil	R ₁₃	= 5000 ohm, 25 watt
		S-1	= Four pole, double throw ceramic switch, see text for more details
		S-2	= DPDT ceramic switch
		S-3, S-4	= SPST toggle switch
		T	= Power transformer, 650 v c-t, 40 ma; 6.3 v. at 2 amp (Stancor P-4076)

be incorporated into the converter if other power is available.

CONSTRUCTIONAL DETAILS

For best results, the layout shown should be followed if possible. The most critical parts of the circuit are the r-f section and the guillotine coil locations. Fig. 5 shows how the 6AK5 grid circuit is enclosed in its own shielded compartment. The socket for the 6AK5 is mounted so that pin number 1 (control grid) is also inside this compartment.

The guillotine coils should be mounted so that they are at right angles to each other and also so that the driving mechanism is located approximately midway between the centers of the coil. Figs. 6, 7 and 8 give complete details of the driving mechanism. This need not be followed in detail, as any type of mechanism which will move the two vanes one-half inch vertically will do the trick. Try to avoid looseness in a vertical plane, as this may affect the tracking.

Referring to Fig. 7, the driving mechanism consists of three sets of parts. Set A includes the back bearing for the driveshaft and also the vertical bearing for the sliding rod. Set B consists of a $\frac{1}{4}$ inch diameter rod which moves vertically as it is driven by the dial cord. Fastened to this rod

is a piece of $\frac{1}{2}$ inch by $\frac{3}{8}$ inch polystyrene which pulls the vanes up and down. Set C is the driving rod which connects to the dial. When this rod is turned through 180 degrees, it gives the proper motion to the vanes when it is $\frac{1}{8}$ inch in diameter. If a different diameter is used, the vanes would cause the coils to tune over either too large or too small a range. The dial cord is threaded through a hole in rod "C" and three complete turns of a dial cord are placed on this rod. The dial cord is fastened securely to the bottom of the vertical drive rod (see Fig. 5) and also to the top of part "B." If desirable, a compression spring, similar to those shown on the polystyrene piece, may be placed on the top of piece "B" to keep the dial cord under tension.

When the driving mechanism is completed, the vanes should be adjusted so that they are covering $\frac{1}{8}$ inch of the coil opening, from the top, with the dial at the low-frequency end of its range. Moving the dial to the opposite end of its range should then cause the vanes to move into the coil an additional $\frac{1}{2}$ inch, so that they now are not quite half-way down between the coils. Figs. 6 and 8 show the vanes in this position.

Referring to Fig. 5, switch S-1, which has four sections, A, B, C and D, consists of a three-pie

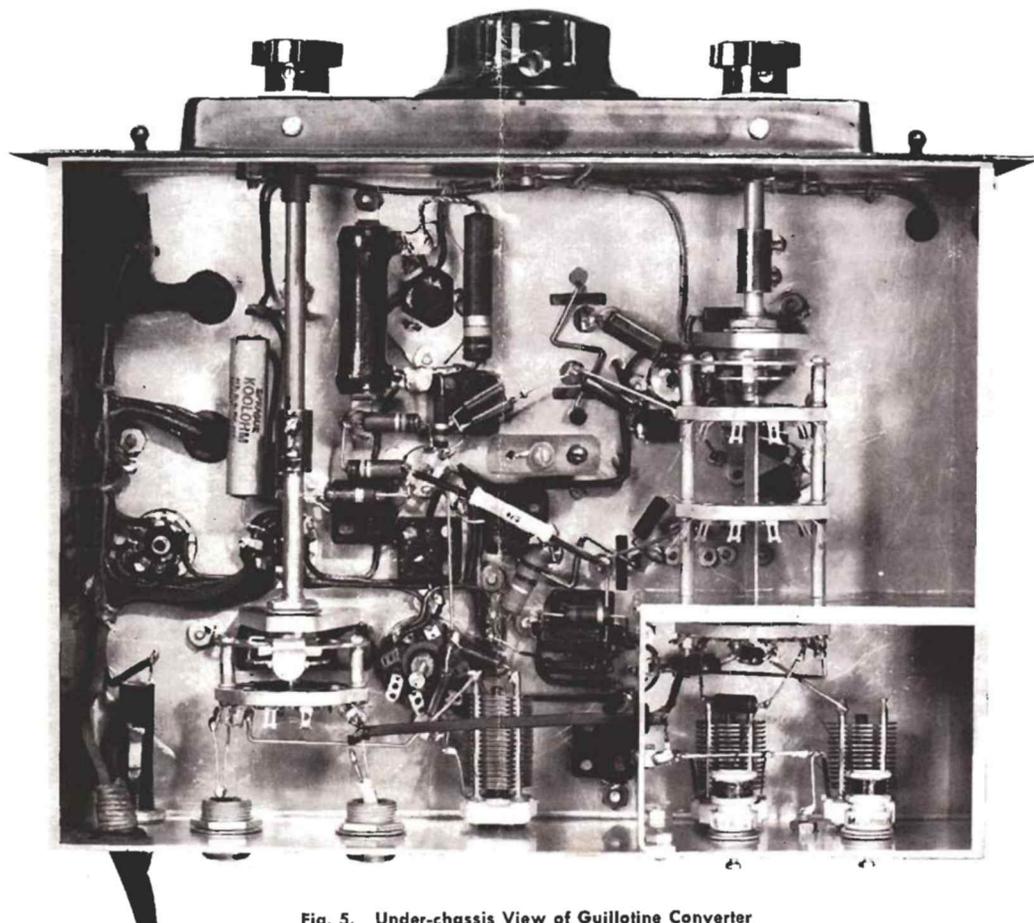


Fig. 5. Under-chassis View of Guillotine Converter



Fig. 6. Left Detail of Guillotine Tuner

ceramic switch. A six-position switch is used because no other type was available. The third pie, which is mounted inside the input compartment, has two sections, and is diagrammed as S-1A and S-1B on the circuit diagram, Fig. 2. The other two pies also have two sections each, only one of which, on each pie, is used.

Switch S-2A and S-2B is a single pie, two-section switch which allows the converter to be cut out of the circuit when desired.

TUNE-UP PROCEDURE

When the converter is completed and turned on, the output frequency may be adjusted between 9.5 and 11 megacycles by the slug in L3. Pick any frequency desired, and tune your receiver to that same frequency. The input circuits, L1, C2 and L2, C4 should now be peaked on 6 and 10 meters respectively. (Switches S-1A, S-1B, S-1C and S-1D are all shown in the 6 meter position in Fig. 2.) Tune L1 (or L2) to resonance by peaking some received signal, then tune C2 (or C4) until the signal is again peaked.

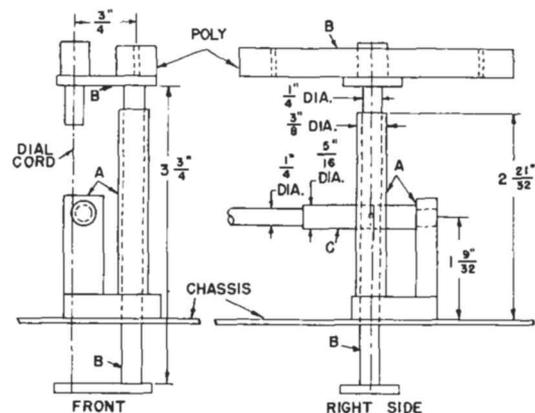


Fig. 7. Guillotine Tuner Dimensions

Condenser C20 should now be adjusted to peak the output signal and match L3 to the input of your receiver. Good quality coaxial cable is recommended for use between the converter and the receiver. Keep this lead as short as possible. However, if C20 is either at maximum or minimum capacity, add line length until the condenser tunes somewhere between maximum and minimum capacity.

This same system of adding feeder length should also be used on the input circuit if condensers C2 or C4 do not tune "on scale."

The converter should now be ready for operation and calibration. The guillotine tuner gives a calibration which is practically a straight-line frequency curve (see Fig. 4).

The set is calibrated by setting the dial at exactly midscale, and then adjusting C 24 until a 52 megacycle signal is heard. The dial should then be turned to the left and a 54 megacycle signal located, and similarly to the right until a 50 megacycle signal is heard. The intermediate frequency spots may then be found, or, it is possible merely to divide the space with a ruler in order to locate the other points.

The same procedure is followed for the ten meter band except that the middle of the dial is set to 29 megacycles by adjusting C 26. The top and bottom of this band is then located by a calibrated signal and the intermediate points may again be measured.

It will be noted, from Fig. 4, that the dial readings run from 54 to 50 megacycles, from left to right. This may be reversed by wrapping the dial cord in the opposite direction and also changing the dimensions of the support piece (A in Fig. 7) so that the dial cord makes a straight line from part B, through the chassis, to the other end of part B.

PERFORMANCE

A greater over-all gain is accomplished because of the guillotine coils. Further, the convenience of bandswitching is obtained with practically no loss in performance. A voltage gain of approximately 100 may be obtained on ten meters, and a gain of over 250 on 6 meters.

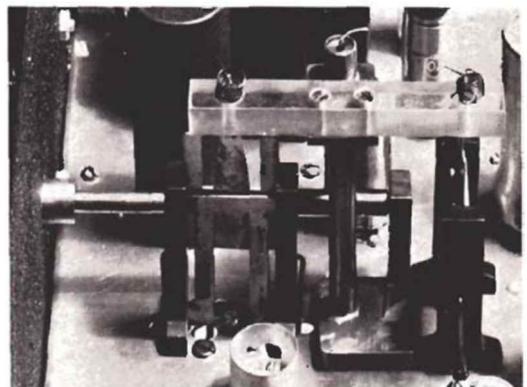


Fig. 8. Right Detail of Guillotine Tuner

QUESTIONS AND ANSWERS



Do you have any questions about tubes or tube circuits? Lighthouse Larry would like to answer them for you. For each question published you will receive \$10 worth of G-E electronic tubes. All questions not published will be answered promptly by mail. Send your questions to Lighthouse Larry, Tube Division, Bldg. 269, General Electric Company, Schenectady, New York, or in Canada, to Canadian General Electric Company, Ltd., Toronto, Ont.

Question: How do you compute the driving power for RF amplifier circuits? All technical information sheets give data for single tube operation only. I am interested in both push-pull and parallel operation.—VE6GO.

Answer: To compute the drive requirements when more than one tube is involved it is necessary to use the following data from the typical operating conditions for a single tube: Grid bias, peak r-f grid input voltage, grid current and driving power. The following two examples are based on the data for class C telegraphy use of the GL-812 using 1500 volts on the plate. For a typical case, a single tube requires a d-c grid bias of -175 volts, a peak r-f grid voltage of 285 volts, a grid current of .025 amperes, and a driving power of approximately 6.5 watts.

If GL-812 tubes are used in push-pull, the d-c grid voltage will still be the same (-175 volts) but inasmuch as the grid current will be doubled (.050 amperes) the grid resistor should be one-half the value of that used with a single tube. Assuming no fixed bias, this resistor, for push-pull operation, would be computed by $R = E \div .05$. (3500 ohms). The required peak r-f grid voltage per tube (grid to ground) will be the same but the peak r-f grid to grid voltage will now be 570 volts. This means that the driving stage must be capable of supplying an r-f voltage of at least that amount. Driving power requirements are doubled, hence at least 13 watts is now required.

For parallel operation of two tubes, grid bias is still -175 volts and the grid current is again doubled, requiring a grid resistor of 3500 ohms. The peak r-f grid voltage required is 285 volts, but as before, the driving power required is double, or approximately 13 watts.—Lighthouse Larry.

Question: Is it true that reducing the filament voltage of a transmitting tube five per cent will increase the life of the tube?—J. O. Pilant.

Answer: Transmitting tubes usually employ one of three types of filaments—tungsten, thoriated tungsten, or oxide-coated. Very few tungsten filament tubes are found in ham shacks, as this type of filament is usually found only in very large tubes. However, the pure tungsten filament tube will have its life almost doubled if the filament voltage is reduced five per cent. In this case,

approximately 67 per cent of normal emission is available, which means the tube cannot be run at full rating. However, if the full emission is not required, advantage can be taken of this filament voltage reduction. If the emission is reduced, by this method, too close to the actual requirements, distortion may be increased.

On the other hand, thoriated-tungsten and oxide-coated filament tubes must be run at approximate rated filament voltage, or the emission may gradually decrease until too little is available. Many factors enter into this statement, but it is recommended that the filament voltage be held as nearly as possible to rating.—Lighthouse Larry.

Question: A 6C4 tube, as an example, has IC shown for pin No. 2 on the socket connection diagram. This means internal connection, but what do we do about it when wiring?—W8GG.

Answer: The words "internal connection," when used to refer to a tube pin, mean that an electrical connection has been made from that pin to some portion of the internal structure of the tube. In any one given tube, the connection would be to one particular element, or to a getter, but considering tubes as a whole, almost any connection might exist. The reason for labeling the connection "IC" is to warn the user not to use that connection on the socket as a tie-point. Also, many modern tubes have their "dead" pins extending up into the tube, so that the wisest rule to follow is to keep all connections away from the tube socket that do not belong there.—Lighthouse Larry.

Question: When using a tube as a class "C" amplifier, does it harm the tube to overdrive it? That is, not by exceeding the published grid current, but by using a higher value of grid resistance than is normally used?—VE3QC.

Answer: In a class "C" r-f amplifier stage, the drive may be increased (and the grid resistor increased at the same time to hold a relatively constant grid current) without harming the tube provided that the grid bias is not allowed to exceed the maximum allowable value. The net effect is an increase in the grid bias on the tube, as the grid resistor is made larger and larger. Even though the tube is not harmed it may be overdriven, if by this we mean that too much drive is being used from an efficiency or an economy standpoint. In general, the efficiency of the stage is increased as the grid bias is raised. This probably is not economical past certain limits. In other words, even though the efficiency were increased, by increased drive, the net power gained in the final might be less than the extra power required in the driver to attain the extra efficiency.—Lighthouse Larry.



TRICKS AND TOPICS

PILOT BULB REMOVAL

It is often a very difficult job to remove pilot lamp bulbs from the front of the panel, as the fingers tend to slip on the glass, and in addition, the space available is very small. To do the job easily, place a piece of friction tape completely around the bulb. The tape should extend out past the end of the bulb. With the friction tape in place, it is a simple matter to unscrew the bulb with the fingers, or, if there is not room for the fingers, a pair of long-nosed pliers will do the job.—W ϕ VFM.

MOUNTING FEET

A common rubber lavatory stopper can be easily changed over to make an excellent mounting foot for heavy equipment. See Fig. 9. A sharp knife or razor will easily remove the top of the stopper, which may then be drilled to take any suitable machine screw. Four of these feet mounted under any type of desk equipment will provide some shock protection and will also prevent scratches on the operating table.—W4LRE.

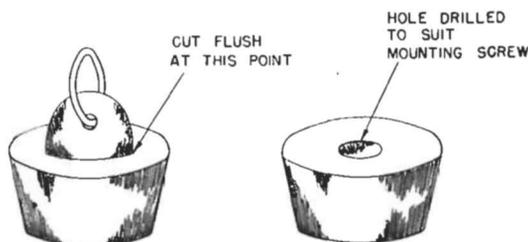


Fig. 9

SOLDERING TRICK

Here is a stunt which will save many hours of grief when working on polystyrene coil forms and sockets, small crystal rectifiers—in fact, any object which may be damaged by prolonged heating from a soldering iron. Use an ordinary pipe cleaner which has been thoroughly soaked in water. Wrap this around the object being soldered to, and it will prevent the heat from reaching the main part of the object. For example, when soldering to polystyrene coil form pins, the pipe cleaner, wrapped around a pin, prevents the pin from becoming loose in coil form.—VE3AOZ.

ANTENNA DE-ICER

Now that folded dipole antennas are very popular, it becomes a simple matter to remove ice from them. See Fig. 10. An electric iron is connected in series with one of the feeders, and the circuit energized by plugging into a 115 volt a-c line. When a current of approximately 5 amperes is made to flow, the heat developed will quickly melt any ice present. This trick is also helpful to

overcome detuning caused by a wet line noticeable after a shower or a heavy fog.—W4KAP.

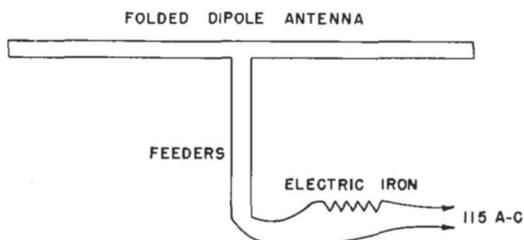


Fig. 10

TUNE-UP TRICK

Here is a little stunt that may save some anxiety when first tuning up a high-power final. Form a link line and couple from the driver plate tank to the final plate tank. (There should be no connection between the driver circuit and the final grid circuit.) The link to both circuits should be loosely coupled. Apply plate voltage to the driver stage, but not to the final. Resonate the driver plate tank. Now tune the final plate tank until resonance is achieved. Approximate resonance will be indicated by a rise in driver plate current, or maximum glow of a neon bulb placed near the final tank, or by maximum brilliance of a pilot lamp coupled to the final tank. When approximate resonance is found, the link may be removed, the driver again coupled to the final grid circuit, and plate voltage applied to the final with assurance that the final is approximately in tune. This trick is only useful when the driver stage is operating on the same frequency as the final.—W3IEN.

D-C RELAY TRICK

This idea was devised in order to utilize a 24-volt d-c relay for antenna changeover switching on my transmitter. D-c relays are plentiful and could often be used if the problem of coil current supply did not prevent.

My exciter uses two 7C5 tubes and a surplus of excitation was available. The relay coil was therefore wired in series with the B-plus lead to the two tubes. Because of the excess of excitation, the additional voltage drop across this coil did not affect the operation of the exciter.

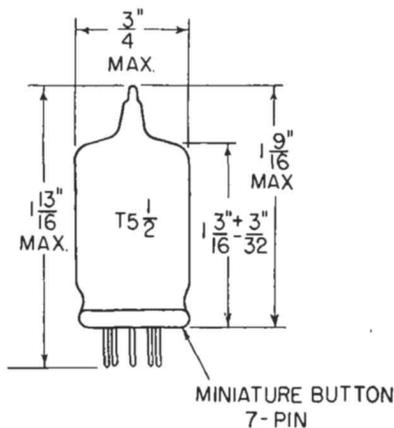
Turning on the plate voltage caused the exciter tubes to draw current, and also caused the relay to throw in. When first this was attempted, the relay action was somewhat sluggish. This was cured, after some experimentation, by adding an extra filter capacitor from the tube side of the relay coil to ground. This made the relay action very positive and reliable.

There is no reason why this stunt would not work in a variety of applications. The one point to be careful of is to make sure that the voltage across the coil is not too high. If this is the case, a shunting resistor could be added to bring the voltage down to the proper value.—W ϕ IYQ.

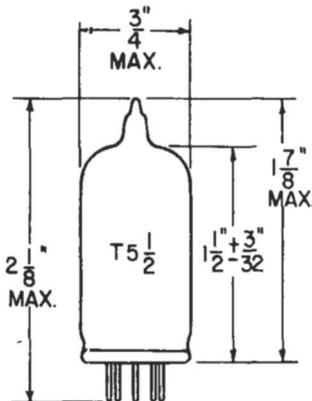
CONDENSED DATA

	6C4	6AK5	6BE6	6X4	UNITS
Heater Voltage.....	6.3	6.3	6.3	6.3	volts
Heater Current.....	0.15	0.175	0.30	0.6	ampere
Maximum Plate Voltage.....	330	180	300	325	volts

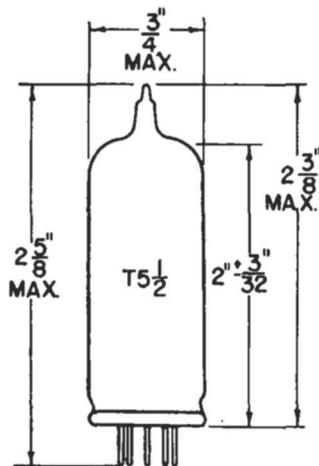
PHYSICAL DIMENSIONS



RMA 5-1
Outline 6AK5

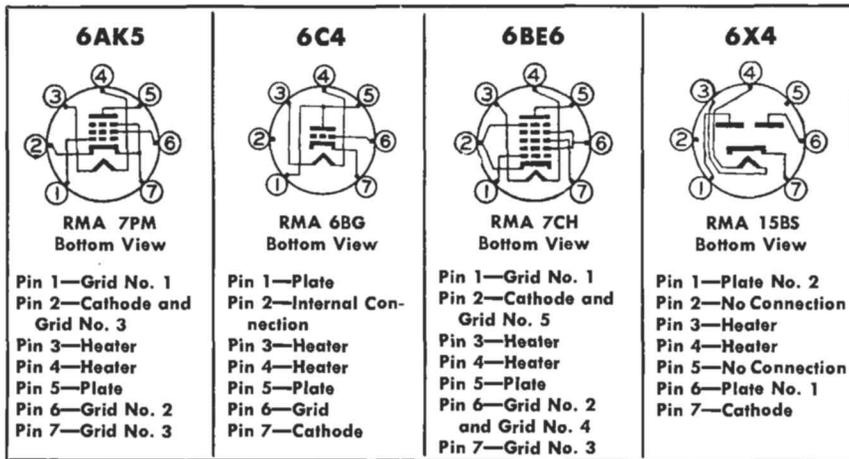


RMA 5-2
Outline 6C4 and 6BE6



RMA 5-3
Outline 6X4

BASING DIAGRAMS—PIN CONNECTIONS



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