RCA Ham Tips

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HAM DISPLAY GREETS RCA VISITORS

The many visitors to the RCA Home Office during January were greeted by this display. Set up, ready for operation, it gave hundreds of people their first glimpse of a complete amateur radio station. QSL cards displayed were those of some of the many RCA Tube Department employees who are active ham operators. (I have to use the side entrance now—the receptionist still has a sore jaw from answering questions.—Ed.)

ELECTRONIC KEYING SYSTEMS

By Mack Seybold, W2RYI
RCA Tube Department, Harrison, N. J.

Amateurs have been using electron tubes in keying circuits for the past twenty years. As a matter of fact, it was almost that far back when I operated cw on 80-meters with a pair of UX245's in parallel, to key the cathode circuit of an old 210. My recollection of that rig, even though it was a hay-wire bread-board dust-catcher, is very pleasant, and I never did get any key-click complaints from the nearby broadcast listeners or local hams.

Just to get an idea of where that keying circuit had come from, I recently thumbed back through the years of radio journals in my shack. To my amazement, I found dozens of keying circuits for the betterment of ham's estate.

Keying Filters

Among the more complete articles on the subject, there was one by the late Ross Hull. This carefully prepared resume in February, 1929, *QST*, covered all of the major systems in use up to that time. Even today, I'll bet that more than half of the boys on the air are using keying systems that were described in Hull's article. The main components used are chokes and capacitors. In addition to eliminating the sparks at the key contacts, proper utilization of the components in the keyed stage or in the feed lines to that stage minimizes the production of transients in the radiated signal when the key contacts make and break. A typical filter for cathode keying is shown in *Fig. 1*.

Sometimes the old choke and capacitor methods really do accomplish the desired results. But the

Continued on Page 2, Column 1

A SIMPLE CODE-PRACTICE UNIT FOR THE NOVICE

By Ken Bucklin, W2CDP
RCA Tube Department

Practice with a soldering iron is as important to the newcomer entering amateur radio as learning the code. The code practice oscillator described helps to accomplish both purposes. It is essential to prepare for the inevitable code test and to develop a good fist; it serves as a practical experiment for the novice; and after the new call letters have been issued, the parts can be put to other useful purposes.

Continued on Page 3, Column 3

"MEET THE GANG"

(First in a series of thumb-nail sketches introducing RCA Tube Department amateurs who contribute to Ham Tips. We hope you enjoy "Meeting The Gang.")

Mack Seybold, W2RYI
ex-W8GGN, W3CQX

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Employed in—Chemical & Physical Lab, RCA Tube Department, Harrison, N. J.
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Graduate of—Lehigh University
Active on—2, 10, 20, and 75-meter Phone and cw.
Rig—300 Watts to RCA 813
XYL—Lois
Harmonic—Susy, Age 4½
Articles—Plate Traps—Low-Pass Filters *(QST)*
TVI Shielding—TVI-Proof Rig *(CQ)*
Class-B 807 Modulator and many others (Ham Tips)
Other Hobbies—Photography, Fishing, Boats

KEYING SYSTEMS

Continued from Page 1

tinkering required to clean up a thump or click condition with those systems, and their unreliability under varying conditions, are probably the fundamental causes for all of the additional work that has been done on keying circuits in subsequent years.

Early Electronic Methods

The first complete references that I could find in which vacuum tubes were used to make and break the circuit in the cathode lead of an amplifier were in *QST* for August, 1931. These references were, evidently, the source information for my earliest venture into electronic key-click control. One circuit is shown in *Fig. 2A*, and the *QST* article attributes the original idea to F. B. Kennell of RCA Communications. The immediate proponent of the system, W. H. Hannah, W2US, had remarkable success with the device in his amateur rig.

The same issue showed the circuit *(Fig. 2B)* of C. W. Carter, W3AGT, for another electronic key-click control which was the basis for many series-controlled systems which were to follow.

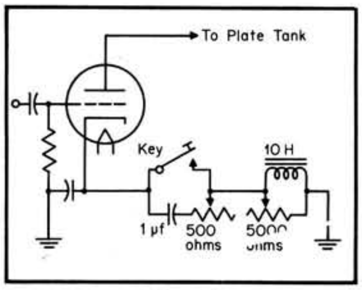


Figure 1

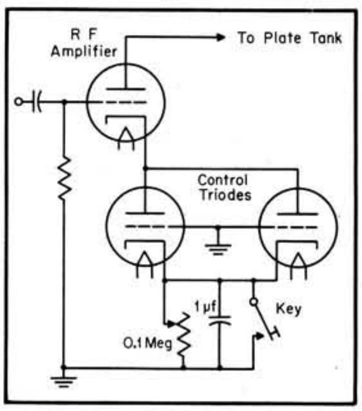


Figure 2A

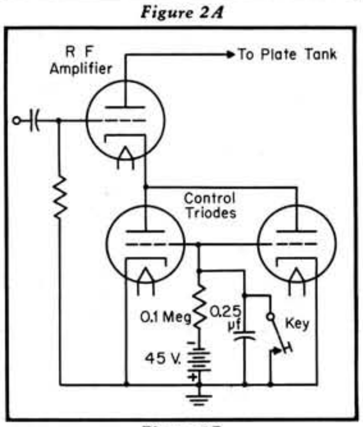


Figure 2B

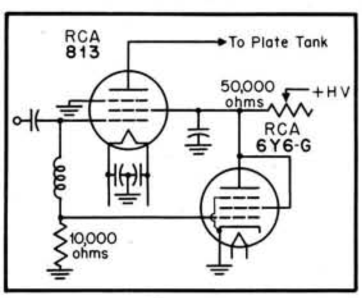


Figure 3

Screen-Grid Transmitting Tubes

During the first few years after power pentodes and tetrodes became available for amateur use, the same general methods that previously had been used for keying triodes were employed. Some of the boys did utilize the screen grid as a keying control element by putting a key or a relay in series with the screen lead, but this method still required the use of key-click filters.

The beginnings of vacuum-tube control of pentode-screen keying seem to have occurred in 1941. In the December *Radio* for that year, W. W. Smith, W6BCX, described "A Substitute for Safety Bias" which utilized a triode shunting the screen of an output tube. Later, F. T. Smith, W1FTX, built a transmitter (Feb. 1947 *QST*) in which a 6Y6-G, triode connected, controlled the screen of an 813. In these screen-shunting systems, an earlier stage is keyed, and the bias developed across the grid-leak of the final amplifier is the voltage which triggers the control tube. A diagram of the W1FTX final is shown in *Fig. 3*.

VR-Tube Keying

My solution to the problem of key-click control has been arrived at from a somewhat different approach, in that voltage-regulator tubes are used. The characteristics of the VR tubes are suited remarkably well for this application and the maximum ratings established for them are not exceeded in this new circuit.

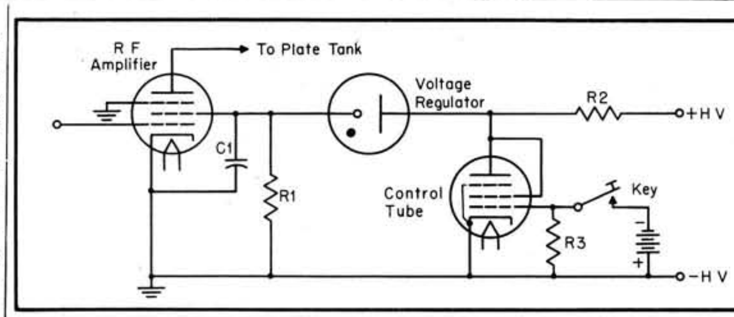


Figure 4

The gaseous atmosphere within a VR tube limits the tube to two major operating states — conducting, and non-conducting. In the conducting state, the current-carrying medium is ionized gas, and the voltage drop between anode and cathode is constant throughout a range of current flow from 5 to 40 milliamperes. In the non-conducting state, when the voltage applied between the anode and cathode falls below the ionizing potential of the gas, the tube virtually is an open circuit. For the 0A3, the voltage required for tube operation is 75 volts. For the 0C3 and the 0D3 it is approximately 105 and 150 volts, respectively. For the miniature types 0A2 and 0B2 it is approximately 150 and 108 volts, respectively.

When one of these tubes, say the 0C3, is placed in the screen supply lead of a pentode or tetrode, the tube will do one of two things: it will conduct or it won't. That, of course, is just what a mechanical key will do. In opposition to the key, however, there are no mechanical components to arc and spark when the circuit opens and closes. In addition, the ionizing and de-ionizing time of the gas within the VR tube causes an infinitesimal time delay which smooths the leading and lagging edges of a keyed character.

Operation

The VR tube in a keying circuit is an effective non-mechanical keying gap. Since the tube needs no filament supply, it can be placed at any convenient point in the screen supply line. The VR tube is controlled by an auxiliary vacuum tube which determines the "on" or "off" conditions. This control tube is activated by applying the correct potential to its grid No. 1 and, since the grid No. 1 is operated at a negative potential, very little current flows in the actual key circuit. Figure 4 shows the basic components of the system.

When the key is down, the bias voltage applied to the control tube prevents it from conducting and the VR tube and the rf amplifier conduct current through R_2. The supply voltage, minus the drops across R_2 and the VR tube, is the effective screen-grid potential applied to the rf amplifier and permits normal key-down operation. When the key is up, the bias on the control tube drops to zero, making it conduct and, as a result, the voltage drop across it becomes lower than the required ionizing potential for the VR tube. The VR tube, therefore, stops conducting, the supply voltage is com-

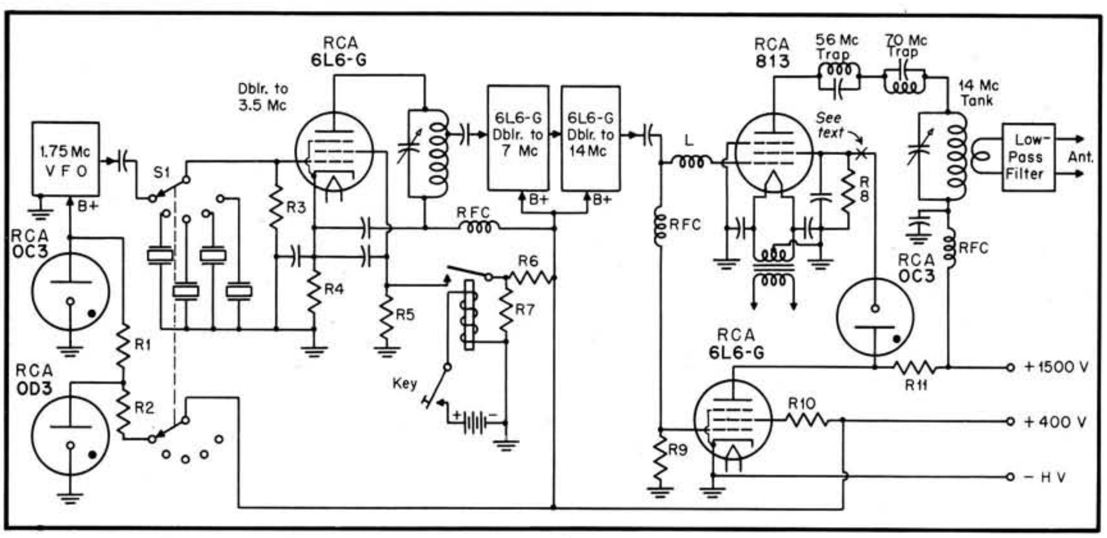


Figure 6

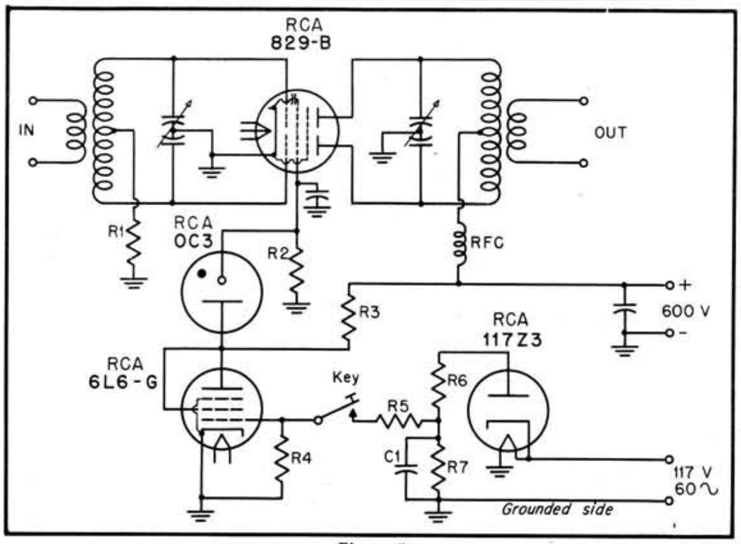


Figure 5

pletely removed from the screen-grid of the rf amplifier, and the transmitter goes off the air.

This procedure can be repeated as often as desired, as in cw work; the rapidity of keying is limited only by the ionizing and de-ionizing characteristics of the VR tube. In the circuit of *Fig. 4*, the resistors R_1 and R_3 are high in value, and are present merely to maintain each grid at a potential near zero when keying potentials are removed. C_1 is a conventional rf by-pass capacitor.

Transmitter Circuits

A practical application of the system is shown in *Fig. 5*. Here an 829-B final is keyed with an 0C3 controlled by a 6L6-G. Cutoff bias for the 6L6-G is obtained from a 117Z3 as shown, or it can be taken from any type of supply capable of furnishing 125 volts of bias.

Another application of the VR tube keying circuit is shown in *Fig. 6*. This arrangement makes it possible to key a buffer stage or the oscillator so that break-in keying may be utilized. Bias for the control tube is obtained automatically at the correct time from the grid resistor of the final amplifier. The protection the control tube gives to the final amplifier, if excitation fails or when doubler and buffer stages are being adjusted, makes this keying system a valuable adjunct to a beam power or pentode final. (On higher-powered finals, a huskier beam power tube must be used as a control tube.)

One additional component has been added to the circuit by Bill Scherer, W2AEF. This addition is a 5-henry choke placed in series with the screen lead at the point marked "X". The choke was added to give a more rounded leading edge to the keyed character. Further details on this addition may be found in Scherer's article, "The Gold-Plated Special," in *CQ*, October, 1948.

For those who wish to design an amplifier operating under conditions other than those shown here, a detailed description of the system is given in "VR Tube Keying Circuits," which appeared in the May, 1948 issue of *CQ*. Another version of the system is described in "A TVI-Free Transmitter for 10 Meters" which was published in *CQ* for October and November, 1949.

If clickless keying is desired, the VR tube keying system is a straightforward answer to a problem that has been confronting hams since the days of the spark transmitter.

PARTS LIST

Fig. 5
- C_1 = 3.0 uf, 150 working volts
- R_1 = 5800 ohms, 2 watts
- R_2, R_4 = 0.25 megohm, 0.5 watt
- R_3 = 10,000 ohms, 50 watts
- R_5 = 50,000 ohms, 0.25 watt
- R_6 = 100 ohms, 0.5 watt
- R_7 = 0.1 megohm, 0.5 watt

Fig. 6
- L = 0.5 henry, grid choke
- R_1 = 1250 ohms, 5 watts
- R_2 = 4400 ohms, 20 watts
- R_3 = 0.1 megohm, 0.5 watt
- R_4 = 1000 ohms, 10 watts
- R_5, R_7 = 0.25 megohm, 0.5 watt
- R_6 = 20,000 ohms, 5 watts
- R_8 = 7500 ohms, 5 watts
- R_9 = 0.5 megohm, 0.5 watt
- R_{10} = 35,000 ohms, 100 watts
- R_{11} = 50,000 ohms, 5 watts

RF components and bypass capacitors are conventional.

TYPE DESIGNATIONS

The following dual type designations are being dropped in favor of single identification. As stocks of double-branded tubes are exhausted, single branded tubes will take their places. There is no change in tube characteristics or quality.

Old Brand	*New Brand*
1B3GT/8016	1B3GT
6AB7/1853	6AC7
6AC7/1852	6AB7

CODE-PRACTICE OSC

Continued from Page 1

The code oscillator is mounted on a wood board and is complete except for headphones. A 1½-volt radio "A" cell (RCA-VS036) serves to heat the 50-milliampere filament of the 1A5-GT, and a very small 45-volt "B" battery (RCA-VS055) is adequate to supply power to the plate of the tube, which draws only ½ milliampere. The transformer and circuit were chosen to provide good volume for the phones at low battery drain.

The 1A5-GT is a pentode, connected as a triode (with screen tied to plate) in a Hartley-type oscillator circuit. When the transformer is mounted, washers or some other type spacers should be used to provide clearance between the base of the transformer and the baseboard for the transformer leads. The batteries are held with wires fastened to the baseboard by means of soldering lugs and woodscrews. The connections to the 1½-volt VS036 are soldered. A standard snap-type battery plug is used for the 45-volt VS055.

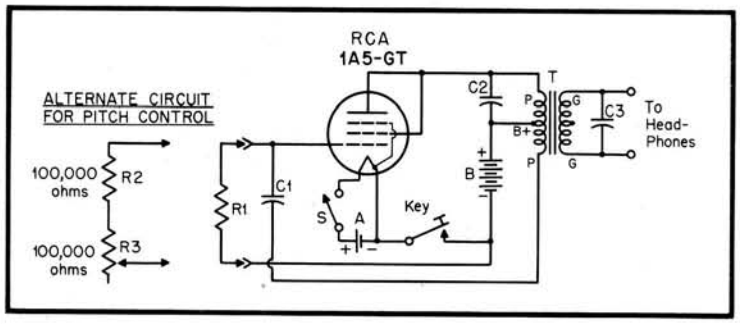
Pitch Control

No provision was made in this model for changing the tone of the oscillator, but a pitch or frequency control can be added if desired. This control is a 100,000-ohm potentiometer (such as an ordinary volume control) which, in series with a 100,000-ohm fixed resistor, replaces the 180,000-ohm resistor. An on-off switch on the pitch control may replace the knife switch (S).

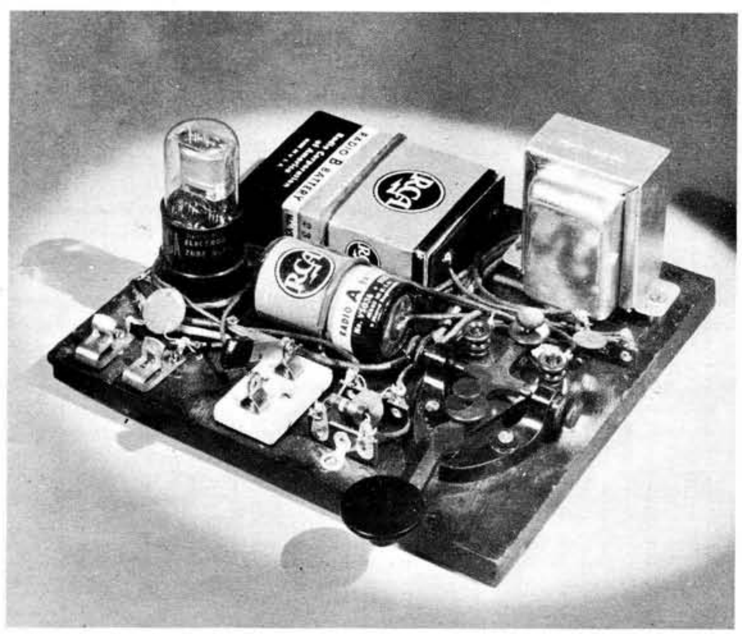
With this code practice oscillator, several headphones may be used in series, or an amplifier may be connected in place of the phones. The tone is very good, and is much more pleasing and realistic than that obtained with a buzzer.

PARTS LIST

- R_1 = 180,000 ohms, 0.5 watt
- R_2 = 100,000 ohms, 0.5 watt
- R_3 = Pitch control potentiometer, 100,000 ohms, 0.5 watt
- C_1, C_3 = 0.005 uf, Sprague disc ceramic
- C_2 = 0.001 uf, Sprague disc ceramic
- S = SPST knife switch
- T = Audio interstage transformer, push-pull plates to push-pull grids, Thordarson T20A24 or equivalent
- A = "A" battery, 1½ volts, RCA-VS036
- B = "B" battery, 45 volts, RCA-VS055
- Socket = Panel-mounting type Eby 12-8 octal



Wiring diagram of the code-practice oscillator.



Completed code-practice oscillator is simple and compact. (Those RCA Batteries last longer!)

SIMPLE OVER-MODULATION INDICATOR

By George Hanchett, W2YM
RCA Tube Dept., Harrison, N. J.

This simple and inexpensive over-modulation indicator is a useful piece of equipment which enables the amateur to comply with the FCC requirements for amplitude-modulated transmitters. It consists essentially of a high-voltage rectifier, type 1B3-GT, a 50-ohm potentiometer R, and a small neon glow lamp (NE45). A diagram of this indicator connected into a typical class C modulator stage is given in *Fig. 1.* Filament voltage for the 1B3-GT is obtained from the drop across the potentiometer R. This potentiometer is calibrated, as described below, in milliamperes of plate current so that when once the final has been adjusted, the proper filament voltage can be applied to the 1B3-GT. The 1B3-GT can be used with any transmitter in which the final plate current exceeds 225 milliamperes. Transmitters having a final plate current of less than 225 milliamperes may use a tube such as the 3V4 diode-connected (grid No. 1 tied to filament mid-tap; grid No. 2 tied to plate) provided the plate supply voltage does not exceed 600 volts.

When the amplitude of the modulation voltage drives the instantaneous plate voltage of the modulated amplifier to a value negative with respect to B— the rectifier conducts allowing the neon lamp to glow and, thus, to indicate over modulation.

Adjustment and Use

When the transmitter is being adjusted, potentiometer R should *always* be set so that there is no voltage on the filament of the 1B3-GT. This precaution is necessary to prevent damaging the tube. After the transmitter adjustments are completed, the plate current of the modulator stage is measured and the potentiometer R set accordingly. In the circuit shown in *Fig. 1*, the neon lamp will glow when the rectified voltage is approximately 75 volts. If indication of 100-per-cent modulation is desired, the bleeder tap should be set at 75 volts. If it is desired that modulation percentages of less than 100 per cent be indicated, the following equation should be used for calculating the position of the voltage tap on the bleeder. (See Figure 3)

Calibrating Potentiometer R

Potentionmeter R may be calibrated, as shown in *Fig. 2*, by means of a 6-volt battery, a 25-ohm (25-watt) variable resistor Rs, and a meter. Adjust the variable resistor Rs to provide a definite value of current, say 300 milliamperes on meter A, and then adjust potentiometer R so that the voltage applied to the filament of the 1B3-GT is 1.25 volts. Because there is slight interaction resulting from the position of the variable arm of R, a few further adjustments of Rs and R may be necessary to obtain correct voltage and current readings. Rs is then set for different values of current and R is again adjusted to obtain the proper filament voltage. After sufficient readings are taken, a curve of final plate current versus dial reading for correct filament voltage may be plotted for future reference.

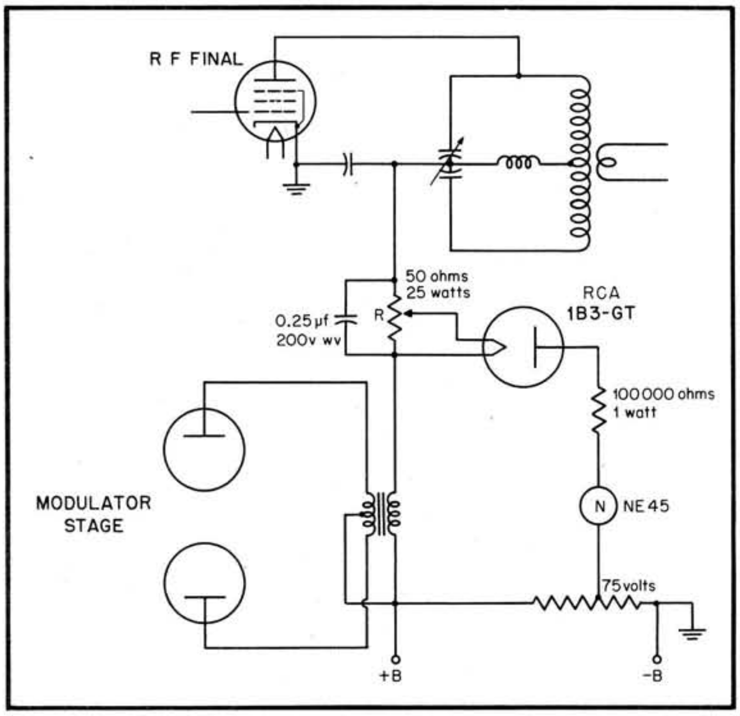


Figure 1

HAM TIPS is published by the RCA Tube Department, Harrison, N. J., and is made available to Amateurs and Radio Experimenters through RCA tube and parts distributors.
T. A. 'PAT' PATTERSON, W2VBL .... *Editor*

UP TO 3000 MC!

Another "RCA First" in advanced tube design . . . the RCA-5675 "Pencil Type" triode for UHF applications is typical of RCA engineering leadership in developing new and better tubes for communcations and industry. The Fountainhead of Modern Tube Development is RCA.

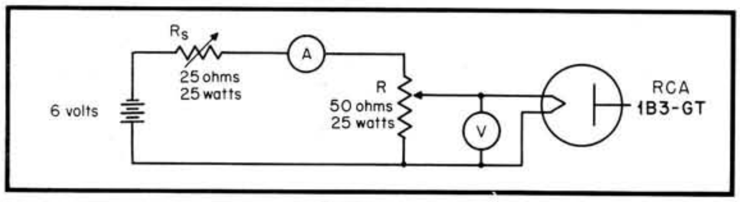


Figure 2

$$\frac{\%\text{ modulation}}{100} = \frac{\text{Total bleeder voltage} - \text{tap voltage} + \text{glow lamp voltage}}{\text{total bleeder voltage}}$$

Figure 3

Getting Out OK!