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HAM NEWS

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GADGETS

Three Useful Accessories for the Shack

AUDIO OSCILLATOR

An audio oscillator can be very useful, but very few ham shacks can boast of one. The reason for this is understandable, as many types of audio oscillators are complicated and difficult to construct. The type to be described here is not only easy to build, but it also is easy to get working properly.

By reference to the circuit diagram in Fig. 2 it will be seen that a 6SK7 is used in a transitron oscillator circuit. This type of oscillator may be made to oscillate over a very wide frequency range, from tenths of cycles per second to megacycles per second. If the oscillations are confined to the audio spectrum it is possible to design it so that the entire audio range may be covered by a variable grid resistor.

Fig. 1. Front View of Audio Oscillator

Several of the uses which suggest themselves for a gadget of this sort are: (1) Code practice oscillator; (2) Oscillator for ICW operation; (3) Source of continuous audio voltage for use while testing a speech amplifier and modulator.

The transitron oscillator puts out an audio wave which is essentially a sawtooth wave. Inasmuch as this waveform is difficult to interpret on an oscilloscope this oscillator is not recommended for use in running audio response curves on audio amplifiers. For work of this sort it is advisable to use an oscillator with sine wave or square wave output.

CIRCUIT DETAILS

A power supply is incorporated in the unit so that the audio oscillator would be self-contained. Two filament transformers are employed in this connection. One transformer supplies filament voltage to the 6SK7 and the other one is used as the power transformer. The selenium rectifier, X, rectifies the 115 volts. Resistor R_5 is a protective resistor and resistor R_6 with condensers C_6 and C_7 forms the filter circuit.

Resistor R_1 is the frequency control potentiometer, seen on the left in the photograph, and R_3 is the output gain control, which is on the righthand side of the panel. Other components on the panel are the pilot light in the center, with the output jack directly below. The on-off switch and the keying jack are on each side of the output jack.

Two output arrangements are shown, A and B. When the output of the audio oscillator is used to modulate a transmitter, for test purposes, or for ICW use, it will be necessary to use the setup shown at A. Resistor R_7 and C_8 form a filter which tends to cut off all high frequency overtones so that wide sidebands are not present. When this circuit is being used the audio frequency should be between 500 and 1000 cycles.

The setup shown at B indicates that a pair of earphones may be placed directly across the output. This would be the case when the oscillator were used for code practice work. Keying is done in the cathode circuit.

CONSTRUCTION

The entire unit is built in a 6 by 6 by 6 inch box. For convenience in wiring a small sub-chassis was

ELECTRICAL CIRCUIT

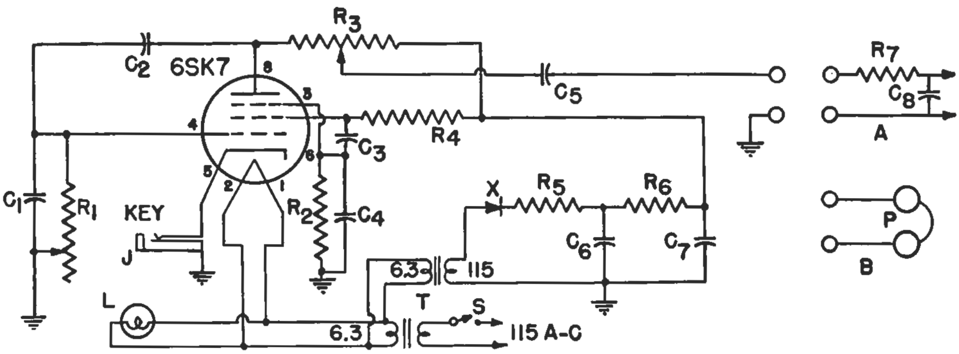

Fig. 2. Circuit Diagram of Audio Oscillator

CIRCUIT CONSTANTS

C_1,C_4	=500 mmf mica	R_3	=0.5 megohm potentiometer
C_2	=200 mmf mica	R_5	=25 ohm ½ watt
C_3	=0.1 mf paper	R_6	=4700 ohm 2 watt
C_5	=0.005 mf mica	R_7	=1 megohm ½ watt
C_6,C_7	=40 mf electrolytic	S	=SPST toggle switch
C_8	=0.001 mf mica	T	=6.3 volt filament transformer
J	=Closed-circuit jack	X	=Selenium rectifier
R_1	=3 megohm potentiometer	P	=Earphones
R_2,R_4	=0.47 meg ½ watt	L	=6.3 volt pilot light

bent out of aluminum sheet. The photograph, Fig. 3, indicates how this is made. The tube is mounted near the front panel, with the two filament transformers in line to the rear. A dual 40 mf. electrolytic condenser occupies the other side.

The under-chassis view, Fig. 4, shows the layout of the rest of the components. The selenium rectifier is attached directly to the rear of the chassis. This is done so that the heat generated by the rectifier does not affect the other components, and also so that the chassis itself can carry away some of the heat. No critical layout is required, and no special precautions need be taken with the wiring.

TESTING

After the unit is completed, the first step is to check the audio frequency range. This may be done easily by monitoring with a pair of earphones. If accurate measurements are desired, another calibrated audio oscillator can be compared with this one by means of an oscilloscope. The output of one oscillator is fed into the vertical plates of the scope and the output of the second oscillator is fed into the horizontal plates. By means of Lissajous' figures, the two frequencies can be compared.

If the audio frequency range is not wide enough or does not cover the desired range, several adjustments may be made. Reducing the value of C_2 will raise the maximum frequency of oscillation. Varying the value of the screen resistor, R_4, and the capacitor C_3, will also affect the frequency range covered. When adjusted properly, the frequency control should be capable of producing a continuous audio range from below audibility at low frequencies to above audibility at the high frequencies.

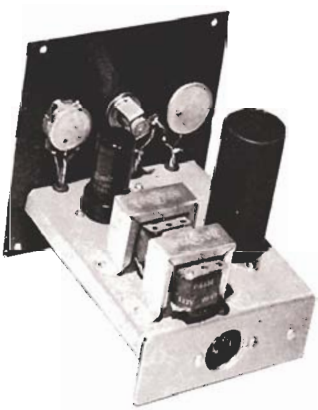

Fig. 3. Rear View of Audio Oscillator

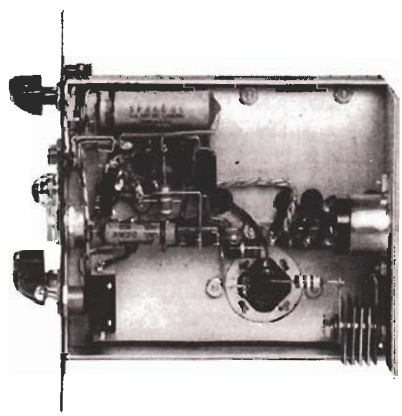

Fig. 4. Under-chassis View of Audio Oscillator

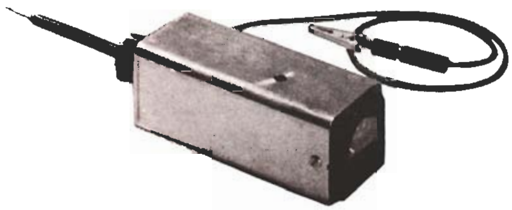

Fig. 5. Miniature Volt-Ohmmeter

No ham shack is complete without a volt-ohmmeter of some sort. Their biggest use is in checking continuity, and reading a-c and d-c voltages. An instrument of this sort need not be elaborate, nor is extreme accuracy required.

Fig. 7 shows the circuit for a volt-ohmmeter which will measure 0-10, 0-100, and 0-1000 volts a-c (switch positions 3, 2 and 1 respectively); 0-100 and 0-1000 volts d-c (positions 5 and 4) and 0-100,000 ohms (position 6). These ranges can be added to quite easily, as later data will show, but they represent ranges which are used most.

Practically any type of constructional arrangement can be followed, but a little effort will produce a very handy device. Fig. 5 shows how the entire volt-ohmmeter may be placed in a shield can, with a small 1½ inch meter on one end and the probe and range switch on the other end. In use the device may be held in one hand much like a probe. The wire with the clip is the negative lead, with the probe proper being the positive lead.

OHMMETER CALCULATIONS

In deciding what resistance scale can be obtained, it is first necessary to determine how much battery voltage you wish to provide. This, together with the meter, determines the resistance scale. In the ohmmeter shown it was not practical to use more than three volts. Full scale on a one mil meter, with three volts in series, requires a series resistance of 3000 ohms. The ohmmeter will therefore read 3000 ohms at mid-scale. (Mid-scale reading is always the same as the total circuit resistance.)

This 3000 ohms series resistance is made up of the resistance of the meter (100 ohms), R_2 of 2000 ohms and 900 ohms in R_1. To calculate the resistance values indicated by various meter readings, use the formula

$$R = \frac{BR_s}{M} - R_s$$

where R is the resistance to be read, B is the battery voltage (3 volts in this case), R_s is the series resistance (3000 ohms) and M is the voltage read by the meter. This latter voltage is determined from the ratio of meter reading to battery voltage. Full scale is three volts, half-scale (0.5 ma.) is 1.5 volts, etc.

Carrying these calculations through for this particular ohmmeter we find the following resistance readings for each 0.1 ma. scale division—starting from 1.0, 0.9, 0.8 etc.: 0, 333, 750, 1285, 2000, 3000, 4500, 7000, 12,000 and 27,000. The last value is for a meter reading of 0.1 ma. Inasmuch as 0.025 ma. may be read, the highest value of resistance which may be read is 117,000 ohms. If desired, values may be calculated for each meter division, and a chart made up which may be pasted to the ohmmeter case.

To design an ohmmeter to read higher values of resistance, it would be necessary to use more batteries, and then calculate the series resistance by dividing the battery voltage in volts by the full-scale meter reading in amperes. The formula given above will then permit you to calculate the resistance range which can be covered.

VOLTAGE CALCULATIONS

D-c voltage calculations are very simple. Start with the lowest range (0-100 in this case). The resistance to use in series with a 1 ma. meter to read 100 volts is merely the voltage divided by the current, or 100,000 ohms. The next scale of 0-1000 volts gives a resistance of 1 megohm. Since these two resistors are in series, the resistor for the 1000 volt range would be 1 megohm less 0.1 megohm, or 0.9 megohm. The resistance of the meter is so small that it may be neglected.

In designing a voltmeter to read above 1000 volts take care that adequate insulation is used with the leads, and also that not more than 1000 volts appears across any one resistor used as a multiplier.

The voltmeter shown has a sensitivity of 1000 ohms per volt on both d-c ranges. A more sensitive voltmeter can be made only if a more sensitive meter, such as a microammeter, is employed.

For measurement of a-c voltages, a rectifier is required. The rectifier shown in Fig. 7 consists of two germanium crystal diodes. One acts as the rectifier proper while the other passes current in the opposite direction on the other half-wave so that a high voltage is not built up across the first diode. The action is that of a half-wave rectifier. Because of this, and because the meter will read the average value of voltage, a multiplying factor of .45 must be used to calculate resistance.

In other words, if 10 volts is applied to the voltmeter circuit, the meter would only read 4.5 volts. In order to make the meter read full scale on 10 volts we therefore calculate on the basis of 4.5 volts. The series resistance to use is therefore 4.5 volts divided by 0.001 ampere or 4500 ohms. Similarly for 100 volts a total resistance of 45,000 ohms is required and for 1000 volts .45 megohms is required. Doing the proper subtraction, because the resistors are in series, shows us that we need 4500 ohms, 40,500 ohms and 405,500 ohms. The values need not be that exact, and those specified will be close enough.

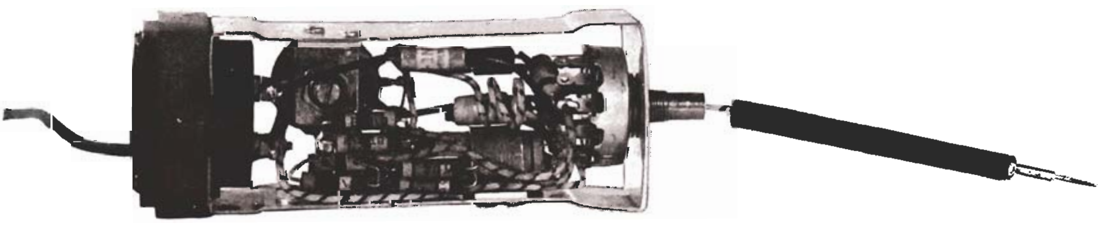

Fig. 6. Internal Construction of Volt-Ohmmeter

ELECTRICAL CIRCUIT

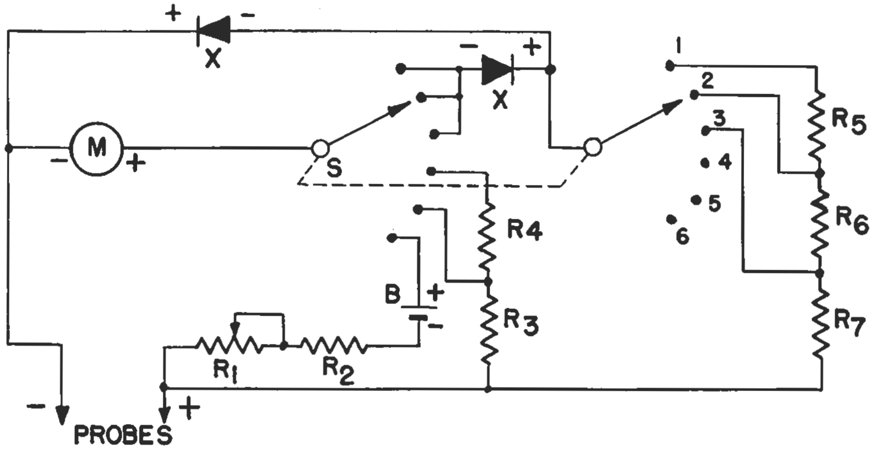

Fig. 7. Circuit Diagram of Volt-Ohmmeter

CIRCUIT CONSTANTS

B = Two 1.5 volt penlite cells in series

R_1 = 1000 ohm wire-wound rheostat
R_2 = 2000 ohm ¼ watt
R_3 = 0.1 meg. ¼ watt
R_4 = 0.9 meg 1 watt
R_5 = 0.4 meg ½ watt
R_6 = 0.04 meg ¼ watt
R_7 = 4100 ohm ¼ watt

S = Double pole six position (Mallory 3226 J)

M = 0-1 ma. meter (G.E. 411X92)

X = Germanium crystal (1N34 or equivalent)

CONSTRUCTION

The circuit of Fig. 7 may be used to build a volt-ohmmeter using any size meter in any style of box desirable. However, if a small meter is used a much handier device will result. The volt-ohmmeter pictured in Figs. 5 and 6 was built into a 2 x 2 x 4⅞ inch shield can (Millen No. 80005). No special tools are required. Referring to Fig. 6, the meter fits into a piece of one-half inch thick bakelite. The bakelite is cut 2 inches square and the corners rounded with a file.

The inner case is made by bending a piece of $\frac{1}{32}$ in. aluminum to the shape shown. Before bending the piece is 1⅝ inch wide and 11¼ inches long. The two ends which meet on the bakelite piece are filed out to fit around the meter and the entire aluminum bracket is held to the bakelite piece by the meter mounting screws.

A square angle bracket is made to support R_1 and the two small batteries are held by another clamp made of aluminum. It is also necessary to drill a hole in the end of the inner case to support the rotary switch.

In order to bring the connection from the positive probe into the case it is necessary to drill a hole axially through the switch shaft. This is not a difficult task if the switch is held firmly in a vise and moderate care taken to keep the drill straight.

The next step is to procure a probe which has the same diameter as the shaft on the switch. This is necessary because the switch knob must be capable of sliding off over the probe. Finally the knob must be drilled and tapped so that the probe can be held into the knob by the setscrews in the knob.

When this work has been done the parts may be assembled on the inner case and the wiring completed. The lead which goes through the switch shaft from the probe should be left slack and formed into a loop so that the switch is free to turn. Finally, holes should be drilled in the outer case for the probe, negative lead, and adjustment of R_1. The bakelite piece is drilled and tapped to hold the outer case.

To assemble the unit, remove the switch knob and feed the probe into the hole on the end of the case. Push the unit in at the same time as the negative lead is pushed through its hole. When the unit is together slide the knob over the probe and tighten the setscrews which hold the knob to the shaft and the probe to the knob. Fastening the case to the bakelite completes the assembly.

CALIBRATION

After the volt-ohmmeter is completed it is desirable to check its accuracy. To do this easily, locate another voltmeter that you can trust and check the two together. Some juggling of resistance values may be necessary for extreme accuracy, although the unit described was within three per cent without changing resistor values.

For the ohmmeter circuit, short the two probes and adjust R_1 so that full-scale deflection of the meter is obtained. While it is possible to now calibrate the meter, for most uses this will be unnecessary. However, you may wish to check some known values of resistance against the calculated meter readings that you have made.

As the battery voltage drops it will be necessary to readjust R_1 for full-scale meter deflection.

PARASITICS

The Five-band VFO circuit diagram (November-December 1947 Ham News) is in error. Another five position switch should have been included in the plate circuit of the GL-807 stage. With reference to the circuit on the top of page 5, the connections which are made from the right-hand side of meter M_2 should be removed. A five-position single-pole switch should then be connected so that the pole connects to the meter and the five positions each connect to their respective plate coil where the other connections formerly went.

This additional switch section is S-1I and is shown in Fig. 4 in the original article. It is on the same switch pie as section S-1G. (The circuit as originally shown shorts out the B plus voltage to ground.)

MODULATION MONITOR

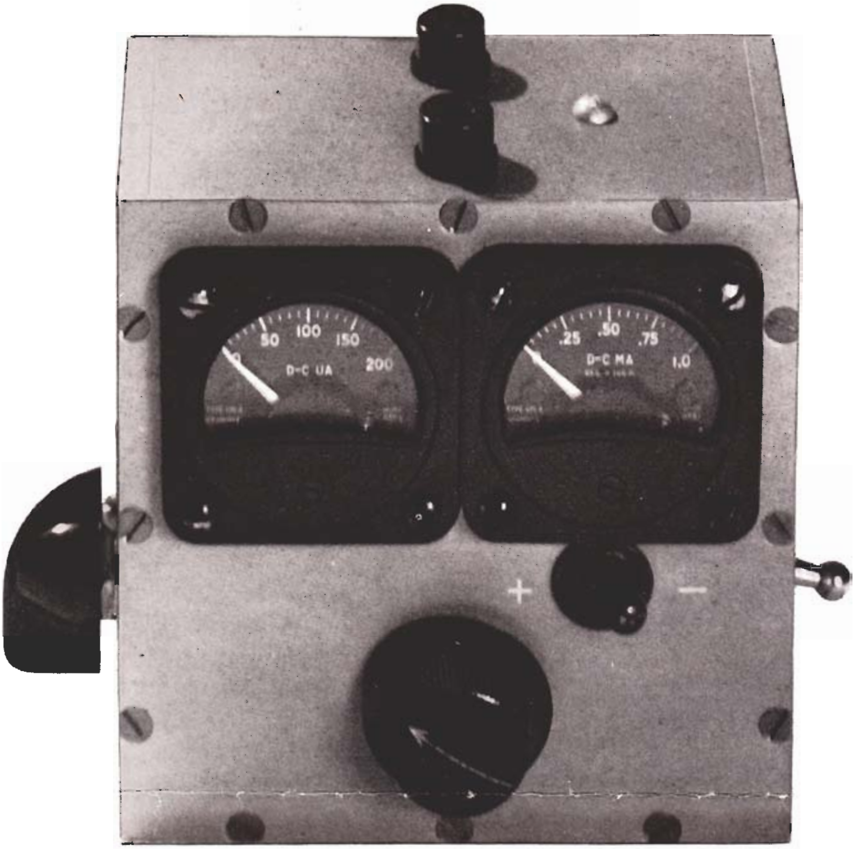

Fig. 8. Front View of Modulation Monitor

While serving primarily as a guide to proper modulation of a phone station, the device pictured in Fig. 8 is a valuable addition to any shack. It will serve as a carrier shift indicator, a field strength meter, a neutralization indicator, a phone monitor and a sensitive wavemeter.

Referring to the circuit diagram in Fig. 9, meter M_1, which is on the left in the photograph, is a sensitive instrument which reads the carrier level, or indicates the pressure of r-f when the device is used as a field strength meter, a neutralization indicator or a wavemeter. Meter M_2 is used only to give per cent modulation readings. If the modulation monitor feature is not desired, meter M_2 and the copper-oxide meter rectifier CO may be omitted, and the device will still retain its versatility.

To use this gadget as a wavemeter, a pickup loop is coupled to the input circuit and switch S_1 is placed on the proper position. Coil L_1 tunes to 80 and 40 meters, L_2 tunes to 20, 15 and 10 meters, L_3 tunes to 6 meters and the tap on L_3 tunes to 2 meters. With switch S_1 on the proper tap, condenser C_2 is used to peak the reading of meter M_1. Using a calibrated dial, frequency may be read directly. Switch S_2 should be on the RF position for these readings.

For use as a phone monitor, r-f should be fed into the input via a link or a pickup wire on the positive terminal, and the LC circuit tuned to the frequency involved. Earphones inserted in jack J will allow you to monitor the signal. S_2 should be in the AF position.

Field strength readings can be taken with this device by using a short pickup antenna on the positive input terminal. Again the LC circuit should be tuned to resonance. Meter M_1 will now give an indication of field strength. With S_2 in the RF position the meter is very sensitive, but if the input is too great, switch S_2 can be thrown to the AF position which will greatly reduce the sensitivity of M_1. Sensitivity can be reduced still further by using switch S_1 connected to L_4. This is a 2.5 mh. r-f choke, and tunes the input very broadly. C_2 still has some effect and may be used as a vernier adjustment.

Neutralization measurements are made by coupling the device through a pickup link to the tank coil, with S_2 in the RF position. When the LC circuit is tuned to resonance, the gadget acts as a very sensitive r-f indicator. As a matter of fact, it is so sensitive that it is doubtful where any stage could be sufficiently well neutralized so that the meter could be made to indicate zero r-f.

To use the device as a modulation monitor, use a pickup link to couple in r-f energy. Tune the LC circuit to resonance on the proper band, and then adjust the pickup link coupling until meter M_1 reads your calibrated point value. (Calibration procedure will be discussed later.) Now, meter M_2 will respond to voice modulation and permit a constant check on the percentage of modulation. In addition, meter M_1 will give a constant check on the carrier level, which normally should stay constant.

ELECTRICAL CIRCUIT

The part of the circuit to the left of the germanium crystal X, referring to Fig. 9, is the r-f pickup and

ELECTRICAL CIRCUIT

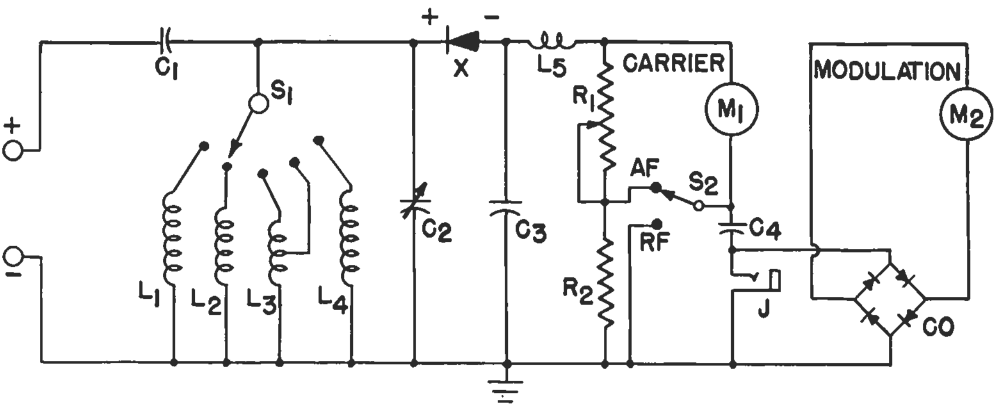

Fig. 9. Circuit Diagram of Modulation Monitor

CIRCUIT CONSTANTS

C_1 = 25 mmf mica
C_2 = 75 mmf variable
C_3 = 0.001 mf mica
C_4 = 0.1 mf paper
J = Open circuit jack
L_1 = 65T No. 30 enamel wire close wound on ½ inch diameter form
L_2 = 14T No. 30 enamel wire close wound on ½ inch diameter form
L_3 = 6½T No. 14 wire space wound, ¼ inch diameter, ½ inch long with tap 1½ turns from ground end

L_4,L_5 = 2.5 mh r-f choke
M_1 = 0-200 ua. meter (G.E. 411X88)
M_2 = 0-1 ma. meter (G.E. 411X92)
R_1 = 50 ohm semi-adjustable
R_2 = 5000 ohm ½ watt
S_1 = Single-pole, five-position switch
S_2 = SPDT toggle switch
X = Germanium crystal (1N34 or equivalent)
CO = Full wave copper-oxide meter rectifier

tuning section. C_1 is employed as a blocking condenser and C_2 acts as a tuning condenser. The crystal acts as a half-wave rectifier, while C_3 and L_5 serve as an r-f filter, so that the input to resistors R_1 and R_2 is d-c with a superimposed audio waveform.

When switch S_2 is in the RF position, the d-c current which flows through M_1 is a measure of the r-f in the input circuit. With S_2 in the A-F position, meter M_1 is shunted with resistor R_1 and again reads a value of current which depends upon the r-f input, but M_1 is now much less sensitive. The portion of d-c voltage with superimposed audio which exists across resistor R_2 is now picked up by the full-wave copper-oxide rectifier, rectified, and given as a d-c current to the percent modulation meter M_2. Condenser C_4 acts as a d-c blocking condenser so that audio voltage only is presented to the copper-oxide rectifier. The phone jack at this point permits the insertion of earphones for monitoring purposes.

CONSTRUCTION

The unit shown in Fig. 8 was constructed in a 4 by 4 by 2 inch chassis. The particular chassis shown is not a commercial chassis but one made up of aluminum. A switch is shown on the front panel marked plus and minus. This was used in an earlier version and is not included in the present circuit.

One precaution only should be observed when laying out the unit. The r-f section should be separated from the meter circuits to prevent stray fields from injuring the meter movements.

Although a 0-200 microammeter is specified for meter M_1, a 0-1 ma. meter will work just as well and no circuit changes need be made. The unit will be less sensitive when it is used as a field-strength meter, neutralization indicator or wavemeter. Operation will be unaffected for modulation monitoring use, as resistor R_1 acts as a shunt and can be adjusted to accommodate either a 0-200 uamp. meter or a 0-1 ma. meter.

With reference to Fig. 8, the band switch is placed on the left panel and the RF-AF switch is on the right panel. The front panel contains the two meters, the tuning condenser in the center, and the phone jack is placed where the switch is shown.

WAVEMETER CALIBRATION

To check coil L_1, the unit should be coupled to a source of 3.5 megacycle energy, and meter M_1 peaked for maximum current. The condenser setting should be such that most of the capacitance is in use. If this is true, put 7 megacycle r-f in and again resonate the LC circuit. The condenser should now be approaching minimum capacitance. The coil should be adjusted until both bands can be resonated with the condenser. The same procedure is followed with coil L_2. The 15 meter band should peak with the condenser approximately half-way meshed, in which case the 20 and 10 meter bands should fall on each side. In position 3 the six meter band will be found, and the tap on L_3 can be adjusted until the 2 meter band is peaked when the switch is in position 4.

MODULATION METER CALIBRATION

To prepare for the job of calibrating the modulation meter, it is first necessary to use an oscilloscope and set up the scope so that it is reading trapezoidal patterns. This is discussed fully in radio handbooks and will not be repeated here. Once this setup is complete, the modulation monitor should be coupled lightly to the final tank coil and the LC circuit in the modulation meter brought to resonance. S_2 should be in the AF position. The coupling should now be adjusted so that meter M_1 reads half-scale.

The rig should now be voice modulated, and the voice level maintained so that the trapezoid pattern indicates 100% modulation on the audio peaks. Under these conditions, check the maximum deflection of meter M_2. If the maximum deflection is full scale, you may consider this as the 100% point and calibration is completed for that one point. However, if the meter does not read high enough on voice peaks, adjust the shunt R_1 on meter M_1 so that more resistance is in use.

Following this, readjust the link coupling to the final until M_1 again reads half-scale. Again check meter M_2, and repeat the above until M_2 reads full-scale, when M_1 is at half-scale and the trapezoid pattern is indicating 100% modulation voice peaks.

Inasmuch as meter M_2 will not read in a linear manner, it will be necessary to repeat the above calibration procedure for other percentages of modulation. Suggested values might be 75%, 50% and 25%. In other words, when R_1 has been adjusted so that 100% modulation is approximated by full scale deflection of M_2, it should be kept at this value of resistance.

By changing the voice level so that the trapezoid pattern indicates 75% modulation peaks, the reading of meter M_2 can be noted which corresponds to 75% modulation. This same process may be carried out for other modulation percentages.

The unit pictured read 100% modulation at full-scale, when M_1 was adjusted to half-scale, and the value of R_1 was 42 ohms.

Inasmuch as there is a possibility that some error will be introduced if the meter is calibrated on 75 meter phone and then used on 2 meter phone, it is advisable to make the calibration on the band that will be the most widely used.

After the unit is calibrated, it will always give the same readings as a modulation indicator, whenever the LC circuit is resonated and the pickup adjusted so that M_1 reads at mid-scale.

TRICKS AND TOPICS

How did you solve that last problem that almost had you stumped? Be it about tubes, antennas, circuits, etc., Lighthouse Larry would like to tell the rest of the hams about it. Send it in! For each "trick" accepted you win $10 worth of G-E Electronic Tubes. No entries returned. Submit to Lighthouse Larry, Tube Division, Bldg. 269, General Electric Company, Schenectady, New York or in Canada, to Canadian General Electric Company, Ltd., Toronto. Ont.

SCREEN GRID KEYING

Keying the screen grid of a beam tube used in an r-f amplifier stage of a c-w rig has not been very popular. Perhaps one reason for this is the fact that when the screen is open (key-up position) there is a certain small amount of feed through from the control grid circuit which will affect the plate circuit. If the beam tube is driving a final stage or is coupled to an antenna, this feed through effect generally causes a back wave to be heard at the receiving end.

A system for eliminating this feed through which has been very effective is shown in Fig. 10. It consists of placing a high resistance negative voltage on the screen during key-up periods. During key-down periods the regular screen voltage is applied. Clean cut keying is the result.

A battery is used to supply negative screen voltage and in practice this battery has long life because even with the key down, only a mil or so of current will flow.

The break characteristic is easily controlled by changing the capacity of C_1. Filter C_2-R_2 is the "spark killer" for eliminating BCI. For a starter, use 0.01 mf for C_1, 0.003 mf for C_2 and 100 ohms for R_2.

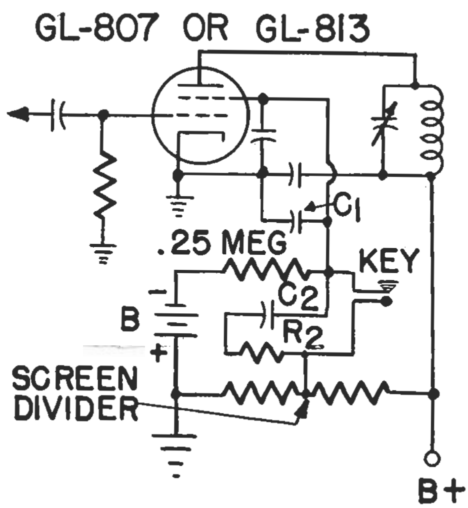

Fig. 10. Circuit Diagram of W3GRZ Screen Keying System

Another advantage of this system is that the negative screen voltage has plate current limiting action when the excitation is removed, thereby furnishing overload protection in case of drive failure.—W3GRZ. (Note: A battery voltage of 45 volts is adequate when a GL-807 is used in the circuit. To use a GL-813, it is necessary to use 90 volts for 2000 volts or less on the plate. If over 2000 volts is used, 135 volts will be required for negative screen voltage.—Lighthouse Larry.)

WAVE AWARD

The May-June 1947 Ham News carried details of six amateur radio achievement awards. It has been called to Lighthouse Larry's attention by CAROA (Canadian Amateur Radio Operator's Association, 46 St. George St., Toronto 5, Ontario) that the WAVE Award was not mentioned. This award was sponsored originally in 1939 by CAROA and to date certificates have been awarded to only FOUR amateurs, three W's and one VE. Here then are the details on WAVE (Worked All Ve Districts). These data are from Xtal Magazine, October, 1947.

Submit proof of contact with two different stations in each province, contacts being on two different bands. (A total of 18 confirmations—Yukon and Northwest Territories shall be considered a part of British Columbia.) All contacts must be made on or after January 1, 1939. Applicants residing in territory designated by the prefix Ve or W shall make all contacts from within one province or state. A handsome certificate awaits those who qualify.

TECHNICAL TIDBITS

That new final of yours has just been completed, and you anxiously throw the high voltage on, and dip the final plate current to resonance. Then you couple in the antenna, again dip to minimum plate current, and finally make sure that you have maximum radiation from the antenna by checking with a neon bulb on the antenna, by again retuning the final plate condenser. In this simple operation you have passed over several points which will inform you as to how the final and the feeder system is working.

When final plate current is dipped to a minimum value with no load on the tank coil, make a mental note of the tank condenser setting. Now couple the antenna to the final tank coil and again tune the tank condenser for minimum plate current. If the condenser is not on the same dial setting as before, you definitely know that your feeder system has standing waves on it, that is, the line is not flat. On the other hand, if the loaded minimum plate current occurs at the same condenser setting as the unloaded minimum plate current you may or may not have standing waves on the feeder system. This is important. In other words, if you do have a flat line the two condenser settings will be the same, but the fact that they are the same does not necessarily imply that the line is flat. It will be necessary to check the line by other methods to guarantee the absence of standing waves.

The next thing to examine is how the condenser setting changes when going from minimum loaded plate current to maximum power output. That is, check the condenser setting when you have minimum plate current and the final is loaded. Next, check the antenna output by means of a field-strength meter and tune the plate condenser until the final is putting out the maximum power as indicated by the field-strength meter. If these points coincide, the final tank circuit has a proper loaded Q. However, if these two tests do not give the same condenser setting the Q is not right in the final tank circuit. To correct this add more C across the final coil.

Maximum power output and minimum loaded plate current depend upon the power factor and the impedance in the final tank circuit. Zero power factor and maximum impedance occur together only in high Q circuits (a Q of 12-15). If you have too low a Q you must operate with either one condition or the other, that is, with minimum loaded plate current, which does not give maximum power output, or with maximum power output which will not give the lowest possible plate current.

If you operate with minimum loaded plate current, you effectively lose power output due to poor plate-circuit efficiency. If you operate at maximum power output the tube efficiency is low and it is not possible to obtain full use of the tubes. Obviously, therefore, it is desirable to operate so that minimum loaded plate current and maximum power output occur at the same setting of the final tank condenser. Another reason to make sure that you have a high Q tank is that harmonic radiation is aggravated in a low Q tank circuit.

This type of thing occurs most often on the lower frequencies, and is a simple matter to remedy. Add capacitance across the final tank coil, removing turns from the coil as you go, until you have sufficient capacity to make the two points mentioned above coincide.

Too high a value of C will cause high circulating current in the tank coil, but this will not occur unless you add a great deal more capacity than is needed to get a high Q tank.

Once you have this fixed, these two points will be inseparable, regardless of your feeder system. However, these two points, which are now coinciding, may not coincide with the unloaded minimum plate current point. However, all three points will be the same when you have a flat line, and the first two points will differ from the unloaded minimum plate current point when you have standing waves. The same precaution still holds if all three points coincide. This does not guarantee that the line is flat, and separate tests must be made to vertify that point.—Lighthouse Larry.

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