MODEL 027 VACUUM TUBE VOLTMETER

The 027 Gives Utmost Accuracy While Setting Stations on Push Buttons and Maximum Push-Button Performance

The vacuum tube voltmeter in the Model 027 has many important uses. The most important of these is the accuracy you can get when setting stations in any automatic tuning radio. Dealers and servicemen find it difficult to make the proper connection of an output meter. There is some difficulty in determining the correct connections to the prongs of output tubes and the load imposed by the meter may be too great to obtain satisfactory connections to the voice coil of the receivers. Many speakers are wired in such a way that a connection to the voice coil is either difficult or impossible. The vacuum tube voltmeter, however, can be made to serve the purpose perfectly by simply connecting it through a 2 megohm resistor to the grid of any tube which has automatic volume control furnished to it in the circuit. This is a tremendous advantage because the control grid cap is readily available and a connection can be made by simply clipping a lead from the "High" terminal of the vacuum tube voltmeter over the grid cap of the detector oscillator, R.F. or I.F. tube most readily reached in the circuit. The "Low" terminal of the vacuum tube voltmeter is clipped onto any metal part of the chassis or the ground terminal.

Servicemen in general have been using an oscillator to set up stations. This is satisfactory when distant stations are being set up, but on locals the signal is so strong that it has been difficult to get an accurate setting of the oscillator coil and antenna padder. The problem of setting up local stations is tremendously simplified when the vacuum tube voltmeter is connected and the oscillator coil and antenna padder adjusted for maximum reading. The exact setting of the station is indicated when the A.V.C. voltage reaches its highest point.

By setting up stations this way, automatic tuning will produce the maximum tone quality possible from the receiver.

Accurate Adjustment of Mystery Control

When changing the control frequency or padding the Mystery Control circuit, the vacuum tube voltmeter provides an absolutely accurate method of adjusting the circuits both in the amplifier in the the receiver and the Mystery Control itself. All stages of the Mystery Control amplifier circuit are adjusted using the vacuum tube voltmeter connected by means of an adaptor made from the base of an octal base tube. Connect a lead to the No. 8 pin (the one to the right of the key looking at the end of the tube base). Connect a 3 or 4 megohm resistor in series with this lead and run the end the approximate length of the test lead furnished with the 027 so that it may be connected to the "High" terminal of the vacuum tube voltmeter. Connect a .05 mfd. condenser to the meter side of the 4 megohm resistor and connect the other side of the condenser to chassis. The "Low" terminal of the vacuum tube voltmeter is connected to the chassis.

In order to replace the capacity of the Thyratron tube, a 10 mmfd. condenser is next connected between pin No. 4 and pin No. 5 of the adaptor socket. The leads from the condenser should be pushed through the openings in the pins and soldered at the end. Excess solder must be removed so that the adaptor base may be inserted and removed from the Thyratron socket. The type 2A4G Thyratron tube is now removed from its socket and the adaptor inserted in its place. Since the No. 8 socket contact is connected to the A.V.C. voltage source, the vacuum tube voltmeter will now read the A.V.C. voltage normally applied to the control frequency amplifier and this will provide a perfect indication of resonance as the various circuits are adjusted.

A 50,000 ohm resistor is shunted across the terminals of the Padding Condenser in the loop. This is for the purpose of decoupling the secondary coil (loop) from the first stage while the first stage is adjusted. With this resistor in position, the first stage may be adjusted for maximum signal in the vacuum tube voltmeter. In order to obtain a signal it is possible to use either a pulse from the Mystery Control or a signal from the Model 077 Signal Generator.

The adjustment procedure, when using the Model 077, is as follows:

Connect a piece of wire to the output leads from the Model 077. Form this in a loop and place it near the secondary coil (loop) in the bottom of the receiver cabinet. Tune the signal generator to the control frequency desired and turn the attenuator on full. Increase the sensitivity control of Mystery Control until there is a reading in the vacuum tube voltmeter. Using an adjusting wrench or screw driver, turn the adjusting screw on top of the first control frequency transformer and adjust it for maximum reading in the vacuum tube voltmeter. Next adjust the second control frequency transformer in the same manner. Finally, the third control frequency transformer may be adjusted in the same manner.

Now remove the decoupling resistor from the secondary coil (loop) Padding Condenser and adjust the secondary coil air padder for maximum reading on the vacuum tube voltmeter. It may be necessary to reduce either or both the attenuator setting on the signal generator and the sensitivity control on the chassis as these adjustments are made.

To adjust the Mystery Control, the same method is followed. The Mystery Control can now be adjusted to the frequency of the control frequency amplifier by dialing a station and pushing the plunger in so that a continuous pulse is produced by the Mystery Control. There is a padding condenser located beneath the Mystery Control housing which adjusts the Mystery Control frequency. Adjust this condenser for maximum reading in the vacuum tube voltmeter. It will be necessary to have the sensitivity control at the near position. If the vacuum tube voltmeter reads full scale, move further away from the receiver chassis and the reading will decrease, permitting an accurate setting of the Mystery Control padding condenser. Set it in the position where the vacuum tube volmeter reads maximum AVC voltage.

NOTE: The Mystery Control is now adjusted to the same frequency as the control frequency amplifiers.

Padding the Control Frequency Amplifier, Using a Pulse from the Mystery Control

The Model 077 Signal Generator is needed if the control frequency is to be changed. If the control frequency amplifier is to be repadded the signal generator can be eliminated. With the same adapter arrangement described above, it is possible to use the vacuum tube voltmeter and the Mystery Control itself in realigning the control frequency amplifiers.

Insert the adapter referred to in the 2A4G socket and shunt a 50,000 ohm resistor across the terminals of the Padding Condenser in the loop. Now dial a station and hold the plunger in so that a continuous pulse is generated by the Mystery Control. Increase the sensitivity control on the chassis until a reading is noted in the vacuum tube voltmeter. If no reading is obtained, adjust the Padding Condenser on the Mystery Control until a reading is noted on the vacuum tube voltmeter scale. Now adjust the first, second and third control frequency transformers for maximum reading in the vacuum tube voltmeter and remove the 50,000 ohm decoupling resistor from the loop Padding Condenser terminals. Now adjust the air padder on the secondary coil (loop) for maximum reading in the vacuum tube voltmeter. Now carefully adjust the padder in the Mystery Control itself for maximum reading in the vacuum tube voltmeter.

These two important uses of the vacuum tube voltmeter will tremendously simplify the service problem of setting up stations and adjusting Mystery Control circuits. By means of a simple clip connection to the control grid of tubes which have automatic volume control applied to them, absolute accuracy and fast adjustments are made possible.

Checking Automatic Volume Control

A set that distorts on strong local signals might have trouble in the AVC circuit. It is possible to connect the vacuum tube voltmeter to the AVC circuit using a 2 meg. resistor in series with the meter lead and measure the actual

AVC voltage. If this is greater than the normal amount of bias that the tube can handle, trouble has occurred in the AVC system and is causing the distortion. An open in the AVC circuit should be indicated by a lack of AVC voltage. Excess signal could be detected in this way and the correct application of a wave trap would follow, eliminating the extra voltage which the abnormal amount of signal would produce.

The reason for inserting the resistor in series with the meter lead is to make readings at the grid cap of tubes on top of the chassis. If the chassis is out of the cabinet and readings can be made at the low side of the coil connected to the tube, this part of the AVC circuit is well bypassed and the capacity of the meter leads will have no effect on the circuit. In this case the resistor is not needed in making AVC readings.

Measuring the Performance of a Radio Set Brought in for Service

The vacuum tube voltmeter can be used to check radio sets against established standards. When performance seems to have decreased, it is possible to measure the gain in RF and IF stages of frequently handled models and when similar models are brought in for service a comparison against those standards will disclose, first, whether the radio is normal, and, second, the exact location of the loss of gain.

In making connections for establishing standards or checking the gain in circuits, it is necessary to connect a .1 mfd. condenser in series with the Model 077 lead in order to avoid bleeding of the AVC voltage.

A suggested method of checking gain is, first, connect the 077 to the antenna terminal and the vacuum tube voltmeter across the primary of the first IF tube. Note the voltage reading and then move the 077 lead to the grid of the first tube. This shows the gain in the first transformer in the receiver. Next connect the vacuum tube voltmeter across the primary of the second IF transformer and note the voltage reading. This indicates the gain in the second transformer. Next move the 077 lead to the grid of the second tube, and so on. Each time the oscillator and vacuum tube voltmeter are moved through the circuit a voltage reading will be noted which should be recorded as an indication of the amount of voltage increase obtained in each transformer and tube in the RF and IF portion of the receiver. Similar models returned for service can be checked against these standards. This will save a great deal of time in checking receivers for performance or in locating the cause of weak reception on the various wave bands.

Adjusting Magnetic Tuning

The vacuum tube voltmeter may be connected directly to the output of the discriminator tube in magnetic tuning circuits and the circuit adjusted for the maximum amount of discriminator voltage. This greatly increases the accuracy of adjusting magnetic tuning receivers.

Eliminating Distortion

Distortion in automatic volume control circuits or in resistance-coupled circuits may be detected with the vacuum tube voltmeter. The distortion may be due to excess AVC voltage, open or incorrect value resistors or condensers, or leakage in coupling or blocking condensers. A vacuum tube voltmeter makes it possible to check the voltages produced in these circuits and to discover whether they are normal or are causing the distortion.

Checking Oscillators in Superheterodynes

It is generally difficult to determine whether the oscillator circuit in a superheterodyne is working properly. However, by connecting the vacuum tube voltmeter directly across the oscillator bias resistor, the entire performance of the oscillator circuit can be completely checked. When the leads of the vacuum tube voltmeter are connected across this resistor, the oscillator voltage is built up in its biasing resistor and should read between three and seven volts in normal radio circuits. As the receiver is tuned, the oscillator voltage should be fairly uniform. The oscillator voltage might vary as much as two to one, but if it varied more than that across the wave band there is trouble in the oscillator circuit. If the voltage is low in the oscillator circuit, the coil, tube, resistors and coupling condensers should be checked to locate the cause of the oscillator failure.

Checking Condensers for Leakage

The megohm meter in the Model 027 can be used to measure condenser leakage. A condenser to be tested should be connected directly to the terminals of the megohm meter, thus avoiding any leads in the circuit. A good condenser, when connected to the terminals of the megohm meter, will produce a slowly rising indication until the megohm meter reads infinity (above 150 megs.). High resistance leakage across a coupling condenser would allow B plus voltage to reach the grid of the next tube or would reduce the amount of voltage produced by an oscillator. Condensers can be checked in this manner for leakage.

Checking Resistance-Coupled Circuits

The vacuum tube voltmeter should be connected to the grid of the audio tube. Leakage across the coupling condenser would be disclosed if a positive voltage appears on the grid of the tube. If there is any positive voltage on the grid of the tube, remove the condenser from the circuit and connect directly across the terminals of the 150 meg. range megohm meter. If the condenser is good, the megohm meter indicator will slowly rise towards infinity.

(A good condenser reads above 150 megs.)

Locating Leakage in Humid Climates

The megohm meter may be used for checking various parts of radio circuits for leakage. We have already discussed the method of checking condensers for leakage. The same thing applies to leakage across wave band switches or the coil forms, or in the wiring of the receiver. In order to check the wave band switch for leakage, connect the vacuum tube voltmeter to the first detector grid. If a positive voltage is present, remove the B plus lead from the wave band switch. If the voltage returns to negative, a new switch should be installed.

Checking the Gain in Transformers and Tubes

Much has been said about checking the gain in radio receivers. This makes the Model 027 have tremendous practical value to a service shop. If numerous sets of the same model are going to be serviced by the dealer or serviceman, it would be advisable to establish standards on that model so that gain measurements can be made in the future. The first standard to establish is an indication of the amount of signal introduced by the signal generator at some point in the radio circuit where enough amplification has been made to secure a reading with the vacuum tube voltmeter. This generally occurs after the first transformer in the receiver, so by connecting the vacuum tube voltmeter to this point and the Model 077 to the antenna terminal of the receiver, set the Model 077 so that a reading of 3 V. is secured on the vacuum tube voltmeter. This is approximately a one-half scale deflection. The leads to the receiver chassis should be as short as possible and whenever gain tests are made in the future, they should be as near to the same position as the serviceman can get them. As the vacuum tube voltmeter is moved up through the circuit an increase in voltage should be noted for each transformer and amplifier tube in the circuit.

By checking receivers brought in for service against these standards a quick decision may be made as to whether the set is normal or whether trouble has occurred.

There are many additional uses of the vacuum tube voltmeter. It is a remarkably stable instrument when its application is understood. Lead capacities need not upset the readings if correct and simple precautions are taken when using the instrument. Leads should always be short. They should not be moved during the procedure of reading the instrument. The fact that the instrument is an accurate indicator of voltage can be disclosed by reading a battery cell. Keep in mind that fresh cells read more than 1½ V. New batteries probably will read .2 or .3 high in voltage.

The many uses of the vacuum tube voltmeter described above make it clear that it has numerous practical uses in radio servicing. The best way you can give improved service to your customers is to use the Model 027 Vacuum Tube Voltmeter in all your service work.