SIMPLIFIED RADIO TESTING

A time-saving procedure for locating circuit troubles with two inexpensive test instruments that can also be used for ALL other aligning and testing purposes INCLUDING TUBE TESTING!

EQUIPMENT

All circuit troubles can be located quickly with the same two basic instruments that perform every other testing operation in radio service work. These instruments, the Philco Model 070 All Wave Signal Generator and the Philco Model 027 Circuit Tester with Vacuum Tube Voltmeter are the basis for the most efficient and least expensive service technique. Portability and freedom from obsolescence, are additional features of both instruments.

PHILCO MODEL 070 SIGNAL GENERATOR

In addition to being a most efficient and accurate aligning instrument, this generator is ideal for checking the operation of all R. F., I. F. and audio circuits. It has sufficient output to impress a signal on R. F. and I. F. stages WITH NO ELECTRICAL CONTACT BETWEEN THE SIGNAL GENERATOR AND RADIO! This feature is helpful in locating the source of intermittent troubles and avoids the aggravating experience of starting the intermittent radio operating by the touch of a test lead, after waiting patiently for the set to stop. The constant impedance ladder-type attenuator adapts the 070 to the testing of gain in individual amplifier stages, coupling transformers and tubes.

PHILCO MODEL 027 VACUUM TUBE VOLTMETER AND CIRCUIT TESTER

This is a perfect companion-piece to the 070. In following the 070 R. F. and I. F. or audio signal through the set, the well damped output meter is quickly brought into step by push button control of its four ranges. When confining the "signal test" to a single amplifier stage, the stable vacuum tube voltmeter will indicate gain in the plate circuit of the same tube on which the signal is impressed! In this way any stage in a radio can be operated independently of the rest of the receiver to definitely locate the cause of intermittent operation.

The usefulness of these instruments is not confined to the simplified test procedure described below. The symmetrical modulation in the Model 070 Signal Generator provides laboratory precision in all aligning adjustments. This feature is absolutely essential in aligning high fidelity band expander circuits and automatic frequency control systems. With nineteen meter ranges available at the touch of a button, the Model 027 Vacuum Tube Voltmeter and Circuit Tester is also indispensable for all ordinary testing operations. The Vacuum Tube Voltmeter further extends the usefulness of this instrument to the testing of voltage in A.V.C. and A.F.C. circuits. The Vacuum Tube Voltmeter is the only means of properly adjusting Mystery Control circuits and setting up push button tuning with final precision.

PROCEDURE

PRELIMINARY TESTING

As most radio troubles are due to burned-out tubes or D. C. voltage supply failures, it is always advisable first to examine all tubes, connections, etc., and to test the plate voltage supply system. It is also good practice to follow this procedure with a test for the common sources of trouble associated with the various types of radios.

Only a small percentage of repair jobs require a complete step-by-step analysis of the entire radio. When this is necessary, however, the following detailed procedure will provide the shortest and easiest path to the source of the trouble.

LOCALIZING TROUBLE

Trouble that seems to be confined to some particular amplifier stage can be quickly localized to the audio, I. F. or R. F. sections of the receiver by means of the signal generator.

The 400 cycle audio signal is first applied to the grid of the first A. F. tube to test the functioning of the audio amplifier. In receivers using a diode-triode tube as the second detector-first audio amplifier, the audio signal can be applied to the diode plate. By applying the signal to the diode plate, a complete check of the diode circuit and volume control which feeds the first audio is obtained.

The I. F. amplifier is next tested by applying an I. F. signal to the control grid of the detector oscillator tube. The operation of the first detector can then be checked by readjusting the signal generator to the same frequency at which the radio tuning dial is set. A signal of this same frequency is then applied to the antenna terminal of the radio to complete the general testing procedure.

TESTING INDIVIDUAL AMPLIFIER STAGES

The components of each amplifier stage—tubes, transformers, coupling units, etc., can also be tested for operation by means of the signal generator. With the shield of the signal generator antenna lead grounded to the chassis, and a test prod connected to the antenna lead of the signal generator through a condenser of suitable size (.1 mfd. for A. F., 500 mmfd. for I. F. and R. F.) a signal can be conveniently applied to the control grid and plate of each amplifier tube. In this manner the trouble in any individual stage can be quickly isolated to the tube, transformer or other part which is at fault. For example, if a signal applied to the plate of an amplifier tube produces a sound in the speaker while there is no response, when the signal is applied to the grid of the same tube, trouble in the tube or in the voltage supply to that particular tube would be indicated.

TESTING OSCILLATOR STAGE

The voltage output of the oscillator can be measured conveniently by means of the vacuum tube voltmeter. This voltage will appear across the oscillator bias resistor and can be checked at that point by connecting the test leads of the vacuum tube voltmeter directly to the terminals of this resistor. In most oscillator circuits the voltage can also be measured across the oscillator section of the tuning condenser. In this case the "high" test lead of the vacuum tube voltmeter should be connected to the high potential side of the tuning condenser through a small condenser of approximately 200 mmfd.

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 varies more than that across the tuning range 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. Absence of bias voltage of course indicates lack of oscillator action.

The operation of the oscillator in superheterodynes can also be checked by means of the signal generator. An unmodulated signal from this instrument will provide a substitute for the output of the oscillator stage. This signal, which can be fed into the grid or cathode circuit of the oscillator, should be tuned to the proper oscillator frequency for a local station. This frequency is calculated by adding the frequency of the local station to the intermediate frequency of the set. With the tuning dial set at 600 K. C., in the radio having 465 I. F., the signal generator should be adjusted to 1065 K. C. to reproduce the signal of the local 600 K. C. station.

TESTING A. V. C. ACTION

By connecting the Vacuum Tube Voltmeter through a suitable (4 meg.) isolating resistor to any point of the A. V. C. network an accurate indication of performance is obtainable.

Lack of voltage indicates trouble along the line. High negative (or positive) voltages are a positive indication of defective components. By observing the no-signal A. V. C. voltage and then tuning in a signal, a good observation of A. V. C. time delay can be made. Excessive time requirement for reaching terminal A. V. C. voltage indicates trouble in the various resistor—condenser (time delay) combinations in the A. V. C. filter network. Observation of A. V. C. voltage by means of the Vacuum Tube Voltmeter is a very satisfactory padding method, since maximum signal transfer (hence A. V. C. voltage) is obtained at resonance.

INTERMITTENTS

There have been many ways suggested in the history of radio servicing as a solution to the intermittent problem, but none so far have been able to replace the brains of the man testing.

The two most annoying parts of this problem are:

1. Inability to produce cut off in intermittent set.
2. Inability to properly test set when intermittent because of upsetting conditions (and restarting operation) by contact potential of test leads.

Heat is the cause of most of the "number one" problems. Instead of operating the set in its proper position, in its cabinet, the serviceman must turn it bottom up on the bench and expose it to the air on all sides. The lowered chassis temperature is in many cases too low to cause condensers or resistors to open or short.

A satisfactory solution employed at Philco and by many servicemen is the enclosing of the chassis in a box, either of wood, paper or metal, which so restricts air flow and radiation as to permit the high operating temperatures to be obtained.

Having thus produced a "cut off" in performance, it is necessary to locate the offending stage.

This can be done with a Signal Generator and Vacuum Tube Voltmeter as follows:

1. Connect the Vacuum Tube Voltmeter capacitively to the output stage.
2. Using maximum signal generator output, bring the "High" lead of the signal generator near the tube grids in turn, starting at the second detector and working toward the antenna.

The offending stage is shown immediately by exploring in this way, and no contact potential has been generated which would cause operation to be resumed.

An alternate method is to connect the signal generator and Vacuum Tube Voltmeter to the input and output of any stage, and allow the set to operate. Any changes in performance are indicated on the Vacuum Tube Voltmeter without dependence on any other stage but the one under test.

TESTING TUBES

An unusual tube comparison test can be made at radio frequencies by connecting the signal generator and Vacuum Tube Voltmeter as above, taking an attenuator and Vacuum Tube Voltmeter reading, and substituting another tube. A higher output reading for the same attenuator setting, or the same output for a lower attenuator setting indicates superiority of one tube over the other. Observations across oscillator bias resistors also will give comparative information for various tubes at various frequencies. This kind of tube performance information is obtainable in no other way.

GENERAL CIRCUIT TESTING WITH VACUUM TUBE VOLTMETER

Modern set design necessitates a measuring instrument independent of frequency and having no power requirement. Ordinary meters require so much current for operation from the source under test that they are completely worthless even on direct current. The requirements of radio frequency further reduce the utility of these meters.

The Vacuum Tube Voltmeter included in the Philco 027 meets these requirements perfectly.

Measurements of voltages in grid and plate circuits containing high resistances, A. V. C. and A. F. C. circuits, oscillators, R. F., I. F. and Wireless Control circuits can all be made quickly, conveniently and accurately.

It should be remembered that Vacuum Tube Voltmeter leads should, when working on R. F., be kept as short as possible. The Vacuum Tube Voltmeter should be decoupled from the receiver circuits wherever necessary. After Vacuum Tube Voltmeter leads are connected to the circuit under test, the position of the leads should not be disturbed, as this will affect the circuit capacities. Voltage measurements must always be made across a load: resistive for D. C. and reactive for A. C. For example, the plate winding of the I. F. transformer is the A. C. plate load for the I. F. tube, and voltages should be measured across this winding.

SUMMARY

The Philco 070 Signal Generator and 027 Vacuum Tube Voltmeter comprise testing equipment suitable for all radio circuit problems. Expensive, heavy, bulky, complicated equipment can do no more—in fact, **does not** do as much.

Test equipment is intended to supplement the service engineer—not to replace him. There is no substitute for knowledge, experience and ability.