Servicing Intermittents

TO REPAIR INTERMITTENTS

DO—

1. Obtain all possible information from customer.
2. Avoid jarring set until trouble appears.
3. Check tubes for intermittent shorts and noise.
4. Check capacitors by probing and tapping them gently.
5. Check resistors by tapping at connections.
6. Check wiring, terminals, etc., in same way.
7. Check tube sockets, particularly the rectifier, for arcing.
8. Play set for several hours if doubtful.

DON'T—

1. Jar set until trouble is found.
2. Treat components roughly.
3. Repair open filter capacitor by bridging with good unit. Remove defective capacitor.
4. Replace one section of a filter capacitor and leave others in place. Replace all.
5. Take anything for granted.

By JOHN B. LEDBETTER

ONE of the most trying and time-consuming problems of radio receiver servicing is the location and correction of intermittent troubles. Intermittents not only waste valuable time; they also cut down profits. It is often difficult for the customer to understand a repair bill for "three hours labor" when the trouble was caused by a 15-cent capacitor.

Intermittents produce a variety of symptoms and are due to as many causes as there are parts in the set. In the majority of cases, however, the probable sources of trouble can be narrowed down and the defective part located by making a few simple aural checks. In addition, it is common knowledge that certain makes and models of receivers have recurrent troubles which often are peculiar only to that model.

Familiarity with these peculiarities, gained through past experience, often will indicate the approximate, if not exact, component at fault. For example, a particular set of several years ago was notorious for its poor bypass capacitors (it was not unusual for the whole capacitor to fall out of the set when one lead was clipped); another was known for open, noisy i.f. primaries. Another set often came up with intermittent broken leads in the voice coil.

The tests described below admittedly will not show up the trouble in every instance; there are many elusive cases which will clear up at the slightest circuit disturbance or will occur only at rare intervals, sometimes days apart. For ordinary or recurrent intermittents, however, these tests will prove to be worth-while in saving time, patience, money, and customer good will.

In any intermittent complaint, first secure all the information possible from the customer. Here are some of the stock questions which can help a great deal in locating the trouble:

1. Does turning an electric light or appliance on or off cause the set to cut in or out, or does this occur independently?
2. Does jarring the set or operating the volume control or waveband switch affect operation?
3. Does the customer use an external aerial or ground?
4. Does the pilot light flicker or go out when the trouble appears?
5. How long has the set been acting this way?
6. Does the condition appear only after the set has been on for a certain time?
7. Is the trouble more noticeable at certain hours of the day?
8. Does trouble occur at both ends of tuning range on a given band?

On service calls to the customer's home, turn the set on and wait for the trouble to appear before disturbing any connections or jarring the set. In this way you will obtain first-hand information as to the nature of the complaint; taking the set to the shop *first* often relieves the trouble and makes for undue difficulty in making it reappear. Frequently such simple things as a loose or shorting antenna wire or a loose ground connection are responsible for intermittent, noisy reception. Poor connections at the wall socket or extension plug also contribute their share. Noise in the set can also be caused by a dirty ground, loose lamp socket, etc. Check all light bulbs for tightness in the socket; examine line plugs for loose, dangerous connections. A noticeable change in volume as a light or appliance is turned on is a good indication of a bad coupling or bypass capacitor.

If you have no chance to observe operation of the set in the owner's home, handle it as gently as possible until the trouble has had a chance to show up. Avoid placing the receiver on a metal-top bench where possible contact with the chassis or antenna lead might upset the electrical balance and clear up the intermittent condition. It is always best to obtain an aural indication of the trouble *before* checking the tubes or removing the chassis.

In many cases the fault may be due to a short in the wiring, tube-socket terminals, or component leads; pulling a tube from the socket may relieve the trouble temporarily. Sometimes this effects a permanent cure; more often, it results only in restoring normal operation *until the set is taken home.*

The most common causes of intermittent reception are (in the order in which they commonly occur) capacitors, tubes, coils and transformers, resistors, high-resistance joints, poor connections, and socket breakdown. However, it is more convenient to check the tubes *first*. Many times the symptoms may point to a defective capacitor when actually a tube is at fault. Testing the tubes first often results in locating and correcting the trouble without removing the chassis. (It might be pointed out however, that many technicians remove the chassis anyway to check and clean all components.)

Tubes

Intermittent operation in a tube is usually due to an internal short or to an open due to the heat in the heater circuit. In most instances, intermittent shorts or poor connections in a tube can be located quite readily by tapping the envelope or grid cap. The usual symptom which denotes this kind of tube trouble is a drop in volume, accompanied by a crackling or rustling noise. In oscillator or converter tubes, the noise is often accompanied by loss

or shifting of the station. In high-gain, multi-element tubes, a poor grid connection is frequently responsible for intermittent operation. This trouble is prevalent in such tubes as the 6T7-G, 6B6-G, 75, 6Q7, 6F5, and their 12-volt or single-ended counterparts. Converter tubes such as the 6A7, 6A8, 6K8, and 6SB7Y are similarly affected.

Intermittent heater operation, especially in metal tubes, is a bit harder to locate, particularly when the heater is opening at a steady, slow rate. In the majority of cases, the tube filament will show continuity when checked with an ohmmeter, but will open again as soon as the heater reaches normal operating temperature. The faulty tube may sometimes be located by placing a hand on the metal shell and comparing its warmth with that of similar tubes in the set. Many times it is necessary to use the substitution method. Some servicemen use an electric sun lamp or heater element to raise the temperature of the suspected tube. This method is all right if used for only a short time, but don't overdo it. A sun lamp on the loose can wreck more than a little havoc of its own, particularly on parts adjacent to the tube.

In cases where vibration of *any* tube or *any* part of the set produces the same amount of noise, it is a good idea to try the substitution method first, starting with the converter tube. If the set is out of the cabinet, it is well, of course, to examine the wiring and component leads briefly for indication of poor contact or soldered joints.

Heat-affected heater elements are more prevalent in high-voltage a.c.-d.c. tubes such as the 25L6, 35L6, 50L6, 50A3, and 117L7. The higher operating temperatures in these tubes, along with the increased filament contraction and expansion, make them more susceptible. The 35Z5 and similar types of rectifier tubes are also in this category. In tapped-heater types, such as the 35Z5, which show up with an open pilot-lamp section, be sure to check the pilot lamp for burn-out and to replace it with a bulb having the proper current rating before replacing the tube. If either the pilot lamp or the pilot-lamp section of the tube burns out, the current load on the remaining branch is doubled and *it* soon burns out.

In some cases a replacement tube in an a.c.-d.c. set will show a tendency to burn brighter than normal. Although this does not necessarily mean trouble, the a.c. voltage across each tube heater should be checked. If any one tube is taking more or less than its share of voltage, the cause should be found and corrected. Often the resistance of the tube is incorrect. (This may be checked by substituting a new tube.)

Capacitors

The most common source of intermittent trouble in capacitors is the loosening of lead contacts which results in a very light pressure on the foil. Usually the trouble can be found by tapping or probing the capacitor lightly. Avoid pulling or striking roughly, since this is an almost sure way of *making* an intermittent. An intermittently open capacitor generally can be located by bridging it with a good capacitor of the correct value. In some cases, however, substitution may not give an absolute indication unless one end of the suspected unit is cut loose. Bad paper or mica capacitors in the oscillator circuit usually result in a shift in frequency of the station, especially at the lower end of the band.

Electrolytic filter capacitors of the fabricated-plate type often are the cause of intermittent popping, static-like noise, which may be accompanied by hum and oscillation. As with bypass or coupling capacitors, the surge caused by bridging a filter capacitor with a good unit may cause it to heal. The entire filter block should be replaced at the first indication of trouble. Avoid replacing just the bad section; the other is likely to give trouble shortly. If this happens, you will have a dissatisfied customer on your hands.

Coils and transformers

I.f., oscillator, antenna, and r.f. windings are subject to electrolysis and corrosion because of moisture content in the coil forms and absorption from the atmosphere. Trouble usually appears in the primary section first, the windings next to the coil forms showing green, corroded spots on the form and throughout the first few layers of wire.

Noise originating in a transformer can be determined either by measuring the winding resistances with an ohmmeter or by momentarily shorting the plate end of the suspected transformer to ground. Resistance of a corroded winding will vary from the readings of the other windings, reading higher if high-resistance corroded spots are present, and reading lower if the winding is partially shorted.

Coil and transformer noise in a set may be isolated in the following manner:

1. First short the second-detector grid to ground. If the noise persists, the trouble is in the second-detector plate circuit, the audio stage, or the speaker. If it ceases, it is *ahead* of the second detector.

2. Short the grid of the last i.f. stage to ground. If the noise stops, look for a defective tube or plate circuit in the stage *ahead*. If the noise is still present, the trouble is in the last i.f. stage.

3. Continue the test, successively shorting the grid of each stage to ground, working back to the converter or r.f. stage. Noise which ceases when the grid of the r.f. stage is grounded is being picked up from a defective antenna coil or from an external source.

A defective oscillator coil is indicated by improper tracking or by inability to pick up a station even though the converter is operating. Noise in the speaker may be due to a defective field coil or to turns of the voice coil which are rubbing against the speaker frame. The voice coil may open intermittently or short under these conditions. Braided voice-coil leads are found in some sets; vibration may cause the braid to wear and pull loose, producing an intermittent open.

Resistors

Resistors usually giving trouble are wire-wound, metal-covered bleeder units which are riveted to the chassis. Poor connections between the terminal lugs and resistor elements often cause an open condition, which may show up when the set is first turned on but which will disappear after the resistor has warmed up and expanded. To check this possibility, make a resistance measurement of the resistor sections when the set is hot, and again after it has cooled. An open or partially shorting condition will often be shown up here.

Carbon resistors frequently develop internal noise. This trouble is usually continuous when it develops and may easily be found; intermittent noise may be located by twisting or probing the resistor.

Other causes

A set may become intermittent only at certain times of the day. Usually trouble will be found in a poor oscillator or rectifier tube or filter capacitor. Operation becomes erratic only when the line voltage drops below a certain critical point. Intermittent distortion, especially in a.c.-d.c. receivers, may be due to secondary emission in the output tube when the line voltage is *increased* to a certain value.

Arcing or intermittent operation caused by loose tube-socket terminals, poorly soldered connections, etc., can be located by probing and tapping the wiring or by turning off all lights and watching for a small arc at the loose point. High-resistance joints may be located best by applying a hot soldering iron to the terminals. This is particularly effective in oscillator, r.f., and a.v.c. circuits.

As mentioned before, servicing of intermittents can often be expedited by focusing a heat lamp on the set so that its operating temperature increases. Thermal conditions may also be checked by placing the set for a time in an old refrigeration or cold-storage unit. A flasher placed in the a.c. line often causes breakdown of faulty capacitors by generating peak surges. The same result may be accomplished in a.c. sets by removing all the tubes except the rectifier and letting the set "cook." The increased voltage, in most sets at least, will not damage a good capacitor but very often one on the verge of breakdown will be shown up.

Most intermittents can be located by combining patience with simple logic and circuit analysis, based on practical experience and a knowledge of typical receiver peculiarities. There are cases, however, where an intermittent may refuse to show up for hours or even days. This type of set should be connected t some form of signal tracer and left to run while other sets are being repaired.