How to Make Extra Money

FIXING RADIOS

NATIONAL RADIO INSTITUTE WASHINGTON D.C.

No. 24 How To Fix a Noisy Receiver

RADIO SERVICING METHODS
Dear Mr. Smith:

When I enrolled with NRI I was a cotton mill hand, making only $6 to $10 per week. I even had to put off a bill I owed to make my first payment. The Course soon more than paid for itself, and my income rose steadily. In four years I have reached an income of over $3000 a year. I owe it all to NRI.

C.W.H., Georgia
Disconnect the Antenna. The first step is to disconnect these paths to prevent the noise voltage from getting to the set. If the set is losing power to block these paths and prevent the noise voltage from getting to the set, you will have to block these paths directly. There are two ways to do this: (1) use high impedance receiver or (2) use a low noise receiver. The choice is yours, and the choice is yours. In general, the lower the noise in the receiver, the lower the noise produced. Noise impulses can get into the receiver from an outside source through the antenna-ground system or from the receiver itself through the power line. Also, the receiver is in a sensitive state throughout the antenna-ground system or it may be in a sensitive state in the receiver itself.

Localizing the Noise to the Set

Let's see how this is done.

First step in the set is to determine if some outside interference is to blame. If so, go to the receiver to find out if the receiver is the source of the noise. Therefore, the first step is to connect the receiver to the set to see if the noise is present in the receiver or in the set. If the noise is present in the receiver, then the noise is coming from the receiver. If the noise is present in the set, then the noise is coming from the set. The next step is to look for the source of the noise. Noise may be caused by some external condition, such as a thunderstorm, or some external interference. Noise may be caused by a defect in the set, but it may also be caused by a defect in the receiver. Noise may be caused by a defect in the signal source. Noise may be caused by a defect in the receiver or the set. Noise may be caused by a defect in the signal source. Noise may be caused by a defect in the receiver or the set. Noise may be caused by a defect in the signal source. Noise may be caused by a defect in the receiver or the set.

We say a radio is noisy when it makes popping, crackling, and hissing sounds.
nect the antenna from the receiver. (If the set has a built-in or loop antenna, follow the directions given later.) With the antenna disconnected, connect a short piece of wire between the antenna and ground posts on the receiver. This effectively prevents noise pickup by the antenna system. If a ground is used on the set, leave it connected temporarily, but connect the antenna itself to the ground, or move it well away from the receiver.

With the volume control turned full on, listen to the receiver. If the noise has decreased greatly or has disappeared altogether, probably the noise source is outside the set.

If the receiver has a loop antenna, try rotating the loop (or the entire receiver cabinet). Since loop antennas are rather directional in their receiving characteristics, any change in noise level as you rotate the loop indicates that the set is picking up the noise from some external source.

When a built-in antenna "hank" (a length of wire permanently fastened to the set) is used, roll the wire up so as to reduce its effectiveness as an antenna. If this reduces the noise level, the antenna is picking up the interference.

If the noise is still strong, continue the tests to determine whether the noise is originating in the set, or is coming in over the ground or power line.

Disconnect the Ground Lead. If the noise level remains the same when the ground lead is disconnected, the receiver is at fault, or the noise signal is coming in over the power line. However, if the noise decreases, you may have a poor ground. If it increases, the noise signal is probably coming in over the power line.

Filter the Power Line. You should have a power line filter — various commercial ones are available — for checking for noise coming over the power line. Fig. 1 shows how the filter is installed: you plug the filter into the wall outlet, and then plug the radio into the filter. This filter, which consists of by-pass condensers and r.f. choke coils, reduces the amount of r.f. energy traveling down the line to the receiver. If the filter reduces the noise, the noise voltage is coming in over the power line.
Remove ground and disconnect antenna.

Power line set plugged into connected to set and with antenna and ground.

Confirm the complain.

Plug filter into wall outlet, plug power cord into filter.

To a receiver how to localize noise.
On the other hand, if the noise remains the same for all these tests, either the receiver is noisy, or it is picking up noise directly because of exposed wiring or because of its location.

**Using a Test Receiver.** Sometimes these tests will not be conclusive. If you are not sure whether the receiver is defective or whether the noise is of external origin, you can try another receiver in the same location as the suspected one. A small three-way portable receiver is excellent for this purpose. To make a test with such a portable, proceed as follows:

Turn on the customer's receiver so that the noise can be heard and identified. Then, disconnect the antenna from the customer's receiver, and connect it to the aerial post of the test receiver. Plug the power cord of the test receiver into the outlet, turn on the test set, and tune it to see if the same noise is picked up. If the noise is heard on the customer's receiver but not on the test receiver, the customer's set is probably defective. If noise is heard on both receivers, the noise is probably being picked up.

If the noise is apparently being picked up, try the test receiver on its built-in battery supply, unplugging its cord from the wall outlet. If the noise disappears, it was coming in over the power line. If it is still present, it is being picked up by the antenna. In the latter case, disconnect the antenna from the test receiver. If the noise decreases greatly, it is definitely being picked up by the antenna.

- If you have no test receiver, you can take the customer's set to your shop. If the set is noisy in this new location, it is probably defective. On the other hand, if the set plays normally and quietly on your work bench, but is noisy in the home of the customer, then the noise signal is being picked up.

**Procedure for External Noises.** When you find that the noise originates outside the set itself, the exact procedure to take will depend upon just what you think is causing the noise. If the trouble is atmospheric disturbances, explain to the customer that the noise will go away as soon as any nearby thunderstorms clear up. (Incidentally, f.m. receivers have very little trouble with
INSTALLATION DEFECTS

Closer installation, defects within the receiver or associated with the re-
ceptacle, or defects in the wiring or ground system, or a loose antenna lead-in, may be the source of noise. Once you discover that the noise volume originates from man-made...
To prevent interference caused by ground pipes that make variable contact with each other, either bond them electrically (left) or wedge them apart permanently (right).

- Similarly, shake the ground wire. Many people wrap the ground wire loosely around a radiator pipe. After a time, corrosion will set in between the wire and the pipe, or the wire may oxidize because of the heat. Either condition will partially insulate the wire from the pipe; then any movement of the wire may make and break contact between them, and cause noise.

  If you find such conditions, see if it is possible to connect the ground wire to a cold-water pipe. Also, use a ground clamp to make good contact between the ground wire and the pipe to which it is connected.

  Sometimes the noise is caused by a poor joint in the heating system. Kick the pipe leading to the radiator to which the ground wire is connected. If this causes noise, but a good connection is maintained between the ground wire and the pipe, there is probably a poor electrical contact somewhere in the pipe. Plumbers use a paint or dope in the joints between pipes to seal them and prevent the escape of water and steam. This seal prevents a good electrical contact, and as corrosion develops and joints loosen, the contact becomes poorer.

- Sometimes the noise will occur or increase when you move about the room near the radio. Once in a while this means the receiver is defective, and you are jarring it enough to set the noise off. However, it often indicates that the pipes in the plumbing system under the flooring
WHAT CAUSES NOISE IN A SET

Let's see if the noise disappears.
Replace the radio with another one.
Place the radio into another outlet.
In the wall outlet itself may be worn and in need of repair. The wall outlet is itself may be worn and in need of repair. Place it in one of the wall outlets. If you suspect this, disconnect every possible connection to the radio. Place it in one of the wall outlets.

Cautiously, if necessary, bend the printed circuit to make a better contact. Place it in one of the wall outlets. If you suspect this, disconnect every possible connection to the radio. Place it in one of the wall outlets.

Nonetheless, if the noise persists, it may be necessary to purchase a new radio.

Shake the power cord tightly to the receiver, also, be aware of the effectiveness of the grounding system, will cause noise. The remedy is to locate the pipes and then either cover them with two ground clamps and a piece of wire to make a per-

mermanently By placing a wooden wedge between them, temporary connections between the pipes or separate the two ground clamps and a piece of wire to make a per-

are barely touching each other and are making and
sharply, and another noise pulse will be created. A steady noise will be heard if the intermittent open recurs rapidly.

Notice—an open must be intermittent to cause noise. A permanent open circuit will result in a dead receiver or in improper operation, depending on the circuit in which the open exists.

*Noise is also caused by a poor connection where no connection is desired.* A partial short circuit is an example. Suppose that the support of a screen grid becomes loose, allowing the screen to move when the tube is jarred. A sound wave from the loudspeaker may cause the chassis and the tube to vibrate. If the screen grid touches the suppressor grid, the B supply will be shorted; a noise pulse will be set up because the plate current will at once drop to zero. Another mechanical shock may break the connection between the screen and suppressor grids, setting up another noise signal as the contact is opened.

**SPECIFIC DEFECTS THAT CAUSE NOISE**

Now that you know how a noise signal is generated, let's learn which radio parts cause the complaint. As we discuss each part, we shall describe the tests to use on it, and tell you how to cure the trouble. Hence, when you have localized the trouble to a stage (by methods we will describe later), you should follow the suggestions given for each part.

*Variable Resistors.* Volume and tone controls are the most frequent cause of noise. They come in two types, wire-wound and carbon, and, with use, both types develop poor contacts between the resistor elements and the sliding contact.

If you hear noise when you adjust a volume or tone control, you can be sure the control is defective. A very bad control will cause noise whether the control is adjusted or not, but the noise will be worse as the control arm is moved.

Once a control goes bad, the best thing to do is to replace it. Any repair you might make would be temporary at best—and would probably take longer than installing a new control.
The condenser C can be from 0.05 to 0.1 micromfd.

The control can be from 0.05 to 0.1 micromfd.

The resistor is a carbon type. A wire wound resistor should be used.

The resistance of the resistor is difficult to determine. If the resistor is not used, it may cause noise, especially in older sets. They are not widely used in modern receivers. If pulling on wires when using a wire wound resistor, cause no noise.

Wire-Wound Resistors. Wire-wound resistors are not widely used in modern receivers.

To determine the location of the carbon control, you can check if by touching the resistance strip, turning the control arm, one can turn the control rapidly. If touching the resistance strip, you will be able to turn the control rapidly. Therefore, you will be able to turn the control more rapidly. The carbon control should not be used in a circuit where d.c. current flows. The current produces sparking.
springing out the resistor unit enough to subject it to a mechanical strain. (Insert a screwdriver blade between the resistor can and the chassis, and twist it to cause this strain.) If this causes a sudden appearance or disappearance of the noise, the unit is defective. A defective wire-wound resistor of any type should be replaced.

Transformers. We shall discuss several kinds of transformers in this section, because the same methods of localization and cure are used for each.

Noise originating in a transformer is normally caused by electrolysis (electro-chemical corrosion) at a soldered joint or terminal of the transformer (sometimes, also, between layers of windings). This corrosion will eat through the fine wire of the transformer and thus break the connection. However, the ends of the wire are so close together that arcing occurs across the break. Thus, the circuit is intermittently and rapidly opened and closed, producing sharp changes in the current. This causes machine-gun-like bursts of noise, often so loud they drown out the program.

This form of electrolysis occurs most commonly in a coil that carries d.c. current. Therefore, you can expect the primary windings of transformers to be more affected by this trouble than the secondaries. It is also more apt to occur in a damp climate; in fact, if you live in such a climate, you may find that transformers are a very common source of your noise complaints. In modern receivers, the i.f. transformer is the one that causes the most trouble. The output audio transformer is next, and the r.f. transformer is third in this respect. It is seldom that noise is caused by a power transformer winding, probably because the wire used is so large that electrolysis cannot readily eat all the way through it.

You can check a suspected transformer with your ohmmeter or voltmeter. An ohmmeter test is not always conclusive, because there is at times only a partial open, or the circuit may be completely rejoined at the moment the ohmmeter is used. If you do not find an open at once, hold the ohmmeter test probes on the winding for a few moments to see if the resistance reading changes. If it does, the transformer is defective.
only as an indication that the transformer is defective.
rent. This will clear up the noise; however, take the
the weak spot may be welded together by the high-cur-
momentum theory. It is possible that the ends of the wire at
usually open permanently, thus indicating that the
former. If the transformer winding is weakened, it will
through the primary winding of the suspected trans-
a screwdriver or test lead. This will draw a high current
momentarily from the plate socket terminal to D—with
cover using a power transformer, you can short-circuit
As a "Killer" or cure, procedure on an A.C.-operated re-
Either the transformer is defective, or it soon will be.
you have definite proof that electrolysis is at work.
If you can see green corroded spots on the winding,
the wire will vary erratically. If the transformer is defective,
line when the meter is connected. Also, the voltmeter read-
through the transformer, and the noise may disappear
plate-to-cathode voltagel. The voltmeter draws current
further test (with the tube removed), measure the
appear when the tube is removed from the socket. As a
operation and the tube is in the socket, but should dis-
most affected, the noise will occur while the set is in
Since the primary winding (in a plate circuit) is the

Use a test lead equipped with prods to short from a tube plate
Through the restricted space (for simplicity, we have shown no parts of
the rectifier, space in the chassis. If engine 7110 is being a screwdriver into
socket to the chassis, it is easier than getting a screwdriver into

Wires connected to the socket in this illustration.)
If you suspect a tube has loose elements, snap it with your finger. A burst of noise from the set indicates your suspicions are probably correct.

Do not consider that the defect has been repaired, because it will recur shortly.

Each of the above tests is for the primary winding. If the trouble is in a secondary winding, then the ohmmeter test can be used. Also, you can momentarily short the B supply through the secondary winding of the transformer by holding a test lead between B+ and the grid end of the transformer. This again may open the transformer, thus indicating the location of the defect.

A defective transformer must usually be replaced. Sometimes, as you learned in an earlier Booklet, it is possible to repair a winding if corrosion has occurred at only one end.

Wave-Band and Push-Button Switches. Dirty and loose switch contacts in signal and voltage supply circuits are prolific sources of noise. You can locate these readily, since you will hear noise when you operate the switch.

Usually, you can clean dirty contacts with a tooth brush dipped in carbon tetrachloride. You can often restore lost tension by bending the contacts with a pair of long-nose pliers. Of course, the receiver must be turned off while you are working on the switch.
You can clean out dust and dirt from between the blades, a puller knife, or a spatula. Apply heat or wax, and sharpen them with a thin-bladed knife. If only one or two of the plates touch, they are probably strayed, so loosen all the screws, and square them up. The screws, to make a repair, loosen all the screws, re-space, and then turn the stator to the insulating strips by hand. This can occur occasionally. If the plates all seem to touch, the stator see-

When you meet this condition, examine the condenser, which is located on the tuning range. Low-frequency and the set may be dead over a portion of the range. The set may become much worse as the tuning dial is turned. The noise will increase as the tuning condenser is turned, because the noise may cause a short circuit of the plate, or poor contact to the rotor. When you meet this condition, examine the condenser, which is located on the tuning range.

Tuning Condensers. Dirt between the plates, warp-

Still test O.K. in a tube tester. This problem is usually because the tube may be a new tube, you probably were listening to a station that is tuned to a station that is not tuned to a station that is tuned. When the set is not tuned to a station that is tuned, the noise may be caused by a certain amount of hissing and truing noise heard.

Part, or have a defective socket. If the noise increases with a new tube, you probably were listening to a station that is not tuned to a station that is tuned. When the set is not tuned to a station that is tuned, the noise may be caused by a certain amount of hissing and truing noise heard.

Tubes. Loose elements or poor internal contacts are often caused by a defective socket. If the noise increases with a new tube, you probably were listening to a station that is not tuned to a station that is tuned. When the set is not tuned to a station that is tuned, the noise may be caused by a certain amount of hissing and truing noise heard.

Instal
plates by blowing between them with compressed air or by passing a pipe cleaner (obtained at tobacco stores) between each set of plates in turn.

**Poor Contacts.** Various other kinds of poor contacts can cause noise. Poorly soldered joints are frequent offenders. Always be sure you do a good soldering job yourself—and examine any noisy receiver for evidence of poor soldering by some other serviceman. If solder appears to be lumped or cracked, pull on the leads, and wiggle parts to see if you can make the noise start or stop. Sometimes you can locate a defective joint by pushing on the joints with a wooden stick. When there is any doubt, resolder the connection.

Watch out for drops of excess solder that hang down from a joint and cause a partial connection to the chassis. Remove any you find.

▶ A poor contact can also exist at a bias cell. These bias cells are held in small holders that depend on spring tension for contact. Sometimes it is necessary to clean the cell or to strengthen the contact.

▶ Once in a while a shield over a tube or over another part will be a source of noise because it makes a poor contact to the chassis. Normal speaker vibration will shake the shield and thus vary the contact. To improve the contact, tighten the screws holding the shield to the chassis, or bend the shield if it is a pressure fit. If the shield is fastened by rivets, drill them out, and use machine screws, lock washers, and nuts in their places.

**Leakage Paths.** Sometimes arcing occurs across a dirty or moist bakelite part, producing a charred path of low and varying resistance. Leakage current flowing along this path will also vary, causing noise.

This sometimes happens to tube sockets, particularly those of rectifier tubes. In this case, you will hear a sizzling sound, and, with the lights turned off, you may be able to see the arcing. It is best to replace the socket. Sometimes you can make a repair by scraping away all the carbonized material and painting the spot with speaker cement. This should be considered a temporary repair, however, although it will often last a long time.

**Less Common Noise Sources.** There are several other
Therefore, the volume control separates the R.F. from the detector, and when the volume control is set at R.F.-I.F. section, the detector is disabled. If the R.F. and I.F. are both used, a noise source may cause the noise to appear on both sections.

Locating The Noise Source

Certain clues will lead directly to the noise source. As we have already said, a change in noise level when

**Diagram:**

- A.F. Section
- Volume Control
- R.F.-I.F. Section
i.f. section from the audio section. If you turn the volume control to the minimum volume position and the noise disappears, its source is in the r.f.-i.f. section of the receiver; if it remains, its source is in the audio amplifier or in the power pack. (This is not always true—severe changes in current, such as may be caused by a plate circuit defect in an r.f. or i.f. tube, may affect the power supply to the audio amplifier even when the volume control is turned to zero volume. However, in such cases, turning down the volume control will decrease the noise intensity greatly.)

LOCALIZING NOISE TO A STAGE

Noise signals pass through the stages in the same way as other signals do. Their source can be located with a signal tracer, or stage blocking can be used.

To use a signal tracer, tune to some quiet point on the dial. Trace from the first stage of the defective section towards the set loudspeaker. When you first hear the noise coming from the signal tracer speaker, you have located the defective stage.

Remember that noises caused by defects in common power supply circuits may feed into a number of stages, so it is possible to pick up a noise signal in the plate circuit of one tube when the noise is actually originating in a later stage. This can occur only when the noise signal is unusually strong, or in sets in which there is insufficient by-passing of the supply leads.

Once the defect has been isolated to a stage, check the voltages in that stage to determine which voltage seems to be varying. This may provide an additional clue to the defective circuit.

If you use the stage blocking method, start from the second detector. Work toward the loudspeaker if the trouble is in the audio section, toward the antenna if the trouble is in the r.f.-i.f. section.

When the receiver is a standard a.c. receiver with tube filaments in parallel, it is possible to pull out tubes to block stages. For example in Fig. 3 let's assume first that the noise is in the a.f. amplifier. In this case, you can pull out tube $VT_2$. If the noise stops, but continues when this tube is in the socket and the volume control
FIG. 3
is turned to minimum volume, it must be originating in
the first a.f. circuit. Assuming that the volume control
is good, the most likely source of noise in this circuit is
the tube itself.

If the noise continues with tube VT₃ out of the socket,
it is originating in the output tube stage. Here, a defec-
tive output transformer or tube is the most likely cause.
▶ If, instead, the noise is in the r.f.-i.f. section, turn the
volume control to maximum volume and remove tube
VT₂. If the noise continues with this tube removed, it
must be originating in the diode detector stage; tube
VT₃ and the volume control are the most likely suspects.

If the noise stops when VT₂ is removed, replace this
tube and pull out VT₁. If the noise continues, it is prob-
ably originating in the VT₂ stage. I.F. transformer T₃
and the tube are the most likely source of trouble here.

Of course, if the noise ceases when VT₁ is pulled out,
it must be originating in that circuit. I.F. transformer
T₂, the tube, the oscillator transformer T₁, the loop an-
tenna L₁, or either of the tuning condensers (C₃ and C₄)
could be at fault. Examine each carefully.

To determine whether the noise is in T₂, leave VT₁
out of the socket, and connect a voltmeter between the
plate terminal of the VT₁ socket and the chassis. The
voltmeter current will then be drawn through the pri-
mary of T₂. If the noise occurs now, but does not with
the voltmeter disconnected, the primary of T₂ is defec-
tive.
▶ Of course, if the receiver is not a standard a.c. set,
you can’t pull out the tubes. In this case, block the grid
or plate circuits. It is easiest to block grid circuits, and
the simplest way to do so is to connect a large by-pass

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**BENCH HINTS**

Many record changers will not work properly if the motor
board is not level. Check levelness with a carpenter’s or
machinist's level resting on the motor board (not on the
turntable). If you find the board is not level, slip small card-
board or wood wedges under the cabinet.
Almost the only other quick stage localizing test be-
these disadvantages.

These disadvantages. Blocking the grid circuit does not have
returns later. Blocking the grid circuit will not hurt
you without a clue to the detector part until the noise
will increase. This may have been due to a heavy enough discharge current to weld
each time you use it. In some low-voltage plate circuit,
furthermore, the condenser will charge or discharge
do. However, there is always danger of getting a shock.
If it is possible to block plate circuits by the same meth-
the noise, the oscillator circuit is at fault.

Circuit containing condenser C, with a strobe driver. If this Hills
circuit contains can be eliminated by temporarily short-
plate circuit of L2 or in the oscillator circuit. The os-
the noise continues, it may be oscillating either in the
places, or in the L1-C circuit. However, if
stays, if is oscillating in the L1-C circuit. However, if
pass condenser, use a smaller condenser (say, 0.6 mkf).
Since a large condenser is not too good as an r.f. by-
circuit on the diode detector circuit.

So, if the noise continues, it is existing in the
place L2. If the noise continues, it will eliminate any noise originating nearer the antenna,
and the chassis. If the noise
cooler. In a similar manner, blocking the grid of
You can move through the r.f. section of the re-
and L2. If it is oscillating in L2 or in the condensers,
move back to the grid of L2. If the noise now continues,
If the noise stops when the grid of L2 is blocked,
be oscillating in the output stage.
our example, this would be L2. If the noise is occurred, the
grid resistor of the output tube (ground) is as
To use this method, first hold the condenser across

held to the grid terminals of the tube
terminal of the condenser to B — while the other end is
must wind B — and perform use a test lead to connect one
You can connect the condenser between the control grid —
if the chassis is connected to B,— this is rather easy.
signal generator, and a multimeter) is to strike the chassis with your palm. If this intensifies the noise, or changes its volume, try jarring different places about the chassis. Usually one part of the chassis (or a certain tube) will appear more sensitive to jarring than the rest. You should then wiggle leads and pull on parts in the nearby stage or stages. Very frequently this will localize the noise.

**THE NRI PRACTICAL EXPERIENCE PLAN**

It is not possible to duplicate all the parts defects described in this Booklet on your test receiver. However, this is not important. In servicing a noisy receiver, the real job is in localizing the noise to a stage, and that is what you should learn to do now.

Try to make a poor connection that will cause noise when the receiver is jarred. Hold your soldering iron tip on the plate socket terminal of one tube, and grasp the lead going to this terminal with your pliers. When the solder melts, remove the iron, and wiggle the lead while the solder hardens. This will cause a loose connection. Next turn on the receiver, and when it warms up, jar the chassis with your hand. Noise should result. If it does, proceed to localize the trouble by the procedures we have described. Try this on several tube socket terminals. Be sure to resolder carefully these connections when you have finished.

When you service a receiver—for noise or for any other complaint—try several different localization tests after you have found the defect. For example, you may find a noisy tube almost at once. However, leave the tube in the set and try other localization tests to see how they work out. Do the same for other defects. In this way, you will learn the method that works best for you for each particular kind of difficulty.
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<td>Scratching</td>
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