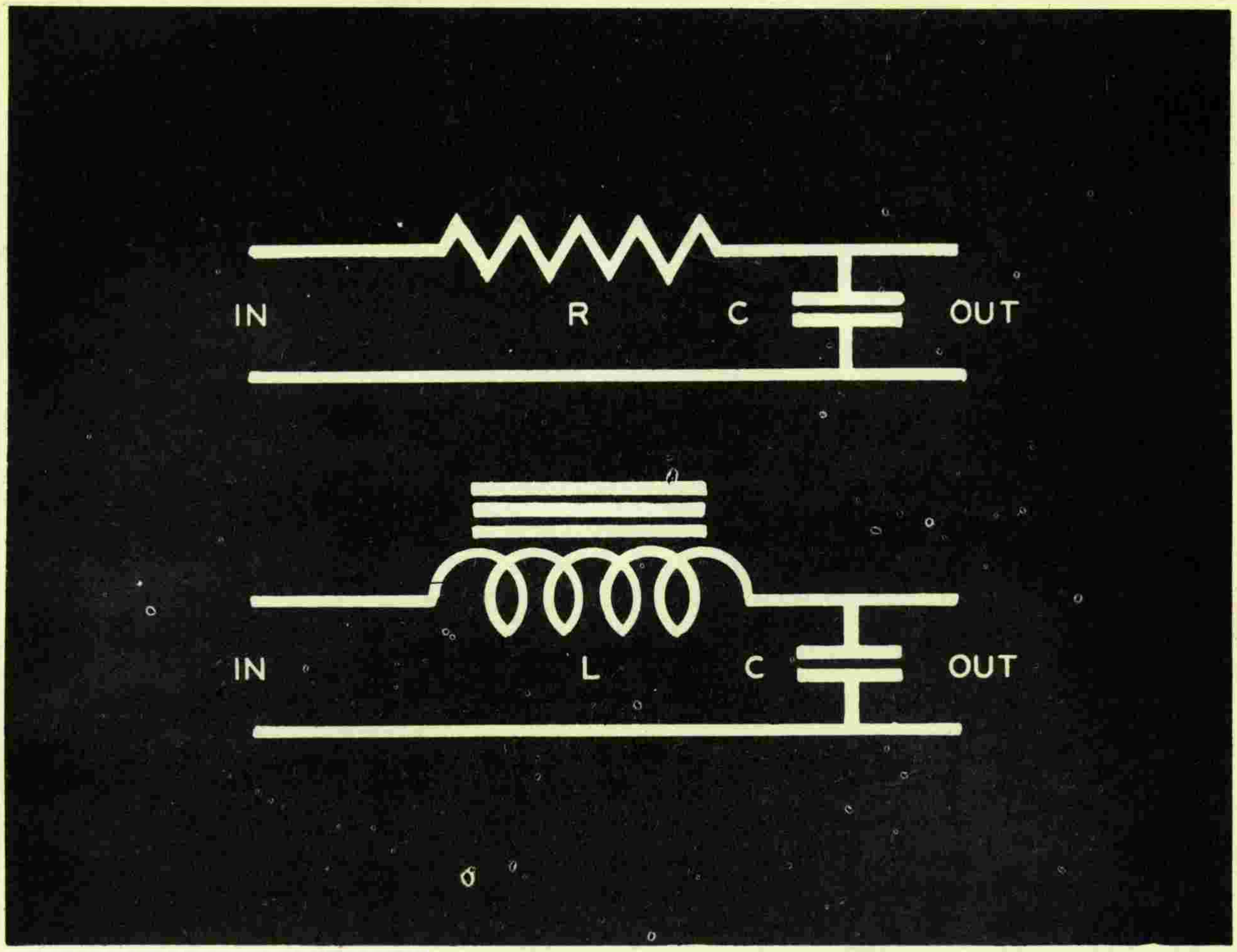

LESSON 49 RA

RECEIVER HUM AND OSCILLATIONS

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RECEIVER HUM AND OSCILLATIONS

Oscillation in radio receivers is evidenced by unstable operation often accompanied by disturbing squeals and howls. Squeals and howls, however, are not always a sign of oscillation, for they may be caused by two stations being received on adjacent wave lengths with their modulation frequencies interfering and heterodyning. Sometimes oscillation is caused by the use of a very short antenna. The antenna comprises a load on the first R.F. tube, and if this load is too small (antenna is too short), excess regeneration takes place and oscillation results. The remedy, it is evident, is to lengthen the antenna.

Oscillation in tuned radio frequency sets can usually be detected by shifting the tuning dial back and forth, which causes the sounds to rise or drop in pitch. Or, touching the finger to the grid terminals of the R.F. amplifier tubes frequently reveals oscillation -- when the finger touches the faulty stage, oscillation stops and the stations come through clearly.

A very common cause of oscillation in both tuned R.F. and superheterodyne receivers, is a high-resistance contact between a shielding element (such as a tube or coil shield) and the grounded chassis. Often due to vibration or corrosion, a mounting screw or rivet may become loose and interrupt the electrical bonding. Consequently, after the antenna has been eliminated, a mechanical inspection should be made of the chassis before it is removed from the cabinet, for moving or twisting a shielding can, or tightening a set screw, etc., may quickly remedy the condition.

Another frequency cause of oscillation in modern tuned R.F. sets, is an open by-pass condenser in the plate or screen circuits. To prevent undue or "stray" coupling between the successive stages, each is equipped with a decoupling filter consisting of an R.F. choke or resistor connected between the plus B terminal on the R.F. transformer and the high voltage line, and a suitable by-pass condenser from the same B terminal to chassis. If this condenser opens or loses its effectiveness, the radio frequency impulses get into the B-supply line and interfere with the stable operation of the other stages, causing excess regeneration and resulting in oscillation. Similar results occur if the choke or resistor short-circuits, for then there is no confining restraining element to keep the impulses out of the Bline.

In screen grid circuits, both R.F. and I.F., by-pass condensers are similarly employed between the screen terminals on the sockets and chassis or ground. Also, it is customary to supply the screen circuits through a common voltage dropping resistor. If one of these by-pass condensers opens or becomes ineffective, the screen current disturbance in one stage affects the others, a reaction or interchange of energy occurs between them, and oscillation results.

Oscillation in R.F. or I.F. circuits can also be cause by excess plate and screen voltages being applied. One of the voltage control resistors may have deteriorated and changed in value, permitting more energy to be supplied to these tubes. When it appears that oscillation is due to some fault in the circuit system, first check the plate and screen voltages supplied to the R.F. and I.F. tubes. If these measure above normal, check the voltage divider and voltage dropping resistors. Open or defective bleeder resistors in the plate or screen circuits are very often the cause of excess voltage. If there is any doubt about these resistors, they should be replaced, irrespective of how they test. If these elements test good, then check all of the R.F. and I.F. by-pass condensers, or replace them one by one until the faulty one has been located.

Hum in an A.C. receiver may be due to external pick-up or may be caused by some faulty condition within the set itself. Hum may also be due to a poor ground. First determine whether the hum is due to external pick-up or originates within the set, by disconnecting the aerial and ground from the receiver. If the hum disappears, no further concern about the set itself is necessary. Reverse the position of the plug in the wall outlet, for this may change the ground on the A.C. line in the set and remove the hum. Hum will also result if the A.C. supply cord for the set is placed too close to the tubes or if it runs close to the speaker cord.

Examine the ground connection to make certain that a good low-resistance contact is had, preferable to a cold water pipe. Too often the importance of a good ground is underestimated, for at times operating a set without a ground affords greater volume but only at the expense of increased hum and higher noise level. The aerial lead-in may be too close to the A.C. line. A shielded lead-in wire may even be necessary. If hum is due to external pick-up and the above steps fail to eliminate it, an inspection of the electrical system within the house may be necessary, or the assistance of some interference locating device may be required.

When it is evident that the hum comes from within the set, the trouble may be in one or several poor tubes, more commonly in the rectifier or the detector. A defective power tube with an open or shorted grid, or a pair of badly unmatched power tubes in the push-pull output stage may cause hum. If one plate of a full wave rectifier tube delivers more current than the other, an unbalanced condition exists that results in hum. All tubes should, therefore, be tested or replaced.

Also, the hum adjuster, if the set is equipped with one, may need resetting. If adjusting it has no effect on the loudness of the hum, it may be that this adjuster is burned out or otherwise defective or disconnected from the circuit and requires examination or replacement. Hum may likewise be caused by a piece of ungrounded shielding or by a shield that has become loose or disconnected. A careful inspection may be necessary to locate such a loose shield. Such conditions are found occasionally when the shielding is held together with screws instead of being riveted. A screw may become loose and a poor grounding contact result.

When the above steps fail to disclose the source of hum, attention should be turned to the power supply and filter system. Some sets employ an input filter consisting of two fixed condensers in series and with the midpoint grounded across the primary of the power transformer. If one of these condensers is open or breaks down, hum will result. Both the core and the shield between the primary and secondary of the transformer should be well grounded. An open or ungrounded center tap, or a grounded filament winding that cuts out the grid bias somewhere in the circuit may cause hum trouble. Shorted turns in one of the secondary windings besides causing over-heating will usually also produce hum due to the unbalanced circuit condition.

If a hum is noticeable around the power transformer but is not heard in the speaker, it may be caused by loose laminations in the core of the transformer or filter chokes. This condition can often be remedied by clamping the loose laminations more tightly or by coating the core with heavy shellac. If the transformer is in a case filled with insulating compound, it may be possible to femove the unit and heat it slowly, permitting the compound to soften and fill in between the loose parts and then set and harden again. However, this is a very delicate process involving quite an element of danger, for if the unit is heated too much in one spot, the compound may melt and vaporize; and if the pfessure gets too great inside, an explosion may result in which the molten compound is thrown outward in all directions. Serious burns may be feceived from such an accident. Similar care should be exercised when an enclosed condenser or any other unit impedded in compound is heated. If any of these attempts do not correct the fault, it may be necessary to discard the transformer or choke and replace it with a new one.

In the filter system, a shorted or grounded choke may be the seat of the trouble, although a faulty or punctured filtef condenser is more likely to be the cause. The filter condensers should receive first consideration. If a tuned choke is employed and the tuning condenser breaks down or changes in capacity, hum will set in. Electrolytic condensers, especially if there are two or three units in one can, may have lost their capacity, and if suspected, should be replaced with a substitute to ascertain if the hum originates there. If the hum is of a 120-cycle frequency, it seems to indicate insufficient filtering and generally additional filter capacity will eliminate it. If the power supply and filter system all appear in good working order, a thorough inspection of the entire receiver system is needed. An electrolytic filter or by-pass condenser may have dried up and stopped functioning as a condenser.

Hum in the receiving circuit itself can often be quickly traced to a certain section of the receiver by removing a tube. For example, if the detector tube is pulled out and the hum continues, it is at once evident that the source of the hum must lie somewhere in the audio amplifier or in the speaker. It might be that one of the by-pass condensers in the B-supply line or voltage divider system has broken down or is too small. Often the use of a larger by-pass condenser will remedy the condition. Sometimes a 25,000 or 50,000-ohm filter resistor in series with the plate supply line and a 0.1 MFD by-pass condenser are effective in reducin g or eliminating hum in the A.F. stage.

If the hum disappears when the detector tube is removed but is heard again when it is replaced and the last R.F. or I.F. tube removed, the hum originates in the detector stage. If the tube is good, it may be caused by an open grid circuit, an open biasing resistor or an open by-pass condenser. Excessive plate voltage may also cause hum. If the hum does not come from the detector, one tube at a time should be removed toward the antenna and until it is isolated. All resistors and by-pass condensers should be checked both for open circuits and for grounds. It might be that one of the circuit wires has become grounded, or that a necessary ground connection has become open. One side of a center-tapped filament resistor may have opened or the wire leading to the center tap may have become disconnected.

Sometimes an audio transformer may not be placed properly, but such faulty design conditions are rare. In the average D.C. dynamic speaker, there is little chance for hum to develop, except in case the hum bucking coil fails or a short circuit develops in the field coil. Such a failure would, of course, reduce the filtering effect of the field. It can be detected by measuring the resistance of the field. In an A.C. dynamic speaker, a 2000 or 4000 MFD condenser connected across the rectifier will help much toward eliminating hum. Low A.C. line voltage that causes low voltage throughout the entire receiver may produce appreciable hum.

A receiver may be encountered in which a prominent hum appears when a station signal is tuned in but disappears again when the station is tuned out. This is known as carrier or modulation hum, and is generally due to a certain amount of modulation occurring in the R.F. amplifier of the set. It can be corrected in most cases by connecting two .01 condensers in series across the A.C. line terminals on the primary of the power transformer, and grounding the middle or common connection between the two condensers.

PRACTICAL SERVICE POINTERS

1. Hum in an output pentode can often be greatly reduced by inserting a 50,000 ohm resistor bypassed by a .5 condenser in the screen grid circuit to reduce the screen voltage somewhat.

2. A temporary audio transformer repair can be made by shunting the primary with a 250,000-ohm resistor and the secondary with a 500,000-ohm resistor and using a .01-mfd. coupling condenser from grid to plate.

3. A.C. hum that increases as the volume control is turned up and in some cases becomes very loud, may be due to a cathode to heater leak or short in one of the tubes. Check the tubes with a good leakage tester.

4. The selectivity of many 4-tube midgets can be improved by soldering a 3-inch piece of heavy wire to the plate lug on each coil, running it along the length of the coil to within a half inch of the top of the secondary, and encircling the coil with one open turn.

5. A defective or shorted line voltage regulator may often be the cause of frequent tube burnouts by impressing 115-volts on the primary of the input transformer instead of the normal 85 volts.

6. An extra magnetic speaker can be operated in addition to the dynamic speaker by connecting it to the plate terminals of the push-pull output transformer with a .5-mfd. condenser in series in each line.

7. Microphonic noises in a console receiver may be caused by the wooden chocks or bolts which were used to hold the chassis secure in transit and which were not removed by the installation man.

8. Mushy tone and low volume from a cone speaker may be due to the apex of the diaphragm having become soft and flexible. Stiffness can generally be restored by painting the soft part with one or two coats of orange shellac.

9. Oscillation in screen grid T.R.F. sets is often due to excessive screen voltage, and if so, can generally be corrected by connecting a 50,000-ohm resistor from the common screen terminal to ground to act as a bleeder.

10. A D.C. electric set equipped with a line voltage regulator may, at times, refuse to perform. This can be remedied by discharging the line filter condenser by pulling out the wall plug and shorting the prongs for an instant.

11. Loss of volume and distortion may often be due to a poor or dirty contact at the phone switch which disconnects the radio frequency tuning system from the detector or audio amplifier.

12. Excessive line voltage on radio sets having no taps on primary of power transformer can be reduced by connecting in series with the A.C. line a 32-volt tungsten lamp. The 25-watt or 50-watt size will take care of most cases. Use size giving correct filament voltage.

13. When one pair of tubes in a push-pull stage is replaced, care should be taken that both tubes are properly matched, or noticeable hum will result. Both may need replacing.

14. The performance of many A.C.-D.C. sets can be improved by adding another 25Z5 or similar rectifier tube if the chassis space permits, one rectifier supplying the receiver circuits and the other the speaker field.

SERVICE POINTERS ON A.C.-D.C. SETS

Due to the compact construction commonly employed in Universal A.C.-D.C. sets, the temperatures generally rise higher than in the larger sets in which there is better opportunity for the heat to be dissipated to the surrounding space. These higher temperatures have harmful effects on all component parts, especially the resistors and electrolytic condensers.

The resistors are usually of the carbon type with a 1/4-watt rating, and on account of the high temperatures they often change in value and hence upset the circuit stability, the result being decreased volume, distortion and, at times, serious hum. Frequently the resistors change greatly in value when hot, but regain their normal value when cold. Resistance measurements should, therefore, be made after the set has been turned on for at least ten minutes and the resistors are at their operating temperature.

The heat also causes the electrolytic condensers to deteriorate and dry out and hence to lose their capacity rating. This, likewise, results in distortion, low volume, increased hum, and often violent oscillation. Excessive leakage and partial short circuits also develops. Heavy leakage current quickly exhausts the rectifier tube (usually of the 25Z5 or equivalent type), and although the tube may light, it may have lost all emission. Hence, at low or no volume, the rectifier tube should be tested at once or checked by replacing it with a new one.

In such cases, the filter condensers should also be tested for high leakage and short circuit; and if they appear questionable, they should be replaced, for they will only break down in a short while anyway. A completely shorted condenser generally causes the rectifier tube to burn out, and may also ruin the line resistor or ballast tube. Always use replacement condensers made by a reliable manufacturer and of at least a 200-volt rating. Avoid any so-called special sale units.

Large cathode by-pass condensers are generally used in the detector and audio output stage; and if these lose their capacity, the tone quality goes down and the reproduction sounds thin and mushy. If these condensers are suspected, they should be checked for capacity values. Where only small condensers are used in these places, replacing them with larger ones of 10 or 25 mfd. capacity (25-volt rating) will generally greatly improve the tone quality and hence make a more satisfied customer.

Other troubles commonly experience with A.C.-D.C. sets are the following:

1) Tubes do not light - Defective tube or open line resistor.
Defective ballast tube.
Open contact on high-wattage resistor.
Poor or open contact where filament circuit connects to chassis.

2) Exhausted Rectifier-Tube - Frequently caused by a shorted filter condenser placing an excess load on the tube and exhausting it. Always test both plates of a 25Z5 or similar tube, only half of a tube may be working and other half not.

3) Defective Audio Output Tube - Frequency trouble is experience with tubes of the #43 and similar types. Internal short circuits often develop and render the tube inoperative.

4) Audio Plate By-pass-Condenser - Often a .01-mfd condenser used from the plate of the output tube to ground or chassis breaks down and cuts off the plate voltage, rendering the set inoperative.

5) Oscillation - Aerial is not stretched out enough, or aerial lead is broken where it connects to the antenna coil. Filter condenser is open or short-circuited. Some shielding

element may not be grounded well, especially check tube shields. Use larger by-pass condenser from detector plate to ground.

Set may be out of balance or alignment.

Broken down screen grid by-pass condenser.

Poor chassis grounds, check all soldered joints on the chassis.

6) Hum - May be due to defective filter condenser or may originate in audio output tube.

Modulation hum - connect a .05-mfd condenser from hot side of A.C. line to chassis. Hum can often be cut out by connecting a .01 condenser from one of the rectifier plates to chassis.

7) Defective Audio Coupling Condenser - May cause low volume, poor tone, and intermittent operation.

Check carefully with condenser leakage tester.

8) Intermittent Reception - Defective by-pass condenser - check with leakage tester. Also defective coupling condenser.

Defective carbon resistor.

Poorly soldered joint.

Loose shielding element.

Also see special bulletin on fading.

9) Defective Volume Control - Control may be noisy or not make contact over entire range.

10) Low Volume - Bias resistor, off value or leaky by-pass condenser.

Defective filter condenser.

Open speaker field coil or voice coil.

Set out of balance.

11) Poor Tone - May be caused by poor magnetic speaker or speaker being out of adjustment.

Also check all causes outlined above.

Try new coupling condenser between 2nd detector and 1st audio.

12) Rattles and Noises - These can often be eliminated by slipping small felt washers over the control shafts so that the knobs cannot strike against the panel. Also, the escutcheons may be loose and need tightening.

13) Low volume and poor tone quality from sets using dual speakers are often due to the speakers being improperly phased. The condition can be corrected by reversing the voice coil leads of one speaker.

14) Overheated power transformers are frequently caused by a shorted or otherwise defective rectifier tube, by the tube not being inserted correctly into the socket, or by the rectifier tube socket being charred or cracked and permitting heavy current leakage.

15) The selectivity of many of the older type sets using 3 or 4-gang condensers can frequently be greatly improved by equipping the condenser sections with suitable trimmer condensers so that the various stages can be more accurately balanced.

16) The audio whistle heard in some midget sets employing a type 43 output tube can often be cleared away be connecting a 5M or 10M-ohm resistor in series with the screen grid lead to the tube.

17) Long grid leads will interfere with the proper balancing and aligning of sensitive receivers, and whenever possible, these should be made shorter and direct even though they may be more conspicuous than when run in a longer and concealed place.

18) Distortion in some of the early A.V.C. sets can often be eliminated and the set performance greatly improved at the same time by using a smaller grid return condenser.

19) To add an antenna trimmer to a receiver not equipped with one, connect a .002 condenser in series with the stator of the first tuning condenser and install a midget trimmer condenser connected across the secondary of the first coil.

20) A howl in the 2nd audio or output tube may be caused by no load being on its grid while the 27 tube in the 1st stage heats up. Shunting a 2-meg resistor across the secondary of the 2nd transformer usually cures this.

21) The sensitivity of many midget sets using a grid bias screen grid detector can often be increased by inserting a .00025-mfd. condenser shunted by a 250M-ohm resistor in series with the grid lead of the tube.

22) Low volume and poor tone quality from sets using dual speakers are often due to the speakers being improperly phased. The condition can be corrected by reversing the voice coil leads of one speaker.

23) Abrupt changes in receiver volume when different light switches in a house are turned on or off, can often be cured by shunting a 0.1-mfd condenser across the switch that is the worst offender.

24) Poor selectivity and low volume, as well as intermittent reception, are often caused by the insulation becoming worn or breaking down on wires where they pass through small holes in the metal chassis.

25) The tinny or harsh tone of an output pentode tube can often be greatly improved and the base response brought out by connecting a high resistor (1/2 to 1 megohm) in series with a .1-mfd condenser across the control grid and plate terminals at the socket.

Cover Diagram: Two effective filter circuits shown on the cover of this lesson do not require critical circuit values. Any value of R from 5 to 50,000 ohms, any value of L from 6 to 50 henrys of inductance, and any value from 2 to 60 mfd. may be used. The inductor is used in circuits carrying a considerable amount of current. Remember that the **larger** the values of any of the components, the better the filtering action.