

# ANTIQUE RADIOS

## Speakers and headphones

THIS MONTH WE'LL DISCUSS VARIOUS kinds of audio output devices including headphones, electro-dynamic, magnetic, and permanent magnet speakers, and troubleshooting information about each type of reproducer. But before we get to all of that, let's take a look at the antique of the month.

### Looks good, doesn't work

Early Zenith console radios like the 1940-ish model shown in Fig. 1 were very popular in their day, and many of them still are. That Zenith could receive several different bands, and it has a tuning eye and assorted tone controls. That particular radio was chosen to make a point. Although it's in good outward condition, it will never play again. It is beyond repair because it has no tubes, no speaker, and a burned out transformer. But even though it's useless—as a radio—to a collector, it still has value as a display piece. For example, it could be used as a prop in a play or TV show.

The Zenith will be donated to the Golden Radio Buffs of Maryland, Inc. That organization doesn't collect radios and equipment; their interest is in broadcasting and personalities. They have a display at the Museum of Industry in Baltimore, MD. A few antique radios are on display there to set the mood while recordings of early radio programs are played. If you are interested in joining the Golden Radio Buffs, send an SASE to Gene Leitner at 7506 Iroquois Ave., Baltimore, MD 21219.

### Speaker history

Reproducers, like all chassis



FIG. 1

components, have seen many refinements over the years, although the major innovations were mostly completed during the 1920's. As with most advances in radio, it's difficult to say who invented the loudspeaker. And, as in other areas of electronics, the names of many early experimenters are undoubtedly lost.

There are three basic types of speakers: magnetic (not to be confused with either of the following types), dynamic (also called electro-dynamic), and PM (Permanent Magnet). The names of the various types of speakers can be confusing. The names of magnetic speakers, for example, have many variations including the dynamic magnetic, diaphragm and horn, cone and armature, etc. Although all speakers operate magnetically, remember that the "magnetic"



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type of speaker differs from the other types in several significant ways. We'll discuss those differences below.

The earliest reproducers were headphones, but by the mid 1920's, magnetic horn-type speakers had supplanted earphones. Then came cone-type speakers, both single and double. And by 1930 the electro-dynamic loudspeaker was the most popular audio output device. Later, the development of new alloys brought about the permanent magnet, which simplified radio circuitry, because PM speakers don't require a field coil (which is discussed below).

Early radios were often sold without tubes, chassis, or speaker; in fact, the schematics of many early radios seldom indicate anything after the audio output tube. The manufacturers left it to the consumer to decide which type of reproducer to use, and great debates raged regarding the merits of various types of speakers. And, because radios often came without speakers, the manufacture of speakers and cabinets, as well as headphones, constituted a thriving business of its own. An example of each of the four major types of reproducer is shown in Fig. 2. Clockwise from the lower left are headphones, a magnetic speaker, a dynamic speaker, and a PM speaker.

Early headphones were made by about half a dozen manufacturers, and all were basically the same. The headset shown in Fig. 2 is from about 1920 and was probably designed to be used by a telephone operator. It was made by C.

Brandes, Inc., of New York; that company later made speakers and radios too. The Brandes headset is more collectable than many antique radios.



FIG. 2

That magnetic headset operates by means of a diaphragm that is suspended above a magnet. Coils wound around the magnet cause the diaphragm to vibrate when current flows through those coils.

Headphones have survived to the present day, but after speakers became generally available, they proved to be much more popular than headphones. Why did speak-

ers become so popular? One reason is that the earphone cord severely restricts your freedom of movement. And only one person can listen at a time, although two friendly listeners can share a set of earphones if they put their heads together.

So designers began thinking of better ways for people to enjoy radio broadcasts. One method was simply to lay the headphones on a table and strap a megaphone to an earpiece. That method worked and was probably the beginning of the loudspeaker. But of course it left much to be desired, so designers continued their search for a more perfect reproducer.

### Speakers

One early attempt at better sound reproduction is the magnetic speaker. There are many varieties of magnetic speaker, but, in general, a magnetic speaker uses an armature to move a diaphragm, although some use an earphone coil and a cone or a horn attached to the diaphragm.



FIG. 3

Magnetic speakers, especially the various horn types, were popular during the mid 1920's. One very popular magnetic speaker was RCA's model 100-A, which is shown in Fig. 3. There are still thousands of those speakers around, and many collectors have one or more.

The electro-dynamic speaker became popular in the late 1920's and early 1930's. It requires a DC voltage to operate a field coil, which, as its name suggests, generates the magnetic field that, in conjunction with the voice coil, causes the cone of the speaker to move. That field, of course, is gen-

erated in later speakers by a permanent magnet. The dynamic speaker also includes a hum-bucking coil that cancels hum introduced by the field coil.

### Pros and cons

There was much discussion of the relative merits of various types of speakers in the late 1920's when the popularity of the dynamic type was increasing. Proponents of dynamic speakers focused on the faults of the magnetic units, which are really just glorified earphones that produce weak, scratchy sound. They are, however, excellent collectables today. The main advantages of the magnetic units are their lower initial cost and their lack of hum.

But, by the late 1920's, most listeners used dynamic speakers and never noticed the hum. And after a listener heard a dynamic speaker, it was difficult to return to a magnetic speaker.

However, economics sometimes caused a listener to buy a magnetic rather than a dynamic speaker, because the latter often required a separate power pack (with rectifier) to drive the field coil. Of course, a well-informed consumer knew that there was no need to purchase a separate power pack if his radio's chassis had provisions for a field coil built in.

Proponents of magnetic speakers pointed out that it was an advantage not to have to drive a field or hum-bucking coil. No storage battery, rectifier, or filter was needed. And since no hum was introduced, there was no need for a hum-bucking coil.

On the other hand, a magnetic speaker had problems reproducing low notes. Even with a large horn or cone, it couldn't match the frequency response of a dynamic speaker. Most people agreed that magnetic speakers sufficed for telephone use (which is where they began), but not for musical reproduction. The slight hum produced by a dynamic speaker was preferable to lack of fidelity.

Receiver manufacturers who didn't supply a reproducer with a receiver usually recommended that the consumer buy the more expensive unit, because that made

the receiver itself seem better, so the consumer would be more likely to recommend that brand to other people.

Radios made by Zenith, Radiola, Bremer Tully, and others could use various types of speakers. Magnetic speakers were more popular with early battery-operated sets such as those made by Dayton and Radiola. Some radios had both a jack for a magnetic speaker and terminals for a dynamic speaker.

### Troubleshooting headphones

There is little that can go wrong with magnetic headphones electrically. So first check a troubled set mechanically. Remove the caps on the earpieces. The diaphragm should fall out—and maybe a few other things besides. Remove any dust, dirt, or other foreign objects, because they can prevent the diaphragm from vibrating.

The coil connections should be clearly visible, so make a continuity test between the terminals and the plug. The coils may be open, but that's unlikely. The splice leading to the other earpiece is a likely suspect if one side of the headset is dead. When you re-assemble the earpieces, pay attention to the diaphragm. Some have a painted side which should face out.

### Troubleshooting PM speakers

Unlike the complicated speaker array of early radios, small PM speakers can be checked quickly, and they have few components that can go bad. The voice coil (also called the moving coil) and the audio output transformer are the primary sources of trouble. Others include an off-center voice coil, a warped cone, and a bent frame, all of which will distort the sound. The labor involved in trying to straighten a cone or frame, or center a voice coil, simply isn't worth the effort. Just replace the entire speaker. But if the results of a continuity test are negative, don't assume that the voice coil is bad. The trouble is most likely at a terminal, plug, or other soldered connection. The voice coil rarely develops an open in the winding.

If you're not sure whether the speaker or some other component is at fault, the easiest way to

check a small PM speaker is by substitution. Just make sure that you connect the speaker to the secondary of the output transformer. Some transformers are mounted on the chassis, and others are mounted directly on the speaker frame.

You may be able to salvage a seemingly open output transformer. If a winding fails a continuity test, the problem may be a solder joint. Just peel back some of the insulating paper to where the winding wire joins the hookup lead. If you don't find a bad joint there, it's usually cheaper to replace the transformer than to repair it.

### Troubleshooting magnetic speakers

Many repairs required by magnetic speakers are mechanical. If the driving rod is loose, it may only require tightening the nut. If the center of the cone is torn, remove the rod and re-glue the cone. Repairing that type of cone is much easier than trying to attach a torn cone to the voice coil of a dynamic speaker.

Since a magnetic speaker is built like an earphone, it can be checked like an earphone. Continuity can be measured between the coil terminals and the plug. Remove any dirt or dust that may interfere with operation of the diaphragm. The pin connected to the diaphragm and to the center of the cone often breaks loose. A little glue around the area should fix it.

An armature-activated magnetic speaker might have a problem with the armature's striking the pole pieces. That generates an easily-identifiable sound that occurs mostly on low notes. Those pole pieces, by the way, are partly what limited the popularity of that type of loudspeaker. Many people found the mechanical adjustments more trouble than they were worth.

### Troubleshooting dynamic speakers

A dynamic speaker may suffer from any problem that a PM speaker may suffer from, in addition to several of its own. Unwanted vibrations could be caused by a torn cone, dirt or metal particles,

loose mounting screws, or other metal components on the loudspeaker's frame. Unlike PM speakers, most dynamic units provide a means of centering the voice coil.

That is done with a device called a spider, which comes in several variations. Besides centering the voice coil, the stiff material the spider is made of helps the voice coil return to its neutral position when no signal is applied. When centering the voice coil with a spider, sometimes it helps to place some stiff paper around the coil. Doing that helps ensure that the coil won't rub after the spider is adjusted.

Unfortunately, you'll probably have to make every effort to repair a damaged speaker cone yourself. The old speaker reconer is a dying breed.

Hum problems are easy to diagnose. A hum bucking coil is wired in series with the secondary of the output transformer and the voice coil. When disconnecting the voice coil or output transformer leads, be careful not to reverse them in relation to each other. You

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could end up with twice as much hum. To determine whether the hum bucking coil is operating, just bypass it with a piece of insulated wire. If the hum level increases, the coil is working. However, if the hum level decreases, check for a reversed connection.

While we try to maintain the authenticity of our antique radios, sometimes we have to use not-quite-original replacements. For example, you might have to replace a dynamic speaker that is beyond repair with a PM speaker. You can connect the voice coil of the PM unit directly to the output transformer. You don't have to worry about the hum bucking coil, but you may have to connect a resistor or a choke to the point where the field coil was wired. As mentioned above, some chassis allow you to use a PM speaker just by disconnecting the field coil leads. Check your schematic.

If you're troubleshooting an AC/DC radio, in which the output plate current flows through the filament of the pilot lamp, you can spot an open voice coil (or a bad solder connection) by watching the pilot lamp. With the volume turned up full, the light should flicker when you tune in a strong station. That's due to varying plate current flowing through the pilot lamp. If it flickers, but you get no sound output, disconnect one speaker lead and check the continuity of the voice coil. If there's no continuity, find the cause as described above.

Otherwise, the voice-coil may be off-center. Reconnect the speaker and then apply light finger pressure around the inside of the speaker cone. If the problem is an off-center voice coil, as you move your fingers around the cone, at some point you should hear a scratching noise. If there's no way to adjust the position of the coil, you'll have to replace the speaker.

### **Wrapping up**

That's all for speakers and headphones; next time we'll discuss early radio gadgets and trends in cabinet design.

**R-E**