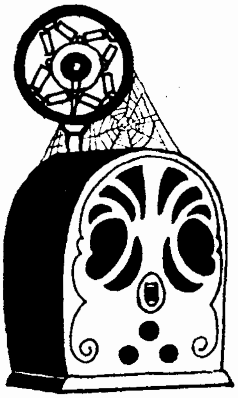
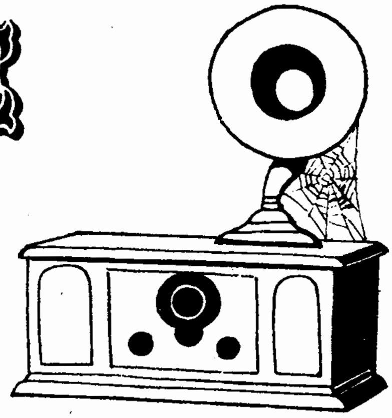


ANTIQUE RADIO CORNER



Put those old-time speakers back in action

James A. Fred

Many of the letters I receive are from readers seeking information about how to replace the electro-dynamic speakers in their old 1928 to 1942 radios. An electro-dynamic speaker is one that has a field coil to supply a magnetic field whereas a PM (Permanent Magnet) speaker has a permanent magnet to supply the magnetic field. Since electro-dynamic speakers are no longer made there are two basic ways to get that old radio to play again.

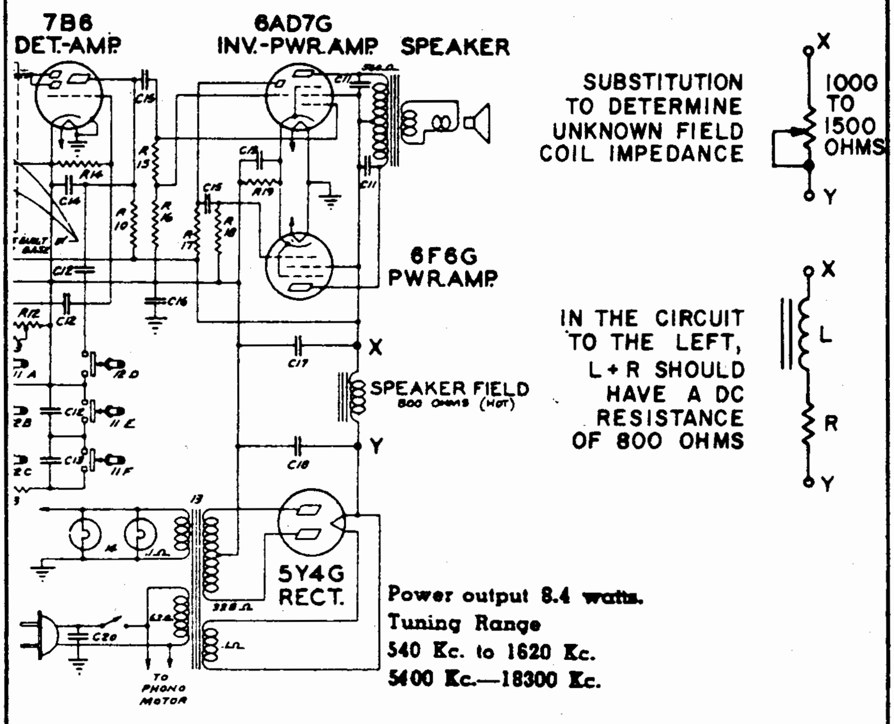
1. Have the original speaker repaired, i.e., replace the cone or have a new field coil installed.
2. Replace the old speaker with a new modern permanent magnet type.

To enable you to make an intelligent choice, I will present a detailed account on how to replace the original speaker. Having the original rebuilt means sending it off to a mail order repair shop. But first, let's review the loudspeaker, story and refresh your memory on the different types of speakers usually found with antique radios.

Early Speakers. First of all, there are two basic types of speakers found in radios made between 1920 and 1950. The first radios only used headphones, sometimes called earphones. Headphones limited the number of persons that could listen to a radio at one time. They were reasonably sensitive, worked with crystal radio sets, or with 1-tube battery-operated radios. The basic design of an earphone consisted of two coils of fine wire, with laminated cores inside the coils, surrounded by a horseshoe-shaped magnet. Suspended a few thousandths of an inch above the coils was a very thin, soft iron diaphgram that vibrated in unison with the received audio frequencies. The diaphgram produced sound waves.

Quite soon, someone mounted the earphone on a horn and the sound was then loud enough for the whole family to enjoy. Soon manufacturers were making larger headphone units to be mounted on larger horns. Distortion was a problem with the limited power handling ability. The next step was to build a cone type speaker, and the center-pin driven reproducer. The above types all fall into the category of Magnetic Speakers. Meanwhile out in California, Magnavox began to build a horn-type dynamic loud speaker. This speaker produced more power and better tone. Since the battery sets of that time used a 6-volt storage battery for the tube filaments, the speaker field also operated on 6-volts. The biggest drawback to the dynamic horn speaker was its size. The consumer was asking for radio that was self-contained with speaker and set all hidden inside a wooden cabinet. The dynamic cone speaker was introduced about the same time that AC operated radios became popular.

Dynamic Speakers. As you can see from the illustration, the dynamic speaker had a paper cone with a voice coil cemented to its center. The voice coil was a cylinder of paper from ½ to 2-inches in diameter, depending on the power handling design of the speaker. One or more layers of insulated mag-



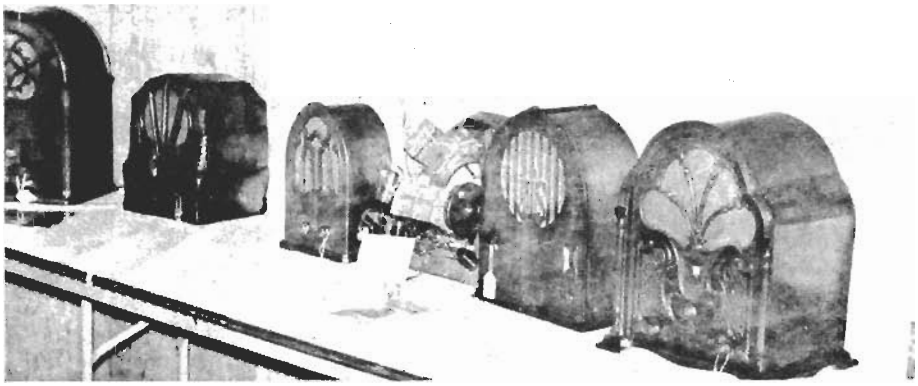
When you want to substitute a modern speaker for an old one that had a speaker field coil, you need to replace the lost impedance in the circuit. Unlike this schematic of a Zenith Model 7S681/2 many old-time schematics don't always include the value of the coil. Determine this with the top circuit and replace it with the bottom one.

net wire was wound on the voice coil and ultimately connected through an impedance matching transformer to the audio output stage of the radio receiver. Centered inside the voice coil was a soft iron pole piece which in turn was surrounded by a field coil wound with thousands of turns (except in car radio speakers) which when connected into the radio high-voltage circuit produced a magnetic force in the pole piece. This speaker was called an electro-dynamic speaker. The illustrations show the various types of speakers we discussed plus a typical radio circuit diagram using an electromagnetic dynamic speaker. It took a lot of electrical power to magnetize the pole piece, so when more efficient permanent magnets were developed most manufacturers began to make PM dynamic speakers.

The EM dynamic speakers used in auto radios, at this time, had only 4 or 6-ohms resistance, and it took 1 to 1.5 amperes to excite the field. If you remember the automobiles that had 6-volt ignition systems you will also remember that they were never too good in winter.

When the PM speaker was introduced, auto radio manufacturers were the first to use them. Later they were used in portables and house radios. Alnico V was the magnet used most successfully in speakers. Generally speaking, a larger magnet will permit the speaker to handle more power. Thus a small 4-inch speaker may have a half-ounce magnet while an 18-inch speaker may have a 2- to 3-pound magnet. Replacing a PM speaker is no problem since replacements are readily available at all radio parts stores.

Replacing an EM or field coil speaker is another problem. To start with, the field coil had a certain amount of inductance and therefore it acted as a filter choke in the "B" power supply circuit. The resistance of the field coil was also the resistance that determined the "B" supply voltage supplied to the tubes in the radio. So when replacing an EM speaker with a PM we have a couple of important factors to consider. The first factor is physical size. Whenever possible, always use the largest PM speaker that will fit the allotted space. The larger speaker will reproduce bass notes more efficiently than a small speaker. If you use a smaller than original size speaker, you will have to make an adapter board with the proper size hole for your new speaker and make it large enough to cover the old hole. Without going into acoustic theory, I would advise you to never leave an opening around the speaker cone. To produce the same amplitude and frequency tone range as the radio did when new, you should try to return the set to its original baffle condition.



When you repair old speakers try to use as authentic a grill cloth as is possible. Note the fine restoration work on these cathedral radios displayed at an Illinois exhibition.

Choke. The second factor is to introduce some inductance into the power supply circuit in place of that lost by removing the speaker field winding. If you are replacing the speaker in a console radio, you may have room to leave the field coil connected and place the coil in an out of the way spot. Mount the new speaker in the proper place and use the old output transformer with the new speaker. If there isn't room, as in a table model radio, then you can use a small inductor and resistor to get the correct impedance.

The rectifier tube changes the 60 cycle AC voltage into 120 cycle pulsating DC. The filter capacitors and inductance (speaker field or choke coil) work together to smooth out the pulsations so the net result is hum-free DC. Since the inductance of a speaker field coil varies according to the number of turns of wire in the winding it is difficult to place a value on every speaker field. I have found that a 1.5 to 2 Henry choke will usually suffice. If you salvage parts from old TV sets, you will find a filter choke that will work fine. The choke should be capable of carrying 150 to 200 milliamperes of current.

Since the choke will usually have less resistance than the field did, you must add resistance in series with the choke coil. The total resistance of the choke and resistor in series must equal the speaker field resistance. If this isn't done all the "B" voltages will be too high. Higher than original "B" voltages can lead to blown out capacitors, overloaded resistors, and tubes being operated beyond their ratings. For example, if the speaker field measures 750-ohms and your choke coil measures 150-ohms, you will need a 500-ohm resistor in series with the choke coil. Use a 25-watt, 500-ohm wire-wound power resistor. If the resistance value had turned out to be a non-standard value you could have used an adjustable, wire-wound resistor.

If, after you replace the EM speaker in the manner we just described, the hum level in the speaker is higher

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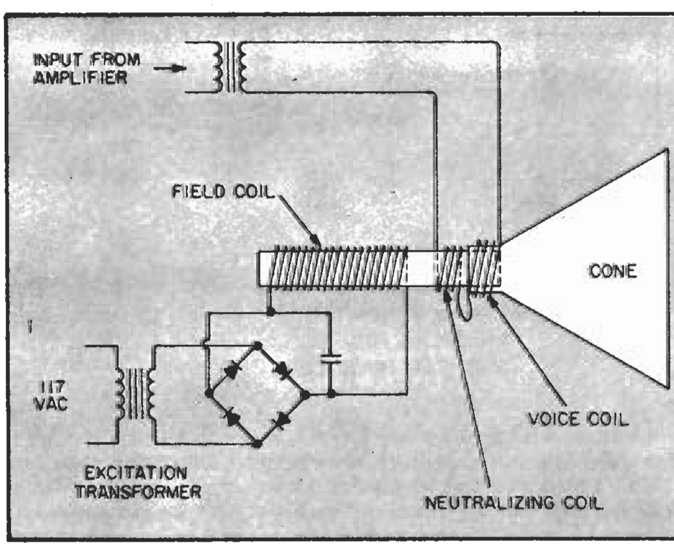

This schematic representation of a dynamic loudspeaker shows how the parts relate to each other. The field coil energizes the core (now permanent magnets are used) so that it is a steady field magnet. The fluctuating magnetic field on the voice coil moves the cone over the core.

Next, keep in mind that when coil so it might be preferred over a top closed or no gas signs. ■

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than normal, then you will have to put additional filtering in the set. Try a 20 μF., 450-volt DC capacitor connected between the junction point of the choke coil and resistor, and "B–." There will be special cases in which the speaker field will have a tapped winding. Use what you have learned and use two resistors if necessary. Remember to connect one of the choke leads to the same point the field coil connected to, i.e., the rectifier filament or cathode.

Find the Value. There will be isolated cases where the speaker field coil is burned out and no value is listed on the schematic drawing or you have no schematic. In this case, use a power rheostat of 1000 to 1500-ohms at 100 watts and connect it in place of the field coil. Adjust the rheostat until the voltage readings on the audio output tube plates are normal, and then connect a choke-resistor combination in the circuit. If you don't have a schematic that shows the proper tube voltages use the data in a tube manual.

If you follow these suggestions, you should have no problem replacing the Electro-dynamic speaker in your radio with a permanent magnet type.

Wire Wound Resistors. Over the past years I've covered the problems of replacing, repairing, or restoring most of the parts in the old radio sets. One item I don't recall writing about is wirewound power resistors. In the beginning, (1921) all radios built had one or more wirewound filament rheostats. The filament rheostat controlled the amount of voltage applied to the tube filaments. The value of the rheostat was usually between 6 and 30-ohms. The end result was that the rheostat controlled the volume of the radio. It was also found that the tube lasted longer if the filaments were operated at a lower voltage. The only other resistor in these old sets was the Grid Leak. Its resistance was usually between 100,000 and several million (megohms) ohms. When "B" battery eliminators were introduced that operated from the 115-volt AC line, it became necessary to divide the high voltage into several lower voltages. The battery sets of the early 20's used as many as 5 different voltages. Some of these voltages were 22½, 45, 67½, 90, and 135-volts. At first, variable carbon potentiometers, i.e., Bradleystats, were used. Soon, fixed wirewound resistors replaced these variable resistors.

When AC operated sets were introduced, several wirewound resistors were needed in each set. Wirewound resistors have two important ratings to consider. One is the resistance value in ohms, and the other is the power dissipation in watts. Some power resistors have the resistance wire wound on ceramic tubes with terminals at each end. These resistors operate at extremely high temperatures and you must be careful to dress wires away from them or the wire insulation will melt.

You will find several other kinds of wirewound resistors in the old radios. A "Candohm" is a resistor with resistance wire wound on a fiber strip and encased in a steel housing. The steel helps radiate heat so the resistor doesn't burn up in normal use. Low power resistors are wound on fiber or phenolic strips.

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Vitreous enamel resistors have wire wound on ceramic tubes and are then dipped into enamel. Vitreous enamel is made from several ingredients including clay. The wound resistor is dip coated and fired in a furnace at 750 degrees Centigrade. This temperature vitrifies the enamel and turns it into a type of glass. Vitreous enamel resistors will operate at temperatures as high as 350 degrees.

Most wirewound resistors are wound with uninsulated wire, in a single layer, with spacing equal to several wire diameters. The winding machine uses several gears to get the proper number of turns-per-inch for the desired resistance. The wattage rating is provided by using larger diameter wire for larger wattage resistors. Resistance wire comes in several different alloys, and many different sizes. Wire is available in diameters less than .001-inch to ribbon wire ⅛-inch or more wide. Low power wirewound resistors used as meter multipliers are wound with cotton covered insulated wire.

You will see resistors in the old Atwater Kent radios using resistance wire wound on phenolic strips with solder lug terminations. If you don't care how the radio looks and just want it to play, you can use carbon composition types as replacements. The purist, however, will either make new ones just like the originals or rewind.

So long for now. I hope many of you remembered to attend the AWA convention in Canandaigua, New York. ■

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any TCA subscriber can use the elec-