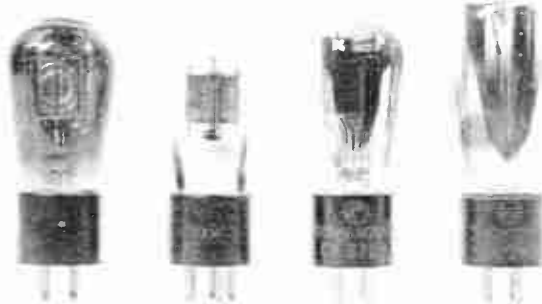


The Radio Collector[®]

February, 1995

The Receiving Tube Story Part 2 - The First A.C. tubes

Last month we covered the development of all tubes commonly used in home battery receivers at the beginning of the broadcast era. Take a few minutes, now, and think about what those battery radio owners had to put up with. If the set was large enough to have good sensitivity and operate a speaker (such receivers would typically be "3-dialer's" using five 01-A tubes), energy to light the filaments came from a six-volt lead-acid storage battery of the type used in automobiles. Plate (and possibly grid bias) voltage came from two or more large dry batteries of the non-rechargeable type.



Here are the tubes that made the first true a.c. sets possible. From left: UX-226, UX-227, UX-171-A and UX-280.

Battery Radio Aggravation

Consider the nuisance and expense of operating these radios. First of all, the typical coffin-shaped case of such sets was not designed to house the batteries. Unless the family purchased a piece of special furniture to accommodate the receiver and its accessories, battery location was a problem. Those energy sources, bristling with interconnecting wires and tied to the radio via a long umbilical, looked quite untidy under the radio table.

The plate and bias batteries (called the "B" and "C" batteries) had to be disconnected, discarded, and replaced when exhausted--an annoying and expensive recurring chore. But the filament storage battery (or "A" battery) was a special problem. It was definitely miscast in the living room because a few stray drops of acid from the battery could play hob with the living-room carpeting.

Moreover, when exhausted, it had to be disconnected and recharged. The hapless radio owner could either

manhandle this 40- or 50-pound load down to the nearest service station and back or purchase a home battery charger. Of course the latter option placed another unit, with more interconnecting wires, under the radio table.

Folks tolerated those messy, inconvenient and expensive batteries at first. They were part of the mystique of owning a radio set at a time when listening to distant signals in one's living room was a thrilling and magical activity. But there was obviously going to be a great market for plug-in radios as soon as they could be invented.

Battery Eliminators

Eventually "B" and "C" eliminators appeared on the market. These converted the 110-volt a.c. house current to the various direct current voltages needed for the set's "B" and "C" supply. Less common, more cumbersome and more costly were the "A" eliminators that replaced the storage battery, converting house current to 6

volts d.c. for lighting the tube filaments.

By purchasing these "eliminators," at some expense, the radio owner could free himself from dependence on batteries--but he still had a bunch of hardware and interconnecting wires under his radio table. Some time in the mid-1920's, the first a.c.-operated sets ("light socket" radios, as they were called) were introduced. But they were really just battery-set designs with built-in "A" and "B" eliminators. These radios were neater because all of the hardware was housed in a single cabinet. But they were just as cumbersome and just as

expensive (if not more so) than battery sets with separate eliminators.

True a.c.-operated sets, with power supply and radio circuitry compactly integrated in one case, would have to wait until the power-hungry filament circuit could be operated directly from an a.c. source. Then the bulky and costly a.c.-to-high-current-d.c. "A" battery eliminator equipment could be abandoned.

A.C. Tubes Arrive

The problem with operating the filaments of most battery tubes from an a.c. source was hum. The 60-cycle hum from the alternating current supply would mix with the radio signal and be amplified along with it, causing a loud and unpleasant raspy noise that made it virtually impossible to hear the broadcast.

In 1927, RCA released two new tubes that solved the problem--each in a different manner. Except for its filament design, the type UX-226 was very similar to the type '01-A it was designed to replace. Engineers had

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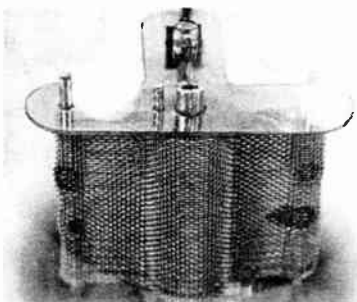
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found that one way to reduce hum was to balance it out by operating the filament at a lower voltage and a higher current. The '26's filament ran on 1.5 volts at 1.5 amperes (compare the '01-A's heater specs of 5 volts at .25 amperes).

The type '27, however, was a true breakthrough design--the prototype for all a.c.-operated tubes to follow. Instead of directly supplying the tube's electron stream, the filament served only to heat a surrounding structure called the *cathode* (originally a ceramic cylinder coated with a metallic substance) which, in turn, emitted the required electrons.



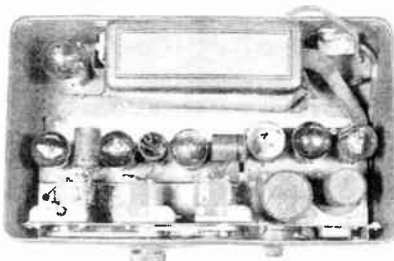
Note the cylindrical cathode emerging from the top of the UY-227's interior structure.

The cathode had enough "heat inertia" to smooth out the a.c. pulsations, so the tube ran without hum. The '27's filament (properly called a "heater" in this application) ran at 2.5-volts, which was to become the industry standard for all a.c. tubes designed over the next several years.

Because it was necessary to bring out an electrical connection from the cathode, the '27 needed a new base having an extra pin. Called the "UY" base, it was like the "UX" design except for having five pins instead of four. The '27's original full designation was UY-227.

The First A.C. Sets

The earliest integrated a.c. radios (the familiar metal-cased Atwater-Kent Model 42 is a good example) tended to use '26's as r.f. and first a.f. amplifiers and the '27 as a detector. In more mature designs, as



Straight-down view on AK 42. Power supply, with '80 tube above; radio chassis, with '26's, '27, and '71-A below.

engineers became more comfortable with

COMMENTS FROM THE EDITOR

Contributing to RC

As promised in this column last month, here's a little more information about the kinds of reader contributions we're seeking for the pages of *The Radio Collector*. We can use both short and long articles. The short ones should be about 750 words. This is about two pages, doublespaced, if you are using standard 10-point Courier printer type (similar to the smaller ["Elite"] typewriter type) and set your margins at one inch all around. All articles should include at least one photo or other graphic (preferably black-and-white, but we can get by with color).

Subjects for the articles may be autobiographical (how you got started in radio collecting, what you enjoy most about the hobby, your favorite types of radios, etc). A suitable photo for this type of contribution would be a shot showing off part of your collection or perhaps your workshop.

Is there a building or location in your area of significance to our hobby? Perhaps a museum, former radio factory, broadcast or short-wave station site? Do you know someone who has an outstanding collection or workshop? Write it (or him) up and shoot a couple of photos for us!

Several people have expressed an interest in seeing some coverage on radio values. If you're planning on attending a radio club auction, take along a notepad or mini tape recorder and note the selling prices of the pieces being offered. You might not even have to do this personally; your club secretary or treasurer might be able to provide you with a list of lots and prices. Send the compilation to us along with a photo of one of the more interesting pieces in the auction, some of the spirited bidders, or whatever seems interesting about the sale.

These are just a few hints to get you started as a "short article" contributor; we'd be interested in almost any subject of interest to radio collectors. On acceptance of your short article, we'll send you one of our handsome white china coffee mugs emblazoned with the distinctive *Radio Collector* logo.

Long articles should be at least 1700 words (or four and a half pages double spaced) using the type and margin standards already discussed. This includes a short (3-paragraphs or so) autobiography that will run in a box on the front page of the article (check some of the autobiographies that ran with previous articles for style). Include at least one photo, schematic or other graphic (two would be better).

We're wide open on the subject matter, it can be technical, historical, documentary or--you name it. Just keep in mind *The Radio Collector's* mission to be of special service to those folks who are just entering our hobby. It might be wise for you to query us with a short outline of any article

(continued on p.4)

(continued on p. 8)

PLAY IT AGAIN!

A No-Nonsense Course in Radio History, Evolution and Repair

TROUBLESHOOTING A SIMPLE BATTERY SET

Last month, we concluded our discussion of all the basic circuit blocks used in early battery receivers. This month, we'll begin talking about how to service these old sets. We'll use the 1925 (late) Atwater Kent Model 20C as our example because it is a simple radio using the circuit blocks we have studied. These AK sets are popular with collectors because they are attractive, well designed and simple to service. Parts are easy to find.

Troubleshooting a radio is best done by following a definite stepwise procedure. This is mine:

1. Keep Written Records

Records are important to help you remember what you did and to "brief" anyone who may acquire the set later.

2. Clean and Inspect Chassis

Remove the chassis from the cabinet and clean it. I use a 1" paint brush to dislodge dust and dirt and remove it with a vacuum cleaner hose held nearby. Don't apply the hose directly to the set; you may disturb components! Inspect the chassis for obvious problems such as loose or broken connections. Check for corrosion of tube sockets and filament rheostats. Check the tuning capacitors to see if they turn freely.

3. Repair Any Problems Found

Solder broken or suspicious joints and repair or replace broken wires. See that screwed or bolted connections are free of corrosion and tight. Clean socket contacts with a small bronze gun-cleaning brush. Burnish the resistance wire and slider of the filament rheostat(s) with 400 grit emery paper. If necessary, lubricate the bearings of the tuning capacitors and filament rheostat(s) with a drop of 20W motor oil. Rotate the shafts to work in the oil until they turn smoothly.

4. Test the Tubes

Follow the instructions for your particular tester and be sure to check for shorts and gas. Clean corrosion off the tube pins with steel wool. *Do not use steel wool anywhere near the chassis!*

5. Check Electronic Components

This step is practical only on simple sets with few electronic components, like this one. The diagram is shown in Fig. 1. It is a TRF receiver using grid damping resistors to stabilize the RF amplifiers. The troubleshooting procedure works backwards. We start at the speaker (if the set has one) and work towards the antenna. This is the best way to troubleshoot complex receivers and find out what does work in an otherwise dead set. It is less important in this simple set, but we will follow the procedure anyway.

Use your ohmmeter to check the primary and secondary of each audio transformer. You should get a reading of a few hundred to a few thousand ohms. You may have to do some wire tracing to identify the leads. In AK sets, the audio units are potted in round metal cans.

Check the resistors next. They are a common problem in 1920's sets. R3, the grid leak, is a glass unit resembling a fuse held in clips. It frequently increases in value or opens up. It should be in the range of 2-5M Ω (original was 2M Ω). If yours is open or out of range, solder a replacement in parallel with it under the chassis out of sight. Leave the original in place for appearances.

R1, R2 and R4 are wirewound units. The resistance wire is often broken. R4 is a tapped resistor of 500 Ω total. AK seemed to think performance was better if the detector grid was returned to a point between A+ and A- rather than to A+ as we learned. The upper portion of R4 was

300 Ω and the lower was 200 Ω . If yours is bad, use small carbon resistors of 220 Ω and 330 Ω wired in under the chassis.

R1 and R2, the grid damping resistors, are 800 Ω each. I rewind mine with resistance wire obtained from Antique Electronic Supply. They are mounted on the backs of the tuning capacitors where they show, and carbon replacements would look bad. R5 is a fixed wire resistor to drop the voltage to the AF amplifier filaments. I have never seen a bad one.

C2 and C3 are mica capacitors which almost never go bad. C1 is a 0.5 μ F paper capacitor potted in a metal case. It bypasses the RF amplifier plate supply for increased stability. It should have infinite resistance, but usually doesn't. If it measures less than 1M Ω , I replace it. Heat the original in a disposable aluminum pie plate on the stove at low heat until the wax softens enough to pull the old capacitor out of the metal case. Solder one lead of a 0.47 μ F/400V "Mylar" capacitor to the case and the other lead to the original wire. Stuff some paper in to take up most of the empty space, arrange the capacitor in the case and top it off with some of the potting wax to preserve the original appearance.

Next time we will finish our repairs and power up.

Conducted by Ken Owens
478 Sycamore Dr.
Circleville, OH 43113

Ken will be happy to correspond directly with readers who have questions about radio theory or repair. Please include a long SASE with your query. The correspondence will be also be printed in R. C.'s "Information Exchange" column so that all readers can benefit from it.

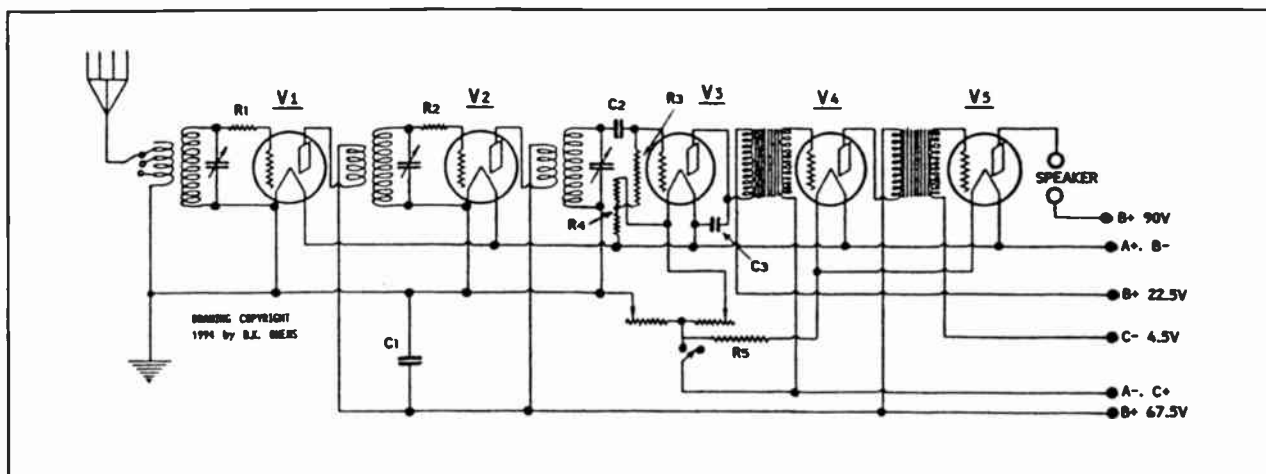


Fig. 1 Atwater Kent Model 20 Compact

AUDIO OUTPUT TRANSFORMERS

Part 2—Identifying Unmarked Junkbox Units

By Anthony P. Jacobi

Here is the conclusion of Tony Jacobi's two-part article on how to find a replacement for a burned-out audio output transformer—even when the manufacturer's specs are not available. Last month Tony showed us how to calculate the turns ratio required for the replacement transformer. This month, we'll find out how to determine the turns ratios of those unmarked audio transformers in our junk boxes so that, hopefully, we can find a match.

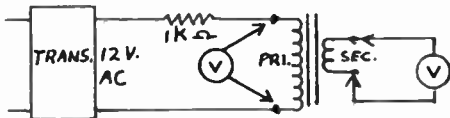


Fig. 1 Test setup for determining turns ratio of an unmarked transformer.

The turns ratio of a "mystery transformer" can be determined by measuring its voltage ratio. The voltage ratio and turns ratio are identical in an ideal transformer. Realistically, the two ratios will not be exactly equal due to the various losses involved, but will be close enough for practical purposes.

Finding the voltage ratio is easy; connect one of the two windings to a low-voltage a.c. source, then measure the voltage appearing across both the primary and the secondary. Divide the primary voltage by the secondary voltage. The result is the voltage ratio and, for all intents and purposes, also the turns ratio.

Figure 1 shows the test setup. You may feed the a.c. into either the primary or the secondary (the results of these two methods will be slightly different because of transformer losses). I prefer to feed the primary, as shown in the schematic. I use a 12-volt transformer in series with a 1000-ohm resistor. The resistor limits the current flow (which is especially important should you try feeding the secondary). If you'd like to substitute a 6-volt transformer, reduce the series resistance to 500 ohms or so.

Make your measurements with a high-impedance voltmeter such as a VTVM or DVM. The DVM is preferred because of its greater accuracy in measuring small voltages.

To summarize, then, the replacement of an audio output transformer of unknown specifications is a two-step process. First, as discussed last month in Part 1 of this article, determine the required turns ratio from the primary and secondary impedances to be matched. You can use either the turns ratio equations of the turns ratio chart. Next, as discussed above, test the transformers you have on hand to determine if any of them have a value close to the one you need.

If the required transformer is not on hand and you have to shop for it, keep in mind that a unit specified to match one set of impedances may also be used for others. For example, a transformer designed to match a 50L6 (load resistance 2,000 ohms) to a 3.2-ohm speaker will also match a 6V6 (load resistance 5,000 ohms) to an 8-ohm speaker—and vice-versa. That's because the required turns ratio in both

cases is 25, as you can verify from the turns ratio equations or chart. (Editor's note: many surplus catalogues list audio transformers by the primary and secondary impedances they were originally intended to match. Using these numbers, you can calculate the turns ratio of such units to see if they could be used in your application.)

One last criterion has to be considered in selecting a suitable transformer. It is the physical size of the replacement unit. That is determined by several factors beyond the scope of this article. The easiest answer is to pick one similar in size to the original or to use the largest size that space permits.

References:

Radio News, July, 1927, P. 60
RCA Radiotron Designer's Handbook, 3rd Edition, P. 206

Tony Jacobi started building one-tube radios at about age 13, when his parents' old Thorola 57 was struck by lightning and became a source of parts. He has been doing electronics work ever since. Tony served as a code radio operator and repairman in the army during World War II. Later, after obtaining his FCC First Phone and Restricted Telegraph licenses, he spent a few years servicing home and aircraft radios. Then came a 26-year stint as electrical-lab technician and product engineer for the Western Electric Company. Tony's antique radio interests include collecting Zenith black dial sets and "restoring old junkers." He is also well known as the compiler and publisher of *The Ballast Tube Substitution Guide* and *The Ballast Tube Handbook*.

THE FIRST A.C. TUBES

(continued from p. 2)

the new "cathode technology," the '26 was phased out—which, incidentally, eliminated the necessity of supplying an extra filament voltage winding on the power transformer. A good example is the very common RCA Radiola 60, which employs '27's throughout—except for the power amplifier and rectifier tubes.

A few power amplifier tubes (otherwise known as audio output tubes) were designed for battery sets. Among them were the '120 (discussed last time), '112 and '171. They weren't widely used, however, because their extra power drain significantly shortened battery life.

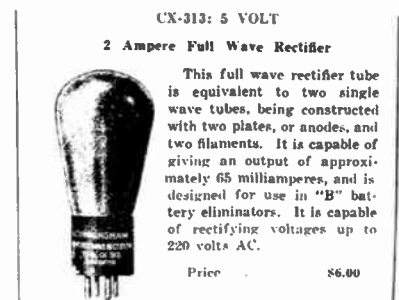
As it turned out, the audio output stage wasn't as sensitive to hum as the earlier stages of the receiver. Battery types used for this purpose could be lit from an a.c. source with no ill effects. So, at least at first, no special a.c. audio output tubes were designed. The most common type used in the early a.c. sets was the UX171-

A, an improved version of the '171. Both the RCA and AK sets just mentioned used this tube as the power amplifier. Its filament operated on 5 volts at .25 amperes, just like an 01-A.

With tube filaments (and heaters) operating nicely on alternating current, one more arrangement had to be made to achieve an efficient "light socket" radio circuit: the conversion of the a.c. line voltage to well-filtered d.c. for use as the "B" and "C" supply. To achieve this, required a full-wave rectifier circuit. Half-wave rectifier tubes (simple diodes having a filament and a single plate, but no grid) had been available since battery set days, but it required two of them for full-wave rectification.

In 1925, the first tube designed specifically for full-wave rectification (containing two plates in addition to the filament) was released. It was called the UX-213. This tube became obsolete almost as soon as it was released; radio circuits were rapidly becoming more sophisticated and powerful and the '213 wasn't able to

deliver enough current to operate them. Very few radio sets incorporated a '213; I've never come across one myself.



Type '13 as introduced in an early ad. As a Cunningham tube, it was designated "CX-313." RCA's version was UX-213.

The UX-213 was replaced, less than two years later, by the UX-280—which had

(continued on p. 6)

INFORMATION EXCHANGE

This is an open forum for interaction among our readers. Here you can ask questions about some aspect of our hobby, answer a question that's been posed or pass along other information of general interest. Send your questions, answers and information to The Radio Collector, P.O. Box 1306, Evanston, IL 60204-1306. Submissions may be edited or paraphrased.

QUESTIONS TO BE ANSWERED

Sensitivity Query

Why do some of my old AM radios seem to lose volume and sensitivity at the higher end of the standard a.m. band?--Bill Miedma, Tower Lakes, IL

ANSWERS TO QUESTIONS

In the December, 1994 issue, Reader David Hofeld raised questions about how to substitute for defective 3-wire line cords, replace dynamic speakers with PM units and check capacitors with simple equipment. Three very experienced restorers responded with long letters answering each question in some detail. Last month, we ran their answers to the line-cord question in "Information Exchange." And we're going to devote almost all of this month's column to their answers to the other two questions. I think you'll find it as interesting as I did to compare the three points of view.

Next month, we'll cover the letters received in response to P.V. Petrosino's question (Also from December, 1994) on grounds and grounding.

Before we get started, here are a couple of recently received notes to add to the information on line-cord resistor replacement covered last month.--ED

Line Cord Resistors Revisited

I would like to add some information with regard to replacing three-wire resistance line cords--which, as of now, are hardly available (at least not in desirable condition).

How much power must be dissipated to replace the "three wire line cord"? If the tubes are of the 300 milliamper heater type, the power in the radio cabinet will be most likely about 40 watts. If the tubes are of the 150 milliamper heater types, the power dissipated will be about 24/28 watts. The older radio sets are most likely to use the 300 milliamper types, but this is counterbalanced by the nature of the cabinets--which tend to be much larger, contain more metal and have a more open arrangement of components.

But adding the 30 watts or so that had been dissipated in the line cord to the heat already being dissipated within the cabinet can be destructive to the set. Your best bet might be to make up the needed resistance with several low-wattage resistors (say 10 watts or so) in series, thus spreading out the heat being radiated. Use square resistors (often designated "PW") for this purpose.

Spread the resistors out as much as possible along the rear chassis apron and clamp them in place, "sandwich" fashion, by laying a large sheet of aluminum over the resistors and bolting it to the apron at

several spots. Before installing the aluminum, spread heat conduction grease on both "clamped" surfaces. You might be able to avoid using the chassis as part of the "heat sink" by making your clamp out of two sheets of aluminum. This assembly can then be fastened to the apron using spacers so that air can circulate freely around it.

If your set uses tubes with 150 milliamper heaters, chances are it won't require a filament dropping resistor and, so, will have a normal line cord. However, if a line cord resistor was used and needs to be replaced, you have to use more caution than with the 300 milliamper sets. Cabinets are smaller and more compact, so it is difficult to install a power resistor without increasing interior heat dissipation to destructive levels. You might consider rewiring the filaments (you'll probably have to use a series/parallel configuration) to run from a low-voltage transformer. These are available from Radio Shack in various voltage and current ratings. Such a transformer will dissipate little or no heat.

Other possibilities for dropping the voltage without developing a lot of heat are to use a diode (see Alan Douglass' letter last month) or a large capacitor. But whatever you do, don't try to power up your set without the dropping resistor. You'll blow out at least one tube, and possibly all of them.--C. Orval Parker, Pocono Summit, PA.

Orval, I got quite interested in your methods and embellished them by adding several details. Drop me a line if I misinterpreted something!--ED

I'd like to comment on Alan Douglas' solution to the line dropping problem when replacing 3-wire resistance cords. It's elegant! (As long a minimum drop required is at least 35 volts.) Sure will save a lot of heat.

Another solution not yet mentioned is to get out the old tube manual and see if some of the tubes can be replaced by similar ones having higher filament voltages. Often, such a tube can be plugged right into the same socket (Example: using a 50L6 to substitute for a 35L6--ED). If an adapter is necessary, you can wire one up (vertical space permitting) using a tube socket and an old tube base. A substitution or two of this kind will reduce the power that the replacement resistor has to soak up.--Dick Mackiewicz, Coventry, CT.

Substituting PM for Dynamic Speakers

How do you replace an electrodynamic speaker with a permanent-magnet unit? Substitute a resistor for the old field coil. The coil was usually part of the B-plus

filter and not very critical as to value. If the resulting hum is too high from having eliminated the "filter choke," simply increase the filter capacitors a little.

Some people (I include myself) will argue that this is not "repair" and certainly not "restoration." It's "modification" at the very least. An open field coil can nearly always be repaired or rewound, and most other defects can be fixed, too.

It's a judgement call, depending on the set's rarity. But once a large component like a dynamic speaker is removed and discarded, making a major change in the set's appearance, no one can bring it back.--Alan Douglass, Pocasset, MA.

I'd be reluctant to do it unless the old speaker is a total loss. Speakers can be re-coned and there are people who are willing to rewind a field coil (for a price). If the field is open, often the break can be found close to one of the coil terminals. You may be able to unwind a turn or two of the coil to get some slack for reconnection. Otherwise, you should be able to splice on a short piece.

If there is no hope except to replace the speaker with a PM unit, choose one that will fit the space available and, if possible, has the same mounting hole pattern as the old speaker. Be aware that the field coil may be open because one or more tubes drew too much plate and screen current. So replace coupling, decoupling and filter capacitors as necessary.

At this point, you need a schematic for the set, a calculator and a tube manual. The schematic may show that the plate and screen currents drawn by only some of the tubes pass through the field coil. Often the output stage plate and screen current does not. Use the tube manual to determine the sum of the plate and screen currents passing through the coil.

For example, suppose this adds up to 60 milliamperes and the schematic, parts list or other source says the field coil resistance is 1100 ohms. A power wirewound resistor of 1100 or 1200 ohms can be used, and it will dissipate $(.060)^2 \times 1100 = 3.96$ watts. A power wirewound resistor with at least a 5-watt rating can be connected in place of the field coil.

Usually, no difference in the amount of hum will be noticed, especially since hum-bucking circuits are used in many sets.--Claude J. Dellevar, Jr., Sylmar, CA

Replacing electro-Dynamic speakers with PM units can easily be accomplished, especially if the resistance of the original speaker field coil is known. If so, the best fix is to substitute a small choke of sufficient current capacity and the correct

(continued on p. 8)

CORRESPONDENCE FROM OUR READERS

Letters may be paraphrased, shortened, or otherwise edited so that everyone gets a chance at the floor!

Siding Squelches Signals

Often collectors who have not erected an outside aerial complain about poor reception—even on their modern sets. Many of these folks have aluminum siding on their homes. Talk about screen rooms? How about shielded houses!--Dick Mackiewicz, Coventry, CT

Quick and dirty Alignment

I would like to pass on this procedure for retuning radios where you do not have an r.f. oscillator but do have a digitally tuned continuous coverage receiver, as in my case. I have used this procedure many times with success. It works quite well with shortwave bands, where broadcasts may not be available at the time of day you are working, or on the longwave band, where there are often no broadcasts to be heard.

This procedure makes two assumptions: 1) the radio has not "been got at" by someone who likes to turn screws, etc. and 2) the dial pointer is correct. If it has been moved, there are usually alignment marks somewhere on the scale. If not, try your best to ensure pointer alignment.

First determine the i.f. frequency by tuning in a local station, then tuning the digital radio to pick up the set's local oscillator. Now subtract the digital readout from the frequency of the station that has been tuned in to obtain the intermediate frequency. *(The i.f. value you obtain in this way may not be exact, but should be close enough to a standard value so you can tell what it is supposed to be. If in doubt, look it up!--ED).*

Once the i.f. has been determined (let's say it's the very common 455 khz), set the pointer at a frequency near the upper end of the dial (let's say 1600 khz). Tune the digital radio to the frequency of the dial marking minus the intermediate frequency (1145 khz in our example). Now adjust the oscillator trimmer until you can hear the oscillator in the digital radio. *(Sometimes tiny changes in the trimmer cause large changes in the oscillator frequency. To avoid "losing" the signal, you might want to try tuning in the oscillator signal prior to making any adjustments, then "follow" it (up or down the band, as appropriate) while you make "tweak" the trimmer to set the oscillator to the correct frequency.--ED)* Repeat this for a lower dial marking such as 540 khz. Use the same procedure on the set's other bands.

Once the oscillator has been aligned, you can then peak the r.f. and i.f. tuned circuits. *(Allan didn't mention his method for doing this, but I assume it could be done by picking up signals on each of the bands and tuning the appropriate trimmers for maximum volume. If no broadcast can be picked up [as, often, on the longwave band] one could perhaps tune in the oscillator of the digital radio [set to an appropriate frequency] and use it as a signal source.--ED)*

Although not as good as a factory tune-up, this method is very effective. I have found that while the oscillator may drift with age, the i.f. value is usually constant.--Allan Brown, Woodlawn, Ontario, Canada

Cord Caution

I thought I should write and offer a word of caution about the black cloth-covered iron cords mentioned in Dick Mackiewicz's article on page 9 of the December, 1994 issue. I believe the white fluffy material directly under the black-and-white woven cover is asbestos. The asbestos was used to insulate the inner wires, protecting them from the hot surfaces of the iron. These cords were also used on toasters, coffee makers, and some portable electric heaters. I changed hundreds of them with never a thought about the dangers involved. Electric ranges also used an asbestos insulated wire, as well as some theatrical stage lights.

Carbon tetrachloride was another deadly substance used routinely through the 40's, 50's and 60's for cleaning purposes. We purchased "carbon tet" by the quart from our local parts supplier.

The Power of Analogy

Years ago, I was teaching radio and TV repair for an adult education program. This was not a theory or engineering course. It was a "locate the problem, read the diagram, and replace the needed part" type of course.

I had an older man in the class who came from a farm background. He couldn't seem to understand the function of a push-pull circuit. After some thought, I asked him if he ever ran a team of horses on a wagon. "Sure," he said, so I proceeded to describe push-pull, using the wagon as the transformer and the horses as the tubes--likening the transformer primary to the whiffle tree. When one horse was changing step the other one was pulling, and vice versa. Suddenly, the light went on!

Analogy is a very good way to get an idea across without a lot of theory. It's not a total answer, but enough to do the job.--Alton A., DuBois, Jr., Queensbury, NY

Transformer Salvage

I recently chanced on a Western Auto table bakelite set at a thrift shop. It was in terrible condition. Most of the brown cabinet was broken away and the speaker was a total loss. Most people wouldn't want it, even for the couple of bucks I paid. But it had a power transformer that did not smell burned, two good 455 khz i.f. transformers, and a useable 2-gang capacitor.

The power transformer was a particularly welcome find because such components are becoming expensive and harder to get. I highly recommend "junk" sets as a source of transformers and useful parts.

When removing an old transformer from

a "junk" and checking its voltages, be careful how you handle the leads. The insulation will probably be brittle and break easily if flexed. You can estimate the power rating of the transformer by weighing it and finding a unit of similar weight in an old parts catalogue (I use one from Newark). Its volt-ampere rating will be very close to that of your transformer. Tag the transformer with the pertinent information so it won't become a "mystery part."

Before putting an old transformer to work, I'd recommend removing the covers and letting it soak for a while in some hot beeswax or other high-melting-point wax (don't use candle wax). Do the job outside and be careful not to overheat the wax. Be gentle with the leads as you remove and reinstall the covers. And slip some fabric insulation over each lead before putting the transformer back together.--Ray Larson, West Los Angeles, CA

THE FIRST A.C. TUBES

(continued from p. 4)

about twice the current rating. The latter provided more than enough power for the sets then in use (both our examples above are powered by '80's) and for those that would be manufactured for years thereafter. In fact, the '80 is probably the most enduring tube type ever introduced, having been manufactured continuously for at least 50 years.

The availability of the types '26, '27, '71-A and '80 tubes made possible the development of the first generation of truly integrated a.c.-operated radios--receivers containing a compact power supply developed as part of the original design and built right into the cabinet along with the rest of the set. Even the table models, complete with internal power supply, were hardly bigger than the 3-dialer "coffin" sets of the previous generation.

Gone was the heavy umbilical dropping down to a jumble of batteries or eliminators under the table. Gone were the batteries themselves and the need to replace or charge them. The only power cable coming out of the new sets was a slender a.c. cord with a plug to be inserted into the wall socket. The cord took care of all energy needs, and the receiver could be operated for hours on just a few pennies worth of electricity.

Not only that, but the new sets were more sensitive and far easier to operate than the old 3-dialers. They also had better volume and tone quality. Is it any wonder that the old battery sets were relegated to attics, basements and (alas) ashcans as fast as their owners could get together the money to buy one of the a.c. models?

Next month the series continues with the next important development in the evolution of the vacuum tube, the introduction of the "screen grid" (or tetrode) design. See you then!

VINTAGE BOOK REVIEWS

Books from the era when vintage radios were new! Look for them at swap meets, flea markets and used book stores.

THE RADIO MANUAL by George E. Sterling. Published by D. Van Nostrand co., NY. Second Edition, fourth printing, 1929. 797 pages. Hardbound.

An experienced radio operator himself, Sterling intended this volume as a textbook and reference for those who (1) planned to enter the radio profession (2) wished to become radio hams (3) were radio "fans" who wanted to learn more about their hobby.

Assuming little prior knowledge of radio, the book provided readers with the information necessary to pass various government examinations and to function well once obtaining licenses.

The first few chapters are devoted to basic electricity, magnetism, storage batteries, motors, generators and electron tube theory. The explanations are quite thorough and the formulas are easily understood by those with a knowledge of simple algebra.

The next quarter of the book covers the various transmitter types used at the time: vacuum tube, arc and spark, as well as to specific uses for radio transmitters (such as marine communications and broadcasting). Also discussed are various types of modulation systems and transmitter test equipment. Diagrams and circuit explanations are quite good, as are the operating instructions and troubleshooting information. Little space is devoted to construction.

Another chapter illustrates and describes receivers designed for use in commercial radio installations. The equipment shown was made by Western Electric, RCA and Wireless Specialty Apparatus Co. Then follow chapters covering SOS auto-alarms, radio

beacons and direction finders, and aircraft radio equipment.

Ham radio is covered in the next chapter, which discusses the properties of short waves, provides instructions for transmitter and antenna construction and reviews regulations governing operation.

The chapter that follows is a interesting one, covering early experiments in television and visionary plans to transmit "radimovies" into people's homes. Instructions are given for constructing an experimental scanning disk receiver.

The final chapters are devoted to the causes of, and remedies for, radio interference and the duties and responsibilities associated with being a radio station operator. Four appendices provide station schedules, a frequency to wavelength conversion chart and article abstracts covering safety at sea.

If you are interested in the commercial and amateur equipment of the late 1920's, *The Radio Manual* is a "must have." Besides the discussions of equipment operation, there are many photographs and schematics. But if your interest is limited to home broadcast receivers, the book will be of only secondary importance.

Please feel free to correspond with me at any time about old radio books.

Conducted by Paul Joseph Bourbin
25 Greenview Ct.
San Francisco, CA 94131
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COMPANY CHRONICLES

Brief Biographies of Classic Radio Manufacturers

DAY-FAN

The "Day-Fan" brand was born when the Dayton Fan and Motor Company (established 1889 in Dayton Ohio) entered the radio business. Dayton Fan had been primarily a maker of electrical and water-powered fans for use in hotels, bars, restaurants and stores. But in 1921, company President M.D. Larkin hired Capt. Orin E. Marvel (no kidding!), who was in charge of aircraft radio research for the McCook Field Radio Laboratory, to design a line of radio components for manufacture by D.F.M. Larkin had been quite successful in handling radio products through another company which he operated (M.D. Larkin Co.), a distributor of mill and electrical supplies.

The original Day-Fan radio line consisted of components (similar to their Atwater Kent counterparts) to be mounted on breadboards. At first, finished radios were not offered, through the company did provide plans for assembling the components into complete receivers. The company's first manufactured sets (the 4-tube OEM-7 and 3-tube OEM-11) appeared in September, 1924. They were modestly-priced 3-dial battery radios employing reflex circuitry.

At this time, Dayton Fan acquired a new president: none other than the legendary "Boss" Kettering of General Motors. Charles F. Kettering was the founder of Dayton Engineering Laboratories and the inventor of automotive self-starting and lighting systems. When he took the helm at D.F.M., Kettering was Vice President of GM and General Manager of its research organization. He changed the

firm's name to the Day-Fan Electric Co., invested additional capital (becoming a major stockholder), and moved the company to a 400,00 square foot plant elsewhere in the city.

Day-Fan's 1925-1926 advertising showed several 4- and 5-tube radios in a variety of table and console styles, some with built-in speakers and/or single knob control. Also included was a free-standing accessory speaker and the "Dayphone," a 5-tube panel set designed for mounting in the radio/phono combination cabinets being offered by some of the "talking machine" manufacturers. This is an amazing product line expansion undoubtedly resulting from the drive and engineering acumen of the new "boss."

Day-Fan was an early entrant in the "light-socket radio" arena, showing plug-in sets in its 1927 advertising. The 1928 and 1929 models were mature examples of the radio engineering art that look similar to other sets of their era. But by then the company was losing a few hundred thousand dollars per year.

General Motors purchased Day-Fan in October, 1929, creating the General Motors Radio Corp. In a secret "silent partner" arrangement, RCA, GE and Westinghouse became owners of 49% of the stock. GM was not so much interested in operating Day Fan as a going concern as it was in acquiring the firm's RCA license without seeming to be in overt collusion with RCA. However the arrangement became the target of a Federal anti-trust suit in 1930, and GM and RCA liquidated the General Motors Radio Corporation the following year.

The information for this company biography was obtained from Alan Douglas' three-volume encyclopedia "Radio Manufacturers of the 1920's," published by Sonoran Publishing, 116 N. Roosevelt, Suite 121, Chandler, AZ 85226.

INFORMATION EXCHANGE

(continued from p. 5)

d.c. resistance for the field coil. (Ex. 4 Henries, 100 ma., 240 ohms.) The inductance of the choke, in this case, is not as important as matching d.c. resistance and current capacity.

If an adequate choke can't be located, a resistor can be substituted. Use a resistor with sufficient power rating. (I use 10-watt resistors here as standard practice.) A slight increase in filter capacitance may be necessary when a resistor is substituted for a choke or field coil. (Try 20%) If the value of the field coil resistance isn't available, try a value of 200 ohms and check the B-plus voltage against the value given in the schematic. If it doesn't match, adjust the size of the resistor upwards or downwards as appropriate.

Alternatively, if you can find a 1000-ohm 25-watt rheostat, wire that in and adjust until the B-plus is correct. Then measure the resistance of the rheostat and substitute a resistor of the correct value.

If you don't know what the speaker voice coil impedance should be, try a 3.2-ohm one first. If sound seems distorted, substitute an 8-ohm unit. Use the one that sounds the best and allows the output tube(s) to run the coolest.--Dick Mackiewicz, Coventry, CT

When substituting a PM speaker for a Dynamic one (or using a PM to replace a missing dynamic unit), you'll also have to be concerned about the output transformer. It may well be mounted on the old dynamic unit, in which case you'll have to carefully disconnect the voice coil leads, remove it, and transfer it to the PM unit. Chances are, you'll have to drill out some mounting rivets to get it off. Do not disturb the leads running from the transformer to the set.

After the unit is in place on the new speaker, wire it to the voice coil. In some cases, you may find that the output transformer is mounted on or under the radio chassis. This simplifies your work as you only have to transfer the voice coil leads from the old to the new speaker.

If you are replacing a missing speaker and there's no output transformer on or under the chassis, use the techniques outlined by Tony Jacobi (see his two-part output transformer article concluding this month) to find a correct replacement.--ED

Testing Capacitors

How do you tell if a capacitor is bad? The smart-alec answer: it is if it has a wax-covered cardboard case or if it's an electrolytic.

Having said that, the question is not so

much "Is it bad?" as "Does it need replacement?" That depends on where it is in the circuit, how much you plan to use the radio, and how much you value originality.

Here are some examples of what I mean. A cathode bypass might have 1000 ohms of leakage, which would be a really bad capacitor, but still work just fine. However, an audio coupling capacitor wouldn't work at all even if its leakage resistance were as high as several megohms.

If you are only verifying that the set is working, you might not replace anything as long as the old parts held up for a short test. But if you were going to give the set as a Christmas gift, you might want to consider total capacitor replacement for long-term reliability.

A rare or unique radio should be left as is, for the future, but if you substitute parts in a common kitchen radio, or even modify the circuitry for long-term operation, who's to care?

Can you check a capacitor with a VTVM? Yes, either directly with the ohmmeter or by measuring its effects on circuit voltages and currents. But it takes a good deal of experience to interpret the results, so you might just as well do the job right by restoring an old capacitor analyzer.--Alan Douglass, Pocasset, MA.

Checking capacitors with a VTVM: A VTVM will check capacitors (out of circuit) for shorts or leakage, but only under low voltage. The VTVM will not tell you the value of the capacitor or check for power factor/leakage at voltage approaching operating level. Only a dedicated capacitor checker will test these parameters. The newer digital capacitance meters will *not* give a true reading of value on a leaky capacitor. Checkers can be obtained at radio meets and hamfests, or through ads in radio publications, for 15-40 dollars. Some examples were made by Heathkit, Precision (PACO), Solar and Sprague.--Dick Mackiewicz, Coventry, CT

Can you check a capacitor with a VTVM? My answer is that sometimes you can do a crude check with a multimeter--either a VTVM (vacuum-tube voltmeter) or VOM (volt-ohm meter), but not a DMM (digital multimeter)--using the ohms scale. If the value of the capacitor is high enough (as in decoupling capacitors or AF coupling capacitors), disconnect one lead of the component and apply the multimeter leads to charge it. Then reverse the leads and note whether the meter gives a "kick."

After reconnecting the capacitor, turn the set on and measure the tube voltages--

particularly the grid bias--with a VTVM to see that the voltages are in accordance with the data you have for the set. For example, if the grid of the output stage is biased positive, you'd suspect the coupling capacitor from the plate of the first AF amplifier to the output stage grid.

A capacitance bridge is a good investment. Get one with its manual. You'll find them at swap meets, estate sales, etc--or try advertising in The Radio Collector--Claude J. Dellevar, Jr., Sylmar CA

COMMENTS FROM THE EDITOR

(continued from p. 2)

you plan to write. We might be able to slant the piece so that it will be of maximum interest to RC readers.

On acceptance of a long article, we'll extend your RC subscription two months. This award is retroactive for the long articles that have already been printed. So get busy folks. Mount your typewriters and computers, unlimber your cameras, and send us some material to enhance and embellish the pages of RC!

The New Slogan

Last month, I called your attention to the small, but significant, change we made in the slogan at the bottom of page one. The adjective "Inquiring" has been inserted up ahead of "Radio collector and Restorer." This came about as a result of the reader input I received a few months ago in response to my query about whether RC is basic enough. Most felt we were, but there were a few people who felt that we've been introducing technical concepts without adequately explaining them.

Having done some soul searching on this point, I've decided to throw some of the responsibility for being basic back on you, the readers. It's not that we don't want to be clear and basic. It's just that I fear that if each of our writers had to stop and define every new term he introduced, the writing might become labored and dull, the writers themselves might become bored and lose interest in contributing to RC, and--as a magazine--we'd lose our motivation to innovate and grow.

So we'd like to ask you to stretch a bit as you read. Develop the habit of inquiring about the material you may not understand. Keep a reference book handy (one of the older Radio amateur's Handbooks, as reviewed by Julian Jablin in the November, 1994 Information Exchange, is an excellent and inexpensive choice). We'll to our best to keep our material as basic as possible, but meet us half-way and look up the things that puzzle you. Both RC and its readers will benefit!

DICK'S CORNER

Tips and Tidbits from the World of Antique Radio Collecting and Restoring

Choosing a Soldering Iron

You may have just started in antique radio, but it won't be long before you'll need a soldering iron--if only for replacing bad line cords. This month, we'll talk about the different types of irons, and let's start with a word of caution: never purchase a soldering iron if replacement tips for it are not sold at the same store. The tips need to be changed regularly; you should buy a couple of extras when purchasing the iron itself.

The first iron I'll mention is the "instant heat" trigger-operated gun. These are high-wattage devices; they are *not* recommended for printed circuits because they will quickly burn the circuit traces off the board. The guns reach operating temperature in just a few seconds, but they also cool quickly. So each time you pick up the gun to use it, you'll have to wait for warm-up.

Solder guns are large and heavy; they will tire your wrist during long periods of extended use. Further, most won't handle really heavy jobs such as soldering a large ground strap to a chassis. Yet they are certainly handy for jobs requiring only occasional soldering. Because they cool off rapidly between uses, they're not so much of a workbench hazard as more conventional irons.

"Pencil" type irons can be obtained with automatic temperature control. Typically, these can be adjusted up to 40 watts for heavier work and down to 15 watts for delicate printed circuit jobs. Single-temperature pencil irons are commonly found as 30-watt models. While good for general radio work, they don't provide enough heat for some of the heavier connections found in tube-type gear. A 40-watt unit is better. I also keep an older 15-watt iron around for use on integrated circuits and for other sensitive work.

Most pencil-type units can be fitted with different styles of tips. A chisel tip heats most connections faster than a pointed one. But the more slender pointed tip is very handy when working in tight spaces, as when making connections to tube socket pins.

Another type of iron, now seldom used, is a classic from the 1940's and 1950's. It's the old 80-watt American Beauty (or equivalent). A foot or so long and equipped with a patterned asbestos cord, it is easy to spot at flea markets. Such units are also available new, with non-asbestos cord, but at high cost. If you *ever* have to solder or unsolder connections to a heavy metal chassis, this is the *only* iron that will do the job.

Finally, there are a few cordless rechargeable models available. These are low-wattage units, generally most useful for work with modern semiconductor circuits. They are very light weight, and work much like the solder gun--requiring only a few seconds' warmup prior to use.

The automatic temperature controlled irons are the most expensive; next are guns and rechargeable types. Lowest are the single-wattage pencil types--though even these can cost up to forty dollars for a professional or production model. Pencil irons can also be obtained for as little as three dollars but, remember, you get what you pay for!

If you plan to purchase a single iron to begin working on antique radios, I'd recommend a good-quality 40-watt pencil type with an assortment of tips. Later, as opportunity permits and needs dictate, you can expand your collection of soldering irons.

Customize that "House Brand" Radio!

During the 1930's and 1940's, many "house brand" radios were made for sale by drug and department stores and through ads in radio magazines and catalogues. Such radios frequently carried no brand name or manufacturer's identification. If you have one of

these, you can customize it with your own name.

You might remove the dial scale and make a substitute one using a color copier. Your name can then be added using transfer letters. Or you might make a copy of your name (reproduced via transfer letters or a good computer printer) on clear Mylar stock. The result can then be positioned over the original dial scale, making it unnecessary to remove it. Your name could also be emblazoned on the cabinet using transfer letters of appropriate color. Mask the radio and spray a protective coat or two of Krylon over the letters (unless you'd like to remove them at some future time).

With the modified radio to use as a prop, you can regale your friends with an intricate story about how your family was involved in the early radio business!

Junk Box Management

Quite often, in articles dealing with radio restoration, repair or construction, the term "junk box" will appear. An article may state that most of the specified parts can be obtained from the reader's "junk box." The beginning collector may not have a good conception of what a junk box really is.

This term was originally coined by radio-oriented people, probably no later than 1920. The junk box does not really contain junk. True junk goes out with the trash. The radio collector's junk box is actually composed of an assortment of good, useable parts salvaged from non-restorable radio and electronic units.

Let me cite an example: you find a 5-tube chassis, no cabinet, no speaker, no model identification. What do you do with this? Certainly you should consider restoration as a first option. If the chassis is in good condition, save it, research it and attempt to identify it. If this fails determine if it's worth building a homebrew cabinet for the chassis. If not, consider scrapping the chassis. There are some exceptions. I never scrap a chrome-plated chassis, or one with ten or more tubes or one with four or less tubes. These are fairly unusual and should be kept intact.

Hopefully everyone will, upon scrapping a set, save all the knobs, escutcheons, dials, dial plastic or glass and good tubes. By all means save smaller items such as dial pointers, tube shields, decorative screws, shaft couplings and any unusual hardware.

Save all good transformers. Before removing one from the set, note how it was used in the circuit. Is it an i.f. or r.f. transformer; a power or audio transformer, etc. Label the transformer with black marker on masking tape. If dealing with a power transformer, mark it with the tube complement of the set. This will help you deduce voltage and current ratings when you are ready to use the unit. If an audio transformer, note whether it is an interstage or output unit and whether it was used in a single-ended or push-pull circuit.

Visit a local electrical supply house and purchase a supply of "Brady Labels" for marking transformer leads. These are available with a variety of characters, numbers and symbols. Use the labels to mark the leads *before* you remove them from the chassis. For example, mark both primary wires with the letter "P," rectifier filament leads with "RF," etc.

These labels will last forever, and are not easily torn off. Believe me, there is *nothing* worse than a whole box of used transformers with no identification! Once the transformer is disconnected and removed from the set, a simple ohmmeter check will ascertain of the windings are good.

This is the first of a series of articles on salvaging parts from old sets and building up your personal "junk box." More to follow!

CLASSIFIED ADVERTISING

Subscribers may place one free classified ad, up to 30 words long, in each issue. Count your name, ham call (if desired), complete address and one phone number as six words. Do not count the words in the boldface heading. Additional words are 15 cents each per issue. Non-subscribers pay 30 cents each per issue for all words. Free ads will be automatically run in two issues, but expire after their second insertion unless renewed by mail or phone. Those wishing to run the same ad for extended periods of time may want to use a "business card" space (see Display Advertising Dimensions and Prices table elsewhere in this issue). This is a boxed area in which we can print your business card or any advertising message that will reasonably fit (no charge for setting type). We reserve the right to make editorial adjustments in classified ads without advance notification and to refuse advertising at our discretion. We will reprint, without charge, any ad containing typographic errors, but assume no other financial responsibility.

Wanted Combination i.f. oscillator coil for Majestic 15 grandfather clock radio. Also, knobs and pushbuttons for Crosley 02CA console. Joe Bentrovato, 1802 Sagebrush Rd., Plant City, FL 33657. (813) 754-3856.

Wanted Chassis for Philco 16-B. Speaker and tubes not needed, but must be in good condition otherwise. Will pay top dollar, if excellent. David E. Booth, Jr., 831 Fairfield Ave., Westminster, MD 21157-5913. (410) 848-4025.

Wanted Old headphones, headphone parts, plugs, adapters, junction boxes, paper. I will purchase any amount, or trade for phones not in my collection. Dick Mackiewicz 1549 N. River Rd., Coventry, CT 06238. (203) 742-8552.

Wanted Philco grandfather clock radio parts: clock hands, speaker cloth. Sam Zuckerberg, 578 Fifth Ave., NYC, NY 10036. (212) 354-7407.

Wanted Official Radio Service Manuals, Volumes 1 & 2, by Gernsback Publishing. Originals w/supplements in good condition only, please. Scott Holderman, 14431 Ventura Blvd, #296, Sherman Oaks, CA 91423. (818) 981-1782.

For Sale Radio Collection program for IBM compatible computers. Stores manufacturer, model, year, cabinet style, frequency bands, circuitry type, tube complement, value. Has search mode and supports printer. Send 14.75 to Randy Eppinette, 825 Ouachita 64, Camden, AR 71701.

For Sale Reproduction crystal detectors, replacement Philmore domes, new loop antenna wire, grille cloth - more! SASE for details. Do you need some oddball part or information? Drop me a note. I'll try! Dick Mackiewicz, 1549 N. River Rd., Coventry, CT 06238. (203) 742-8552.

For Sale "The Signal Corps" has purchased the entire remaining assets of a 1950's WWII surplus dealer: radios, radars, aircraft, etc. Catalog #9 54 page, \$2.00 US \$5.00 foreign. Sam Hevener "The Signal Corps" 3583 Everett Rd., Richfield, OH 44286-9723. (216) 659-3244.

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1/2 page	4 3/8 x 6 3/4	33.00	88.50	160.00	288.00
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Bus Card	1 1/8 x 2 1/8	-----	12.00	21.50	38.50

MONTHLY MINI QUIZ

Match wits with our quiz editor! See next month's issue for the answer, as well as the names of all readers who responded correctly.

This Scottish TV pioneer was among those experimenting with a mechanical scanning disk system.

Answer to last month's Quiz -- Arthur Korn. Correct answer sent in by Alan Douglass, who points out that Korn transmitted his picture in 1922, not 1928 as postulated by our Quizmaster!



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