The Radio Collector®

July-August, 1995

The Receiving Tube Story
Part 5 - The Format Wars

Editor's note: Last month's installment of "The Receiving Tube Story" was accidentally labeled "Part 5" instead of "Part 4." That being the case, I wasn't quite sure what to call this installment. I finally decided that it would probably be best to designate it as Part 5 also. You may not agree, but by the time you see this it will be too late to argue!

With last month's installment, *The Power of the Pentode*, we completed our coverage of the four major types of vacuum tubes: diode, triode, tetrode and pentode. The next developments in vacuum tube evolution were not so much technical as mechanical--relating more to packaging than to function. Many of these packaging "innovations" were essentially marketing devices, which is why I decided to call this month's story "The Format Wars."

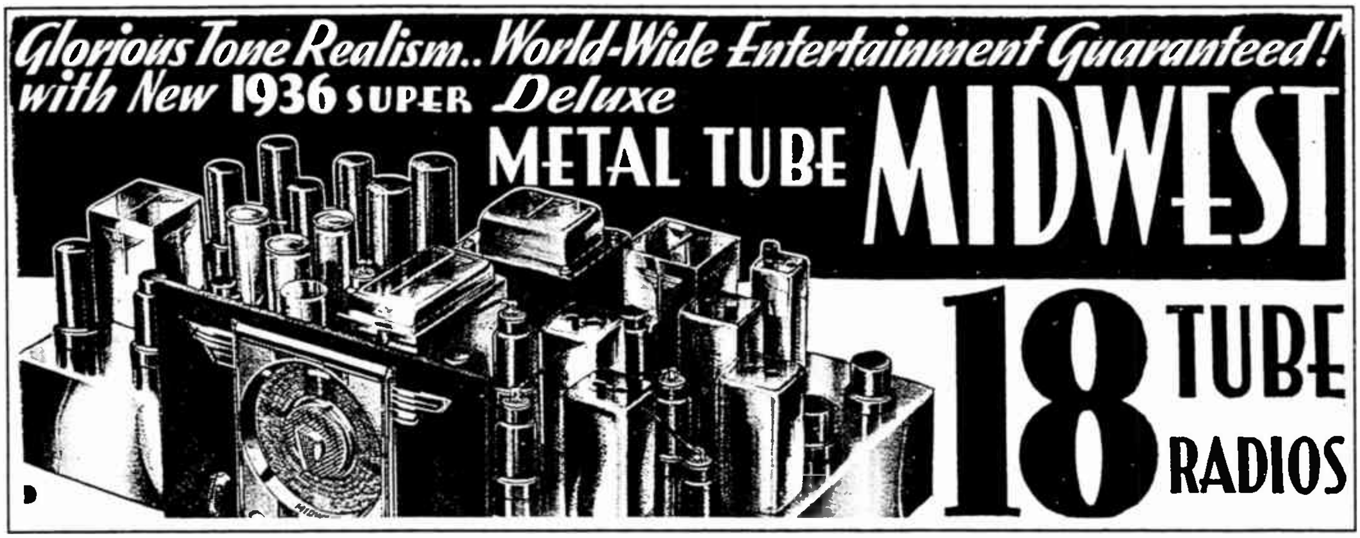
Metal tubes

In 1935, RCA announced the release of a group of tubes that were quite different (at least visually) from any heretofore sold in the American market. Developed for GE, apparently as a gimmick for that company's re-entry into the receiver market after an absence of several years, these new tubes were made of metal instead of glass. They were much more compact than previous American designs and sported a brand-new eight-prong base (dubbed the "octal" base) equipped with a clever locating key molded onto a center post.

Some of the nine tubes that were released by RCA (and later by various independent manufacturers), were simply metal versions of existing glass tubes. Others, such as the 6H6 dual triode and 6L7 mixer-amplifier, were brand-new types. Generally speaking, these tubes did not advance the state of the art in receiver performance, but they did offer some handy features.

Because of their metal shells, the new tubes did not require the use of separate metal shields. And the octal base, which could be installed in its socket with a "rotate-until-it-drops" action, was a real advance in tube-changing convenience. Ask anyone who has ever installed one of the previous, non-keyed, tubes into a tight spot at the back of a chassis!

A few years later, RCA pioneered a new manufacturing concept in its line of metal tubes: the "single-ended" design. Several types originally manufactured with a grid-cap connection, including the 6J7, 6K7 and 6Q7, were re-released without the caps, all leads being brought out to the octal base. This reduced hum and unwanted coupling effects, improving efficiency and performance. The new tubes were identified with an "S" (for "single ended") inserted into their type numbers (6SJ7, 6SK7, 6SQ7, etc.).



As soon as metal tubes were released in 1935, radio manufacturers raced to put them in their sets, hype them in the media.

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Octal-Based Glass tubes
The GE/RCA advertising campaigns for metal-tube-equipped sets tended to put down competitive radios with ordinary tubes. Incensed, Philco refused to have anything to do with the metal tubes--developing, instead, a new line of glass tubes having octal bases. The glass envelopes of these tubes were of the familiar "double-dome" or "ST" design introduced a few years previously to replace the old "pear shaped" style.
The coming of the glass-octal, or "G," tubes (which began to be released just a few months after the introduction of metal tubes) caused a proliferation of "the same but different" types. The first glass-octals to be released were either glass versions of the metal tubes or glass/octal versions of older glass types with traditional bases.
The former carried the same type designation as the metal version with a G suffix to indicate "glass." The latter, of course, were not interchangeable with their parent types because of the basing differences. These required new designations (for example, the octal-based version of the 6D6 was designated 6U7G). Later, of course, completely new types of glass-octal tubes were released.

GT and Loctal Tubes
The vacuum tube envelope went through still another evolution when Hytron announced the "Bantam" or "GT" type tube in 1938. The "GT" tube was a shortened and much more compact version of the "G" tube. It was housed in a tubular (hence the "T" in "GT") envelope instead of the old "double-dome" style. Not much larger than the equivalent metal tube, a "GT" type could easily substitute for it even where space was very limited.
This led to a very confusing and redundant situation in which the same tube could be available in three different styles: metal, G and GT. Eventually, however, the GT design prevailed. While "GT" tubes offered no improvement in performance, set manufacturers favored them over "G" tubes because of their compactness. And for some reason, despite the initial acceptance of metal tubes, glass types came to be preferred in the industry.

(continued on p. 8)

COMMENTS FROM THE EDITOR

Wanted: More Reader Interaction!
With the third bimonthly issue about to go to press, I thought I'd share with you some of my perceptions about how The Radio Collector has been affected by the new 6-issues-per-year policy. I don't know much about how you readers feel about it because I've received very little direct comment. However, I'm happy to say, renewals and new subscriptions are coming in at about the same rate as before.
I take this to mean that most of you are sympathetic to my reasons for changing, as expressed in the March-April, 1995 editorial, and agree that RC is still a very good value.
By the way, I recently received a renewal check based on a "pre-bimonthy" expiration date. That particular subscription actually had several more months to run because it had been extended--like all RC subscriptions--so that the subscriber would receive the full 12 issues originally contracted for. The extension was also mentioned in the March-April editorial, but if you didn't happen to notice it, be sure and check your address label. It will give your adjusted expiration date.
From my point of view, the every-other-month publication policy has been a boon. I have more time to plan each issue without interfering with the other activities (I'm an industrial training consultant and training program developer) that right now are providing the bulk of our income. I also have more time to work on methods of promoting RC and a little more money to put those promotional ideas into action. The problem I see, and I hope it is only temporary, is a definite reduction in reader letters and article submissions.
Prior to the change, our correspondence columns had grown to the point where they had become very lively forums for the exchange of ideas. While I still haven't run out of letters to print, those columns are no longer as crammed full as I like them.
So if you're holding back those questions, answers and comments because you feel RC might not remain around to print them, please be reassured. We may be coming out less frequently, but we are *definitely* planning to be around for quite some time. And we definitely need your input to make RC fresh, lively and relevant. Remember, too, there are still coffee mugs and subscription extensions (see February, 1995 editorial for details) waiting for folks whose articles are accepted for publication.
To open up still another channel for communicating with RC, I've just arranged for an e-mail account. You can now send your questions, answers and comments to me at the following address:

ellis@interaccess.com

You are also encouraged to use this e-mail address to submit your *free* classified ads. Since we're, really not set up to handle billing, ads requiring payment must still be sent by "snail mail" along with a check for the appropriate amount.
Those of you who are planning to attend the Antique Wireless Association Rochester meet (September 6 - 9) should be sure to look me up. Some of the time, I'll be at the flea market RC booth (look for the schoolbus yellow VW camper) and some of the time I'll be inside in the book fair area.--MFE

POWER FOR A.C. SETS

The introduction of AC-powered radios in 1927 immediately made receivers more complex and difficult to service. The power supply is the most troublesome part of an antique radio. The first AC sets were merely adaptations of existing battery sets. RCA modified their Radiola 16, added a power supply on a separate chassis and made the cabinet longer to house it, creating the Radiola 17. The 1928 Radiola 18 was virtually identical.

Atwater Kent modified his Model 33 chassis, added an outboard power supply which sat beside the radio and made the Model 36. Within 2 months, he brought out the Model 37 with the power supply inside the cabinet, but still in a separate box from the radio chassis. His 1928 Model 40 was almost identical to the Model 37.

As we learned a few months ago, the new AC tubes were: Type 26 - RF and first AF amplifiers; Type 27 - detector; Type 71A - power output; and Type 80 - rectifier. Millions of radios using this tube lineup were built in 1927-28. Radiola 17's and 18's as well as AK 40's are frequently seen at flea markets.

Required Filament voltages

A typical "generic" power supply of 1927-28 is shown in Fig. 1. There were many minor variations, but most followed this design. The tube lineup for 1927 required four different filament windings on the power transformer, PT. The 80 rectifier needed a separate 5V winding because the winding carries the B+ also. The 27 detector took 2.5V, the 26 RF and AF amplifiers took 1.5V and the 71A output tube took 5V. The high voltage winding was typically 500V center tapped.

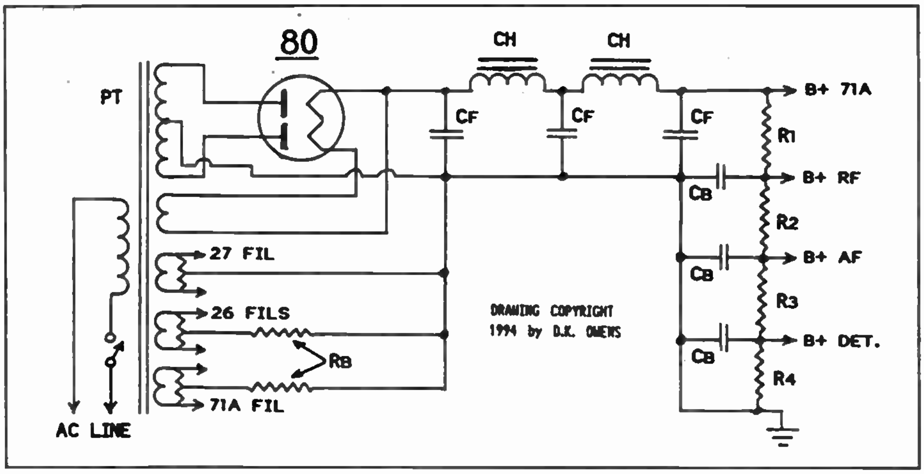


Fig. 1. Generic a.c. power supply of 1927-1928.

Rectification and Filtering

A full-wave rectifier was universally used. The voltages at each end of a transformer winding are 180° out of phase. When the top of the winding is positive, electrons flow from the 80 filament to the top plate and out through the center tap. Meanwhile the bottom of the winding is negative, so no current flows to that plate. On the next half cycle, the polarities reverse. The top of the winding swings negative and that plate stops conducting while the bottom goes positive and electrons flow to the bottom plate and out the center tap. The full AC wave is utilized, hence the name.

The output of a full-wave rectifier is DC pulsating at twice the AC line frequency (120 Hz). The purpose of the chokes, CH, and the capacitors, CF, is to filter or smooth out these pulsations leaving pure DC. Although electrolytic capacitors were available in 1927, nearly all manufacturers preferred paper capacitors. Because of their bulk, values rarely exceeded 4 μF, therefore large amounts of inductance were needed for adequate filtering. Typical chokes were 30H with DC resistances of 500Ω.

Bypassing and Bias

The very low internal impedance of fresh batteries allows stray voltages to bypass to ground. An AC power supply has a much higher internal impedance. Stray voltages are not bypassed and may couple from one stage to another causing instability. The bypass capacitors, CB, prevent this. The resistor string (R1-4) forms a "bleeder" resistor whose individual elements decouple sections of the receiver and also drop the voltage to values suitable for each section. The "bleeder" resistor is a constant load on the power supply which improves regulation and keeps the voltage from soaring as the set is warming up.

Grid bias for all tubes but the detector is the self or cathode type developed through resistors, RB. All of the 26 tubes are biased with a common resistor; the 71A has its own bias resistor. The 27 operated as a grid leak detector without bias (cathode grounded).

Hum Balancing

Each filament winding has a center tapped resistor of 40-50Ω across it. The filament returns to ground through the center tap. In battery sets, the return went to one side of the filament. If we did this with AC heated tubes, half the AC filament voltage would appear in series with the tube and ground causing severe hum. The center tapped resistor balances out the hum. Although the 27 has its cathode grounded, hum can be further reduced by grounding the filament through a center tapped resistor. Some sets use potentiometers instead of fixed resistors for hum control because the best position of the tap for minimum hum is not always in the center.

Power Supply Test Rig

You can't service an AC radio until the power supply is working, so we must check that out first. Build a test rig consisting of a 100-watt lamp wired in series with an a.c. plug and an a.c. socket. Plug in the test rig and insert the set's plug into its socket. The lamp in series with the set and power line keeps the current at a safe level even if there are shorts in the set. The glow of the lamp indicates the current being drawn.

Next time we will service a power supply.

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.

REBUILDING PHILCO BAKELITE BLOCK CONDENSERS

They'll Look Like the Originals--and Outlast Them!

By Chuck Schwark

Reprinted from the Summer, 1995 ARCI (Antique Radio Club of Illinois) News with permission of the author.

Any antique radio collector or restorer that is familiar with Philco radio models from the 1930's through the 1940's has probably seen those black bakelite containers that house wax/paper bypass and coupling capacitors, or condensers as they were originally called. A typical Philco chassis from this era usually has a few of these capacitors. These containers came in at least four varieties with each variety having from 7 to 20 variations of connections and values (see charts on p. 9). Knowing the capacitor's values and lug wiring makes rebuilding them a snap. Replacing the innards with modern parts insures that they will far outlast the original part and give your repaired chassis the original look without visible modern substitutes added to the chassis. I think keeping the radio in as much of its original state has merit, even when the parts are not visible once the radio is back in the cabinet. Also, when adding newer parts, you may not always have enough space to add in the extra parts in a crowded chassis.

Most of these bakelite condensers suffer from old age and should be replaced or rebuilt. The old condensers usually went bad with age after a time. The condenser would swell and start pushing the plug of tar up and out of the bakelite shell. They are usually found in this condition and are good candidates for rebuilding. The rebuilding process is fairly straightforward; the shell and its solder lugs remain intact and the plug of tar and the old condenser are removed. The new part is installed and soldered in place and the shell is refilled with hot glue. There are no special tools needed for this project; just your soldering iron, a pair of regular pliers, a small wire cutter, small needle-nose pliers, a heat gun, a hot-glue gun, and the new capacitors.

The first step is to identify the type of condenser and what part or parts it contains. For example; one of the most common units found in a chassis is part number 4989G. The original unit contains two .09 microfarad (mF) condensers used to bypass both sides of the incoming power cord. Their voltage rating was probably 300-400 volts. Since you can't find the .09 mF value anymore the closest value is 0.1 mF. (Note that the replacement values used in this rebuilding process will vary slightly from the original values, but this will not harm or change operation of the radio in any way.) The voltage rating on the new parts I use is least 400 volts and usually 630 volts. This way they can be used for any application in a radio chassis. The other capacitor "equivalents" I use are a .022 mF value as a substitute for the .015 mF parts in the 3793 series and a .047 mF for the .05 mF parts in the 3615 series condensers. Some of the Philco condensers also included a resistor (see chart). The original resistor is a small piece of fiber stock with light gauge resistance wire wrapped around the fiber in the required amount. I assume from inspecting the size of the wire, that these resistors are rated at about a half-watt. Substituting a new carbon or carbon film half-watt part will work just fine.

The next step is to clean out the old tar and condensers from the bakelite shell. De-soldering the internal condenser leads from the solder lugs on the shell is not necessary as the wire gauge used is fine enough to breakaway when the condenser is levered out of the shell. Using a heat resistant glove and pliers or bench vise to hold the shell, use the heat gun on LOW and thoroughly heat the shell on all sides equally. If the tar starts to smoke, back off on the distance from the heat gun nozzle. You want to soften the tar enough to pry it out, but not so much as to melt the tar. Once the tar is heated enough to slide out, pry it up and out with a small screwdriver or pick. Be careful not to use too much pressure as the bakelite easily cracks on the edges. If the plug does not want to come out, then the tar is not hot enough. You will feel some resistance against the connecting wires, but they should breakaway once you get the plug out far enough to grab with a pair of pliers. Use cotton swabs or paper towels dipped in lacquer thinner to clean out the remaining tar on the inside of the shell. Remember to keep the heat gun well away from the lacquer thinner or rags.

Now de-solder the leftover wires from the solder lugs on the shell. This will make it easier to wire in the new part and clean out the eyelet as well. Bend the wires on the new capacitor to fit into the eyelets from the inside. Note the ground or marked end of the capacitor and orient it to the ground lug (if used) or the lower voltage side of the circuit. Position the new part so it is in half-way down into the shell. In some cases where there are two capacitors mount them side-by-side. This way the hot glue can flow all around the parts to enclose them. Use a one turn wrap on the shorter end of the solder lugs. Solder the leads to the lugs and snip the excess wire.

The last step is to fill up the shell with new potting material. Clear hot glue works fine and protects the capacitors from moisture. Make sure the glue gun is heated sufficiently so the glue almost wants to drip from the gun nozzle. This insures that the glue will flow under the capacitors before it solidifies. Run glue under both ends of the new part so the two globs flow together underneath to force out air bubbles. Wait a minute to be sure there is no air trapped or the bubbles will rise and cause voids in the melt. Continue filling the shell to cover the new part but not overflowing the shell. The hot glue will shrink a little as it cools. As long as the capacitor is covered in glue, it will stay that way once the glue is set. Now you have a refurbished part that actually has better ratings than the old wax/paper part and will last much longer. The physical appearance has not changed and the repair is invisible.

(continued on p. 9)

About the Author. . .

An active member of the Antique Radio Club of Illinois since 1992, Chuck Schwark has been collecting and restoring radios for about three and a half years. He specializes in wood-cabinet table and console radios from the 1930's and 40's, and his wife and 10-year-old son enjoy helping him hunt them down.

Electronics has been both Chuck's hobby and his profession for over 30 years. He is currently Vice President of Engineering for a suburban Chicago based professional video equipment manufacturer.

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

VTVM Quandary

I have an old volt-ohm-milliammeter that I find useful for checking filament continuity, resistor values, B+ and bias voltages, etc. I have been thinking of picking up a used (or inexpensive new) vacuum tube voltmeter. However, I have been told that the VTVM can give misleading readings in some cases. Is there any truth in this?--S. Weller, Skokie, IL.

As always this question is thrown open to the readership at large. However, the VTVM is definitely an extremely useful servicing tool and would be a valuable addition to your test bench. As it happens, this month's "Dick's Corner" is devoted to a comprehensive review of test meters, including the VTVM. Study that first, and next time you attend a radio meet, look around for some of the many beginner-oriented books that include coverage on this subject. A couple of them are: It's Easy to Use Test Instruments (Rider) and 101 Ways to Use Your Test Equipment (Tab).--Ed.

GENERAL

Tube Adapters

If you do any amount of antique radio servicing, you will eventually run into a situation where (a) a tube is missing, (b) a tube is dead, or (c) you suspect the fault must be in a tube. (The tube involved in any of these alternatives will invariably be rare and expensive.)

While it would be ideal to have a large inventory of tube types, that is usually not economically feasible. I have found tube adapters to be very useful in a situation like this. Once the operating condition of the radio is determined, then the proper tubes can be ordered.

The mechanical construction of tube adapters was covered by me in an earlier article (April, 94 issue) so I won't repeat it here. The following tables show the electrical connections for four adapters which I have found very handy. Perhaps other readers could contribute their favorites. (If anyone finds a sub for a 45, please let us know.)

80	**TO**	**5Y3**
4-pin		octal
1fil		2fil
2p		4p
3p		6p
4fil		8fil

42	**TO**	**6V6**
6 pin		octal
1fil		2fil
2p		3p
3scr		4scr
4g		5g
5k		8k
6fil		7fil

75	**TO**	**6Q7GT**
6 pin		octal
1fil		2fil
2p		3p
3d2		4d2
4d1		5d1
5k		8k
6fil		7fil
cap		cap

78	**TO**	**6K7**
6 pin		octal
1fil		2fil
2p		3p
3scr		4scr
4sup		5sup
5k		8k
6fil		7fil
cap		cap

In all of the above cases, I have used octal tubes mainly because I had them at hand. There is no reason why one couldn't use 7- and 9-pin miniature tubes (e.g. 6AQ5 for a 6V6), but for tubes with grid caps, you would have to use a flying lead, which might possibly cause instability.--Bob Zinck, Halifax, N.S. Canada

It's probably worth mentioning that these adapters can be used to substitute between the given tubes in either direction. It just depends on which of the two sockets you choose to make male, to plug into the set, and which you make female, to receive the tube.

My tube substitution references suggest a that a 2A3 can be used as a direct replacement for a 45 (no adapter necessary). But since a 2A3 is a lot harder to find than a 45, you might be more apt to make this substitution in the opposite direction!--Ed.

Replacing Output Transformer Having Hum-Bucking Tap

While working with an a.c.-d.c. set recently, I noticed that its output transformer was oddly configured. Instead of being connected to the low end of the transformer, the B+ lead from the first capacitor in the filter network was wired to a special tap on the transformer winding. The high end of the transformer was hooked to the plate of the output tube as usual. The filter resistor was connected between the low end of the transformer and the second filter capacitor, from which--as is normal--the B+ ran to the other points in the set. Fig. 1 shows an example of a set with this configuration. What was the purpose of this output transformer tap?

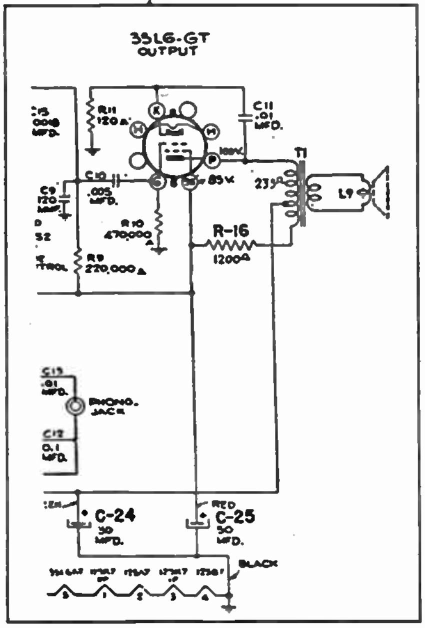


Fig. 1. Output stage with hum-bucking transformer.

After doing some reading, I discovered the answer. To quote one source: "Some receivers make use of a tap on the output transformer to introduce a hum-bucking voltage to cancel the hum that would otherwise appear in the speaker."

If you come across a set like this with a bad output transformer, you won't be likely to locate the correct replacement. Don't try to using a normal center-tapped unit. The tap is not correctly placed to reduce hum and would be ineffective. Instead connect a standard untapped output transformer (of the correct impedance for the output tube), changing the wiring of the filter network to the more normal configuration of Fig. 2.

You may find that this modification does not result in objectionable hum, but if it does, try wiring in an extra 20 mfd.(or bigger) filter capacitor as shown. The reason that the tap was put there in the first place was to avoid using larger components in the filter network, so this strategy should work. Studying the Rider's

(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!

Juicy NJ Auction?

Checking the post office box the other day, I found a flyer from Classic Liquidation and Auction Service, 346 Handsmill Rd., Belleplain, NJ 08270. It announced an auction of the contents of a 50-year-old radio repair shop that closed in the early 90's. The auction is to be held Friday, September 22nd beginning at 10 a.m. and also the following day (if needed) beginning at 10 a.m.

There's a typo that makes the inspection dates not completely clear, but apparently you can look at the items the day before the auction (Thursday) from 3 to 6 p.m. and also the following day, before the auction commences, from 8 to 10 a.m. You might want to call Classic to confirm (Phone 609-861-1111). You can also call or fax (same number for both) to obtain a catalog.

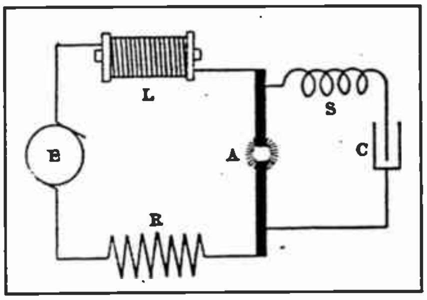
Quoting from the flyer: *This sale includes over 10,000 new boxed tubes, test equipment, military electronic equipment, parts, supplies, speakers, plus much more. We are still finding more incredible items for this sale. Terms: cash only, no exceptions. Absentee bids must be arranged prior to 9 a,m, Friday.*

Inspection and auction are to be held at 90 Cohansey St., Bridgeton, NJ, which, according to the flyer, is "only 45 minutes from Philadelphia and 40 minutes from Delaware." Good luck to those of you who are close enough to check this out!--Ed.

Singing Arc

In answer to last month's *Monthly Mini Quiz*, the British engineer that demonstrated the "singing arc" is William Duddell. Enclosed are copies of relevant pages from Hugh G.J. Aitken's excellent *The Continuous Wave, Technology and American Radio 1900-1932* (Princeton University Press, 1985) and *Principles of Wireless Telegraphy* by George W. Pierce (Mcgraw Hill, 1910).

Have very much enjoyed the articles on tubes. It would be good if you would cover tube manuals like the RCA's RC and HB3 series, Sylvania Technical Manual, etc.--detailing all of the useful info contained in these books.--Charles F. Brett, Colorado Springs, CO.



Here's Fig. 176 from the Pierce book, showing a simplified schematic of the singing arc. The accompanying description reads, in part:

". . . the arc was made to produce electrical oscillations and to give out a musical note. This was brought about by shunting the arc with a condenser and inductance, in a manner resembling that employed by Elihu Thompson. The Duddell circuit is shown in Fig. 176, and differs from the corresponding circuit of Elihu Thompson by the substitution of an arc between carbon electrodes for the metallic arc or spark of Thompson."

The pitch-determining capacitance and inductance are labeled "C" and "S." "E" is the d.c. generator powering the arc and "L" and "R" seem to be the generator's internal inductance and resistance.

Coverage on the tube manuals sounds like an excellent idea! I'll discuss it with Paul Bourbin, our antique book reviewer.--Ed.

Fessenden and the Arc

On the latest *Mini Quiz*, the answer you're looking for is William Duddell. However, Reginald Fessenden always claimed that Elihu Thomson discovered most properties of the arc in 1892. I'm enclosing a copy of Fessenden's 1908 AIEE paper, Wireless Telephony, in which Thomson's work is discussed.

In response to the question raised about Fessenden's December 11th, 1906 demonstration of the transmission of music and speech *(See correspondence column in last issue--Ed)*, It was definitely a demonstration for Telephone Company engineers and not a broadcast.--Alan Douglas, Pocasset, MA.

The Fessenden paper Alan sent contains a good description of Thomson's high frequency arc setup, which does indeed bear a close resemblance to Duddell's. One significant difference: the Thomson unit is shown connected to an antenna and Duddell's is not. Perhaps the latter was more of a lab demonstration piece than a practical transmitter.

Book Review:
Why Computers are Computers

WHY COMPUTERS ARE COMPUTERS by David Rutland; 1995; Wren Publishing, P.O.B. 1084, Philomath, OR, 97370; ISBN 1-885391-05-6; 177 pp; $24.95; Hardbound.

It's a bit hard to realize that personal computers were not common items a decade or so ago. They may have been widely used in business applications, but you had to be a visionary to foresee that kids would be playing games and doing schoolwork on home computers just a few years later.

To a degree, today's explosive advances in PC technology parallel those that took place in the radio industry some 60 years prior. Think of the amazing performance improvements made possible by the introduction of the vacuum tube or--a few years later--the superheterodyne circuit. In the case of computers one of the most epoch-making developments was the concept of the stored program.

In *Why Computers are Computers*, author Rutland traces the innovations made possible by the stored program concept. But this is not just a book about what makes the figurative wheels go round. Instead it leads the reader, a step at a time, through the early history of the computer--especially the creation of the very important National Bureau of Standards Western Automatic Computer (SWAC), a pioneering stored program machine.

Many RC readers will recognize David Rutland as the author of the recently-published *Behind the Front Panel*, a definitive book on the design and development of 1920's radios. Himself an engineer on the SWAC project, Rutland takes us through the development of this important machine in the same clear and engaging style we enjoyed in his previous volume.

The first postwar computer, Rutland tells us, was ENIAC--which was completed at the University of Pennsylvania in 1946. Eniac was the first to use vacuum tubes (18,000 of them) instead of relays for storage. It did not originally use the stored program concept, but was later converted to use it.

SWAC, which came a few years later and was much more efficient, used specialized vacuum tubes that allowed for a lower parts count. Only 2600 of these tubes were needed. Furthermore, SWAC was designed from the beginning to employ stored progams.

To give us some perspective on the magnitude of the SWAC achievement, Rutland tells us that the operating principles of the SWAC were very similar to those of today's personal computers. Modern computers are light enough to carry, while the SWAC and its auxiliary equipment weighed over a ton. Yet SWAC had all the elements of the modern computer and operated in the same manner.

Modern computers use stored programs; so did SWAC. Modern computers have an internal "clock," a memory and an arithmetic logic unit; so did SWAC. SWAC was not as fast or as powerful as a modern desktop computer but it had the same basic hardware and software elements.

Wrapping up SWAC's achievements near

(continued on p.7)

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 METER AT WORK by John F. Rider. Published by John F.Rider Publisher, Inc. First Edition, third printing, 1940. 152 pages. Hardbound.

A good meter is the most important piece of test equipment the vintage radio collector/restorer has. It should be the first piece of equipment the novice radio repairman acquires and the one he uses the most. Having a good instrument is not enough; one has to know how to use it properly. The Meter at Work is a book written by Rider to instruct the radio service person in the proper use of his equipment.

When one sees a copy of The Meter at Work for the first time, one is immediately struck by the unusual, and novel, construction of the book. It is physically split into two sections, one above the other. The top section has the illustrations, while the lower section has the text. The book also has a ribbon bookmark attached to the binding; very like a prayer book.

Rider wanted the reader to be able to study the text while looking at the accompanying illustrations (which, in this book, are extensive). He felt that this format would be more convenient than flipping pages back and forth. According to the preface, Rider intended to publish more split format books. However, this is the only Rider book in my collection made that way.

After a general introductory chapter, a chapter is devoted to each of the five major meter types: moving iron, moving coil, electrodynamometer, electrostatic, and thermal. The middle part of the book is devoted to meter components and characteristics, and to the use of rectifiers and thermocouples to permit the use of DC meters in certain AC applications. The final third of the book covers practical uses of meters.

This book is a good elementary text for someone who wants to learn more about meters. As with all of Rider's books, only simple math is used, and it is clearly explained. Though Rider writes in a simple, easy-to-understand style, he never gives the impression that he is talking down to the reader. The book lacks both a table of contents and an index, which is something I really miss. The split format is interesting. However, I did not find it as useful as hoped.

WIRELESS COMPONENT PARTS AND HOW TO MAKE THEM (one of the Amateur Wireless Handbook series) by the Editors of Amateur Wireless magazine. Published by Amateur Wireless Magazine, 923. 124 pages. Paperback.

I have always had an interest in home-made radio sets. The layout and construction are a reflection of the builder's personality. It's interesting to speculate about why, from the myriad of diagrams and kits available, he chose to build that particular set. It's also interesting to study the modifications and variations that the he incorporated to make the set work better.

I had the privilege of knowing the late Floyd Lyons, a recognized expert on early tubes and a builder of very beautiful one tube, two tube, and crystal sets. He did not follow any particular design, but allowed his sets to evolve as he built them. They always were immaculate and they worked quite well too. Some parts were made from scratch and others were vintage originals.

Floyd felt that to get the real feel of radio in the early days, you had to build a set or two; or, at least, restore a few homebrews. I've built a few simple sets myself and found the experiences to be among the most enjoyable I have had in the hobby.

Wireless Component Parts and How to Make Them, shows how individual parts can be made from materials easily available and with tools that most people would have. It does not cover the construction of complete receivers.

The first chapter is in a question and answer format and explains the function of each type of component. The remaining chapters cover constructional details for building crystal detectors, coils (making and mounting), condensers (variable and fixed), variometers and variocouplers, resistors and rheostats, transformers, and a test buzzer. Interestingly, the information on high resistance grid leaks is included with the condensers.

Each chapter shows a variety of different construction methods, and some are quite clever. There are quite a few illustrations, including many fine drawings. All of the components are designed to work with crystal sets and simple tube receivers.

Although this book was printed in Great Britain, the designs are pretty much universal and, with the exception of a few trade names, nobody should have any trouble understanding the text and following the instructions. There are some interesting advertisements for British wireless magazines and crystal sets. The book has a fairly good index.

This is a book that can provide many hours of reading and construction pleasure for someone who would like to get the feel for radio building as it was in the early days. There are plenty of other books available dealing with the building and wiring of complete sets.

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

Conducted by Paul Joseph Bourbin
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San Francisco, CA 94131
e-mail address: paulbourbin@delphi.com.

CORRESPONDENCE
(continued from p. 6)

the end of book, Rutland says ". . .It continued to operate until December, 1967, when it was shut down for the last time. It was then 17 years old, the oldest of the early computers in operation. It had taken 18 years from conception to birth and a further three years to grow its magnetic drum. It had shown what a stored-program computer could accomplish with a high-speed parallel electronic memory and a simple instruction set. Although it seemed at times to be in the backwater of computer history, by the time of its retirement it had made a significant contribution to the computer revolution."--Julian Jablin, Skokie, IL

Historic Military Communications Award

Sam Hevener, well-known dealer in vintage military communications equipment, has announced a series of awards designed to encourage awareness and use of tube-type military gear. There are several levels of awards, honoring amateur radio operators who make on-the-air contacts with such equipment as well as non-amateurs who display the equipment at public shows. Those who qualify will receive, free-of-charge, a colorful 8 1/2" X 11" certificate documenting their achievements. To obtain a complete set of rules and a description of the requirements for each award, send a long S.A.S.E. to Sam Hevener, W8KBF, 3583 Everett Rd., Richfield, OH 44286-9723. Phone (216) 659-3244 11AM-6PM ET.

COMPANY CHRONICLES

Brief biographies of Classic Radio Manufacturers

Pfanstiehl

The Pfanstiehl story is interesting for a couple of reasons. First it throws light on two pairs of similarly-spelled brand names that many of us have come across: Pfanstiehl and Fansteel; Balkite and Balkeit. Second, Pfanstiehl's activities were a little more subtle than those of many of the radio firms we have chronicled here; firms that simply jumped into the field during the broadcast boom of the 1920's and folded during the Depression.

Carl A. Pfanstiehl, the enterprising son of a Presbyterian minister, was born in 1888, brought up Highland Park, IL and attended Armour Institute of Technology. In 1907, he and a friend organized the Pfanstiehl Electrical Laboratories to manufacture induction coils. This activity was an outgrowth of some work with X-ray machines done by Pfanstiehl during his high-school days.

In a few years, the firm diversified into automotive spark coils and magnetos. These products required the use of expensive platinum contact points--until Carl worked out methods for making them out of tungsten. By 1914, Pfanstiehl was producing its own tungsten and beginning to diversify into other refractory metals--which were to become the company's chief product line.

In 1917, because of the anti-German feelings aroused by World War I, the company name was Anglicized to "Fansteel"--though the Pfanstiehls weren't German at all, but Dutch.

The Company's entry into the radio field came about through some work with tantalum done by Dr. Clarence Balke, who had joined the operation in 1916. Because of its acid-resistant properties, Balke had attempted to use the metal as an electrode in chlorine cells. The project failed, because current would pass through the electrode only in one direction.

It was quickly realized that Balke had discovered a new method of rectification, and the "Balkite" line of rectifiers, chargers and battery eliminators was developed. Sales of these products amounted to $73,263 in 1923 and soared to over four million dollars in 1926.

By the time this product line had been created, Carl Pfanstiehl had already left the firm (1919) to form The Special Chemicals Company. Apparently he wanted to spend more time on experimental product development than on production. However by 1923 he was also in the radio manufacturing business, having formed the Pfanstiehl Radio Service Company.

At first, Pfanstiehl Radio Service manufactured patented adjustable coil mountings, and related components, for use in Montgomery Ward's "Tri-city" radios. A matching accessory amplifier was also supplied. In 1924, the firm came out with its own radio, changing its name to Pfanstiehl Radio Company.

By 1927 Pfanstiehl had decided to leave the radio field to pursue other interests, selling its RCA license to Majestic.

Meanwhile, at Fansteel, things weren't going too well. The battery eliminator business had been destroyed by the introduction of a.c.-operated sets, and a loss of almost $323,000 was posted in April, 1928. However, the firm came out with a complete Balkite brand radio of its own a few months later, apparently having purchased at least a share of Gilfillan's RCA license. Sales of this set seem to have been lukewarm.

In 1929, continuing to slug it out, Fansteel set up the Balkeit Radio Company (note difference in spelling) as a subsidiary. The new company continued to sell the old radios and introduced a new one, the Model C. Most of these were high-priced consoles, the market for which ended abruptly with the Crash. Balkeit went out of business in 1930. But at least as of 1989, Fansteel was manufacturing space shuttle components and still supplying electrical contacts for the automotive industry.

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, and copyrighted 1988, 1989 and 1991 by Alan Douglas.

THE FORMAT WARS
(continued from p. 2)

Approximately concurrent with the first release of "GT" tubes was the introduction of the "Loctal," a new Philco-sponsored threat to the metal tube. Though equipped with a nominal metal shell at the base, Loctals were true all-glass tubes. Instead of being wired into separate base pins, the wires passing through the bottom of the tube were made extra-heavy, to be directly plugged into the tube socket.

Originally manufactured by Sylvania, later by others, the Loctal tubes had a central keyed post somewhat like that used in the octal base. However, the end of the post carried a groove that was engaged by a locking spring built into the tube socket. This arrangement helped lock the tube into its socket; hence the name "Loctal."

Since few set owners that I'm aware of were troubled by tubes creeping out of their sockets--even in auto sets--this Loctal feature had to be of value mostly as a marketing gimmick. In any case, the new tubes were used extensively in Philco radios as soon as they became available.

In order for Loctal tubes to be identified as such by their type designations, a variance was made in the initial numeral of the standard tube designation. Normally "6" for 6-volt tubes and "12" for 12-volt tubes, the numeral became 7 and 14, respectively, for 6- and 12-volt Loctals.

Miniature Tubes

The all-glass design of the Loctal base paved the way for the introduction of miniature tubes about 1940. The new tubes were tubular, with tip seal, about 3/4" in diameter and 2" long. And--as with the Loctals--the wires passing through the tube base were also the contact pins. There was no metal shell or locating key on this tube type, correct insertion being assured by an asymmetrical arrangement of the 7 pins.

The tubes released in 1940 were 1.4-volt filament types for battery portables: the 1R5, 1S5, 1T4 and 1S4. Later, during the war, some cathode-equipped a.c. types (such as the 6C4 and 6J6) were introduced. These, of course found their way into broadcast receivers during the postwar period. Also available immediately after the war was a range of miniature types designed for the a.c.-d.c. sets we know as "baby boomer" radios. These tubes included the 12BA6, 12BE6, 12AT6, 50B5 and 35W4. There were also 6-volt equivalents of most of these tubes for use in straight a.c. radios. -- MFE

INFORMATION EXCHANGE
(continued from p. 5)

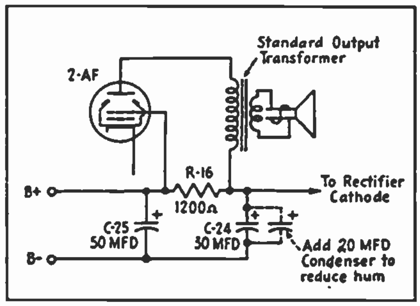


Fig. 2. One way to replace "hum bucking" transformer with standard unit.

Manuals, I've come to the conclusion that most design changes in radios after World War II were made to cheapen the sets.-- Ray Larson, West Los angeles, LA.

DICK'S CORNER

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

When troubleshooting an inoperative radio, the restorer must often measure resistance (ohms), voltage (volts) or current (amperes, milliamperes, etc.) at various points in the set, checking the results against published readings. This means that he/she will need to keep some sort of meter at hand. There are three basic types of meters: the volt ohm meter (VOM), the vacuum tube voltmeter (VTVM) and the digital volt meter (DVM).

The volt ohm meter is the oldest type. It is a passive device, consisting mainly of a sensitive ammeter and a few associated parts. The most inexpensive VOM's have a "sensitivity" rating of 1000 ohms per volt. This means that the meter will impose a load of 1000 ohms on the circuit under measurement for every volt that the operator is attempting to measure.

For example, assume that such a meter is being used to measure one volt across a one-megohm grid resistor. Placing that meter in the circuit will lower the grid resistance by a factor of over 1000! Not only would the meter reading be completely erroneous but, due to the severe loading, the circuit will not perform normally. Better VOM's have sensitivity ratings of 20,000 to 50,000 ohms per volt. These meters are analog instruments. The readings are indicated by the position of a pointer on a selection of scales. The operator must be able to choose the proper scale and decide what the exact reading is. A bit of practice is required before the operator can consistently obtain readings that are truly accurate.

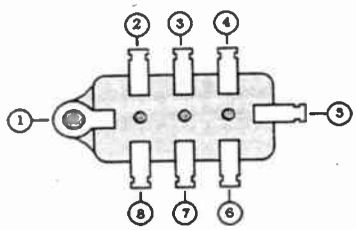
One additional characteristic of VOM's and other pointer-type instruments needs to be mentioned, and that is *damping*. Basically, damping refers to how quickly the pointer will respond to changes in the circuit under measurement. A highly damped meter does not respond well to transients or intermittents. I prefer meters with a minimum of damping for troubleshooting these problems.

Prices of VOM's range from ten dollars for a very basic unit to over two hundred dollars for a sophisticated one. Advantages of a VOM: portability, low cost, ease of use in finding intermittents. Disadvantages: low input impedance, poor frequency response.

The VTVM is a VOM with a vacuum tube amplifier added. This solves two problems. It raises the input impedance (typically to 7 megohms on even the lowest voltage range) and extends the frequency response. It is another analog instrument. Decent units

(continued on p. 10)

REBUILDING PHILCO CONDENSERS *(continued from p. 4)*
Tables refer to lug connections shown on drawing.



Condenser 3615 .05 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
3615-B	.05	1-3-5	250	3-5	1-5
3615-C	.05	1-5-7	250	5-7	1-5
3615-D	.05	1-3-5	---	---	1-5
3615-E	.05	2-5	---	---	---
3615-F	.05	2-3-5	---	---	3-5
3615-G	.05	5-8	---	---	---
3615-H	.05	3-5-8	---	---	5-8
3615-J	.05	1-5-7	---	---	1-5
3615-K	.05	3-5-8	250	3-5	5-8
3615-L	.05	1-5	---	---	---
3615-M	.05	2-5-7	---	---	2-5
3615-N	.05	1-4-7	---	---	1-4
3615-P	.05	1-4-7	250	4-7	1-4
3615-R	.05	1-5-7	250	5-7	1-5
3615-S	.05	1-4	---	---	---
3615-T	.05	1-5-7	150	1-7	1-5
3615-U	.05	1-5-7	---	---	1-7
3615-W	.05	1-2-5	---	---	1-5
3615-X	.05	1-2-5-7	150	1-7	1-5
3615-Y	.05	1-2-5-7	150	1-5	1-7

Condenser 3793 .015 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
3793-B	.015	5-7	---	---	---
3793-C	.015	2-4	---	---	---
3793-D	.015	2-6	---	---	---
3793-E	Twin .015	1-5-7	---	---	1-5 &1-7
3793-F	.015	5-7-8	---	---	7-8
3793-G	.015	2-3-6	---	---	2-6
3793-H	Twin .015	1-3-5	---	---	1-3 & 1-5

Condenser 3903 .01 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
3903-F	.01	3-5	---	---	---
3903-G	.01	2-4-7	---	---	2-4
3903-H	.01	5-8	---	---	---
3903-J	.01	2-5-7	---	---	2-5
3903-K	.01	1-2-4-7	---	---	1-7
3903-L	.01	3-5-8	---	---	3-5
3903-M	.01	4-7-8	---	---	4-8
3903-N	.01	3-5-8	---	---	5-8
3903-P	.01	2-5-7	---	---	2-7

Condenser 4989 .09 Mfd.

Part No.	Cond. Cap. Mfd.	Lugs Used	Wire Resis. Ohms	Resis. Wiring Lugs	Cond. Wiring Lugs
4989-B	Twin .09	1-3-5	---	---	1-3 & 1-5
4989-C	Twin .09	1-5-7	---	---	1-5 & 1-7
4989-D	.09	1-5	---	---	---
4989-E	.09	1-5-7	250	7-5	1-5
4989-F	.09	1-5-7	---	---	1-5
4989-G	Twin .09	1-4-7	---	---	1-4 & 1-7
4989-H	Twin .09	1-5	---	---	1-5 & 1-5

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 to borrow service manual/schematics for Singer/Gertsch FM10CS Station Monitor. Marvin Moss, Box 28601, Atlanta, GA 30358.

Wanted 5-tube radio kit similar to the one that was provided in the NRI home-study course. Claude Jordan, 3010 Acorn Rd., Augusta, GA 30906. (404) 793-9079.

Wanted Cable to connect Drake RV3 remote VFO to TR4C. Also schematic for ERLA Model S51 radio. James C. McColl, KA4PVT, 2627 Whitestone Dr., Florence, SC 29505. (803) 669-4906.

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 Radio Servicing Made Easy by Leonard C. Lane, Volume 2. Claude Jordan, 3010 Acorn Rd., Augusta, GA 30906. (404) 793-9079.

For Sale You need our 80 page set of flyers listing surface mount parts to old radio parts: tube sockets, knobs, terminal strips, etc. All priced right, easy to order - we pay shipping. 3 flyers free, all 80 pages sent Priority Mail for $3.00. Phone (702) 795-7151. Star-Tronics, Box 98102, Las Vegas, NV 89193.

For Sale Old-style crystal radio kits. Includes face panel, base board, variable capacitor, prewound coil, many parts. Remit $22.50. Carl & Grace ent., 5636 Romeyn, Detroit, MI 48209.

For Sale Reproduction crystal detectors, replacement Philmore domes, new loop antenna wire, grille cloth - more! SASE for details. 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 Sencore tube tester TC 136 $35.00. RCA Sound Products catalogue (1948) copies. 83 pages of amps, mics, speakers. $15.00. Kevin L. Moe, 616 Lockrem St., Ottawa, IL 61350. (815) 433-4598.

For Sale Radio collection database for IBM XT or above. Stores information on each radio and your spare tube collection. Prints out list of tubes used by radios and comparative list of spare tubes used in your stash so you know what you need when you go to a swap meet. Requires dBaseIII--demo included. $20.00. Allan Brown, 3934 Stonecrest Rd., Woodlawn, On. KOA 3MO.

For Sale 40-year accumulation of old radios, parts, tubes, service data. Cash and carry only. Phone, write. No lists. Krantz, 100 Osage Ave., Somerdale, NJ 08083-1136. (609) 783-0400.

DICK'S CORNER
(continued from p. 9)
can be found at flea markets for twenty-five dollars or less. The biggest disadvantage of these units is that they are almost always a.c. operated and thus not "portable." The DVM is a true digital instrument. Its direct numerical readout eliminates the interpolation error associated with analog meters. These meters use inexpensive batteries that generally last a few years. Advantages: portability, accurate readout, very high input impedance. Disadvantages: poor frequency response, poor transient response.

A very decent DVM can be purchased for twenty-five dollars. Units with more features (capacitance and frequency measurements, automatic range selection) and better frequency response can cost several hundred dollars.

One last meter worth mentioning is the FET (field effect transistor) VOM. This instrument appeared briefly before DVM's became so popular (and inexpensive). A FET amplifier added to a VOM provided the high input impedance and better frequency response of a VTVM, while retaining the portability of the VOM. These are nice instruments. If you find one in good working condition, plan to pay twenty-five to fifty dollars.

Here are my recommendations: (1) Buy a ten dollar VOM to carry around to yard sales, flea markets, swap meets, etc. They're small, light, and will tell you if those tube filaments are good, if the audio transformers in that vintage battery set are ok, etc. (2) Purchase a basic DVM for your workbench. Their high input impedance makes these meters great for working with both transistor and tube circuitry. (3) If you find a VTVM at a good price, add that to your workbench. You'll appreciate the high frequency response on a.c. if you don't own an oscilloscope.

Conducted by Dick Mackiewicz

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 U.S. physicist and inventor of Yugoslavian descent found a way to dramatically increase the range of long-distance telephone lines through mathematical analysis of impedance effects.

Answer to last month's quiz--William Duddell. Correct answer sent in by Charles F. Brett, Alan Douglas.

Conducted by Julian N. Jablin