# The Jersey Broadcaster

NEWSLETTER OF THE NEW JERSEY ANTIQUE RADIO CLUB

October 2001 Volume 7 Issue 10


## MEETING/ ACTIVITY NOTES

Reported by Marv Beeferman

My apologies for the quality of last month's *Broadcaster*; I was on a tight schedule and Staples had already done the damage. To make room for a little more material this month, we'll limit our Meeting Notes section to just a few comments and delete the advertisements.

The attendance at the September meeting was a little sparse, as expected, but the evening was filled quite nicely with a video of the Ralph Muchow museum and a mini-auction.

First and foremost on the new business agenda is our Winter swapmeet. Because of an expected heightened alert status, the availability of the Freehold armory is questionable and we have not received, as of this date, any follow-up to some suggestions made at the September meeting. If there are any future developments following the October meeting, we'll keep you informed.

Our next Radio Clinic is scheduled for October 20th at our meeting room in the Grace Lutheran Church from 9 AM to 5 PM. If you will not be attending the October meeting, ensure you contact Phil Vourtsis to volunteer as a coach or to give him an idea of what you intend to bring to work on. Phil can be reached at 732-446-2427.

Tom Provost reports that Al Klase is back in circulation; he had a chance to talk to him at the DVRA hamfest. Tom said that Al was recovering nicely, looked good and it was great to see him doing so well. On the same note, the Sibleys are back home and Ludwell sends his regards to all of us that kept him and Marilyn in our thoughts:

"This is to thank all of you who helped sweat out Marilyn's and my, er, "automobiling excitement" just before the Rochester meet. We're now out of medical custody and back home in Oregon. Long-range prospects are quite good. Your cards, emailed encouragement, etc. were most welcome. Jerry Vanicek emerges as the super-hero of this event, having extracted our "stuff" from the ruins of the car, put us up for several days post-hospital, etc."

We've also heard from Jon Butz Fiscina who is now settled in Texas. John asks his NJARC "pardners" not to be strangers and to drop him a line at 2418 Briarbrook Lane, Garland, Texas, 75040 (972-496-5082). He says he'd be happy to talk about a 75-tube radio he just acquired (you know those Texans).

We'll close with an interesting observation made by Ray Chase with regard to recent events:

"It's ironic that the tower that Edwin Armstrong erected in Alpine, NJ in the 1930s, in order to conduct his experiments with FM radio (after having been ousted from the Empire State Building by Sarnoff), is now being used for many of New York City's metropolitan area major TV stations after loss of the facilities on the World Trade Center. Few people are aware of the historical significance of this facility high on the Palisades in this very exclusive community. There has been recent discussions of building a larger tower in this area, since adding the necessary antennae to the Empire State Building will be an expensive and time consuming project. I am sure that Major Armstrong would be impressed with the longevity and new-found significance of the structure that he built and enjoyed so much. (Armstrong delighted in heights and would use any excuse to cavort on a high antenna tower.)

## MEETING NOTICE

**The next meeting of the NJARC will take place on Friday, October 12th at the Grace Lutheran Church, corner of Route 33 and Main Street in Freehold. Contact Phil Vourtsis (732-446-2427) or Marv Beeferman (609-693-9430) for directions. The evening's agenda includes a show-and-tell session with no special theme so we'll accept anything that can be looked at, listened to, turned on, twisted or generally ogled and related to radio or or broadcasting. John Dilks promises to let us look at his repro Marconi Magnetic Detector which an old-timer made for him from dimensions found in an early radio book. We'll also have a mini-auction of the remaining items from the Camden cleanup, a few promising to be a little more desirable than the last few lots.**

## BALLAST TUBE SUBSTITUES

**By Marv Beeferman**

In the early 1930s, hard-pressed radio manufacturers sought a way to reduce the cost of their radios so that more people could afford them. The outcome was the elimination of expensive power transformers by connecting tube filaments and pilot lamps in series, directly across the AC line. Of course, anything that is connected across the AC line has to drop 117 volts.

To accomplish this, tube manufacturers brought out rectifiers and power output

**THE JERSEY BROADCASTER** is the newsletter of the New Jersey Antique Radio Club (NJARC) which is dedicated to preserving the history and enhancing the knowledge of radio and related disciplines. Dues are $15 per year and meetings are held the second Friday of each month at the Grace Lutheran Church, corner of Route 33 and Main Street in Freehold N.J. The Editor or NJARC is not liable for any other use of the contents of this publication.



tubes with filaments rated at 25 volts or higher and equal filament current ratings of 0.3 amps. Filament strings using these tubes would typically require 62 to 78 volts, although greater totals were possible. For example, a 6A8, 8K7, 6H6, 6F5, 25A6 and 25Z6 was a typical tube lineup in sets of this vintage. The filament voltages accounted for 75.2 volts of the 117-volt line voltage (6.3 + 6.3 + 6.3 + 6.3 +25 +25). An additional 6.3 volts was required for each #47 pilot lamp. To drop the remaining voltage, additional series resistance was required.

Faced with this problem, manufacturers thought of using capacitors to drop the voltage while dissipating little power, but the size and cost of the capacitors made them impractical. Another solution was the line-cord resistor, which took the dropping resistor power dissipation completely out of the cabinet. It consisted of a regular line cord with one insulated wire spiral wrapped with resistance wire. However, these cords failed regularly due to overheating and resultant wire breakage and insulation breakdown. People would leave them coiled up or trail them past a steam radiator instead of stretching them out in a cool place.

In some cases, the required dropping resistance took the form of a length of heater wire enclosed in a glass bulb that was mounted on a tube base. This was referred to as a ballast tube or resistor tube. Ballast tubes so resembled regular receiving tubes that some manufacturers couldn't resist the temptation to include them in the tube count for advertising. Some "8-tube" sets actually had only five operating tubes plus three ballast tubes.

The drawback of the ballast tube was the amount of heat it generated. Heat dissipation from filaments alone varied from about 19 watts for a 4-tube set to 23 watts for a 6-tube set. A ballast tube (or tubes) could add an additional 14 to 22 watts of heat dissipation. In a small cabinet, components could easily roast causing numerous reliability problems, especially with capacitors.

The beauty of ballast tube restoration as opposed to line-cord resistor restoration is that replacement components, once determined, can be fitted inside of the emptied tube. Rusted tubes can be easily cleaned and given a spray coat of satin black paint and the originality of the chassis remains closely preserved. But before discussing the particulars of substituting replacement components, let's get an idea of how ballast tubes are typically designed.

The standard RMA. code for the ballast tube of interest can be read directly from the tube or, if obscured, from the radio's schematic. The first letter of the code designates the type of lamp:

K=6-8 volts 150 ma lamp
L=6-8 volts 250 ma lamp
M=6-8 volts 200 ma lamp

The numbers following the letter designate the total voltage drop produced by the resistor, including the pilot lamp voltages, at 300 ma. The last letter designates the particular base wiring employed (see page 4). The letter "J" after the base wiring designation indicates that a jumper is employed between prongs 3 and 4.

For the Clarostat ballast tubes shown on page 4), an additional "X, Y or Z" designation immediately follows the pilot lamp designation to account for non-RMA. codings. The letter X implies that the resistor tube has a UX type base wired in accordance with the accompanying diagram under the X series. The letters Y and Z imply that the resistor tube employs an octal base and is wired in accordance with the accompanying diagram under the Y and Z series. A ballast tube having no modifying letter following the pilot lamp designation indicates that the resistor employs an octal base and is wired in accordance with the RMA standard and with basing as shown.

The example selected for restoration shows a 1936 Freed FE-50 utilizing a K55C ballast tube and two pilot lamps. From our discussion on coding, the K designates 150 ma lamps, a typical current for a #47. The "55" indicates that the total voltage drop of the ballast tube is 55 @ 300 ma. Adding tube filament voltage drops (6.3 + 6.3 + 6.3 + 25 + 12) from the example confirms this value. Finally, the "C" designates the tube's pinout (7,8 and 3) and the pilot light connections.

The solution to the replacement problem utilizes a 1N4005 diode connected as a half-wave rectifier to drop the majority of the line voltage. Tube filaments will

perform their intended function whether they operate on AC or DC as long as the voltage is adequate. The heating or RMS value of 1/2 cycle of the line voltage is equivalent to 0.707 times the RMS value of a full cycle of line voltage. Thus, with a 117-volt line, the theoretical heating value that could be delivered to the filament string is 83 volts RMS. Diode and wiring losses reduce this to about 78 volts. Since our filament string requires 56 volts at 300 ma, a 75 ohm, 10 watt series resistor is required to bring the line voltage to an appropriate value. However, we must also account for the pilot lights.

An appropriately sized shunt resistor (to prevent loss of filament voltage if the lamp should burn out) would be the logical choice. However, this arrangement presents a problem. As tubes heat up, their resistance can rise to a value 6 to 10 times that when cold. Tube filaments are designed to withstand a high cold surge current, and do so in all sets with power transformers. However, pilot light filaments are more fragile and heat up faster than tube filaments, resulting in overvoltage and pilot light burnout in a series string if surge current is not limited. The solution is to shunt the pilot light with a zener diode of appropriate value (depending on the number of lights in the set) to limit the voltage across it during warm-up. A typical value for a single light would be a 1N4735.

Note that the diodes are oriented to conduct on the negative half cycles while the typical B+ rectifier conducts on the positive half cycles. This will reduce hum.

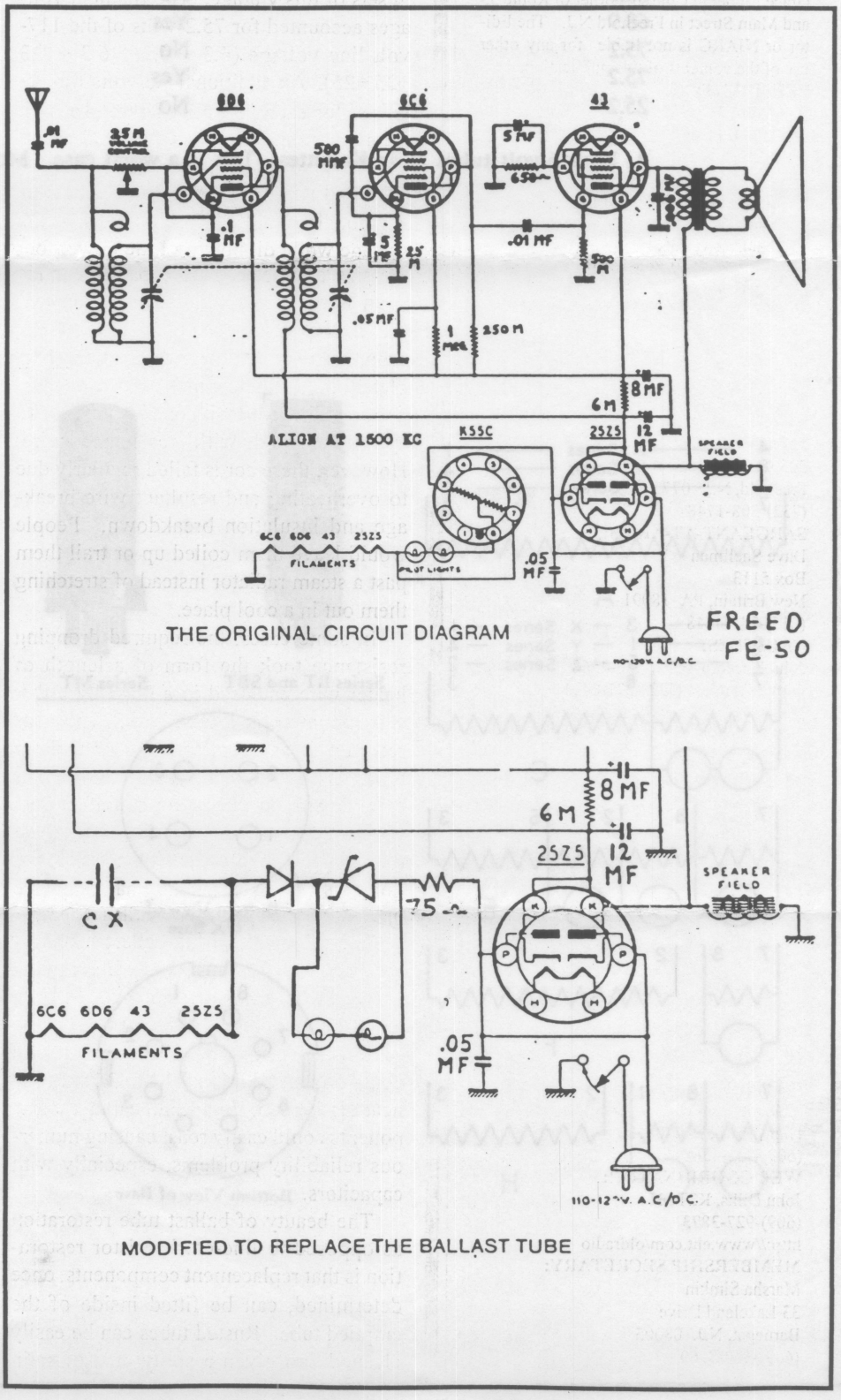
The table on page 4 shows the design center values of R for various filament string combinations with using a 117 volt RMS line voltage and accounting for circuit losses. Note that a single pilot light reduces the required value of R by about 10 ohms.

In some cases, a total filament voltage of greater than the 78 volts provided by the diode may be required. It is possible to add a 150 VDC electrolytic capacitor (Cx) in parallel with the filament string to increase the voltage applied to the string. But some experimentation will be required to determine an acceptable value. A DC voltmeter to monitor one of the tube filaments while trying various values will be required. Try to strive for a filament voltage within 10% of the tube's rating.

As stated, the majority of substitute component combinations can be mounted in the original ballast tube shell. In most cases, heat dissipation will be no more than a couple of watts as compared to the typical 14 to 22 watts dissipated by original ballast tubes.

References:

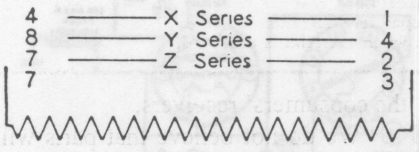
1. James A. Fred, "Old-Timer's Notebook," The Antique Radio Gazette, Vol. 13, No. 2 (Summer 1985)
2. Walt Cury, "Filament Dropping Resistors," MAARC Newsletter, Vol. 7, Number 6 (June 1990)
3. Clayton L. Hallmark, "How to Repair Old-Time Radios," p. 148-152.



Note: Exclude zener diode (1N4735) where no pilot light is used.

| Filament String V RMS | Pilot Light | R |
|---|---|---|
| 62.6 | No | 50 ohms, 5 W |
| 62.6 | Yes | 40 ohms, 5 W |
| 68.9 | No | 30 ohms, 5 W |
| 68.9 | Yes | 20 ohms, 5 W |
| 75.2 | No | 10 ohms, 5 W |
| 75.2 | Yes | 10 ohms, 5 W |
| 25.2* | No | 175 ohms, 25 W |

* Four 6-volt tubes as in Kadettes. This is a worst case. Mount R on top of chassis.

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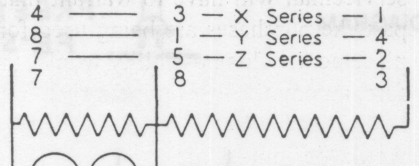


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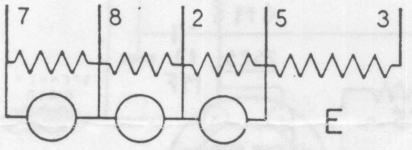


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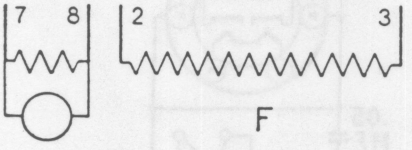


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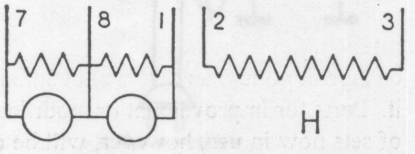


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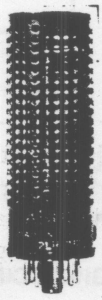


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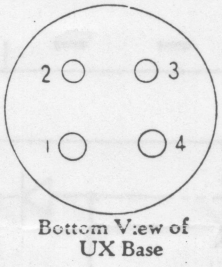
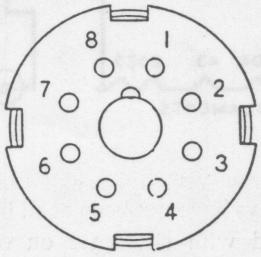



Bottom View of UX Base

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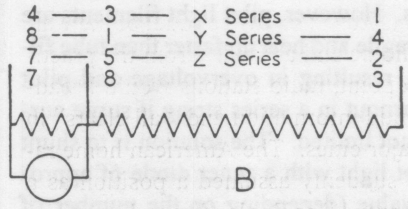


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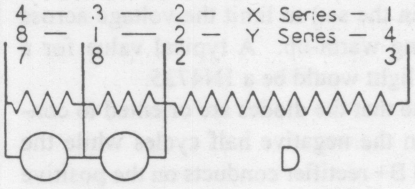


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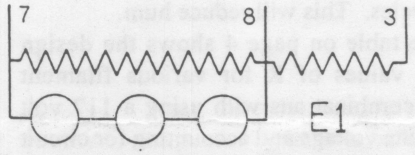


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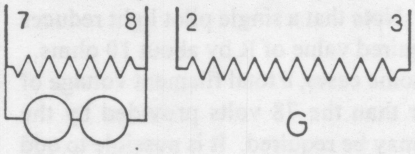


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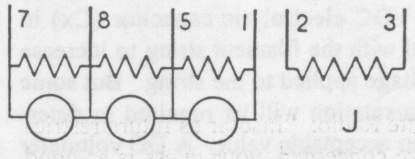


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# DOING WITHOUT

**By Marv Beeferman**

In today's environment, war and shortages of certain essentials do not necessarily go hand-in-hand. For example, through broadcasts, the Internet and more exotic forms of electronic communication, our ability to maintain immediate access to recent unfolding events is taken for granted and is not expected to waiver for lack of radios, TV's and computers. But this has not always been the case.

With the outbreak of WW II, it was quickly recognized that the radio receiver had become an indispensable part of the "home front" in the maintenance of civilian morale and the enlightenment of every American citizen on the conduct of the war, both at home and abroad. From the practical standpoint, radio stations would broadcast air raid information and "all clears" in most major cities. The American home radio had suddenly assumed a position as a "war essential," as England soon learned by bitter experience.

The War Production Board (WPB) stopped the production of home receivers on April 23, 1942 in order to redirect vital materials to the war effort and new radio sets soon became as scarce as tires. Initially, most observers in the electronics industry felt that at a minimum, radio repair parts would remain available to maintain the US civilian communication arsenal, while parts for home construction and renovation and kits for building radios would be limited. This is supported by the response to direct queries from Consumers' Research to various part manufacturers and suppliers regarding future availability of repair parts. Here's a few that I've pulled from my files:

Lafayette Radio: "Insofar as future restrictions are concerned, your guess is as good as ours. For the present we are able to supply the average service man with sufficient material to service practically any set made within the last ten years. Sets sold previous to this time sometimes require special parts, which are no longer available, but even here an intelligent service man can quite often make a suitable substitution that will enable him to put the set in operating condition."

Miller Radio Products: "It is our opinion that regardless of restrictions on civilian goods, steps will be taken to permit the delivery of all necessary replacement parts to insure the continued operation of the millions of radio receivers in the hands of the public."

Meissner Manufacturing Company: "The supply of all radio parts, including audio transformers and speakers, has diminished somewhat but we do not know of a single case where any consumer has found it difficult to obtain repairs on a defective receiver. There is some delay here and there, of course, but up until this time such delays have not been at all bad when compared with shortages on other requirements. We do feel that eventually the Government will set up some priority arrangement for replacement parts so as to make them more readably available. All of us know that our Government is very seriously interested in the maintenance of the consumers' receivers.

"We do not believe that parts will be rationed. We do feel, however, that the serviceman will have to warrant that the parts he purchases are being used for replacement. This possibility would, therefore, automatically eliminate custom built radio kits for home construction since it would be impossible for the serviceman and se builder to state that the parts used were being used for repair or replacement."

Alled Radio Corporation: Our Government must depend on radio to maintain public morale and unity and for emergency instructions should the occasion arise. The policy of the administration, therefore, will be to have adequate radio parts available for repair and maintenance. Such parts will be available indefinitely unless there should be a drastic change in policy, and we do not anticipate it. Parts for improvement or modification of sets now in use, however, will be definitely discouraged, and within a short time parts for that purpose will not be available.

The optimism reflected in the above

# WANTED: Signal Corps Equipment

You may have Radio-Amateur and Photographic equipment that is urgently needed by the Army Signal Corps. The Army will buy the following from private individuals.

Radio: Standard and commercial built short wave transmitters (such as Hallicrafters HT-1, etc.; Temco and Collins Model 32 and 30) and Standard and commercial built short wave receivers (such as Hallicrafter, National, RCA, RME, Hammarlund or Howard); AC and DC Voltmeters, Ammeters, Milliammeters, Radio Frequency Meters and Volt-ohm-milliammeters; Oscilloscopes, 2-3 inch; Audio sig. gen. 30-15,000 cycles; RF sig. gen. 15-215 megacycles; late model Tube Checkers, and other test equipment.

If you have this type of equipment, you can assist the war effort materially by selling it to the Army. Write to:

EMERGENCY PURCHASE SECTION
PHILADELPHIA SIGNAL CORPS PROCUREMENT DISTRICT
5000 WISSAHICKON AVENUE, PHILADELPHIA, PA.

briefly describing the equipment you have and stating the price at which you can offer each item, FOB Philadelphia. Do not ship any material without specific directions from that office.

Price consideration is based upon your net cost less reasonable depreciation for use, age, and condition of equipment. Inasmuch as all equipment is being purchased FOB Philadelphia, cost of packing and shipping can be shown separately so that an allowance for the costs can be made when material is accepted.

3/26/43.

I have tried both at the factory and at the Lafayette Radio to obtain a K17950 plate for my Stromberg Carlson radio, without success. Factory says it is made of critical materials and none will be made for duration. Being a subscriber to C R for may years I thought maybe you might have a suggestion as to where I might try. This plate ties the tuning condenser shaft to the dial and tuning knob. Reply postal card attached. Thank you.

Armand F. Jones
Box 327, Toms River,
N. J.

MAR 29 '43

comments regarding repair parts availability in the years following 1942 were far from prophetic, but the expected programs for regulating production and distribution did emerge.

On February 16, 1943, the American Standards Association published American War Standard C16.8-1943, "Simplified List of Home Radio Replacement Parts." This was a first of a series of standards which radically reduced the variety of radio parts and was intended to provide "war model" replacement parts to keep home radio sets running in spite of wartime shortages. The standards were expected to enable radio owners to keep their sets in repair for the duration of the war regardless of the firm which made them or the year in which they were made. The basis of these two philosophies was to use a minimum of strategic materials in part design and require performance characteristics from an electrical and service life standpoint so that the replacement would last for the duration of the war.

The standards also provided for new "War Model" part numbers and a special symbol consisting of a V with the Morse Code "V" - three dots and a dash - enclosed in a circle to appear on all parts made in accordance with them. They also provided for a manufacturer's identification symbol assigned by the WPB appearing on all parts so that responsibility for the quality of unbranded and private brand parts could be definitely ascribed to the original manufacturer.

Standard C16.8 covered a simplified list of paper and electrolytic capacitors, volume controls, power and audio transformers and reactors. The standard was progressively supplanted by complete standards for each type of part which included minimum performance, construction and dimensional requirements.

It was expected that this simplified line of parts would be sufficient to service an estimated 90 percent of the home receivers in use at the time. It was also expected that the standard would make things easier for dealers who were formerly forced to hold large inventories comprising many slow lines in order to satisfy all customers. For example, nine types of electrolytic capacitors replaced the 350 formerly manufactured. The standard also reduced the number of paper capacitors to nine, volume controls to 11, power transformers to six, chokes and interstage audio transformers to two, output audio transformers to three and driver audio transformers to one.

On April 24, 1943 the War Production Board issued an order requiring radio set owners to turn in old parts in exchange for comparable new ones purchased or installed by repair men, except in cases in which return of the part was impracticable. This exception was for the benefit of rural radio set owners who could buy only by mail and for those who have lost the parts that were replaced. These buyers were required to "certify" that the parts they want to buy were essential for repair. Radio repair men or dealers were not required to pass along to their suppliers the worn parts they collected but merely send in certifications that they have collected such parts.

By mid-1943, it was obvious that the War Productions Board's efforts to keep America "on-line" was a dismal failure; soon, heated and less than patriotic demands for an ease in radio part restrictions bega to surface. The August 1943 issue of *Radio Retailing* noted that the "adequate supply" promised by the WPB had not been forthcoming, especially in radio tubes, with the result that the number of dead sets was significantly increasing. The condition was reported to be so grave that the Philadelphia Radio Servicemen's Association had gone on WFIL radio to urge the public to send letters to their Congressmen, newspapers and radio stations to complain about their dead radios. Terms such as "administrative red tape" and "avoidable and needless limitations on production and deliveries" could be found in many other commentaries of the time.

The 1943 parts shortage had some interesting consequences, some obvious and some not:

1. Radio dealers and brokers revived the old practice of assembling radio sets by combining chassis and parts of chassis that were liquidated by manufacturers with cabinets similarly made available when the government ordered a cessation of the production of radio sets. Even radio-phonograph combinations were being assembled in this way.
2. Many automobile radios were transformed into home radios by converting them for power line use.
3. Radios and amplifiers quickly disappeared from secondhand stores and junk dealers. Much of this material was gobbled up not only by the general public and servicemen for repair parts but by the government itself as war material replacements and by Army schools teaching radio fundamentals to new recruits..
4. Transformers became significantly scarce because of their copper content. However, output transformers were more affected since manufacturers had since been eliminating audio transformers as a

cost-cutting measure.
5. Midget and other small ac-dc receivers were especially vulnerable because their tubes had a way of burning out with unusual frequency and were hard to replace. They also suffered from numerous component failures resulting from the huge amount of heat generated inside the set.

Included in this month's *Broadcaster* is a reproduction of a May 17, 1943 *Wall Street Journal* article which provides a first-hand summary of the situation and some of its consequences. Of course, radio part shortages continued for some time following 1943 even with WPB action and for some time after the war ended.

REFERENCES:

1. Correspondance as noted between radio part manufacturers and Consumers' Union (author's collection).
2. The CD Capacitor, Vol. 8, No. 10 (November 1943), p.4
3. Consumers' Research Bulletin, September 1943, "Remade Radios"
4. Radio Retailing Today, August 1943, p. 42, 58
5. New York Times, April 24, 1943, "Orders an Exchange for New Radio Parts"
6. Industrial Standardization, March, 1943, p. 77-78; December, 1942, p. 33
7. Consumers' Research Bulletin, February 1943, "Notes on the Current Radio Situation"

# SILENT RADIOS

**Reprinted from *The Wall Street Journal*, May 17, 1943**

Millions of home radio sets - no one knows quite how many - are out of commission and the situation will get worse over the next few months. A shortage of batteries has silenced a high percentage of the farmer's three and a half million sets. At mid-March, for example, surveys showed 40% of the rural radios in Nebraska and the Dakotas out of operation.

Lack of parts, principally tubes, has silenced hundreds of thousands of sets in city homes, including an estimated 100,000 each in Detroit and Philadelphia and 50,000 in Los Angeles. These figures, radio men say, are typical.

## W.P.B Takes Action

The War Production Board has now taken action to relieve the situation, releasing critical materials for manufacture of badly needed parts and radio batteries. However, the industry thinks that while the Government's actions will help, it won't serve to keep America's 58 million home radio receivers in operation.

Currently, in many cities it "is nearly as difficult to get a radio part as a porterhouse steak. Repair shops in many cities are reported turning down jobs. They lack not only parts but skilled workmen. One large Chicago repair shop in the Loop district now places a minimum charge of $3.50 on all calls--whether or not work is done. In San Francisco, buyers eagerly offer black market prices of $5 for a $1 tube, but they aren't to be had. There are reports of repair men cornering the limited supply and selling them as "repair jobs" for as much as $10 each. Washington householders say some shops there are working using the same dodge.

The situation apparently is not as serious generally in the East as elsewhere. New York and Boston report considerable difficulty to getting radios repaired, but apparently no crisis exists. This is probably due to two facts: (1) Many Eastern homes have several sets, and are not "off the air" when one goes bad; (2) retail stocks of new radios are not exhausted in the East as in some places. These can be drawn on when old sets can't be fixed. Hence, New England reports radio audiences in that area at a new peak.

Elsewhere, where homes are without radios, the situation goes beyond one of inconvenience, radio men declare. Air raid warning systems, for example, are correlated with radio.

Because neighbors are distant, Western farm homes are particularly dependent on the radio. Congressman Stefan of Nebraska calls the situation in respect to farm radios "critical." Thousands of sets in his home state are idle because of the shortage of batteries, he said yesterday. He said he was convinced the situation in other farm states was similar to Nebraska's.

Radio men are critical of the War Production Board's policies on materials for civilian radios. The trouble here, the say, is: "Too little and too late." The W.P.B. has authorized manufacture of 2,000,000 tubes a month, which compares with normal consumption of over 4,000,000 a month. While this might seem to leave a monthly deficit of 2,000,000 tubes as between demand and supply, actually, radio men say, the deficit will be greater. Because manufacture of new radio sets is suspended and stocks of those on hand now, householders must make their present sets last longer. Hence, tube mortality is bound to be heavier than usual. In any case, the first of these newly-authorized tubes are not slated to appear on the market until mid-June.

Authorization of the manufacture of 4-1/2 million batteries for farm sets over the next 12 months contrasts with an apparent demand for 7 million; each of the 3-1/2 million farm sets normally consumes two batteries a year. No battery manufacture has been authorized for portable sets of which there are 3,000,000 in consumers' hands and of which probably one-third are dependent entirely on batteries.

Manufacture of V (for Victory) parts - condensers, resistors, etc. - has been under way for some time. Some of these are on the market. These parts are especially designed to save critical materials.

Complicating the radio parts situation are these factors: Despite the W.P.B. authorization, some manufacturers doubt whether they have been given high enough priorities to obtain the needed materials; reduction in the number of types of tubes from a pre-war total of 600 to 114 will require readapting (changing sockets, etc.) of many sets to the new tubes. Repair men already are flooded with more business than they can handle, and the trade doubts whether they can handle this additional need for wholesale alterations.

# American War Standard

# Simplified List of Home Radio Replacement Parts

## (Paper and Electrolytic Capacitors, Volume Controls, Power and Audio Transformers and Reactors)

## 1. Fixed Paper-Dielectric Capacitors

| Capacitance, Microfarads | D-C Working Voltage |
|---|---|
| 0.00025 | 600 |
| 0.001 | 600 |
| 0.002 | 600 |
| 0.005 | 600 |
| 0.01 | 600 |
| 0.02 | 600 |
| 0.05 | 600 |
| 0.1 | 600 |
| 0.25 | 600 |

## 2. Dry Electrolytic Capacitors

| Capacitance, Microfarads | D-C Working Voltage |
|---|---|
| 100 | 25 |
| 10 | 50 |
| 20 | 150 |
| 20-20* | 150 |
| 50 | 150 |
| 20 | 250 |
| 10 | 450 |
| 10-10* | 450 |
| 40 | 450 |

*Dual units are common cathode type.

## 3. Volume Controls

### 3.1 Untapped Composition Element Type

| Resistance | Taper |
|---|---|
| 10,000 ohms | reverse |
| 25,000 ohms | reverse |
| 250,000 ohms | audio |
| 500,000 ohms | audio |
| 1 megohm | audio |
| 2 megohms | audio |

### 3.2 Tapped Composition Element Type

| Overall Resistance | Tapped Resistance |
|---|---|
| 500,000 ohms | 150,000 ohms |
| 1 megohm | 300,000 ohms |
| 2 megohms | 15,000 & 500,000 ohms |
| 2.25 megohms | 500,000 & 1 megohm |

### 3.3 Wirewound Element Type

| Resistance | Taper |
|---|---|
| 10,000 ohms | linear |

### 3.4 Volume Control Switches

Single pole, single throw
Double pole, single throw
Single pole, double throw
4 pole, single throw, shorting

## 4. Transformers and Chokes

### 4.1 Audio Transformers

#### 4.1.1 *Interstage Transformers.*

| Transformer | Voltage Ratio | Maximum D-C Primary Current in Milliamperes |
|---|---|---|
| A | 3:1 | 10 |
| B | 1:1, 3:1 or 6:1 (Single or push-pull input and output) | 10 |

#### 4.1.2 *Driver Transformers.*

| Transformer | Voltage Ratio | Maximum D-C Primary Current in Milliamperes |
|---|---|---|
| A | 1:1, 1.5:1 or 6:1 (Single or push-pull input and output) | 35 |

#### 4.1.3 *Output Transformers.*

| Transformer | Rated Wattage | Impedance Ratio | Maximum D-C Primary Current in Milliamperes |
|---|---|---|---|
| A | 4 | 2500 to 15,000 ohms primary impedance to 2, 4, 6, 8, and 15 ohm voice coils | 50 |
| B | 8 | 2500 to 13,000 ohms primary impedance to 2, 4, 6, 8, and 15 ohm voice coils | 70 |
| C | 15 | 2500 to 13,000 ohms primary impedance to 2, 4, 6, 8, and 15 ohm voice coils (push-pull input only) | 70 |