



# CALIFORNIA LETTER

VOLUME 16

SEPTEMBER 1990

NUMBER 9

## Spartan



# CALL LETTERS

*The Northwest Vintage Radio Society is a non-profit historical society incorporated in the State of Oregon. Since 1974 NWVRS has been dedicated to the preservation and restoration of Antique Radio & Wireless apparatus. The Northwest Vintage Radio Society meets at the Buena Vista Club House (Atkinson Park) 16th & Jackson Street, Oregon City, Oregon. (Note: take I-205 & Exit at Park Place, take first right onto Washington St. continue to 15th, left up 15th hill to Jackson, turn left to 16th).*

*Meetings are held at 10:00 AM on the second Saturday of each month except for summer vacation in July and August. The meetings are an opportunity to exchange information and advice.*

## Annual Dues:

|                      |        |
|----------------------|--------|
| Regular Membership   | \$15-- |
| Associate Membership | \$12-- |

Renewals are due on January First

## 1990 NWVRS OFFICERS & STAFF

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| VICE PRESIDENT | Art Redman     | 503-774-9913 |
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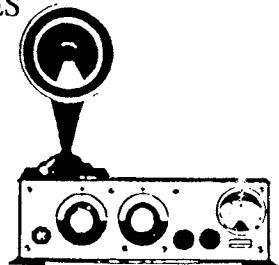
## NWVRS MAILING ADDRESSES

### Membership Applications & Renewals:

Northwest Vintage Radio Society  
P.O. Box 82379  
Portland, Oregon 97282-0379

### All Newsletter Business/Information:

Call Letter  
4041 NE Wistaria Drive  
Portland, Oregon 97212-2963



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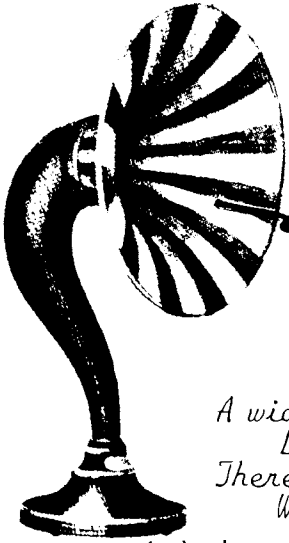
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# ATMOSPHERICA

By J

## The Silent Treatment

A widow, with four daughters fair,  
Lived in town beside the lake---  
There were sly, cloudy whispers heard;  
Were these rumors true or fake?

And then in the early thirties,  
While "Depression" was the scare,  
They left our little country town  
To---the Lord knows only where.

The house was sold some years later;  
Furniture and trivia all.  
That's where I got this old speaker,  
From a shelf along a wall.

The horn was dented and dirty,  
There were cobwebs in the throat,  
The driver was long since ruined  
With a green corrosive coat.

I often stare at that relic  
And roll back memories clock---  
Golly, the tales that horn might tell,  
If the thing would only talk!

\*\* \*\* \* \*\* \* \*\* \* \*\* \* \*\*

## Mamma Goose # 4

Four and twenty stations,  
Broadcasting on the air.  
So Jack built a crystal set,  
Mostly on a dare.

He got all the stations,  
Proof he was no dunce,  
But much to his chagrin  
They all came in at once!



tj/11/81

# Radio Waves

---

Dick Karman, NWVRS President

## *Involved*

As the president I have enjoyed the activities of our society. But just as a group of you came to talk to me last year, I am asking for you to come talk to me now. Who would be willing to run for president for next year. Let's not wait until someone gets volunteered. I look forward to next year's president being more involved than this year's.

## *In Demand*

Don't forget to bring your gear to the auction to be held directly following the September meeting. Bring a list of your gear so that I know who it belongs to.

## *In Passing*

I regret to report to you the passing of two of my favorite people from the golden days of radio. Michael Rafetto passed away May 31st. I remember him as Jack Packard in *I Love a Mystery*. Rafetto also played one of the Barbour family in *One Man's Family*. Both of these series were written by Carleton E Morse. Other credits include *Numb and Dumb*, *Arm of the Law*, *China Town Squad*, and *Death Valley Days*.

Radio's Sam Spade, Howard Duff, passed away on July 7th. Duff began as a disk jockey on KFRC in the Bay Area. He, like the late Elliott Lewis, worked with the AFRS during the war and gained both experience and skill. *Sam Spade* was everybody's favorite. Regretably, the McCarthy era influence caused the show to leave the air during the season when it was the highest rated show on radio. More can be said about both of these men, but let it suffice to say we'll miss them and their part of radio's past.

## *Banquet*

During the summer have you all looked into the location for our fall banquet? I hope that more than a few of you will have some facts for me by the meeting. Give me the details before we begin and I'll announce it and keep it brief. But if we want to have a good time in October we have to plan now.



# N W V R S AUCTION

September 8, 1990 11AM  
Auctioneer Dick Karman

## Future Events

October 13 Contest  
November 10 Swap Meet  
December 8 Annual Election



# PSARA ANNUAL ELECTION

SEPTEMBER 16, 1990 1PM  
also featuring  
Ken Korhonen on Early TV

John Schneider's outstanding leadership made 1990 a record year for PSARA. The Museum really moved forward with Ken Korhonen as Curator. We thank all of the 1990 officers for a super job!

## Future Events

October 21 AWA Slides by Walt Kiefner  
November 18 Annual Show & Contest



## THE 5-TUBE AC-DC SUPERHET

BY MATT THORNTON  
FROM APRIL 1984 THE HORN OF PLENTY

Once almost as numerous as the buffalo, this low cost table radio is now virtually extinct. In its day, which extended from roughly 1940 to 1960, most radios sold were variants of a single basic design. The design goals were maximum performance at lowest cost. Key elements of the design solution were series filament tubes and a resonant loop antenna. Operating the filaments in series directly on the 117V line saved the cost of a transformer. The loop antenna avoided external antenna connections. This article offers a trip down memory lane for some of us and a brief historical vignette for others.

Figure 1 shows a typical circuit. The series circuit of the filaments has some interesting features. The filament string and the common cathode are both isolated from the chassis. This was an important safety feature and was followed in most cases. The filament of the first audio amplifier (type 12SQ7) was connected to the common cathode. This reduced hum because this tube was the most susceptible to capacitive coupling from the filament to the cathode. The intermediate-frequency amplifier and the converter were next above the common cathode with the power amplifier and the rectifier at the highest a-c potential. The rectifier and the power amplifier have higher voltage filaments because these tubes required greater electron emission for their heavier plate currents. The sum of the filament voltages is 122.8, which means that the filaments were slightly underheated when the radio was operated on a 117V line but that the radio would also withstand minor surges and last longer.

The more expensive ac/dc superhets had a panel lamp. The cheaper ones did not, and usually had a resistor connected in place of the lamp. A peculiarity of the panel lamp circuit was that the plate current of the set passed through the lamp filament. You could observe this when the set was turned on. When the line voltage was applied to the cold tube filaments, the panel lamp came on brightly for an instant until the resistance of the filaments increased. It then went dim until the cathodes heated up and then the lamp would slowly brighten as plate current increased. The set would continue to play indefinitely with a burned out panel lamp, although part of the 35Z5 filament had to carry too much current.

The d-c power supply consisted of a half-wave rectifier and a low-cost pi filter. I have never seen an ac-dc superhet with a filter choke as our example schematic shows. If the filter had an inductive element, it was the speaker field winding. Field-coil speakers disappeared as the permanent magnet speaker cost and performance advantages grew. Later radios used a 1k (approximate) resistor in the power supply filter. The filter capacitors were dry electrolytic units. Deluxe radios had upright chassis mounted filter capacitors. Ordinary sets had tubular units with pigtail leads fastened under the chassis. With 117V ac power input, the typical radio would have approximately 85V dc at the output of the filter.





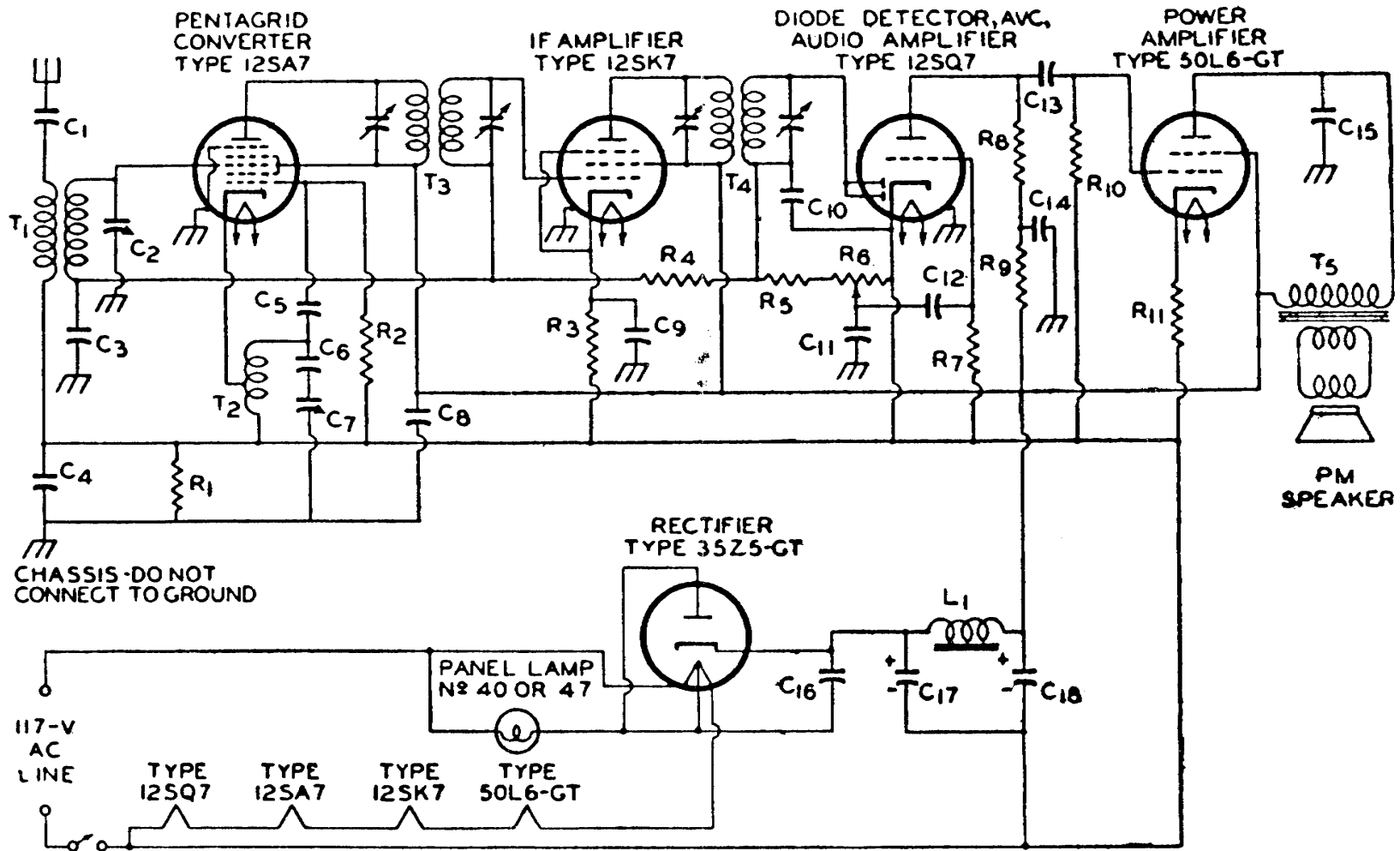
Receiving stages - the converter, intermediate frequency amplifier, detector and audio amplifiers - were adaptations of the same circuits as used in transformer-operated radios of the time. Our example circuit shows the input to the converter coming from a radio frequency transformer (called an antenna coil in shop language). Such a device was in fact very rare. Almost all ac-dc sets had a direct pickup resonant loop antenna. This comprised 20 or 30 turns of wire attached to a piece of cardboard at the back of the chassis. The size and number of turns were made to have the right inductance for tuning the amplitude-modulated frequency band (550 to 1600 kHz) with a variable capacitor of approximately 365 picofarads maximum capacitance. Because of the size and layered design, a loop antenna could have a fairly high Q and thus improve front-end selectivity. Loop antennas are also fairly directional. It was possible to turn the radio on the table to null out stations. The main reason for the loop antenna, though, was to avoid external antenna connections.

A pentagrid converter performed the dual function of a local oscillator and a frequency mixer. Our example circuit shows a series capacitor in the oscillator resonant circuit. This was called a padder capacitor and was only used on fairly elaborate sets. It allowed the set to be aligned more accurately at the low end of the band. Your standard low-cost ac/dc set did not have an oscillator padder. Instead it had the oscillator section of the tuning capacitor made with smaller plates. Not only was the cost of a padder capacitor saved, but also labor to align the set. The result was that most ac/dc sets were not overly sensitive or selective at the low end of the band.

Intermediate frequency (455kHz) amplifiers were strictly conventional. The example schematic shows a cathode resistor for self bias. Most low-cost sets had the i-f cathode connected directly to the common cathode bus. The tube was effectively biased by the automatic volume control voltage and, for low signal levels, by the fact that a 12SK7 will not self-destruct on 85V plate supply at zero bias. Early sets had fairly large i-f transformers with air cores and screw-type variable mica capacitors. Later sets used smaller i-f transformers that had variable inductance tuning by means of movable powdered iron or ferrite cores.

The 12SQ7 performed two functions: it detected (actually rectified) the intermediate frequency signal and amplified the resulting audio voltage. This stage was called the detector, AVC (automatic volume control) and first audio amplifier. The detected audio voltage went as audio to the triode section of the 12SQ7 and also to a long-time-constant RC circuit (R4 and C3 in our example) for AVC. This AVC circuit worked by increasing the negative bias on the converter and i-f amplifier grids. These tubes were designed to decrease amplification factor as the signal grid bias increased.





$C_1 = 500 \mu\mu\text{f}$   
 $C_2 C_7 =$  Ganged tuning capacitors,  $365 \mu\mu\text{f}$   
 $C_3 C_8 C_{14} C_{16} = 0.1 \mu\text{f}$ , paper  
 $C_4 = 0.25 \mu\text{f}$ , paper  
 $C_5 = 50 \mu\mu\text{f}$   
 $C_6 =$  Oscillator padding capacitor—follow oscillator-coil manufacturer's recommendation  
 $C_9 = 0.05 \mu\text{f}$ , paper  
 $C_{10} C_{11} = 250 \mu\mu\text{f}$   
 $C_{12} = 0.005 \mu\text{f}$

$C_{13} = 0.01 \mu\text{f}$ , paper  
 $C_{16} = 0.025 \mu\text{f}$   
 $C_{17} C_{18} = 40 \mu\text{f}$ , electrolytic, 150 v.  
 $L_1 =$  Filter choke, 200 ohms, inductance as large as practical  
 $R_1 R_8 = 250000$  ohms, 0.5 watt  
 $R_2 = 20000$  ohms, 0.5 watt  
 $R_3 = 260$  ohms, 0.5 watt  
 $R_4 = 2$  megohms, 0.5 watt  
 $R_5 R_9 = 50000$  ohms, 0.5 watt  
 $R_6 =$  Volume control, potentiometer, 250000 ohms  
 $R_7 = 10$  megohms, 0.5 watt

$R_{10} = 0.5$  megohm, 0.5 watt  
 $R_{11} = 150$  ohms, 1 watt  
 $T_1 =$  RF transformer, 540-1600 kc  
 $T_2 =$  Oscillator coil, tapped, for use with  $365\text{-}\mu\mu\text{f}$  tuning capacitor, and 455 kc if transformer  
 $T_3 T_4 =$  Intermediate-frequency transformers, 455 kc  
 $T_5 =$  Output transformer for matching impedance of voice coil to 2500-ohm tube load



The audio amplifier function was done as a simple triode resistance coupled amplifier operating on contact potential bias. The bias resulted from using an extremely high value of grid polarization resistor, on the order of 10 megohms. Some audio fidelity was lost but that was not a paramount concern anyway.

From the 12SQ7 plate the audio voltage was resistance coupled to the 50L6 grid. The 50L6 was a beam power tetrode that had high enough gain to improve the overall sensitivity of the set. It has high enough gain, in fact, to operate without a cathode bypass capacitor in low priced radios. Output of the 50L6 was transformer coupled to the speaker voice coil.

Circuit design of ac-dc receivers must have included a fair amount of cut and try. Hum was a perennial problem. Occasionally you would find a part that had no apparent function. The capacitor connected from the rectifier cathode to the pilot light tap (C16) in our typical circuit is an example. In all probability it reduced hum in some or most sets leaving the production line.

Packaging of ac-dc radios must also have been as much art as science. Some sets were very densely packaged to make them as small as possible, but most allowed a little more room, probably to save labor during assembly. Part location must have been chosen to minimize hum and prevent oscillation.

Cabinets were usually bakelite. The cheapest sets had a knob on the end of the tuning capacitor shaft, which did not make for easy, accurate tuning. Better sets had a dial cord that was wrapped around the tuning knob shaft to turn a sheet metal drum on the tuning capacitor. The frequency dial on these sets often had the pointer extending both ways from the hub, and had either alternate numerals denoting frequency or the second set of numerals denoting wavelength in meters. This was probably a gimmick to suggest long range capability by resemblance to a short wave receiver dial. Later and more deluxe sets had a slide rule dial that worked off the dial cord.

As mentioned earlier, audio fidelity was not a primary concern. Quality radios of the day had wooden cases and six-inch or larger speakers. Low cost table radios had four-inch speakers 90% of the time. A few had five-inch and some of the smallest had three-inch. Because the speakers were attached to the front of the chassis, there was usually a gap between the speaker and the case. If there had been any low frequency energy developed by the speaker, much of it would have been lost through the gap. It probably was never developed because speakers of that era had a relatively high free



air resonant frequency. High frequency response was intentionally suppressed, partly because AM radio stations are 10kHz apart and partly to lessen the shrillness of the small speakers and cases.

Although these sets had a finite life because the tubes would eventually lose emission or burn out a filament, they could and often did play for years.

The commonest failures were:

1. Open filaments
2. Bad filter capacitor
  - a) Low capacitance
  - b) Shorted
3. Shorted paper capacitor
4. Broken wire, usually one going to the loop antenna
5. Warped speaker cone
6. Bad volume control

These sets were often repaired even though the original cost was relatively low. Tubes were cheap and could be replaced by the owner. Shop repair was reasonable because the sets could be taken to the shop easily. The technology was so widespread that a whole generation of technicians were taught troubleshooting using the 5-tube superhet as the example.

Nowadays you seldom see one of these radios except in a basement or a garage. They used to occupy places of some honor, such as the top of the refrigerator for the news and the soaps. They have been replaced there by imported solid state receivers that are almost never repaired. It is usually preferable to replace them. Consequently, the radio repair business today concentrates on stereo and car radios. One final observation about the new generation of public consumption radios is that they are usually not very good as AM receivers. At their best, the 5-tube ac-dc superhets could be surprisingly sensitive and selective. The typical low cost solid state radio of today is evidently not designed for long distance reception.

Something of a nostalgia market is forming for old radios. Floor models in wood furniture cases bring high prices now. It is possible that the more humble ac-dc set in its plastic case may also be sought after in a few years. If you have one, you might consider keeping it as a potentially valuable antique.



## TUNING IN....

Ray Nelson, past president and member of NWVRS, is a familiar face to most of us. He's an easy going guy with lots of interesting topics to talk about. When I recently visited with him, I learned more about him.

Ray, a native Oregonian, hails from Newberg. As a young boy he moved to LeGrand to live with his grandmother, then lived in Medford till he graduated from high school.

Ray's interest in electronics sparked at an early age. He still remembers all the cathedral radios he tore up just to see how they worked. He liked to build three tube radios and crystal sets and completed the NRI Radio Course that his dad had started.

Just out of high school, Ray joined the Navy. Among his assignments were guided missiles and radar including the Sidewinder and Sparrow III.

After his discharge from the navy, Ray returned to Medford where he was employed by Greyhound as a dispatcher. He then moved on to San Francisco to work for Western Union repairing teletype military communication systems. Western Union transferred him to Puerto Rico for two years as a maintenance supervisor. Ray's boyhood interest in tropical fish was revived here and he bred and raised them commercially. He still enjoys a small tank in his Portland home.

The next several years were spent in Colorado Springs working as a liaison for NORAD. Ray was also employed by J.C. Penny for ten years as a radio and T.V. technician and five years for RCA. Currently Ray is employed by the Clackamas Education District repairing audio/visual equipment for over one hundred schools.



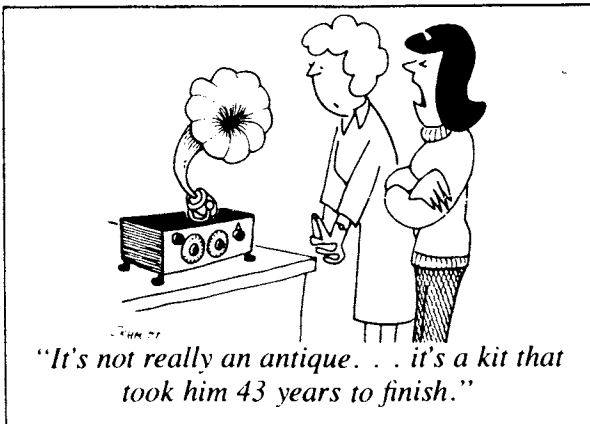
Ray gets most of his exercise trying to keep up with daughter Rachel who is nearly three years old. His other daughter Erika, age nineteen, lives in Washington. Audrey, his wife has a very busy schedule as a critical care nurse in an intensive care unit at the University Hospital.

Ray has a wide variety of radios in his collection, with a special interest in small wood and plastic types. But his favorite piece is an early Grebe highboy console.

Since finishing his basement, and it has taken him quite a while, he can now display his collection with pride.

My sincere thanks to Ray for sharing his time and thoughts with me.

L.L.C.



# SWAP SHOP

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## WANTED

Early shortwave sets: National, Hammarlund, Silver Marshall, Doerle, IRC and similar. Also, European sets, pre-WWII. Max Kaplan W7INB  
14902 84th Ave Ct NW Gig Harbor, WA 98335 206/851/4187

Philco 89 Cathedral cabinet, first type. Gordon Phillips 610 NE Royal  
Ct. Portland OR 97232 503/234/3517

## SWAP

Zenith K731W Danish/Walnut for K731R in Colonial/Mahogany. AK  
Cathedrals for Zenith 15-U-273 Console. Edwin Buhite 4041 NE Wistaria  
Dr Portland OR 97212 503/288/8719

## FOR SALE

Radiola VIII Portable with 6 good 299 tubes works, good handle, both  
battery panels, good shape \$200. AK 55 with speaker, works \$100, AK 42  
With E speaker, works \$85. Cash, pick up only on all sets. Pat Stewart  
W7GVC 1404 Ruth Ave. Walla Walla, WA 99362 509/525/1699

Electronic Instruments, Tubes, parts, meters, Battery sets, AC sets. Bob  
Lee at R5-D3 Electronic Surplus 6111A SE 82nd Ave. Portland, OR 97206  
503/774/6560

## LEAD

Dumont dual beam oscilloscope P-7  
phosphor \$35. 1937 Clough - Bringle 1  
inch scope \$65. Don Knotts 503/648/1738



# N.W.V.R.S. EDITORIAL

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We've had a long summer vacation from those NWVRS meetings, now its time to get back to business and look back over the summer. Many of the NWVRS members think that it is just fine to take the summer off, but always vote to keep the Call Letter a monthly publication. A few members have spent many hours working during the summer on the Call Letter. Over 90% of the NWVRS membership did little or nothing.

Two common excuses for not helping are: "I'm too busy this month" and "Let the younger members take care of it". Fortunately a few of us don't feel that way. What do you suppose would happen if the Editor was too busy this month? We are currently in our 16th year of never missing a single monthly issue. Does the possibility of ending this tradition concern you? If you care about the NWVRS portion of this Publication let me know A.S.A.P. We presently need two people for the position of assistant editor.

Does anyone recall talk about a summer swap? (I thought one was planned). While trying to get the Information for the Call Letter, I learned that nothing was being done!

Sonny & Speed came to the rescue, doing the best possible on such short notice. At least one new member was signed up in addition to several good contacts. Everyone should show our appreciation and support at the September meeting for Sonny & Speed's hard work.

One more reminder, Ed Charman (503-654-7387) is the treasurer of NWVRS, any financial questions should be directed to him. As your Editor, I'm not the person to ask about financial matters. My position is: don't spend money on anything that is not absolutely necessary. I've always been careful to keep newsletter costs as low as possible. Everything has been approved up front (not after the fact). I expect that all NWVRS charges should be approved up front by our Treasurer (not after the fact).

EJB





# Ole! (acquisitions)

---

## Edwin Buhite

1938 Zenith

1962 Zenith K731 Danish in Walnut AM/FM

1962 Zenith 2000 AM/FM Portable (fair condition)

## Ed Charman

1933 Silvertone very ornate table model

## Max Kaplan

1937 Breting 14AX, USA

1938 Bush PB50, England

1936 Volksempfanger VE301WG, Germany

1938 Volksempfanger VE301Dyn, Germany

1950 Grundig 4004, Germany

1950 Grundig 2035, Germany

1950 Grundig 2012, Germany

## Jim Mason

1924 Stromberg Carlson 1-A Neutrodyne Battery Set

1940 Crosley 649 AC/DC Table set

1943 Philco Transitone PT-89 Battery portable

1950 Zenith AC/DC Damerow Ford Sales Award.

1953 RCA 2XF935 AM/FM table set

## Ray Nelson

Crosley 11-105U chartreuse

Airline 93BR715A Tombstone

Bullet Transducer Corp. TR-5 Microphone

Electro Voice V-2 Ribbon Velocity Mike & Stand

Western Electric 387W double button Microphone

## Jerry Talbott

1933 Colonial 250AC

1933 Airline 62-104

1934 Detrola 4J

1937 Howard S-259

## Tom Moore

Radiola 61-3

Philco 41-235

Grunow 576

Philco 38-15

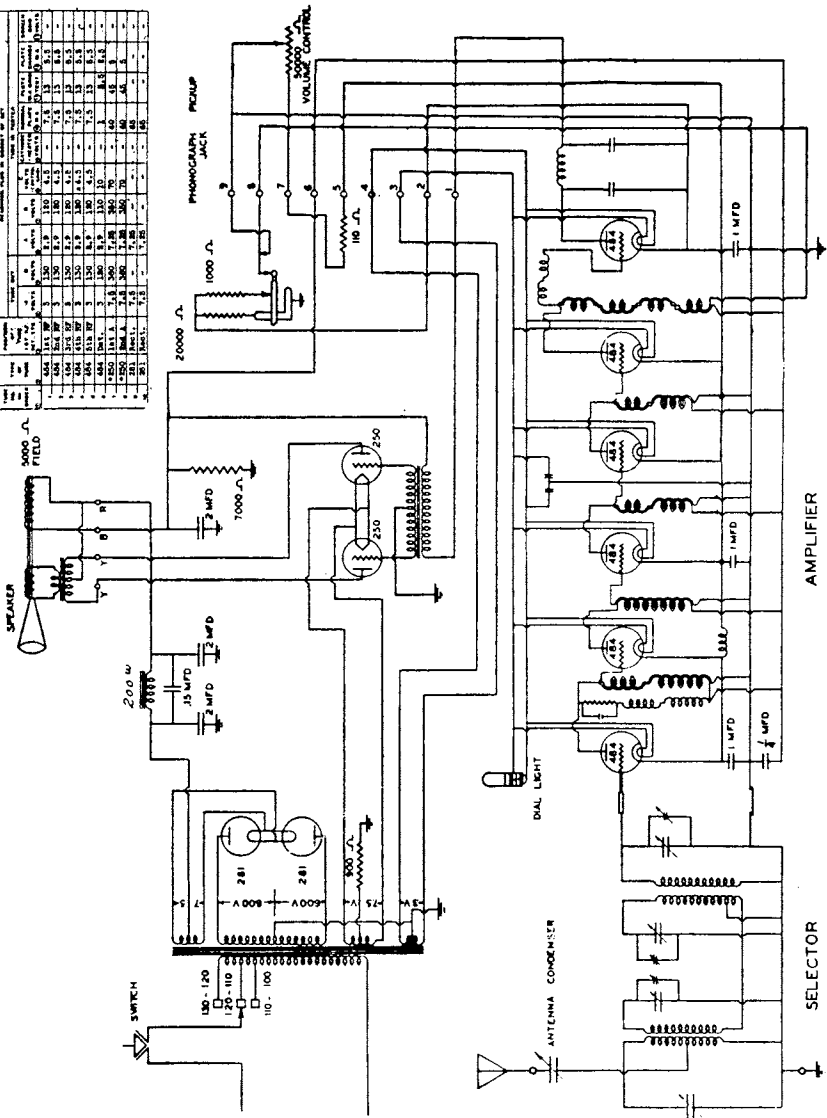
Zenith 760

Atwater Kent 46

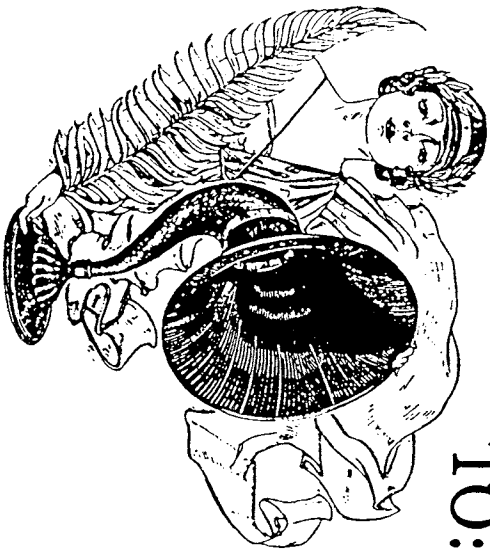


**SPARTON—Model 301**  
**Line Voltage 120—Set on 120-130 Volt Tap—Volume**  
**Control Position Max**

| TUBES |     | RESISTORS |           | CAPACITORS |           | INDUCTORS |           | SPEAKERS |     |
|-------|-----|-----------|-----------|------------|-----------|-----------|-----------|----------|-----|
| TYPE  | NO. | VALUE     | TOLERANCE | VALUE      | TOLERANCE | VALUE     | TOLERANCE | POWER    | NO. |
| 5Y4   | 1   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 1   |
| 6X4   | 2   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 2   |
| 6X4   | 3   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 3   |
| 6X4   | 4   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 4   |
| 6X4   | 5   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 5   |
| 6X4   | 6   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 6   |
| 6X4   | 7   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 7   |
| 6X4   | 8   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 8   |
| 6X4   | 9   | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 9   |
| 6X4   | 10  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 10  |
| 6X4   | 11  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 11  |
| 6X4   | 12  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 12  |
| 6X4   | 13  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 13  |
| 6X4   | 14  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 14  |
| 6X4   | 15  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 15  |
| 6X4   | 16  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 16  |
| 6X4   | 17  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 17  |
| 6X4   | 18  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 18  |
| 6X4   | 19  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 19  |
| 6X4   | 20  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 20  |
| 6X4   | 21  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 21  |
| 6X4   | 22  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 22  |
| 6X4   | 23  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 23  |
| 6X4   | 24  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 24  |
| 6X4   | 25  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 25  |
| 6X4   | 26  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 26  |
| 6X4   | 27  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 27  |
| 6X4   | 28  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 28  |
| 6X4   | 29  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 29  |
| 6X4   | 30  | 100K      | ±5%       | 100K       | ±5%       | 100K      | ±5%       | 100W     | 30  |



4041 NE Wistaria Drive  
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