SYLVANIA NEWS

TECHNICAL SECTION

February, 1937 EMPORIUM, PENNA. Vol. 6, No. 11

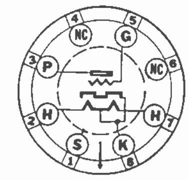
BACK ISSUES AVAILABLE

For some time we have been unable to fill requests for back issues of the Sylvania News Technical Section. To make these available to new readers, and to servicemen who have lost or clipped their original copies, we are making reprints of all back issues, beginning with May, 1935 (14 issues). These will be furnished in a serviceable binder, which will also accommodate future issues of the Technical Section. The cost of the complete file, including the binder, is fifty cents. A convenient order form is enclosed with this issue. It is important that these orders be returned immediately, as a limited number of the reprint files will be available and orders will be filled "first come, first served". Please note that there may be a slight delay in shipment, as this announcement has been made in advance of completion of the work of reprinting and binding.

FOR YOUR CONVENIENCE USE THE ENCLOSED ORDER BLANK

NEW TUBES

Type 6A5G Power Amplifier



6-T

Type 6A5G is a heater type triode for use as a power output tube. Because of the heater-cathode design this new tube is quite hum free, thus no potentiometer is required to balance out hum. Type 6A5G is identical in ratings and characteristics to types 6A3 and 6B4G with the exception of the Class A power output rating which is 550 milliwatts higher.

In using this new tube in new circuits, any of the conventional methods may be used for the input coupling, providing the resistance added in the grid return is not excessive. The d-c resistance in this circuit should be less than 0.5 megohm for self-biasing or not greater than 10,000 ohms for fixed biasing.

Although the basing arrangement and characteristics of the 6B4G and the new 6A5G are identical, interchanging of the two types is not recommended since the latter type has a cathode connection. Any exchange of the two types should not be made until the circuit is analyzed for biasing arrangements, etc.

CHARACTERISTICS

Heater Voltage	6.3 Volts
Heater Current	1.0 Ampere
Maximum Over-all Length	5-11/32 Inches
Maximum Diameter	2-1/16 Inches
Bulb	ST-16
Base	Medium G Type Octal No. 6-T
Direct Interelectrode Capacitances (Approx.):	
Grid to Plate	16 μμf
Input	7 μμf
Output	5 μμf

OPERATING CONDITIONS AND CHARACTERISTICS

Class A Amplifier (One Tube)

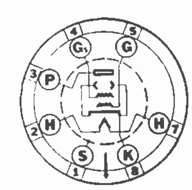
Heater Voltage	6.3 Volts
Plate Voltage	250 Volts Max.
Grid Voltage	−45 Volts
Plate Current	60 Ma.
Plate Resistance	800 Ohms
Mutual Conductance	5250 μmhos
Amplification Factor	4.2
Load Resistance	2500 Ohms
Power Output (With 5% 2nd Harmonic)	3.75 Watts

Push-Pull Class AB Amplifier (Two Tubes)

	Fixed Bias	Self-Bias
Heater Voltage	6.3	6.3 Volts
Plate Voltage	325	325 Volts
Grid Voltage	−68	Volts
Self-Bias Resistor		850 Ohms
Plate Current Per Tube*	40	40 Ma.
Plate to Plate Load Resistance	3000	5000 Ohms
Power Output	15	10 Watts
Total Harmonic Distortion	2.5	5 Per Cent

*For Zero input signal.

Type 6V6 Beam Power Amplifier



7-AC

Type 6V6 is an all-metal beam power amplifier tube identical in characteristics and circuit ap-

Continued on Page Four

ADDING A TUNING INDICATOR

WALTER R. JONES

An Article Covering the Addition of The 6E5 or 6G5 Tubes to Older Receivers

So many requests, for information regarding the addition of tuning indicators such as the 6E5 or 6G5 to receivers which already incorporate tuning meters or which do not employ any tuning devices, have been received, that it is felt that a real service will be rendered to readers by supplying this information in the Sylvania News.

In the first place it is not recommended that attempts to install these tubes be made in receivers except those which already are provided with an automatic volume control system.

Complete Kits Available

There are several kits available for this type of remodernization, all of which are very similar as regards application. Such a kit includes a mounting bracket, a socket provided with a five or six wire cable and a little bezel for the cabinet. Lacking one of these kits the bracket and socket assembly can be made up by any service man for any particular job, although a completed kit will probably make a more workmanlike job. In some of these kits only 5 wires will be used since the one megohm resistor which is connected from the plate to the target is connected at the socket, thus reducing the number of wires required. After having the complete unit together it is a simple matter to connect the cable wires into the circuit. Assuming there are six wires in the cable the connections should be made as follows:—The heater wires should preferably be connected to one of the sockets rather than to the pilot light socket since this will then permit all wires to be brought through a hole in the chassis rather than requiring the separation of the filament wires from the other wires. A one megohm resistor (R1) should be connected from the end of the triode plate wire to the target wire. The target wire should then be connected to the 250 volt or 100 volt supply, depending upon whether the receiver is an a-c receiver or an a-c, d-c receiver. In most cases either the 6E5 or the 6G5 will operate quite satisfactorily with 100 volts applied to the target although if higher voltage is available it is permissable to apply up to 250 volts. The cathode lead wire should be connected directly to the chassis or to the low end of the voltage supply system when making the additions to an a-c, d-c receiver. The connection of the remaining wire, the control grid lead, depends upon several things; particularly whether a 6E5 or 6G5 tube is to be employed.

Choice of 6E5 or 6G5

A previous issue of Sylvania News, (Vol. 6, No. 5 and 6) described the difference between the 6E5 and the 6G5 tubes. The reader is referred to that article for comparison of the two types. In most cases the 6G5 tube should be employed since strong signals will not cause the shadow to entirely close, thus permitting accurate tuning, even on local stations. It is necessary that a filter be employed in the control grid lead of this tube in order that the shadow will not blink with modulation. This can best be provided by inserting a 1 megohm resistor (R2) in series with the control grid lead. A 0.1 microfarad by-pass condenser (C1) should be connected between the grid side of the 1 megohm resistor and ground, as shown in the accompanying diagrams, Figures 1 or 2. This will serve to prevent any audio fluctuations from affecting the voltage applied to the grid of the tube. The 1 megohm resistor must be inserted in order that audio voltage which is developed across the diode for other purposes will not be short circuited. If a 6G5 is employed the 1 megohm resistor may then be connected directly to the a-v-c supply so that full a-v-c voltage will be applied to this control grid. If however the 6E5 is employed, only a fraction of this voltage can be used since the shadow will completely close when 8 volts is applied to the control grid. In this case, a voltage divider system such as shown in Fig. 2 will be required in order to limit the maximum voltage applied to the tube. It is to be borne in mind, of course, that such a voltage divider system will reduce the voltage applied to the tuning tube when weak signals are tuned in, with the result that an extremely small indication will be noticeable on the target of the tube. Regardless of which type of tuning tube is used, it is not recommended that the cathode of either of the tubes be connected to any other bias source in the receiver since the cathode current of these tubes is not very uniform and may vary during the tube life or between different tubes when replacements are required. Such variation might well cause considerable change in sensitivity in the receiver due to changing the bias applied to other tubes.

Care should be taken to see that the cable to the tuning tube is kept as far away as possible from the antenna system and r-f and i-f tubes since otherwise overall coupling between the input and output systems might be introduced which would result in instability or poor performance.

TYPE 6G5

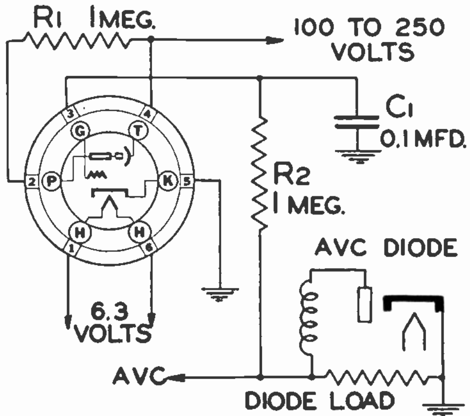


FIG. 1

TYPE 6E5

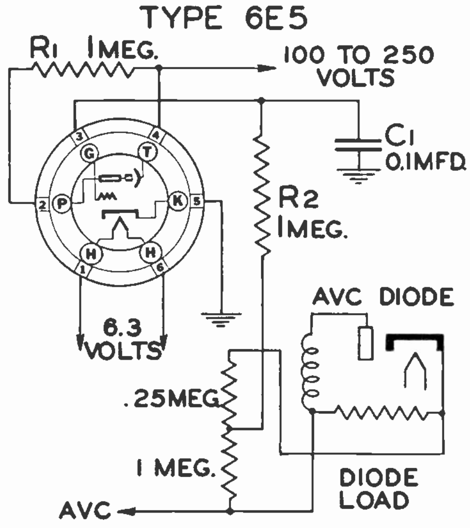
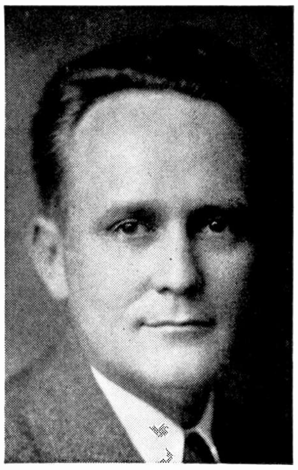


FIG. 2

A CHAT WITH ROGER WISE



Chief Tube Engineer
Hygrade Sylvania Corporation

There is an increasing amount of interest being manifested in the new 150 milliampere tubes for application in 6 volt farm battery sets. This line of tubes was introduced too late last season to have played a very important part in sets manufactured during 1936. However, with the rapid progress that has been made in the development of Windchargers and small gasoline-driven battery chargers, it is possible that the low drain, 6.3 volt tubes will, in many instances, replace 2 volt battery types for farm receivers.

It will be noted that the types which have been announced to date have characteristics which indicate performance at least equivalent to their standard 6.3 volt 300 milliampere counterparts, in spite of the fact that filament drain has been cut in half. In order to obtain this performance with lower filament consumption, it has been necessary to reduce mechanical clearances to a point where the spacing between elements is in general less than has been used heretofore. In spite of the smaller clearances, the mount structure is rigid enough to provide adequate margin of safety for use in battery sets. No recommendation that their use be extended to other classes of service has been made, pending further experience in production, together with field and laboratory tests.

Substitution of these newer types for the 300 ma. tubes in sets designed for the latter should not be undertaken indiscriminately; in fact, only where a substantial saving is effected by the reduced filament drain is such a change warranted. Even then a careful check must be made to see that the operating conditions imposed on the tubes are within the ratings approved for these types.

THE SERVICE EXCHANGE

THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility with respect to results. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please indicate preference when submitting hints. Don't send routine or generally known information. Please Specify Tube Choice.

Apex Model 99A. A common trouble is intermittent reception with the set only working when the off-on switch is snapped, or when one of the lights in the house is turned on. In the non-reception periods, touching the plate leads of the first detector, i-f, or oscillator leads will restore reception. Such trouble will be found in a defective cathode bypass on the detector tube. Replace the condenser.—Park Radio Center, Seaside Park, N. J.

* * *

Coil Moisture. In the South, coils absorb moisture and many sets which use a 77, 44 etc., as the osc-det. have a 10,000 ohm cathode resistor shunted with a small condenser. Changing this resistor to 5,000 ohms will repair such sets. The moisture in the oscillator causes the tube to stop oscillating with the 10,000 ohm cathode resistor.—John Bricker, Miami, Fla.

Editor's Note: Mr. Bricker has given insufficient address, therefore, tube awards are being withheld awaiting complete address.

* * *

Crosley Model 167. A very common complaint in this receiver is no signals and a low pitched hum. This is caused by a leaky 6 mfd. section in the dry electrolytic condenser which has a working voltage of 300 volts. I have found that an exact replacement develops the same trouble in a very short time. However, an effective remedy is made by replacing the original W-27488 condenser with a W-27488-A which has a 6 mfd. section with a working voltage of 450 volts.—Angelo L. Giorgi, Syracuse, N. Y.

* * *

Crosley Model 645—32 Volt D.C. Intermittent distortion accompanied by variations in the audio output is caused by a broken lug in the type 48 tube socket. We never fail to give the tube socket lugs a good check, because we know that most of the servicemen do not do this. —Joseph S. Napora, Uniontown, Pa.

* * *

Crosley Model 716. A complaint of a terrific noise when the set is tuned to resonance, will usually indicate a defective 6A8 oscillator-mixer tube. Several makes may have to be tried before one is found which is satisfactory. I have found that a Sylvania 6A8 is the best replacement.

No reception on the broadcast band is caused by a loose connection on the frequency series adjustment. We have found this defect in several of these models.—Joseph S. Napora, Uniontown, Pa.

* * *

Frozen Electrolytics. During the cold months when a low hum is encountered in a receiver that has been in a cold place, look for a frozen electrolytic condenser. The best thing to do in such a case is to leave the condenser thaw out gradually in a warm place. I have encountered this trouble in delivering and in servicing receivers set up in rooms that were shut off from the rest of the house.—Harry Farber, Syracuse, N. Y.

* * *

G. E. Model K65. I have found that the performance of these sets can be greatly improved by replacing the original 2A7 tube with a Sylvania 2A7. If you encounter one of these receivers having poor oscillator performance try this hint.—Radio Service, Pasadena, Calif.

* * *

G. E. Models E81, E86, E91, E95, E01, E05. We have encountered trouble with the 5Z4 tube going bad frequently. An investigation showed the filament voltage on the 5Z4 to be over 5 volts on some of the sets which give us trouble. A low value resistor (10 watts) in series with the filament will correct this.

The total milliampere drain pulling through the 5Z4 is more than its recommended rating. Change the 5Z4 to a Sylvania 5V4G, which is directly interchangeable and will stand the extra drain.—G. O. Zimmerman, Hagerstown, Md.

* * *

G. E. Model E105. When these sets start and stop and make a noise as if the switch is turned off, look for a bad 6L6 tube. In my experience I have found that a Sylvania 6L6G should be used as a replacement tube for a trouble-free job. This also also applies to other sets having the same trouble.—Sidney Block, Bronx, N. Y. C.

* * *

Grid Lead Trouble. In most of the early electric radios, it was found that long grid leads decreased the sensitivity and selectivity of a set; but it is no uncommon complaint even on the latest sets, which are usually small, and on which the manufacturer, usually for the sake of appearance, often runs a grid lead from a coil under the chassis and up alongside the tube, often reaching a length which exceeds the length of the whole set. This sets up a distributed capacity in parallel with the tuning condensers, great enough to offset any good from an attempt to align the trimmers. The cure is simply to remove such wires and connect a wire direct from the connection on the condenser to the grid cap, even though the wire may be conspicuous. The distributed capacity will now be found to be small enough to be easily offset by the alignment of the trimmers.—Ivan C. Quackenbush, Chicago, Ill.

* * *

Grunow 660. Mushy reception is often due to a leaky .01 mfd. coupling condenser between the plate of the 75 and the grid of the 42. Resistances as high as 5 to 10 megs. is sufficient to impair reception. Replace with 600 volt type.—Baer Radio Service, Roslindale, Mass.

* * *

Grunow Chassis 8-B. Fading:—Check the first detector plate by-pass condenser No. 39 i-f plate by-pass condenser No. 38, and a-v-c condensers No. 36. If these show any leakage on a neon type condenser tester, change them.

Motor-boating:—Blocking condenser No. 27 between plate of the 37 and grid of the 42 leaking through .5 meg grid resistor of the 42. Replace the grid resistor with a .05 or .1 meg. unit and replace blocking condenser No. 27.

Distortion:—If the type 37 tube overloads, reduce the blocking condenser No. 29 to .01 mfd. —R. D. Butchart, Detroit, Mich.

* * *

Label For Stolen Radios. No doubt many servicemen have had trouble with stolen rental radios. In our location, which is a summer resort, we lost quite a few sets until we used stickers on the bottom of the cabinet where only a serviceman could see them. If all servicemen would use this method and co-operate in the return of stolen sets the individual servicemen would suffer much less than in the past. Our stickers read: "Fellow Servicemen; this is a rental set stolen from PARK RADIO CENTER, Seaside Park, N. J., Phone 265, please communicate with above.—Park Radio Center, Seaside Park, N. J.

* * *

Majestic Model 20. Weak or no reception and low voltage is a frequent trouble and is caused by a 0.1 mfd. condenser in the first i-f transformer can. To repair it is not necessary to melt tar. Remove the can and slit on the side near the red lead. Bend metal back and cut loose the offending condenser. Replace can and install a new 0.1 mfd. 600 volt condenser on the outside of the can.—Baer Radio Service, Roslindale, Mass.

* * *

Majestic Models 130 and 132. Cutting off of reception is often due to the secondary of the output transformer being shorted to the electrostatic shield. Remove grounded lead from same for temporary repair.

Audio whistles or oscillation birdies in the output of these receivers can be stopped by connecting an .006 mfd. condenser from plate to screen of the pentode.—Fred Keutmann, New York, N. Y.

* * *

Microphonic Noises. Both howl and microphonic noises in older receivers are quite often due to the deterioration of the soft rubber placed under the chassis to prevent vibration. These rubber cushions either harden through age or become worn, thus causing the entire chassis to vibrate especially when the loudspeaker is operating loudly. After replacing these rubber rings, be sure to tighten all the bolts holding the chassis down.—Gerald Liccione, Syracuse, N. Y.

* * *

Norco Model 160. These receivers manufactured by Remler in the 71000 series often develop faulty volume controls. The volume control has too much carbon on the high end and as this wears it deposits on the moving contact causing a 1000 ohm loop to ground. This causes the set to operate at extremely low volume although all voltages check ok. To remedy, use a new ½ megohm control or take the old one apart, clean it and then shellac the carbon. However the new control is the best bet.—Walter T. Walsh, San Francisco, Calif.

* * *

Packard Philco H122. If there is no reception and no voltage, but when the set is cold, everything apparently OK, look for the following: Condenser No. 78 in the diagram, an .01 unit across the rectifier plates often shorts under load. This condenser is located directly under the rectifier socket and can be seen through a small hole in the bottom of the chassis. Replace with a good condenser of 1000 volt rating.—Bill Abele, Newark, N. J.

* * *

Philco Model 70. When replacing the filter condensers in this model, be sure to insulate the can from ground connection of old Mershon condensers. Otherwise, the 47 tube will draw too much plate current, causing distortion.—Marseilles Radio Service, Mystic, Conn.

* * *

Philco Model 470. If the signal fades out entirely in this set and can be brought back only by snapping the switch on and off several times, the trouble most always lies in a leaky or intermittently open by-pass condenser from the plate of the detector tube type 24A to ground. Replacing this condenser with a 0.1 mfd. will cure the trouble.—Angelo L. Giorgi, Syracuse, N. Y.

* * *

Philco Model 630. In one of these receivers I found that the .05 mfd. by-pass in the plate of the 78 i-f amplifier appeared to be open since shorting a good condenser across it restored the set from squeals of oscillation and very low volume to normal operation. This condenser is connected from one side of the shadow tuning meter to ground. However, further investigation showed that the condenser was good but that it was not grounded to the chassis. The condenser is one of the regular bakelite cased units with the ground lug made to fit under the head of the mounting screw for completing the ground connection. The ground connection was not being made since a small piece of bakelite, with lugs for insulating and supporting other parts, had been placed between the head of the screw and the ground lug. The only way connection could be made was by the screw touching the edge of the ground lug. A good ground connection should be made and any such receivers, received for repair should be checked for such possible trouble.—Franklin A. Longely, Rome, New York.

NEW TUBES

Continued from Page One

Type 6V6 Beam Power Amplifier

plications to type 6V6G announced in the last issue of the Sylvania News Technical Section.

The outstanding design feature is the careful arrangement of elements so as to confine the electrons into beams of high density. Due to limited space and the fact that this new metal tube is identical to type 6V6G, it is suggested that the reader refer to the last Technical Section, Volume 6, No. 10 for a more complete description.

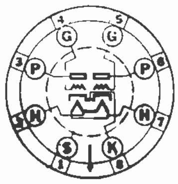
CHARACTERISTICS

Heater Voltage	**6.3 Volts**
Heater Current	**0.45 Ampere**
Maximum Over-all Length	**3¼ Inches**
Maximum Diameter	**1-5/16 Inches**
Bulb	**Metal**
Base	**7 Pin Octal No. 7-AC**

OPERATING CONDITIONS AND CHARACTERISTICS

Refer to Type 6V6G Sylvania News Technical Section Volume 6, No. 10.

Type 6Y7G Class B Amplifier



8-B

Sylvania Type 6Y7G is a highly efficient complete Class B Power amplifier tube having ratings and characteristics identical to those of Type 79. The tube is equipped with an octal base.

Type 6Y7G may also be employed as a combination voltage amplifier and phase inverter. It is applicable only to Class A output systems.

When used as a cascade amplifier each section of the 6Y7G is operated as a separate triode. Due to the high values of amplification factor and plate resistance, the sections are well suited to resistance coupling. An over-all voltage gain of 1000 is easily obtainable. With such high gain considerable care is necessary in the choice of circuit constants in order to reduce hum and noise. Additional data on circuit applications of this new type may be had by referring to type 79 in the Sylvania Technical Manual.

CHARACTERISTICS

Heater Current	**6.3 Volts**
Heater Current	**0.6 Ampere**
Maximum Over-all Length	**4¼ Inches**
Maximum Diameter	**1-9/16 Inches**
Bulb	**ST-12**
Base	**Small G Type Octal No. 8-B**

OPERATING CONDITIONS AND CHARACTERISTICS

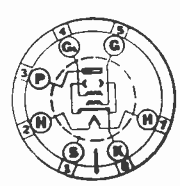
Heater Voltage	6.3	6.3 Volts
Plate Voltage	180	250 Volts
Grid Voltage	0	0 Volts
Plate Current (no Signal)	7.5	10.5 Ma.
Load Resistance (plate to plate)	7000	14000 Ohms
Power Output*	5.5	8.0 Watts

All characteristics shown are for two triodes operating in "Class B" service.

All plate currents are sum of currents flowing to each plate.

*Average Power Input—380 Mw. grid to grid.

Type 25L6 Beam Power Amplifier



7-AC

Sylvania Type 25L6 is an all-metal beam power amplifier intended especially for operation in the output stage of AC-DC and d-c receivers. This new tube provides high power output at the comparatively low plate and screen voltages which are available in such receivers.

The new design features, which are similar to those employed in Type 6L6, involve the use of directed electron beams. These effects are produced by careful arrangement of the tube elements, so placed as to set up potential fields which confine the electrons into beams of high density. High power output is obtained with good power sensitivity and high efficiency.

TENTATIVE CHARACTERISTICS

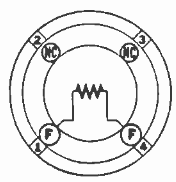
Heater Voltage	**25.0 Volts**
Heater Current	**0.3 Ampere**
Maximum Over-all Length	**3¼ Inches**
Maximum Diameter	**1-5/16 Inches**
Bulb	**Metal**
Base	**7 Pin Octal No. 7AC**

OPERATING CONDITIONS AND CHARACTERISTICS

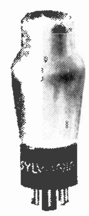
Heater Voltage	25.0	25.0 Volts
Plate Voltage	110	110 Volts Max.
Screen Voltage	110	110 Volts Max.
Grid Voltage	-7.5	-8 Volts
Plate Current*	49	45 Ma.
Plate Current**	51	48 Ma.
Screen Current*	4	3.5 Ma.
Screen Current**	10.3	10.5 Ma.
Signal Input	5.3	5.65 Volts RMS
Plate Resistance¶	10000	10000 Ohms
Mutual Conductance	8200	8000 μmhos
Load Resistance	2000	2000 Ohms
Total Distortion	10	11.5 Per Cent
Second Harmonic	3.5	4.5 Per Cent
Third Harmonic	8.5	9.5 Per Cent
Power Output	2.2	2.2 Watts

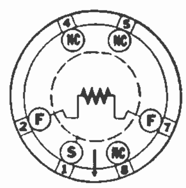
*At Zero signal.
**At Maximum signal.
¶Approximate values.

BALLAST TUBES



4-A





4-T

Five new ballast tubes have been added to the Sylvania line of tubes. The five new tubes are all intended for use in 2 volt battery receivers. Like other Sylvania battery ballast tubes, these new types are designed to hold the variation in terminal voltage within the correct filament operating range.

These new types will replace any ballast tubes having like type numbers or any ballast tubes having identical filament current load and like base pin connections. To determine the filament current load across a ballast tube it is necessary to include the total filament current requirements of all the tubes plus the current drain of the dial light.

The five new Sylvania Ballast Tubes are:

Type	Base	Ma. Load Current	Average Voltage Drop*
1F1	4-A	720	1.0
1R1G	4-T	540	1.0
1T1G	4-T	560	1.0
1Y1	4-A	540	1.0
1Z1	4-A	900	1.0

*The voltage drop shown is for average operation and may vary according to supply voltage.

BOOK REVIEW

"JONES ANTENNA HANDBOOK". 68 pages. 6X9. Price 50 cents List. Published by Pacific Radio Publishing Co., Inc., Pacific Building, San Francisco, California.

The JONES ANTENNA HANDBOOK is a practical guide in the selection and construction of a type of antenna for every radio purpose—short-wave broadcast, amateur, commercial, ship, shore and special purpose types for both transmitting and receiving.

A number of new antennas are described for the first time, principal among these being the non-fading type for short-wave communication, new rotary beams and directive arrays for amateur and experimental operation and two-direction semi-rotatable high-frequency antennas.

Every known type of practical antenna is treated. There are numerous heretofore unpublished charts on calculating antenna and feeder lengths for any type of antenna, for any frequency from 228 megacycles (1-1/4 meters) to the broadcast band of 550 meters. One chapter is devoted to Antenna Tuning Systems, another to ultra-high-frequency antennas of every known type. Concentric lines, antenna loading systems for small sea-going craft, solution of perplexing problems of space limitation and other problems which confront the short-wave experimenter, amateur and commercial radio man are answered in this book.

SYLVANIA OFFERS

Auto Radio Service Manual—free.
Service Hints Booklet—free.
Technical Manual (revised)—15 cents.
Base Diagram Chart—free.
Ballast Tube Chart—free.
Characteristic Sheet—free.
Interchangeable Tube Chart—free.
Pocket Price Card—free.
Bound File Sylvania News Technical Sections, May 1935 to date—50 cents.

Tubes and Poetry

We don't often talk about the people who make Sylvania tubes, because we know that you are more interested in what Sylvania tubes can do to give you more profits. But Sylvania tubes would not be so good if the men and girls who work here were not intelligent and interested in making good tubes better.

For instance, up in the mounting department hundreds of skillful (and very good-looking) girls use flying fingers on the tiny wires and delicate parts that go into Sylvania tubes. At noon, and after work, you'll see these girls crowded around a long chart on the wall, pointing proudly to the line that shows how little above zero their daily "shrinkage" record runs. You'll hear them talking about their work as they walk home, and you'll know that making Sylvania tubes is more to them than just a job.

It's the same in the offices. They don't have a hand in making Sylvania tubes, but they are proud of the good reception that comes with the use of Sylvania tubes, and they are interested in radio.

Perhaps you don't care for poetry, but read these lines written by a young lady in our accounting department, and see if they don't express the whole meaning of radio to the listening public, and just the things that you should point out to your customers when you sell them new Sylvania tubes for better radio reception.

Aerial Magic

High up above toward the vastness of heaven
With delicate tendrils of wire
Are two slender arms stretching sturdily upward,
To capture a message, delightful or dire.
Tapping the ether, searching for sound
Those two slender rods, like old Merlin's wand.
Work magic, in granting each listener's desire.

One moment the rods are casting in air
To fill every sports lovers cup to the brim;
The thrill of a touchdown, the racket and net;
Describing each stroke of the champion's swim;
The graceful regatta, exciting home run,
The ski jumper's tumble, and which fighter won;
The clatter of hoofs, as the racer tempts lady lucks' whim.

Presto, they answer the musical mood,
Producing great harmonies, richly sonorous;
Music symphonic, inspiring, divine;
Lullabies tender; love's melody glorious;
A new dancing tune for the gay feet of youth,
Or a hymn old and loved, a sad heart to soothe;
Then the bold marching song of an army victorious.

A whisk, the divining rod seeks out the news.
All the world is a gossip, with aerial ears.
From the east to the west, from equator to poles
Words shaping our history; laughter and tears;
The thoughts of a statesman, the death of a king,
The sound of a battle, a plane on the wing,
The howl of a mob as it hisses or cheers.

Aerial magic, 'tis yours to command,
Bringing the world to the touch of your hand.

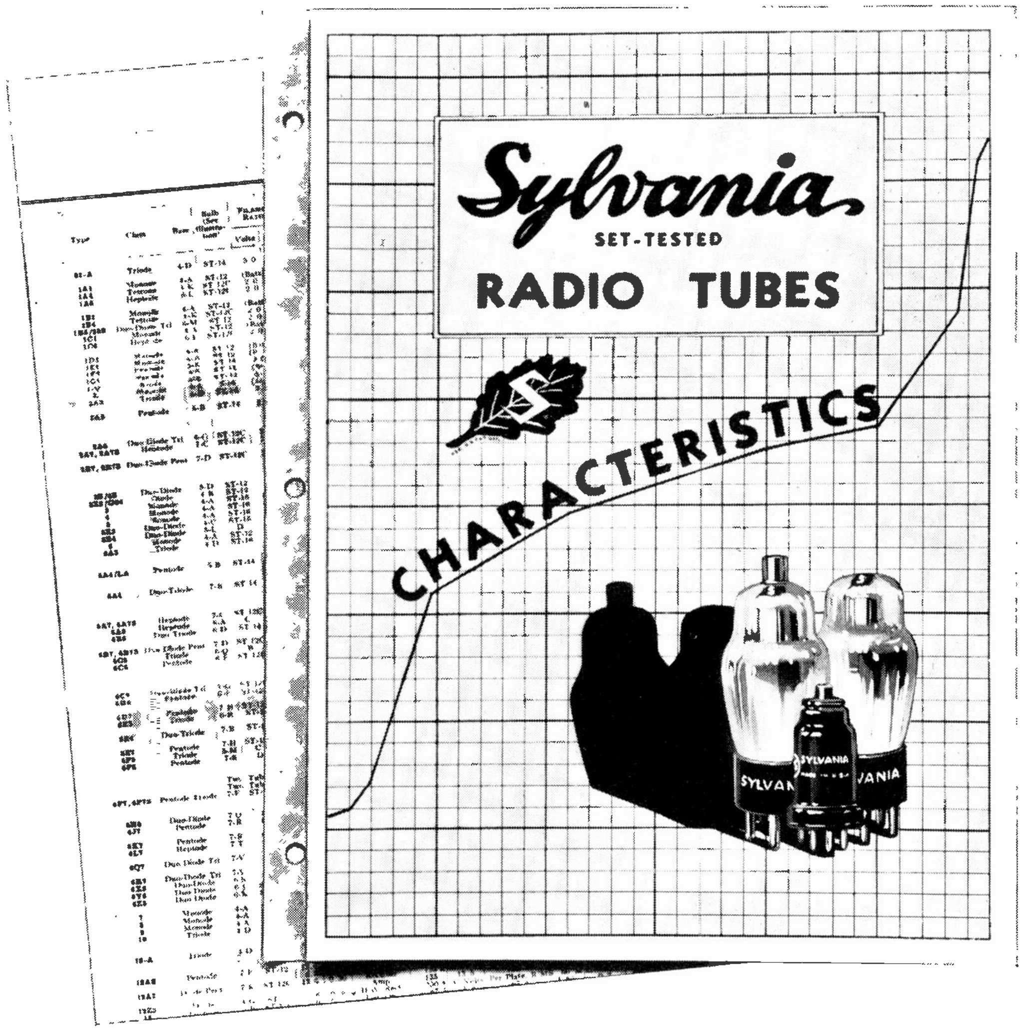
BEULAH RHOADES
Accounting Department,
Hygrade Sylvania Corp.

SYLVANIA NEWS

TECHNICAL SECTION

March-April, 1937 | EMPORIUM, PENNA. | Vol. 6, No. 12

Free Characteristic Chart Revised



The latest edition of the Sylvania Characteristic Sheet, shown above contains complete characteristics, condensed information and operating conditions on the complete line of glass, metal and "G" tubes, including those types shown in this issue of the Sylvania News Technical Section, together with 69 base diagrams. Tube types are listed numerically, characteristics are tabulated, and new and more legible type makes for easy reading. The information and characteristics contained in the Sylvania Characteristic Sheet are available nowhere else in this convenient and complete form. It should not be considered a substitute for the Sylvania Technical Manual, which offers complete data, typical circuits and circuit applications.

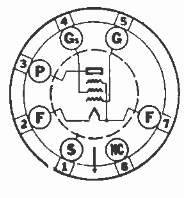
All characteristics and base diagrams are arranged on one side of the sheet so that this important service data is instantly available. Many servicemen prefer to tack it above the service bench. The sheet also folds down to convenient size for pocket or service kit. and is punched so that it may be used in a standard three ring binder.

Why do we offer this chart free? Because for years we have worked in close cooperation with servicemen, and knowing their needs, we present the best efforts of our engineering department to give them information they can use, in a condensed and practical form.

ORDER FROM YOUR SYLVANIA JOBBER

NEW TUBES

Type 1G5G Power Amplifier



6X

Type 1G5G is a new power output tube of pentode construction. It was designed especially for operation from a 90-volt B supply and will be found mainly in battery receivers, particularly where current limitations are a factor.

Resistance coupling may be employed and the rated output obtained under Class A operation. Larger power output is available by employing two tubes in push-pull service.

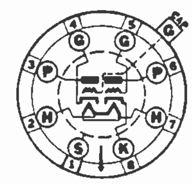
CHARACTERISTICS

Filament Voltage	2.0 Volts
Filament Current	0.12 Ampere
Maximum Over-all Length	4-11/16 Inches
Maximum Diameter	1-13/16 Inches
Bulb	ST-14
Base	Medium G Type Octal No. 6-X

OPERATING CONDITIONS AND CHARACTERISTICS

Filament Voltage	2.0 Volts
Filament Current	0.12 Ampere
Plate Voltage	90 Volts Max.
Screen Voltage	90 Volts Max.
Grid Voltage	−6 Volts
Plate Current	8.5 Ma.
Screen Current	2.7 Ma.
Plate Resistance	135,000 Ohms
Mutual Conductance	1,500 μmhos
Amplification Factor	200
Load Resistance	8,500 Ohms
Power Output	300 Mw.
Total Harmonic Distortion	9 Per Cent

Type 6C8G Duotriode Amplifier



8-G

Type 6C8G is a double triode amplifier with each cathode brought out to separate base pins. The particular design of this new tube makes it especially adaptable to use as a voltage amplifier for a phase inverter. It will also lend itself to other circuit applications since each element terminates at separate base pins. The voltage between heater and cathode should be kept as low as possible if direct connection is not made.

For phase inverter service the effective plate voltage is the supply voltage less the voltage drop in the plate resistor. The self-biasing resistor will not require a by-pass condenser in this service. It will be noted in the operating characteristics below that the value of the grid return resistance of the succeeding audio amplifier should be governed by the type of tube employed in that stage.

Continued on Page Two

NEW TUBES

Continued from Page One

Type 6C8G Duotriode Amplifier

CHARACTERISTICS

Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
Maximum Over-all Length	4-17/32 Inches
Maximum Diameter	1-9/16 Inches
Bulb	ST12C
Base	Small G Type Octal No. 8-G

Direct Interelectrode Capacitances:

Grid to plate	2.4*	2.5# μμf.
Grid to Cathode	2.5*	3.4 μμf.
Plate to Cathode	3.9*	3.5# μμf.
Grid to Grid		0.1 μμf.
Plate to Plate		1.5 μμf.

*Triode Section with grid connected to top cap.
#Triode section with grid connected to base pin.

OPERATING CONDITIONS AND CHARACTERISTICS

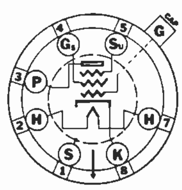
Class A Amplifier—One Triode

Heater Voltage AC or DC	6.3 Volts
Plate Voltage	250 Volts Max.
Grid Voltage	-4.5 Volts
Plate Current	3.1 Ma.
Plate Resistance	26,000 Ohms
Mutual Conductance	1,450 μmhos
Amplification Factor	38

TYPICAL OPERATION AS PHASE INVERTER

Plate Supply Voltage	250	250 Volts
Grid Voltage	-3.0	-3.0 Volts
Plate Current per Section	1.7	1.0 Ma.
Plate Load Resistor	50,000	100,000 Ohms
Self-Biasing Resistor	900	1,500 Ohms
Grid Return Resistance of Following Tubes	100,000	500,000 Ohms
Voltage Amplification	45	48
Maximum Output Voltage (RMS)	60	80 Volts

Type 6U7G R-F Pentode



7-R

Type 6U7G is a new "G" tube identical in characteristics and operating conditions to type 6D6. Like the 6D6, it has a remote plate current cut-off. It is suitable as an amplifier in radio or intermediate frequency circuits and it may also be used as a mixer tube.

The "dish-pan" shield located in the dome of the bulb is connected directly to the cathode. In some circuits this new tube may be used interchangeably with types 6K7 or 6K7G but this is recommended only in emergency cases, and the alignment of the circuit should be checked. For further details on the use of type 6U7G refer to Sylvania type 6D6.

CHARACTERISTICS

Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
Maximum Over-all Length	4-15/16 Inches
Maximum Diameter	1-9/16 Inches
Bulb	ST-12C
Base	Small G Type Octal No. 7-R

Direct Interelectrode Capacitances:

Grid to Plate (with tube shield)	0.010 μμF Max.
Input	4.7 μμF.
Output	6.5 μμF.

OPERATING CONDITIONS AND CHARACTERISTICS

Amplifier (Class A)

Heater Voltage	6.3	6.3 Volts
Plate Voltage	100	250 Volts Max.
Grid Voltage	-3	-3 Volts
Screen Voltage	100	100 Volts Max.
Suppressor		Tie to cathode
Plate Current	8.0	8.2 Ma.
Screen Current	2.2	2.0 Ma.
Plate Resistance	0.25	0.8 Megohm
Mutual Conductance	1500	1600 μmhos
Mutual Conductance at -40 volts bias	10	10 μmhos
Amplification Factor	375	1280

OPERATING CONDITIONS WITH VARIABLE BIAS

First Detector in Superheterodyne Circuit

Heater Voltage	6.3	6.3 Volts
Plate Voltage	100	250 Volts Max.
Grid Voltage	-10	-10 Volts Min.
Screen Voltage	100	100 Volts Max.
Suppressor	Tie to Cathode	

A CHAT WITH ROGER WISE

Chief Tube Engineer
Hygrade Sylvania Corporation

A constructive discussion of the industry's need for improved uniformity of tube characteristics occurred in the March meeting of the RMA Committee on Vacuum Tubes. As a result of this discussion, it was decided that the sub-Committee on Tube Numbering should be given more detailed instructions as to the handling of the assignments of tube type numbers. Mr. E. W. Wilby has been assigning tube numbers for several years, and has done excellent work in keeping the assignments up-to-date as far as is possible under present conditions in the industry. He has now been instructed to insist on complete specifications from tube manufacturers when data on a new type is released. The release to tube companies will no longer be marked "tentative," and tube manufacturers have agreed to cooperate in establishing final production centers at an early date so that changes after tubes have been put into production will be avoided, or at least reduced to a minimum.

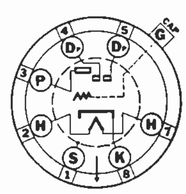
Manufacturers have fallen into the habit of introducing "G" types without supplying full data on arrangement of mechanical details, particularly some of the basing connections. In the future, all types will be released in the same manner as new tubes, and the information will be as complete as possible.

Another report which was of interest was given for Mr. S. W. Seeley, advising that the Sub-Committee on Tube Limits was completing the difficult investigation of the problem of accurately measuring pentagrid converter performance. Improved measuring equipment has been developed which will permit standards to be shown for these types which will accurately define the ability of the tube to perform as an oscillator, as well as its efficiency as a demodulator. Up to this time each tube manufacturer has developed his own methods for measuring such tubes, and the results obtained under one set of measuring conditions could not be correlated with results obtained elsewhere.

Dealers and service men can aid this constructive industry move by urging that receivers be designed to take tubes complying with industry standards, avoiding designs which call either for "hot" tubes or for tubes below the normal design center. All receivers should take tubes within the usual range of manufacturing variations without serious change in receiver performance. Failure to comply with this requirement indicates that the circuit design used is too critical.

It is evident that a similar feeling exists on the part of engineers interested in circuit design, as there is more call for "limit" tubes for use in circuit investigations than has been the case in previous years. With cooperation of this kind being fostered by the industry, we can expect steady improvement in conditions in the field.

Type 6V7G Duodiode Triode



7-V

Type 6V7G is a Duodiode Triode identical in characteristics and applications to Sylvania type 85 and identical in appearance with the exception of the octal type base and miniature top cap. It will be found in the same type of service as type 85. For further details as regards circuit applications reference may be made to the Sylvania Technical Manual.

CHARACTERISTICS

Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
Maximum Over-all Length	4-17/32 Inches
Maximum Diameter	1-9/16 Inches
Bulb	ST-12C
Base	Small G Type Octal No. 7-V

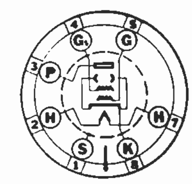
DIRECT INTERELECTRODE CAPACITANCES
(Triode Unit)

Grid to Plate	1.5 μμF
Input	1.5 μμF
Output	4.3 μμF

CLASS A AMPLIFIER
(Triode Unit)

Heater Voltage	6.3	6.3	6.3 Volts
Plate Voltage	135	180	250 Volts
Grid Voltage	-10.5	-13.5	-20.0 Volts
Plate Current	3.7	6.0	8.0 Ma.
Plate Resistance	11,000	8,500	7,500 Ohms
Mutual Conductance	750	975	1100 μmhos
Amplification Factor	8.3	8.3	8.3
Load Resistance	25,000	20,000	20,000 Ohms
Power Output	75	160	350 Mw.

Type 25L6G Power Amplifier



7-AC

Type 25L6G is a new Beam Power Amplifier tube intended especially for operation in the output stage of AC-DC or d-c receivers. It is the glass counterpart of the metal 25L6 and the design features are very similar to those of previous Beam Power tubes. This new tube may be used interchangeably with the metal 25L6 providing space in the receiver permits.

CHARACTERISTICS

Heater Voltage	25.0 Volts
Heater Current	0.3 Ampere
Maximum Over-all Length	4[11]/16 Inches
Maximum Diameter	1[13]/16 Inches
Bulb	ST-14
Base	Medium G Type Octal No. 7-AC

OPERATING CONDITIONS AND CHARACTERISTICS

Heater Voltage	25.0	25.0 Volts
Plate Voltage	110	110 Volts Max.
Screen Voltage	110	110 Volts Max.
Grid Voltage	-7.5	-8 Volts
Plate Current*	49	45 Ma.
Plate Current**	51	48 Ma.
Screen Current*	4	3.5 Ma.
Screen Current**	10.3	10.5 Ma.
Signal Input	5.3	5.65 Volts RMS
Plate Resistance¶	10,000	10,000 Ohms
Mutual Conductance	8,200	8,000 μmhos
Load Resistance	2,000	2,000 Ohms
Total Distortion	10	11.5 Per Cent
Power Output	2.2	2.2 Watts

*At Zero signal. **At Maximum signal.
¶Approximate values.

THE SERVICE EXCHANGE

THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility with respect to results. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please indicate preference when submitting hints. Don't send routine or generally known information. Please specify tube choice.

Airline Models 62-120, 62-122, 62-126, 62-128. If you suspect the type 34 second detector of going bad or it burns out, be sure to test the coupling condenser between this tube and the preceeding tube before you replace the suspected tube. This condenser (50 mmf,) the condenser across the primary of the first i-f transformer (70 mmf,) the condenser across the secondary of the first i-f transformer (45 mmf,) the condenser in the antenna circuit (200 mmf,) and grid condenser of the first detector-oscillator tube (35 mmf,) are all made of braid tubing pulled over a piece of silk covered wire and they usually become corroded inside and short. They can all be replaced with mica dielectric molded condensers and the set will work very well.—Percy Lemon, Tiffin, Ohio.

* * *

AC-DC Midgets. Oscillation of most AC-DC midgets can be reduced by slightly increasing the by-pass from detector plate to the chassis. The tone is usually improved by this change. In most of the sets it is wise to bore all the holes possible in the bottom of the case for ventilation. Tom Elliott, Deer Lodge, Montana.

* * *

Fada Model 42 AC. A common complaint in this receiver is lack of sensitivity. On measuring the voltages, the plate of the detector tube may be found to be at a slightly lower potential than normal. Replacing the 50,000 ohm resistor in the plate circuit, with one of lower resistance will cure it. I have also found that replacing the detector tube even though it tested good, with a Sylvania, greatly improves reception.—Angelo L. Giorgi, Syracuse, N. Y.

* * *

Grunow Model 9-C. This receiver may operate normally on the broadcast band, but when the band selector knob is turned to the short wave position and back again, the receiver is silent. This trouble is not traced to the wave band switch, but to the 6A7 detector oscillator tube. Replace with a Sylvania 6A7 and the job is done. Incidently a good accurate alignment on this model will make it work wonders. Joseph S. Napora, Uniontown, Pa.

* * *

Howards Models 68, 118. When blisters form on the calibrated dial scale in front of the 6G5 tuning eye, and if operated under those conditions the heat will blister the dial. replace with a Sylvania 6G5 for permanent repair. This tube turns from green to purple.—C. W. Nowell, Hagerstown, Md.

* * *

Philco 1937 Models. When the 1937 Philco Models, with rectifier tube on top of the transformer, are inoperative, check this socket for poor contacts. Apparently too much strain is put on the contacts and they break between the two insulating wafers. To remedy—file out the socket cup and replace with a clip-tite socket.

If the tone is distorted or fuzzy, first check the voice coil gap for steel filings. These filings get behind the heavy cardboard spacer and gradually work into the voice coil gap. This trouble is quite frequent.—J. M. Binding, Manistee, Mich.

* * *

Philco Model 625. Normal short wave reception on the short wave bands, and no reception on the broadcast band led us to suspect the wave band switch, but this proved futile. Our next unit under suspicion was the r-f transformer, and there we found the loose connection which we have found in other models of this same make.—Joseph S. Napora, Uniontown, Pa.

* * *

RCA D9-19. On one of these radio-phono-combinations only the powerful local stations would come in very weakly and the tuning eye would show no decrease of angle, with all d-c voltages checking OK and the alignment satisfactory except for the second i-f transformer trimmers. Removal of the transformer showed the trimmers were soaked in oil that had dripped from the phono-motor, thus changing their capacity. The trimmers were cleaned and the receiver completely realigned with original performance restored. Caution should be given to not oil too freely.—Raymond C. Wyman, Medford, Mass.

* * *

RCA T7-5. Distortion with high plate current in the 6F6 audio tube, usually indicates a low bias on the tube. Increase the value of the bias resistor to its normal rating, and the distortion will vanish.—Joseph S. Napora, Uniontown, Pa.

* * *

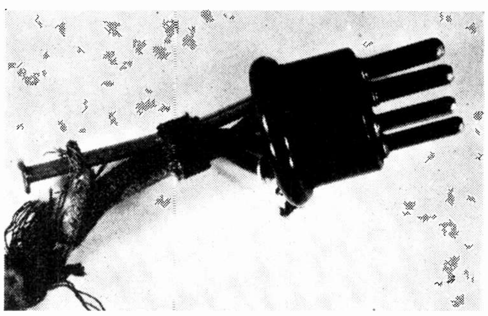
Radiola Models 80, 82, 86. In many of the models, distortion is caused by an open primary of the push-pull input transformer. This is not readily discernable because the plate voltage comes through, due to the presence of the 40,000 ohm resistor (this usually reduces to about 10,000 ohms) across the transformer primary and also the condenser between the primary and secondary. Replace the transformer.—Robert E. Altomare, Washington, D. C.

* * *

Radiola Model 86. Several of these sets have been encountered with the complaint of noise. Although the plate voltage came through to the i-f tubes OK, the i-f transformer primaries of the second and third stages usually show resistances of 6,000 and 10,000 ohms respectively. This indicates bad or corroded contacts on the coil leads. Soldering the leads with a hot iron sometimes cures the noise, but replacing the second and third i-f transformers insures a satisfactory and permanent repair job.—Robert E. Altomare, Washington, D. C.

* * *

CARPENTERED



Here's an interesting sample of home-made service work. We took this speaker plug out of a set that came in for service. The only trouble was that the wire wasn't making good contact with the nail.—Broun D. Rinehart, Rinehart Refrigerator and Radio Sales, Richmond, Ind. (Editor's note: Would this suggest to servicemen that a little detective work might uncover a few crimes like this in your neighborhood, and give you a chance to demonstrate the difference between professional and amateur servicework?)

* * *

RCA M109 (Auto). No reception from 550 to 900 K.C. and weak reception from 900 to 1500 K.C. is often encountered in these receivers. The trouble is an open 100 ohm resistor in the antenna filter circuit. This resistor along with a choke and condenser are contained in a small metal can located where the antenna enters the set and cannot be seen or replaced unless the can is taken apart.—Bill Abele, Newark, N. J.

Remler 52, Norco 178, TOT178, Sky Raider 178. These sets originally had the plate condenser on the 42 output tube connected from plate to ground. In this position the condenser was subject to high voltage stress at certain times. In the later models the condenser is across the output transformer primary, namely from plate to screen of the 42. This produces the same tone quality and the condenser is subject to less overload. This is also true of the Remler Scottie Model 46, which uses a 6F6 output tube. The condenser under discussion is .01 mfd.—Walter T. Walsh, San Francisco, Calif.

* * *

Silver Marshall, Chassis 60. This model uses a 1 megohm grid resistor in series with a bias cell to ground on the 6F5 audio tube. Due to the high grid resistor and small bias, the grid draws current on large signals and lowers the voltage of the bias cell. Distortion results. Change the 1 megohm to ¼ megohm-1/5 watt. There is very little loss in volume.—L. W. Krizan, Chicago, Ill.

* * *

Stewart Warner Model R-128-D (Chassis), (Battery receiver.) For intermittent distortion, replace the volume control even though it checks perfect and is free from noise. I have found that tube life is short in these sets and to eliminate this, 135 volts of "B" battery should be used. In making this change, be sure to move the 22½ volt lead to the 16½ volt tap of the battery.—Norman E. Nelson, Clifford, N. Dakota.

* * *

Transformer Hum. Hum caused by inductive coupling in unbalanced push-pull transformers can usually be cured by connecting a high resistance across one half of the secondary winding. When the proper value is found the hum is balanced out. No appreciable loss in volume will be noted. Values around 50,000 ohms usually work. Try both sides, only one will work.—Ellis H. Disney, Lowry City, Mo.

* * *

Truetone Model D-718. Frequently these sets will play good on powerful stations, but lack selectivity and volume. The trouble is usually high resistance solder connections. Resolder all C and ohm filament voltage drop connections throughout and coil connections. This will also reduce the hum from the vibrator pack.—Barrett Radio, Sulphur Springs, Texas.

* * *

Zenith 800 Series, Models 805, 807, 809. A common fault with these sets is that after they are turned on for about five or ten minutes all the signals get mushy or modulated and fade. The trouble is either a defective .02 coupling condenser or a gassy 42 tube.—Barrett Radio, Sulphur Springs, Texas.

Did You Get Yours?

We have just about dug out from under the blizzard of orders for the complete file of back issues of the Sylvania News Technical Section with binder. If you forgot to order yours, the price is still fifty cents. The binder will accommodate a large number of future issues, as well as the back issues.

OSCILLATOR PERFORMANCE IN SUPERHETERODYNES

GEORGE C. CONNOR

A Helpful Article On Superheterodynes

Practically all receivers built today employ superheterodyne circuits. The problems arising from the oscillator performance in such receivers are numerous, and in many cases difficult to understand. It is felt that an understanding of the workings of the oscillator circuits employed will greatly help to combat the troubles encountered. Therefore, this issue of the Technical Section and following issues will carry serially an article, "Oscillator Performance in Superheterodynes." The article will be divided into four parts: Part 1—Theory; Part 2—Coupling Between Oscillator and First Detector; Part 3—Autodyne First Detector Combinations; Part 4—The Pentagrid Converters. Part 1 follows:

PART 1—THEORY

The optimum performance of a superheterodyne receiver depends to a large extent upon the correct adjustment and alignment of the local oscillator used to heterodyne the incoming signal to the frequency of the intermediate amplifier. The frequency range, tracking, stability and amplitude of the oscillations must meet rather exacting requirements if maximum performance in the receiver is to be realized.

During the past ten years of superheterodyne design and development more than one hundred different oscillator-detector combinations have been employed. A review of the circuits more widely used and a consideration of the service problems common to them should be of much help to servicemen. These circuits appear to differ greatly from each other whereas actually they have many electrical characteristics in common and can all be traced back to the four basic oscillator circuits shown in Figure 1.

FOUR BASIC CIRCUITS USED

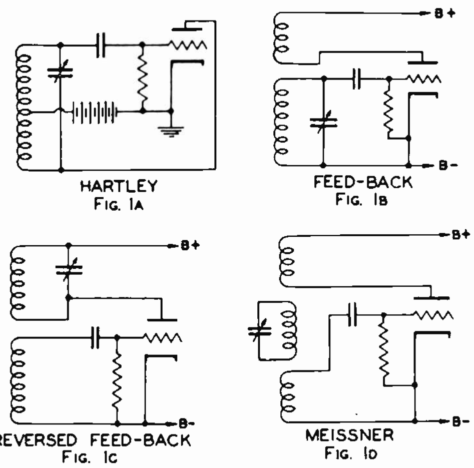
The Hartley oscillator circuit shown in Figure 1A is not in common use in superheterodyne receivers, but is very popular in commercial and amateur transmitters. Two much used variations of this circuit are the tickler "feedback" oscillator of Figure 1B and the "reversed feedback" oscillator of Figure 1C. Radio amateurs will recognize in Figure 1C the circuit of the T. N. T. oscillator (if plate and grid coils are not inductively coupled and if the grid coil is broadly resonant to part of the plate circuit tuning range.) The Meissner circuit of Figure 1D is really a combination of the "feedback" and "reversed feedback" circuits of Figures 1B and 1C or may be considered a tuned circuit with two tickler coils.

TUNED CIRCUITS AND OSCILLATIONS

In each of these circuits, a tuned circuit consisting of an inductance and variable capacitor, determines the frequency at which the circuit will oscillate. This tuned circuit may be in the grid circuit, the plate circuit or in a separate circuit coupled to the grid and plate circuits. It is essential that some method be used that will couple part of the developed a-c voltage on the plate back to the grid circuit. In each of the four circuits shown in Figure 1 this is done inductively. It is only necessary that the tickler coil be connected in the right way and sufficient coupling be supplied to make the tube oscillate. Whether or not the circuit will oscillate during a complete rotation of the tuning condenser, however, is another matter and one that is controlled almost entirely by the coupling between plate and grid coils. In almost every oscillator circuit, the developed voltage will be greatest near the high frequency end and decreases as the frequency is decreased. If sufficient feedback is not provided, the tube will stop oscillating before it reaches the low frequency end of the tuning range. It is very necessary, therefore, to have enough feedback, especially in the new all-wave receivers, in which, for economic reasons, it is necessary to cover the greatest frequency range with the fewest coils. There are two ways in which greater coupling can be secured between two coils. One method is to increase the number of turns in the tickler coil and the other method is to place the two coils closer to each other.

If the first method is used, it will be found that after the number of turns reaches a certain value, the resonance frequency of the tickler will fall within the tuning range of the tuned circuit. This will result in the tickler controlling the frequency of oscillation instead of the tuned circuit, and the tuning condenser may be turned through many degrees without affecting the frequency. This is, of course, very undesirable. On the other hand, if the two coils are coupled tighter by placing them closer together, the tuning range will be sacrificed because the tickler coil adds capacity to the tuned circuit and this limits the frequency range. This indicates that a compromise must be effected to secure:—(1) The maximum number of turns on the tickler that will not cause it to resonate within the desired frequency range. (2) Close coupling between tickler and tuned circuit with the minimum capacity effect. (3) The greatest frequency range that can be covered. This compromise is easy to effect on the broadcast band but becomes increasingly difficult with an increase in frequency. On the broadcast band, if only the range 550 kc to 1500 kc is to be covered we cannot increase the coupling too much or another undesirable trouble is encountered—that of parasitic oscillation. When an oscillator is forced to generate a high a-c voltage, it produces simultaneously a number of harmonics and it also has a tendency to oscillate at a second frequency usually higher than the original. This is called parasitic oscillation and in a superheterodyne oscillator causes squeals and whistles at the high frequency end of the band. Too great a coupling between plate and grid coils in an oscillator causes parasitic oscillation on the high frequency end and too loose a coupling may result in the oscillator stopping at the low frequency end of the band. Somewhere between these two conditions will be found the proper degree of coupling. In service work, many sets will be found where the coupling is at a critical point so that a matched oscillator tube will work, but one that is on the low side of the mutual conductance limit will stop oscillating somewhere near the low frequency end of the band.

FIGURE 1



HARTLEY Fig. 1A — FEED-BACK Fig. 1B — REVERSED FEED-BACK Fig. 1C — MEISSNER Fig. 1D

THE GRID LEAK AND CONDENSER

The function of the grid condenser and leak common to all four circuits shown in Figure 1 may not be apparent at first glance. These two necessary items are used to secure an automatic grid bias for the oscillator tube.

With the grid connected to the cathode by the grid leak, the bias on the grid is, of course, zero when the tube is not oscillating. A tube so operated is very sensitive to any circuit change and is very unstable. With a positive voltage applied to the plate and the heater current turned on, the first surge of electrons from the cathode to the plate will cause the tube to start regenerating and within a few cycles this will build up sufficient feedback voltage to cause the tube to oscillate. With the tube oscillating, the voltage feedback from the plate circuit will alternately make the grid positive, then negative. When the grid goes positive, it will act as a diode plate and attract some of the electrons that would otherwise go to the plate and these electrons flowing through the grid leak will develop a voltage that will bias the grid negative. If the grid condenser and leak are of the proper value to prevent all of these electrons from leaving the grid during the negative cycle, the grid will maintain this bias as long as the tube is oscillating. This effect can be shown in two ways—first by connecting a 0-1 milliammeter in series with the grid leak and, second by connecting a milliammeter in series with the plate return circuit. When the tube is not oscillating, the plate current will be higher than when it is oscillating. The use of a meter in series with the grid leak gives a very good indication of the actual voltage developed by the oscillator. It is only necessary to multiply the grid leak resistance in ohms by the grid current to determine this voltage. Since the voltage developed by an oscillator is proportional to the coupling, this grid current measurement gives a good test for determining the condition of coupling which, we have seen, is very important. This current is larger than would be supposed because when the grid is positive, the plate voltage is at minimum and the grid attracts a relatively large percentage of the electrons. Since the translation gain of the first detector oscillator combination is a function of the oscillator voltage, it is very important that this developed voltage be of satisfactory amplitude.

ENGINEERING AND SERVICE

It is apparent from the foregoing discussion that an oscillator circuit that will cover the desired frequency band with a satisfactory developed oscillator voltage so as to give good translation gain and yet not cause parasitic oscillation trouble at the high frequency end of the band, is one that has been very well engineered and one that must be intelligently adjusted in the field, if satisfactory receiver operation is to be maintained.

The next point to consider is the proper method of coupling the oscillator to the first detector so that the full benefit of the oscillator voltage may be realized in securing optimum gain in heterodyning the incoming signal to the frequency of the intermediate amplifier. This will be covered in Part 2, which will appear in the next Technical Section of Sylvania News.

NUMBERING CHANGE

Types 1A4T, 1B4T, 1D5GT, 1E5GT

Types 1A4 and 1B4 and their "G" tube equivalents, types 1D5G and 1E5G, are now being supplied with the suffix letter "T" so that the designating type numbers now are 1A4T, 1B4T, 1D5GT, and 1E5GT. The addition of the suffix "T" indicates that the tubes are of tetrode construction and is the result of an arrangement made by the RMA Sub-Committee on Tube Numbering to avoid confusion between the tetrode and pentode construction of these types.

The addition of the letter "T" does not indicate any change in the construction of the original Sylvania types 1A4, 1B4, 1D5G and 1E5G. Therefore, Sylvania 1A4T, 1B4T, 1D5GT and 1E5GT will replace those same Sylvania types whose designating type numbers do not contain the suffix letter "T" and vice versa.

Some tubes may be found in service having the original designating type number suffixed with the letter "P", designating pentode construction—a suppressor grid being used which is connected internally. In practically all cases the Sylvania 1A4T, 1B4T, 1D5GT and 1E5GT tubes will respectively replace any tubes bearing the suffix letter "P" in place of the letter "T".

SYLVANIA NEWS

TECHNICAL SECTION

May-June, 1937 | EMPORIUM, PENNA. | Vol. 7, No. 1

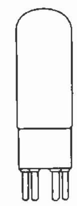
YOU ASKED FOR IT

Here is Sylvania Service Kit No. 2, the answer to many requests from servicemen for a larger, more capacious service kit. Similar to the original Sylvania Kit in its sturdy construction, black leatherette cover, chrome fittings, handy tool tray, and neat professional appearance, Sylvania Kit No. 2 has almost twice the carrying capacity, (approximately 160 tubes.) Note the depth of the top compartment, and the leather flap which holds the contents securely when the case is closed.

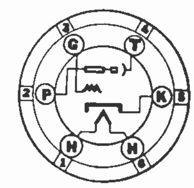
Kit No. 2 was selected after comparison of various samples and consultation with a number of servicemen, who recommended this size and arrangement for capacity and convenience. Inside dimensions are: Height, 14 inches; length, 22 inches; width, 8 inches.

Order Sylvania Service Kit No. 2 from your Sylvania jobber, or direct from Emporium, Pennsylvania. Price $5.00, remittance with order.

The popular Kit No. 1, dimensions 10x17x7 inches (See Techincal Section Volume 6, No. 3) is still available at $3.00. Many servicemen have assured us that they will find both sizes very useful.



Type 6T5 Tuning Indicator



6-R

A new tuning indicator tube, type 6T5 has been developed by the Sylvania laboratories and is now made available. The new tube differs from the other popular tuning indicator tubes in that the visible indication is annular or circular in shape. This can be noted from the accompanying views. It differs also in the bulb size, being enclosed in the T-9 bulb rather than the ST-12 bulb like previous indicators. Otherwise the 6T5 is similar to the Sylvania type 6G5, particularly in the design of the triode unit.

When no voltage is applied to the control grid of the triode section the fluorescent indication is visible only on a narrow region of the outer surface of the target plate. The fluorescent ring or lighted section increases toward the center of the target plate when a negative voltage is applied to the control grid. The lighted section will gradually cover all the target plate as the negative voltage is increased. Thus, a varying negative voltage obtained from some point in the a-v-c circuit can be used to indicate resonance. Resonance will be reached when the lighted portion of the target is at a maximum. When tuning a receiver the changes in the diameter of the lighted section are more readily detected than are the changes in the fan-like sector of the 6G5 indicator.

Although the operating conditions and characteristics of the new 6T5 are similar to those of the Sylvania 6G5 interchanging of the two types is not recommended at this time. The difference in visible indications, the smaller bulb size and the fact that the 6T5 is not designed for 100 volt operation, all tend to withhold any recommendations on interchanging the two types.

Characteristics

Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
Maximum over-all length	4⅛ Inches
Maximum Diameter	1 3/16 Inches
Bulb	T-9
Base	Small 6 Pin No. 6-R

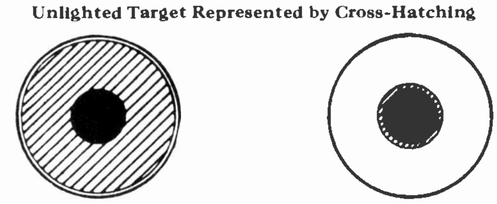
Operating Conditions and Characteristics

Heater Voltage	6.3 Volts
Plate Supply Voltage	250 Volts
Target Supply Voltage	250 Volts
Plate Current (Triode Unit)*	0.24 Ma. Max.
Target Current	3.0 Ma. Approx.
Grid Voltage (Triode Unit)#	0.0 Volts
Grid Voltage (Triode Unit)##	-22.0 Volts
Triode Plate Resistor	1.0 Megohm

*With triode grid voltage of zero volts.
#For minimum illumination of target.
##For maximum illumination of target.

TARGET VIEWS

Unlighted Target Represented by Cross-Hatching



Zero Grid Bias — **Max. Grid Bias**

A CHAT WITH ROGER WISE

Chief Tube Engineer
Hygrade Sylvania Corporation

It is interesting to note that very frequently a number of new tubes are introduced immediately following announcement of a single type embodying a design improvement. This is only natural, as set manufacturers are interested in applying such improvements to all types of receivers. Thus it becomes necessary to make the tube available in different styles suitable for household, battery, automobile, AC-DC, and other classes of service. In the case of the power output tube, the number of variations is particularly large because of the more difficult design problems presented in securing maximum efficiency from a tube of this type.

About one year ago type 6L6, a beam power tube, was made available to set manufacturers. This tube afforded the advantage of high sensitivity and high output levels with increased efficiency due largely to the reduction in screen power achieved by this design. It is interesting to note that this tube was followed by 6L6G (the glass equivalent), 25B6G, 25L6 and 25L6G, as well as 6V6 and 6V6G. The original tube was designed primarily for household receiver and power amplifier use. Types 25B6G, 25L6 and 25L6G were designed for AC-DC receivers, while 6V6-6V6G fills the need for a smaller output tube for automobile receivers as well as small household sets.

It is evident that the possibilities of further variations have not been exhausted, but it is the hope of the tube manufacturers that additional time will be available for refinements in manufacturing processes (particularly as regards grid making) before they are called upon to introduce further tubes of this general type.

For the long pull the best program for tube manufacturers to follow is that of the orderly and not too rapid introduction of tubes which make possible improved receiver performance. It is the well-established policy of the Hygrade Sylvania Corporation to follow such a program to as great an extent as is possible from the standpoint of competitive conditions in the industry.

Speaker Placement And Coverage

The Thordarson Electric Manufacturing Co., in their study of accoustics have found that the placement of speakers plays an important part in the successful operation of public address equipment. Regardless of the quality of microphone, amplifier, or speakers used, there is a possibility of acoustical feedback occurring before a satisfactory level is reached for full distribution of sound.

The directional characteristics of trumpet horns permit unusually good coverage before acoustical feedback occurs. This is because the sound can be directed entirely away from the microphone. For outdoor work the 6-foot trumpet is recommended, whereas the 3½ and 4½ foot models are better indoors.

Trumpet horns are very efficient and provide maximum sound output for a given amplifier input. Either the permanent magnet dynamic or electro-dynamic units may be used. There is some advantage in the permanent magnet type since no field exciter is required, and the unit is considerably lighter.

The use of directional baffle, rather than flat baffle cone type speakers, will often reduce feedback. The speaker unit may be entirely enclosed where unusual conditions exist, leaving only the cone exposed to emit sound through the horn.

Loud speakers should be placed as far ahead of the microphone as conditions permit, and higher. Placing speakers higher makes it possible to direct them down toward the audience. This not only improves audibility but reduces feedback by means of absorption.

Best indoor results are obtained with two speakers. These should be placed, one on either side of the room, facing the coverage, with the trumpets directed toward the rear center. If non-directional or flat baffles are used with cone speakers, it may be necessary to locate the speakers further toward the rear of the room.

The following data. based on experience and theory, should prove helpful in determining what size amplifier is required. Installations may vary somewhat due to the difference in the efficiency of speakers used and in the noise level which the system must over-ride.

In obtaining the information, 12-inch electrodynamic speakers with 15 to 20 watts of field excitation and directional baffle horns,were used. Flat or box type baffles require approximately three times as much audio power. Likewise, if the noise level is high, as in dance halls, etc., it will be necessary to use three times as much power.

After determining the required power, estimate that each speaker will receive about 5 watts. Therefore, if 30 watts are required for the installation, six speakers should be used and so placed that the sound will be evenly distributed.

Outdoor coverage is based on the number of square feet of ground and it has been determined that 1 watt of audio power will cover 1,000 square feet. For example, if we have a park 300 feet long and 150 feet wide, or 45,000 square feet, 45 watts are required and 9 speakers should be used.

Indoors it is necessary to estimate the cubic content of the room or hall. Following is a table showing what size rooms may be covered with a given amount of audio power.

Electrical Watts	Volume of Room in Cubic Feet
2	25,000
4	60,000
8	150,000
12	350,000
20	700,000
30	1,000,000
40	1,500,000

Atwater-Kent Model 76 Type Q-1 and 2 Chassis Modernization. The original tubes used are 3 type 22 in the r-f stages, 12A detector, 12A first a-f and 2 type 71A in push-pull. Change to 3 type 32 for r-f, 1 type 30 detector, 1 type 30 first a-f and 2 type 31 for the push-pull stage. The wiring changes necessary are: 1. Remove the first, second and third r-f filament resistors and the first and second r-f bias resistors (third r-f filament resistor supplies bias for third r-f tube) and, also remove the yellow detector and a-f filament resistor, and then connect direct leads in place of all resistors removed. 2. Replace 30,000 ohm gray detector filter resistor with one of 60,000 ohms so as to reduce original 70 volt detector supply to about 40 or 45 volts. 3. The grids of the 3 type 32 r-f tubes should have a bias of minus 3 Volts, so remove the black leads connected to the second and third r-f secondaries. Connect both these leads to the chassis, and connect the new leads to the bottom of each of these second and third r-f secondaries and connect together with green minus 4½ volt "C" lead. Then by-pass these two secondaries to chassis with 0.1 mfd. capacitors. Next connect a 50,000 ohm resistor from the first r-f secondary bottom terminal to the green minus 4½ volt "C" lead. Then disconnect the red lead on the local distance switch from the chassis and connect a 0.1 mfd. condenser between the red lead and the chassis. 4. All battery connections remain the same except to use a 2 volt "A" battery and connect green minus 4½ volt "C" lead to minus 3 volt tap and connect the black-green minus 45 volt "C" lead to minus 34½ volt tap so as to get correct bias for all tubes. Change the 6 volt pilot bulb to a 2 volt 60 mil. lamp. 5. Realign the set carefully and it will perform even better than when new and the "B" drain will be much less. I have found several sets that were changed to use 2 volt tubes, but with no changes to supply bias on the 32 tubes thus shortening tube life. If dial readings are off calibration, see that 32 control grid leads are all parallel.—Norman E. Nelson, Clifford, N. D.

NEW TECHNICAL LITERATURE

1. **Sylvania Interchangeable Tube Chart**—revised to include all tube types announced to date. Lists all types of tubes manufactured, with correct Sylvania replacement specifications. Also indicates types not interchangeable. For wall or pocket use.
2. **Sylvania Base Chart**—revised to show base arrangements for new tube types to date, in accordance with RMA Standards. For wall or pocket use.
3. **Sylvania Characteristic Sheet**—Revised to May 1 (see last month's Technical Section)

Free from your Sylvania Jobber.

KNOW YOUR RADIO PROGRAMS

Let no one tell you that you do not need to know about radio programs in order to conduct your service or retail radio business successfully. You wouldn't expect a carpenter to build a house without a hammer, or a doctor to cure patients without writing prescriptions. Program information, intelligently applied in your contacts with your customers, is your hammer and your prescription pad.

Consult your news dealer for information on the several excellent radio magazines listing complete radio program schedules for your locality. Many of them are printed in special editions for each broadcasting area. Select the one that suits you best. Then read it regularly. This is just as important as systematic study of the radio trade magazines which bring you technical and merchandising information.

Even in localities where the newspapers print daily radio schedules, this weekly or monthly preview brought to you by the program magazines will be very helpful in keeping you informed in advance of new programs, special features, and other "human interest" information which you need in order to sell that vital point in the radio set-up—radio programs.

THE SERVICE EXCHANGE

THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility with respect to results. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please indicate preference when submitting hints. Don't send routine or generally known information. Please specify tube choice.

Atwater-Kent Model 545. When the stations shift on the dial and in a few days shift back to their right numbers, replace the 360 mmf. (#C3 in Atwater Kent service manual) in the first Det.-Osc. 6A7 circuit. It seems that this condenser develops leakage to a certain extent, changing its capacity.—L. E. Biar, B-R Radio & Sound Labs., Giddings, Texas.

* * *

Automatic Car Radio Model C15. When this set stops, but the vibrator works O.K. with no plate voltage—look for a broken lead or leads from the power transformer to the plates of the 84 tube. Replace the wires with stranded wire as the original are single stranded. Also, put a fuse holder and fuse in the lead to the A battery.—Charles A. Brooks, Philadelphia, Pa.

* * *

Coin-Operated Phonographs. Most coin-operated phonographs are not equipped with fuses, and shorts which stop sound do not always stop coins from tripping relay and keeping the current on. The result is that instead of calling a service man, the owner calls the fire department. Install fuse mountings and fuse for double the normal current drain.—Anderson Radio Hospital, N. B. Anderson, Seattle, Wash.

* * *

Chevrolet Model 985255. A frequent intermittent reception in this receiver gives trouble but can usually be stopped by removing chassis and noting that there is a small 1 meg. resistor connecting the #4 and #2 prongs of the 6R7 tube socket. This resistor frequently touches the #3 prong during driving. To cure trouble unsolder and lengthen the wire so that the resistor cannot touch the #3 prong which is at plate potential.—D. H. Gordoll, De Land, Fla.

* * *

Coronado Model 575. If the complaint is fading look for a poor ground on the battery switch. The ground is obtained through a wire running from the switch to one of the i-f can lugs. This has a habit of working loose. The switch is usually O.K. but if in doubt ground the shaft with a pigtail.—Vere L. Henning, Henning's Radio Repair, Montevideo, Minn.

* * *

Coronado Models 650-A, 650-B. If these sets whistle between 650 K.C. and 550 K.C. insert a .02 mfd. 600 volt condenser from the plate of one of the 950 tubes to ground. Check the i-f adjustments for their proper frequencies and the trouble is corrected.—Vere L. Henning, Henning's Radio Repair, Montevideo, Minn.

* * *

Gulbransen Model 322. This set often has the complaint that the 82 tube is flashing. To cure this replace the wet 8 mfd. 500 volt inverted can condenser and the .25 mfd. tubular condenser which is connected from the Positive Terminal of the wet condenser. Another frequent complaint is that the set is lacking in volume. This is caused by the tuning meter coil leads snapping, thus cutting off the voltage from the associated tube. Replace the tuning meter with one of same type, that is, a meter with a full scale deflection at 5 mils.

It is a good idea to replace the Type 82 rectifier tube with a Sylvania tube at the same time.—Boy's Radio Service, Rochester, N.Y.

* * *

Hammarlund Comet Pro. The gain and sensitivity of these receivers may be greatly increased by a few changes of valve in the two detector circuits. The first detector cathode resistor should be reduced to about 2500 ohms and the screen voltage should be taken directly off the high voltage with a one megohm resistor in series.

In the second detector circuit the cathode resistor should be replaced with a 5000 ohm fixed resistor and a 10,000 ohm volume control, the latter being mounted on the front panel. This control serves as a useful sensitivity control. The screen voltage for the second detector is obtained from the high voltage through a two megohm resistor.

These simple changes increase the sensitivity to about one half microvolt absolute or about twice the original amount. Another worthwhile addition is a tone control in the audio circuit and a dynamic speaker substituted for the original magnetic.—Charles Rockey, Jr., River Forest, Ill.

* * *

Jackson-Bell Model 62. Weak or no reception. All voltages at socket normal. Check resistances of plate coupling coil on top of the r-f coil assemblies. Resistance should be approximately 20 ohms. If any one coil reads much lower than others or shows no resistance, look for a short between lead to the inner end of winding and balance of winding. To clear same, unwind coil carefully and lay strip of paper over the inner lead and rewind coil.

Note: The trimmer condensers on these transformers are coupling condensers so do not attempt to use them for alignment of tuning condensers. No tuning condenser trimmers are provided, therefore, if more selectivity is required new trimmer condensers should be installed in an accessible place along side the respective sections of the main tuning condenser.—John M. Thompson, Canandaigua, N. Y.

* * *

Motorola Model 34. A common complaint is noise-similar to a noisy tube. Taking out the chassis and going over the set in general for poor connections, loose element tubes, etc. is necessary, but does not always reveal the trouble. Always tighten the i-f coil shields that are fastened to the chassis with self tapping screws. This is a common source of trouble and usually overlooked.—H. Amos, Dedham, Mass.

* * *

Philco Models 806, 807, 808, 809, 816, 817, 818, and 819. To eliminate vibrator "hash" and buzz in the above models, insert an iron core "A" choke in series with the speaker field. The type choke used by Mallory in early type motor car "B" power units effectively eliminates the hash in these sets.—Wave King Radio Service, Portland, Oregon.

* * *

Philco Model 20. Tone can be greatly improved by punching many tiny holes in both the solid centering disc and in the outer rim of the speaker cone, which allows freer motion of cone. This repair is not as good as replacement of the cone with new type, but costs nothing and can be done quickly.—Anderson Radio Hospital, N. B. Anderson, Seattle, Wash.

* * *

Repairing Warped Speaker Voice Coils. I have reshaped and remedied warped voice coils by applying banana oil to the form so as to soften it enough to allow reshaping it enough to entirely eliminate fuzzy tone due to scraping. After reshaping, apply a good speaker cement. Be sure to clean-out the voice coil hole in the magent housing with a pipe cleaner and alcohol. This hint is of real value when encountering old speakers or hard to get replacement cones and voice coils.—Norman E. Nelson, Clifford, N. D.

RCA Model RE45. On this combination Phono-Receiver with the switch in the radio position, normal volume is obtained but when turned to phono position the volume is very low. A check-up on the suspected pick-up unit and matching transformer will show them O.K. The trouble lies in a high resistance contact in the radio-phono switch. Sandpaper these contacts and the result is normal phono volume. I have found this trouble on many of these combinations.—W. C. Zieger, New York City, N. Y.

* * *

Sparton Model 410 Chassis. Complaint: Fading and erratic tuning; that is, not being able to get the station on the same number when turning past any particular station particularly in the center of the dial. Trouble is caused by a poor contact between one or more sections of the rotor plates being loose at connection to the shaft. We have remedied every case in the last twelve cases which came for service in our shop by drilling and tapping a hole through the condenser sections into the rotor shaft of the plate and have installed a 6-32 screw for positive ground absolutely eliminating the trouble.—Leonard's Radio Service, Chicago, Illinois.

* * *

Simplex AC-DC Models. To eliminate tunable hum; reconnect the condenser which is now between B minus and one side of the power line, so that it is directly across the line.—Anderson Radio Hospital, N. B. Anderson, Seattle, Wash.

* * *

Truetone Model 6K Auto Radio. This set may come in with the complaint that there is a very bad crackling which will at once indicate that there is a loose connection. Remove the chassis and solder short pieces of wire from coil grounds directly to chassis as the coil grounds on this set are through the rivets. Due to vibration the rivets will loosen and cause a crackling noise which proves very annoying on rough roads.—Roy's Radio Service, Rochester, New York.

* * *

Zenith Models 980, 985, 990. When the complaint is, weak, noisy, and lack of selectivity check the d-c resistance of the primary and secondary of the i-f transformer. The correct reading should be 5 to 6 ohms. In the course of repair I have found some to read as high as 200 ohms, causing the above complaint.—Louis Pallin, Pallin Radio Lab., Chicago, Ill.

* * *

Zenith Models 1004, 5801. The early models had low gain oscillator coils which combined with a 6A8G with low cathode emission, would stop oscillating at 6 Megacycles on the B band.

The best way to remedy this, is to replace the original tube with a Sylvania 6A8 Metal tube. These tubes never fail to bring results.—Louis Pallin, Pallin Radio Lab., Chicago, Ill.

DO THE LADIES?

Call it a passion for statistics, or just plain curiosity—we'd like to know whether there are any feminine "servicemen." We know about the lady Hams. What we want is information about "servicewomen" who actually do service work, either in their own shops, or in partnership with a serviceman. If you know any, drop us a line.

OSCILLATOR PERFORMANCE IN SUPERHETERODYNES

(Continued from last Issue)

GEORGE C. CONNOR

Coupling Explained

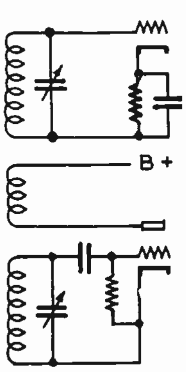
The last issue of the Sylvania News Technical Section contained Part 1 of an article "Oscillator Performance in Superheterodynes." Part 2 of the article follows in this issue. Parts 3 and 4 appear respectively, in the next two issues of the Sylvania News Technical Section. The information given in this article on superheterodyne circuits and the problems encountered in the circuits should prove of great assistance to servicemen in servicing present day receivers.

Part II—Coupling Between Oscillator and First Detector

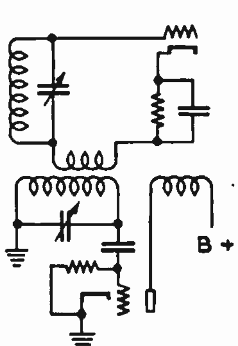
The first commercial superheterodyne receivers employed triode tubes throughout and were of course battery-operated. These early sets are now between seven and thirteen years old, and if they have not already been, should be retired in favor of newer and much better sets. We will therefore ignore these early receivers and consider only the a-c operated, screen grid type receivers employing type 24 and 24A tubes as the first detector, of which there are thousands still being used.

To secure an intermediate frequency in the plate circuit of the first detector, the voltage from the local oscillator is beat against the incoming signal in the control grid, cathode or screen grid circuit of the first detector. Four general methods of coupling the first detector with a separate oscillator tube have been used. These are:

1. Inductive coupling of the oscillator coil to the first detector grid coil, as illustrated in figure 2A.
2. Inductive coupling of the oscillator coil to a separate coil connected in the grid return circuit of the first detector as illustrated in figure 2B.
3. Inductive coupling of the oscillator coil to a coil in series with the first detector cathode circuit, or by capacity coupling between oscillator cathode and first detector cathode, as illustrated in figures 2C and 2D.
4. Electron coupling by introducing the oscillator voltage in the first detector screen-grid circuit by conduction, induction or capacity coupling as illustrated in figures 2E, 2F and 2G.



2 A

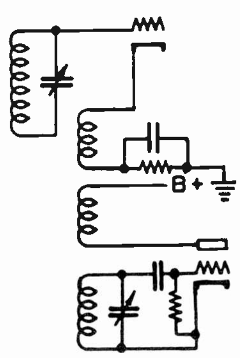


2 B

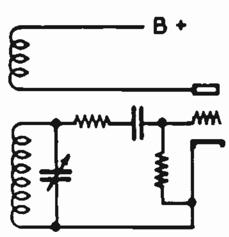
The first two systems (1 and 2 above) introduce the oscillator voltage into the control grid circuit of the first detector and require either a relatively weak oscillator voltage or very loose coupling between the oscillator and first detector control-grid coils. The second method is the more satisfactory of the two because too close a coupling between these two coils may cause the tuning of one circuit to affect the tuning of the other circuit. This type of interaction is very undesirable, and in extreme cases causes the two circuits to "lock" together, making proper trimming and tracking very difficult.

Assuming that the oscillator and first detector coupling is satisfactory from a non-interaction standpoint, there is still one other source of trouble to consider. This is the possibility that the oscillator voltage may be so high (or the first detector grid bias so low) that it will drive the control grid of the first detector positive. This usually occurs at the high frequency end of the band, where in most cases the oscillator develops its maximum voltage. When the second detector control grid is driven positive, grid current flows in the grid circuit and the sensitivity of the r-f stage as well as that of the first detector is seriously reduced. If this condition is suspected it can be easily checked by connecting a 0-1 milliammeter in series with the first detector grid coil (between the low potential end of the coil and ground) and rotating the tuning condenser through its entire tuning range. If at any time the meter needle moves, the first detector bias should be increased or the oscillator voltage reduced. The oscillator voltage may be reduced by reducing the coupling between first detector and oscillator coils, or by reducing the coupling between the two oscillator coils, or by reducing the plate voltage of the oscillator, or by reducing the grid leak or condenser—or both—of the oscillator. To maintain the oscillator developed voltage at a more constant level in many sets a fixed resistor is connected in series with the oscillator grid as shown in figure 2H.

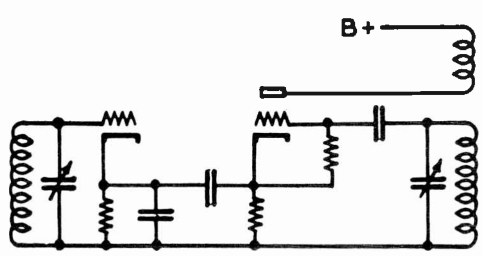
A vacuum tube volt-meter may be used to measure the value of the oscillator voltage induced in the control-grid circuit of the first detector. If the vacuum tube voltmeter is calibrated in R.M.S. volts, the oscillator voltage measured must be multiplied by 1.4 to find the peak voltage. This peak voltage should never equal the bias voltage of the first detector. (A future series of articles in Sylvania News will cover the theory, construction, calibration and use of vacuum tube voltmeters.)



2 C

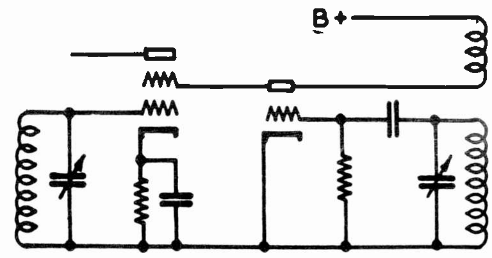


2 H

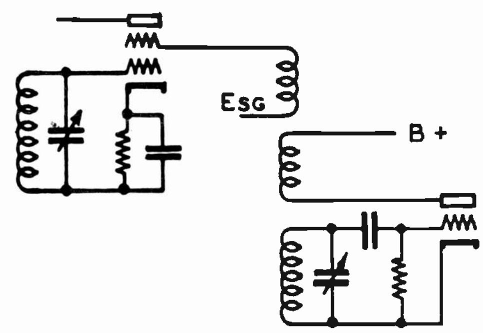


2 D

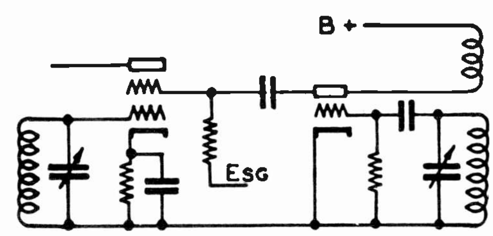
The third system of inductive coupling in which the oscillator voltage is induced into a cathode coil of the first detector (illustrated in figures 2C and 2D) gives less trouble due to interaction between the first detector tuned circuit and the oscillator tuned circuit, but the balance between first detector bias and maximum oscillator voltage must be given the same consideration as the previous systems. In 2D the small by-pass condenser across the cathode resistor of the first detector provides a convenient method of reducing the oscillator voltage at the high frequency end of the band since its reactance will be lower at high frequencies where the oscillator voltage is usually greatest. If the oscillator voltage is too high, increasing the capacity of this condenser will cure the trouble.



2 E



2 F



2 G

The coupling methods illustrated in figures 2E, 2F and 2G introduce the oscillator voltage into the screen grid of the first detector where it is electronically mixed with the signal voltage appearing on the control grid of the tube. The electron stream and the small capacity existing between control-grid and screen-grid are the only links between the two circuits. There is, therefore no chance for the oscillator to override the bias of the first detector and very much less trouble due to interaction between the two tuned circuits. Because the screen-grid has less control over the electron stream than the control grid, the oscillator voltage applied to it must be greater to give the same translation gain in the first detector. For this reason, assuming the same oscillator coils in each case, circuit 2E may not give as good results as circuits 2F and 2G in which the oscillator plate voltage can be higher than the first detector screen grid voltage, and as a consequence develop a higher oscillator voltage. Circuit 2F is not as economical to produce as types 2E and 2G because of the three coil feature, and for the same reason will give more trouble in the field due to difficulty of maintaining proper coupling between the three coils.

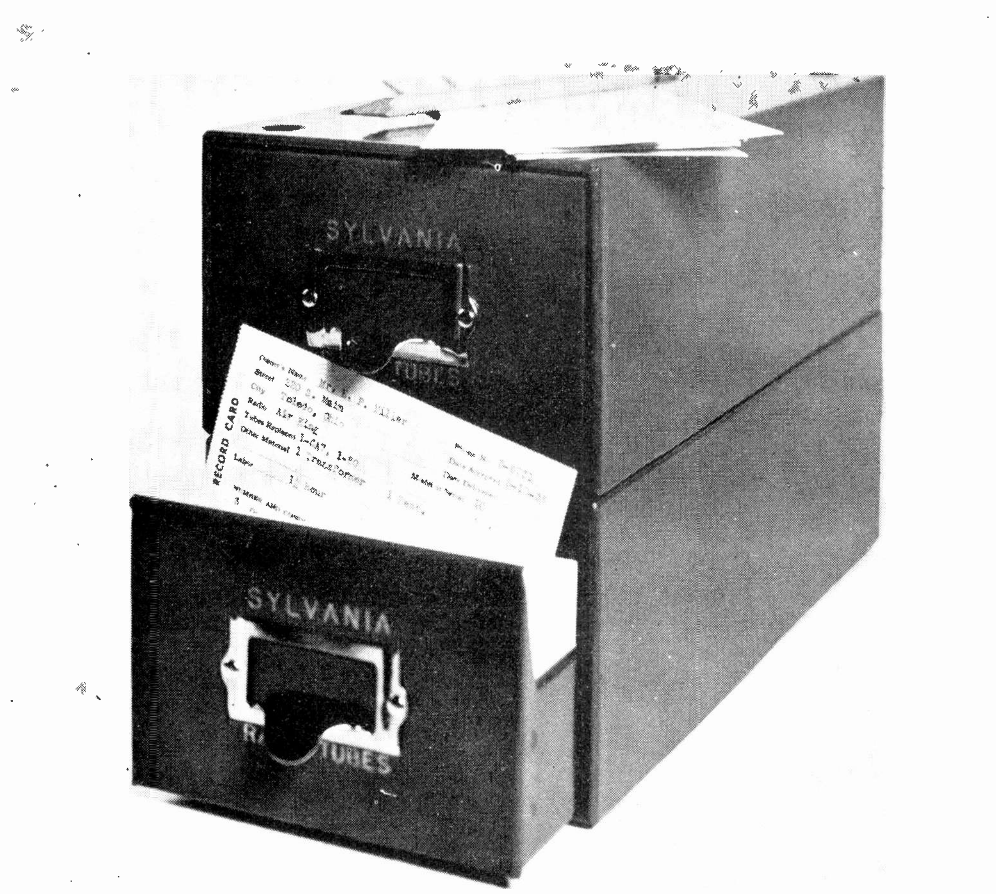
Part III of this series covering the many types of autodyne first-detector and oscillator combinations that have been and are being used at the present time will appear in the next issue of Sylvania News.

SYLVANIA NEWS

TECHNICAL SECTION

July, 1937 | EMPORIUM, PENNA. | Vol. 7, No. 2

YOU'LL NEED MORE THAN ONE



Servicemen who acquired a single Sylvania Card Index File when they were first introduced last year have discovered that additional cabinets provide an efficient, uniform method of filing service hints, business records and other accumulated data necessary for a growing business.

For new readers not acquainted with this useful Sylvania item, specifications are as follows:

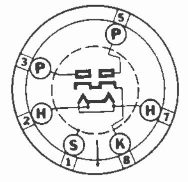
Size: 5⅞ inches wide, 3¾ inches high, 12 inches long, to hold 1000 standard 3x5 file cards. A card guide and set of file cards is included. The material is 22 gauge steel, heavier and more durable than is ordinarily used in such equipment, finished olive green, exactly matching the Sylvania Stock Boy Cabinet. Each file cabinet is provided with recesses in the top, rounded projections in the bottom, so that they may be stacked firmly, without slipping. Drawers slide easily, have a place for a card to indicate contents.

For use with the File, the Sylvania Job Record Card is recommended. This provides complete records of each job, as well as names and addresses of customers. Part of the card is torn off and left in the set for future reference. Your name and address on this stub keeps the customer reminded of you. The remainder is filled out, as shown in the lower drawer, for filing. Samples of Job Record Cards are included with each File.

Order Sylvania Card Index Files through your Sylvania Jobber.

NEW TUBES

Type 6ZY5G Full Wave Rectifier



6-S

Sylvania Type 6ZY5G is a heater type, high vacuum, fullwave rectifier designed especially for use in receivers equipped with low current drain tubes. If a Class B output stage is employed this rectifier is capable of supplying maximum currents up to 40 milliamperes while for straight Class A operation the maximum of 35 milliamperes should not be exceeded.

In order to obtain satisfactory output and regulation careful consideration should be given to secure proper filtering. Filter circuits of the condenser-input or the choke-input type are applicable.

If the d-c resistance from the plate to center-tap of the power transformer is not greater than 225 ohms enough resistance should be inserted in series with each plate to provide this minimum of resistance.

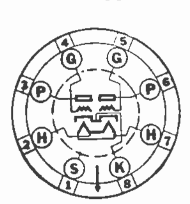
Characteristics

Heater Voltage AC or DC	6.3 Volts
Heater Current	0.3 Ampere
Maximum over-all length	4¼ Inches
Maximum Diameter	1 9/16 Inches
Bulb	ST-12
Base	6 pin octal #6-S

Operating Conditions and Characteristics

Heater Voltage AC or DC	6.3 Volts
A-C Voltage per Plate (RMS)	350 Volts Max.
D-C Output Current	35 Ma. Max.
Peak Inverse Voltage	1000 Volts
Peak Plate Current per Plate	150 Ma.
Voltage between Heater and Cathode	400 Volts DC Max.
Tube Voltage drop (at 35 ma.)	16.5 Volts Approx.

Type 6Z7G Power Amplifier



8-B

Sylvania Type 6Z7G is a complete Class B output tube consisting of two triode units in a single bulb. This tube is designed primarily for use in battery operated receivers utilizing the low heater current tubes.

Type 6Z7G is not recommended for operating in series with other 0.3 ampere tubes directly from power lines because of the danger of heater burn-outs resulting from excessive surge voltages to which the heater may be subjected.

The general circuit applications are conventional with other Class B tubes, such as Types 6Y7G and 79; but in the circuit design, differences in the 6Z7G characteristics should not be overlooked since Type 6Z7G is not directly interchangeable with any other tube types.

Continued on Page Two

NEW TUBES

Continued from Page One

Type 6Z7G Power Amplifier

Characteristics

Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
Maximum over-all Length	4¼ Inches
Maximum Diameter	1 9/16 Inches
Bulb	ST-12
Base	8 pin octal #8-B

Operating Conditions and Characteristics

Heater Voltage	6.3	6.3 Volts
Heater Current	0.3	0.3 Ampere
Plate Voltage	135	180 Volts
Grid Voltage	0	0 Volt
Zero Signal Plate Current per plate	3	4.2 Ma.
Load Resistance (plate to plate)	15,000	20,000 Ohms
Power Output*	1.5	2.2 Watts
Load Resistance (plate to plate)	9,000	12,000 Ohms
Power Output**	2.5	4.2 Watts
Maximum Plate Voltage		180 Volts
Maximum Peak Plate Current (per plate)		60 Ma.
Maximum Average Plate Dissipation		8 Watts

*With average power input of 80 mw. grid to grid.
**With average power input of 320 mw. grid to grid.

A CHAT WITH ROGER WISE

Chief Tube Engineer
Hygrade Sylvania Corporation

The first paper presented at the Summer Seminar held by the Emporium Section of the I. R. E. on June 25-26 was of particular interest to both tube and receiver engineers. It was given by Mr. L. M. Temple of National Carbon on the subject "The Importance of Power Efficiency in Battery Receivers."

Since the power output tube is responsible for a large part of the "B" drain of a receiver, much of the paper was devoted to a comparison of the performance of a number of the newer types of battery output tubes. Types 1F4 (1F5G) and 1E7G, introduced by Hygrade Sylvania during the past year, made possible substantial improvement in B battery life without undue loss in power output. The advantages of Class B operation were stressed, and the efficiency of sets using types 19 or 1J6G was pointed out.

One of the most interesting points mentioned was the fact that a survey among farm users of battery sets indicated that the normal listening level is quite low for power output—perhaps as low as 50 milliwatts. A more widespread recognition of this possibility may result in considerable change in battery set design with lowering of initial receiver cost as well as battery operating costs as a result.

The importance of the farm market to the radio tube manufacturer has long been recognized by Hygrade Sylvania, and much effort devoted to the problem of establishing and maintaining battery tube quality at the highest level. When results with the current production tubes are compared with earlier experiences with more fragile types of battery tubes, the great strides made in development will be apparent. Our present efforts are actively concentrated on still greater improvements.

OSCILLATOR PERFORMANCE IN SUPERHETERODYNES

(Continued from last Issue)

GEORGE C. CONNOR

Autodyne Detectors

In Part I of this series of articles on "Oscillator Performance in Superheterodynes" the vacuum tube as an oscillator was discussed. Part II described methods and problems associated with coupling the oscillator voltage to the first detector; and in this, Part III, the many variations of the self-heterodyne or autodyne detector are explained, in which a single tetrode or pentode tube combines the two functions of oscillator and first detector.

PART III

Autodyne First Detector Combinations

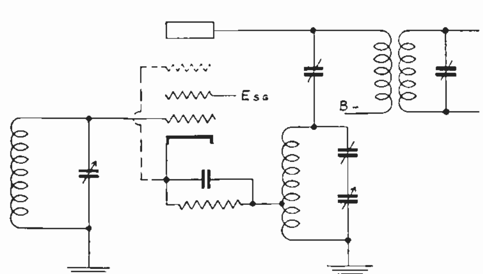
The autodyne reached its greatest popularity and development during the beginning of the depression when a great deal of research work was done on small and inexpensive superheterodynes in which it was necessary to reduce the number of tubes and other parts to a minimum. The greatest impetus to low cost receiver development was, of course, the series heater principle made possible by the 6.3, volt 0.3 ampere tubes perfected and introduced by Sylvania. Prior to the introduction of the 6A7 tube and multi-band receivers, the autodyne detector was used very extensively and a complete knowledge of its mode of operation and adjustment is very necessary to the serviceman.

An r-f type of pentode tube, such as the 6C6 in which three grids are brought out to independent base terminals, can be used in three basic ways as an oscillator. Feedback from the plate circuit to the control grid, screen-grid or suppressor grid will cause the tube to oscillate at a frequency determined by the constants of the circuit elements. In practice the screen grid is not used because of instability caused by operating the screen grid above r-f ground potential, and because of the load imposed on the tuned circuit by the relatively low internal screen to ground impedance within the tube. Therefore for purposes of analysis, we can divide all autodyne detectors into two major groups—the control grid types, in which feedback is between plate and control grid, and the suppressor grid types in which feedback is between plate and suppressor grid. Both of these types for ease of description will be further sub-divided. The tetrode tube cannot, of course, be used as a suppressor grid type autodyne detector.

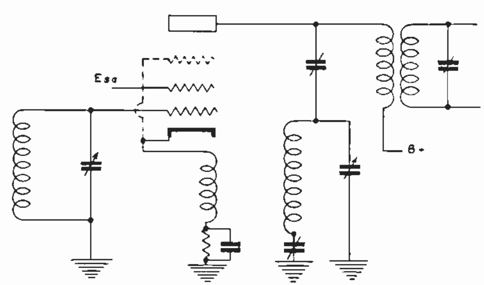
Control Grid Types of Autodyne Detectors

The control-grid type of autodyne detector has been the most popular because of the ease with which proper oscillator amplitude can be secured. (This follows because the mutual conductance between control grid and plate is much higher than that between suppressor grid and plate, and because it can be used with either the tetrode or pentode type of tube construction.)

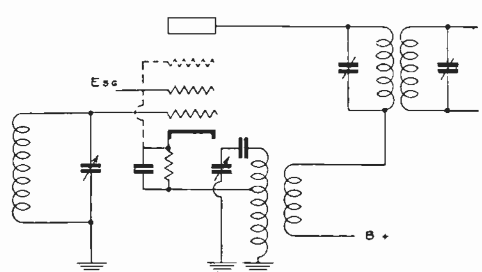
In figures 3A, 3B, 3C, 3D and 3E are shown the three fundamental systems of control grid type of autodyne detector. There are of course many other variations, but these will be found upon analysis to be simple modifications of one of the circuits illustrated. In looking over the five circuits mentioned it will be noted that in each case a coil is shown in the cathode circuit of the tube. **This is a reliable method of determin-**



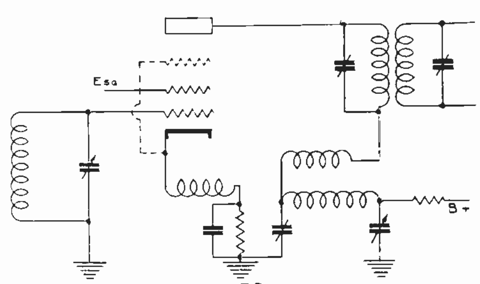
3A



3B



3C



3D

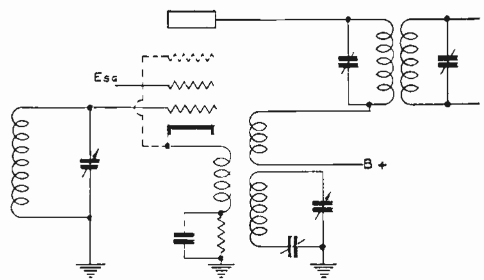
Continued on Next Page

OSCILLATOR PERFORMANCE IN SUPERHETERODYNES

Continued from Page Two

ing that the autodyne under consideration is a control grid type since the suppressor grid type of autodyne detector does not have a coil in the cathode circuit.

The function of the coil in the cathode circuit may not be apparent at first glance. Upon a moment's consideration, however, it will be evident that since all circuits in a vacuum tube



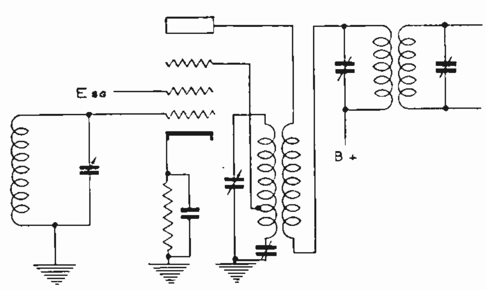
3E

must return to the cathode, a coil in the cathode circuit is common to the control grid, screen grid, suppressor grid and plate circuit and because a given voltage impressed on the control grid will have a much greater effect on the plate current than the same voltage impressed on either of the other grids or the plate, we can ignore the other effects and, for the purpose of this explanation, consider the voltage impressed on the cathode coil as acting exactly as though we had impressed this voltage on the control grid alone. The a-c voltage feedback from the plate circuit at a frequency determined by the L.C. of the circuit, causes the cathode to vary in potential with respect to the control grid which is of course the same effect as varying the control grid voltage with respect to the cathode. Assuming that the coil system has not been damaged and that no other fault exists in the autodyne detector circuit, trouble may be experienced with an improper value of cathode bias resistor. This will show up usually when it is necessary to replace the original tube. It may be found that several tubes must be tried before one can be found that will operate properly. This undesirable condition can usually be corrected by changing the value of the cathode resistor to 10,000 ohms. In general it will be found that this value of resistance will give the most uniform oscillator performance. This bias value is very important to secure the optimum detector sensitivity and uniform oscillator amplitude. In special cases experimenting with various values of cathode resistors may improve the autodyne detector action and make it unnecessary to pick tubes. It must be kept in mind, however, that the value suggested (10,000 ohms) is the best average compromise between uniform oscillator performance, most sensitive detector action and the ability of the detector to handle large local station signals.

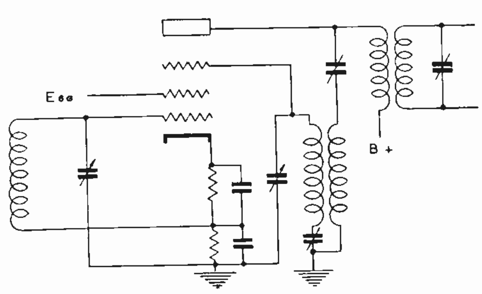
In figure 3A, a single coil is used and a cathode tap is provided which has the same effect as the separate tickler coil shown in figures 3B and 3C. You will note in all five diagrams that no grid leak and condenser is used such as was shown in each oscillator circuit of Parts I and II. These units are not required in the control grid autodyne circuit because the oscillator grid—which is also the signal control grid—must not be driven positive by the peak positive cycle of the oscillator wave (should this occur, the signal input circuit will be seriously loaded and poor sensitivity, selectivity and distorted tone quality will result.) We can consider that the oscillator section of the autodyne detector is functioning like class "A" amplifier, that is the peak signal applied to the control grid (composed of the incoming signal voltage and the oscillator voltage feedback from the plate circuit) must be less at any signal frequency or signal amplitude than the bias appearing across the 10,000 ohm cathode resistor. From this it can be seen that the grid cannot rectify a portion of the oscillator voltage or, in other words, draw grid current such as is necessary for bias purposes in the single tube oscillator or the 6A7 oscillator section (which we will cover in the next issue of Sylvania News) and so a grid leak and condenser are unnecessary. Figures 3A and 3B are examples of the tuned plate, grid tickler types of control grid autodyne. Figure 3C is a tuned grid, plate tickler type and figures 3D and 3E represent the three coil Meissner circuit in which two tickler windings are coupled to a tank circuit.

Suppressor Grid Type of Autodyne Detector

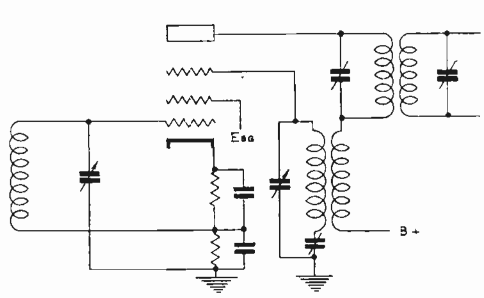
In figures 3F, 3G and 3H are shown three typical examples of the suppressor grid type of autodyne detector. Figure 3F is one of the earliest systems used and has a serious disadvantage in that if a proper bias is secured with the cathode resistor to give good detector action, the mutual conductance of the suppressor grid to plate is so low that it is difficult to secure sufficient oscillator amplitude. On the other hand, if the bias is high enough to give a good suppressor mutual conductance so that the tube will develop a good oscillator voltage, the control grid bias would be so high as to reduce the plate current to such a low value that the system would give very poor gain. There is no satisfactory compromise to eliminate this trouble short of using two resistors in the cathode circuit, such as shown in figures 3G and 3H, so that the control grid and the suppressor grid may each be biased separately. When this is done, we can bias the control grid 3 or 4 volts negative (measured with a high resistance voltmeter from the midpoint of the two resistors to ground) and the suppressor grid from 30 to 34 volts negative (measured with a high resistance voltmeter between cathode and ground) and secure both good detector and good oscillator performance. Figure 3J indicates how



3-F

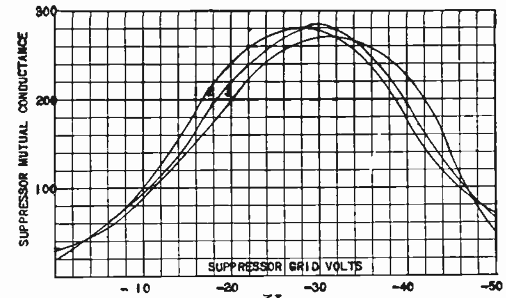


3-G



3H

three good tubes may vary in suppressor grid to plate mutual conductance. Notice that a −15 volts bias on the suppressor grid only one of the tubes would have a high enough mutual conductance to give good oscillator performance whereas at 30 volts all three tubes would work equally well. In adjusting a suppressor grid autodyne, it must be remembered that the developed oscillator voltage will vary through the band and since this in turn varies the plate current (which must of course flow through the cathode circuit resistors) the control grid bias will likewise vary through out the band. It is important that the control grid bias be maintained at a minimum of 2 volts throughout the entire band. If the control grid bias falls below this value, a strong local signal may drive the control grid positive and cause greatly reduced sensitivity, selectivity and poor tone quality. All of the autodyne detector circuits discussed have three limitations. These are 1. low translation gain, 2. limited frequency range (usually the broadcast and police bands only) and 3.



3J

the gain of the autodyne detector cannot be controlled by the A.V.C. voltage. For these reasons, almost all present day receiver designers have abandoned the autodyne detector oscillator combination if favor of the later and superior pentagrid converter type of tube—such as the 2A7, 6A7, 6A8 and 6A8G. In repairing some of the older receivers having critical autodyne circuits, there is much to be said in favor of replacing the tube socket and rewiring the receiver for a pentagrid converter. The theory of operation and method of servicing pentagrid converters will be covered in the next and concluding part of this series appearing in the next issue of the Sylvania News.

NEW IDEAS FOR BENCH AND DISPLAY

Effective Hidden Window Lighting. I have a row of dummy Sylvania cartons across the entire front of my window with 15 watt bulbs hidden in the ends of the cartons. This makes a very effective lighting system as the bulbs are not visible from the outside and it has an element of mystery which seems to stop people.—Kenneth A. Trites, Melrose, Mass.

* * *

File System. Listed below is an outline of a file card used in a file arrangement which overcomes the trouble of hunting through numerous issues of Sylvania News for hints on a particular receiver.

Majestic	(Diagram)	Model 15
No signals	Sylvania News	Vol. 5, No. 9
No signals	Sylvania News	Vol. 6, No. 1
Popping and cracking	Sylvania News	Vol. 6, No. 2
Set dead	Sylvania News	Vol. 6, No. 2
Dead Spots	Sylvania News	Vol. 6, No. 10

On the back of the card is listed the actual position of the tube sockets.

My file cards are 3"x5" in size. They contain all the information I have on a given model, in an itemized list of hints.

J. A. Cape, Jr., Sylvania Radio Service, Atlanta, Georgia.

* * *

Service Bench. To make a good service bench easily, take two Sylvania Stock Boy cabinets and cut off flush with top of drawers. The drawers are used as supports and the top of the bench can be made from ply-wood, prestwood, planks or most anything available. The shelves cut from the cabinets can be used on the back of the bench to hold test equipment, tubes, etc.—Kenneth A. Trites, Melrose, Mass.

THE SERVICE EXCHANGE

THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility with respect to results. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please indicate preference when submitting hints. Don't send routine or generally known information. Please specify tube choice.

Arvin Model 18. These Arvin auto radios often become mushy and lose volume when jarred. The cause is usually due to a .05 mfd. 160 V. condenser; mounted through chassis near power pack, connected from volume control to resistor on end of 2nd i-f transformer. This part is marked C 60, part #17-14600 on Arvin diagram.—Kenneth A. Trites, Melrose, Mass.

* * *

Arvin Model 62. Noisy when tuning dial is rotated. Solder bottom arm on planetary drive system to bracket at bottom front end of condenser gang.—Louis J. Long, Indianapolis, Ind.

* * *

Atwater Kent Model 944. Should this radio lose practically all volume, except a weak signal on strong stations, and if the sensitivity control adjustment has no effect on incoming signals; look for an open 1 megohm resistor connected from the 4 mfd. filter to the grid of a 57 tube. This resistor frequently opens and the trouble is rather difficult to find unless you have experienced trouble of this nature.—L. A. McGregor, Killeen, Texas.

* * *

Bosch Model 60. No pep or intermittent reception in these models has been traced to an open 1 megohn resistor in the detector screen circuit. As there is only a 7-volt screen reading on this tube, it is easy to overlook this defect. Replacing this resistor increases the pep and volume of these sets.—Baer Radio Service, Roslindale, Mass.

* * *

Checking Gassy Tubes. When checking tubes on a tube tester that has a gas test it is advisable to burn each tube about three minutes before the gas test is made. An easy way to do this, if the set is being worked on, is to turn on the set and with all tubes burning take them out one at a time for test. With this method the tubes are warmed up sufficiently for an immediate test. This is vitally important on testing for some abnormal condition such as fading, etc. as a gassy tube, as a general rule, will not show up gassy until it has been warmed up for about three minutes.—Al Anderson, Flagstaff, Ariz.

* * *

Chevrolet Model 985400. Double hump tuning has been experienced with these receivers on strong stations. This can be eliminated by removing the AVC on the first RF tube and applying it to the 6D6 i-f amplifier.—Bernard Kroninger, Oakland, Calif.

* * *

Crosley Model 515. Trouble with fading, but with the entire set checking OK is usually a sign of a defective r-f coil. I have found a number of these models with open coils, which are wound with Litz wire.

Here is something I have found in making repairs of this type. I use a fine sandpaper to remove enamel insulation from the Litz wire. Then I get soldering paste on my fingers and twist the cleaned wires together. This puts paste all around each wire and makes a real soldering job.—Leo W. Brandt, Maybee, Michigan.

* * *

Crosley 706. Warm-up howl, which continues if detector tube is removed but stops if first audio tube is removed can be cured by shunt first audio tube with a 500,000 ohm resistor. Also lower grid resistor of detector to 1 megohm.—W. E. Radio and Electrical Service, Philadelphia, Pa.

* * *

Distributor Noise on Ford V-8. When motor interference is found originating in a Ford V-8 distributor head, it can be eliminated by cleaning the distributor points. Drop a little solder on each of the eight contact points. Turn the motor over by hand, then take off the distributor. This will cut a perfect groove into the solder, and will close up the gap. The condenser used will do away with further interference.—
Baer Radio Service, Roslindale, Mass.

* * *

Ford Philco 1936 Model. A common complaint is loud, deep hum identical with that caused by open filter condensers. If filters check OK, test .25 condenser in grid return of output tube for open.—Norman Maxwell, Clare, Mich.

* * *

Grunow Model 8-A (Chassis Model 801). Weak and distorted reception after replacing filter condensers: be sure to insulate condensers from chassis. If this is not done it kills the speaker field current. The by-pass condenser block and voltage divider are also weak spots in these sets. The voltage divider's high voltage side should be 17,500 ohms and next section from there to ground, 14,700 ohms. Use 10 watt wire wound resistors.—Louis J. Long, Indianapolis, Indiana.

* * *

Kolster Model 70. Noise when first warming up can be stopped by changing the tubes around.

Some models have a 1 mfd. 400 V. condenser across the filter choke. If set does not have one be sure to add one. This will take out hum, increase volume and improve tone.—Kenneth A. Trites, Melrose, Mass.

* * *

Majestic Model 66. When noise from these sets simulates vibrator noise but is not found to be so, and is not easily traced, try replacing the 6Y5 rectifier tube with a Sylvania tube of the same type number. The Sylvania tube is not of the mercury type and therefore, is not susceptible to the disadvantages offered by the original tube, which tends to cause the noise.

When these sets fade out and one notices that the vibrator has ceased to function although the pilot bulb still lights, examine the fuse holders for corrosion.—Robert Eugene Altomare, Washington, D. C.

* * *

Midwest Model 18-36. This and other models employing a large size bell shaped speaker cone, instead of the regulation shaped cone, develop a very annoying buzz on the deep bass notes. This is due to fatigue of the cone and voice coil form. Re-centering and re-shaping of the voice coil will not cure the trouble, due to the fact that the heavy downward pull of the voice coil on the deep bass tones causes the bell shaped part of the cone around the voice coil to be drawn out of shape. This in turn also causes the voice coil to momentarily lose its trueness resulting in the latter rubbing against the center magnet (on the inside) and outer centering hole. This defect can only be detected by removing field coil and housing and observing how bad the voice coil sags when the cone is pressed downward.

To effect a permanent cure first make sure that the voice coil is properly centered. Then, having the correct speaker shims in place between the voice coil and center magnet, apply several coats of speaker cement to the cone, front and rear for about 3 or 4 inches starting at the voice coil, allowing each application to dry thoroughly with shims in place.—Fred B. Honchok, Monessen, Pa.

* * *

Motorola 80-Hum. When played at low volume bad hum and distortion are often present. The resistance of the volume control should be checked. If found defective, the hum can be remedied by replacing the old volume control. Alvin Morgan, Somerset, Ky.

* * *

Overhead Speakers. When repairing auto radios with overhead speakers or speakers that take time to remove, we find it is easy to try the set when repairing by using an ordinary two prong speaker that you have on hand. All that is necessary is a .25 tubular condenser 600V.

Attach one of the prongs to one of the wires of the condenser either by a clip or by soldering. It is immaterial whether you use the positive or the negative wire of the condenser on the above statement. Ground the prong and solder the wire of the condenser to the plate of the power tube. In doing this you will get a clear reception and also save much time.—William Langton, Troy, New York.

* * *

Philco Model 630. High pitched whistle with the volume control about three fourths of the way on, which disappears when the volume control is turned in either direction: look for open condenser (part No. 30-4042 which is numbered 61A in the diagram in Rider's Manual). This condenser is connected from the plate of the 42 to B minus.—Tim W. Shaw, Vernon, Texas.

* * *

Truetone Model 6K. The last issue of the Technical Section contained a Service Hint for noise in the Truetone Model 6K. Since that was published the Truetone Service Department has supplied the following information:

"If noise(not motor or vibrator)is encountered in this model it may be due to the fact that the antenna transformer shield can is not grounding satisfactorily. The noise brought about by this condition is a popping or scratching, and will be heard only when the chassis is bumped or shaken.

This condition can easily be remedied without removing the chassis from the case by inserting a phosphor-bronze spring between the antenna coil can and the chassis bracket. This spring is inserted with a pair of long nose pliers. Although in most cases this spring will not be required each store has them on hand should they be needed."–Truetone Service Department.

* * *

U. S. Apex Model 7. A common defect is intermittent reception on the low frequency end of the dial, perfect otherwise. Filter condensers will check OK on leakage test but capacity will be low. Measure capacity or try adding another condenser. This will entirely cure this somewhat baffling trouble.—Kenneth A. Trites, Melrose, Mass.

* * *

Whip Aerials. When installing one of the new Ford "Whip aerials" for use on any other set except the Ford radio it is designed for, disconnect the matching transformer which is located in the header board. A small bare wire will be found inside the shielded loom which is fastened to a terminal on the transformer can. Disconnect this and fasten it direct to the lead coming from the aerial; this should not have any connection to the aerial transformer at all, so be sure it is taken off the terminal as originally fastened. If the set has an aerial compensator adjustment, be sure to adjust this.—Al Anderson, Flagstaff, Ariz.

* * *

Wurlitzer 312 Automatic Phonograph. When abnormal hum is encountered,try changing the 1B5/25S tube before tearing into the filter pack. A Sylvania 1B5/25S has been found to be hum free in this position.—Al Anderson, Flagstaff, Ariz.

* * *

Zenith 52. If this set oscillates badly, although gang is bolted tight, add jumpers from rotar wipers to ground and from center gang shield to ground.—W. E. Radio and Electric Service, Philadelphia, Pa.

* * *

Zenith 230-245 Motorboating. Motorboating is caused by insufficient filter. This can be cured by adding a 4 mfd. condenser to the filter circuit. This also will reduce the hum level.—Alvin Morgan, Somerset, Ky.

SYLVANIA NEWS

TECHNICAL SECTION

Vol. 7 EMPORIUM, PENNA. No. 3

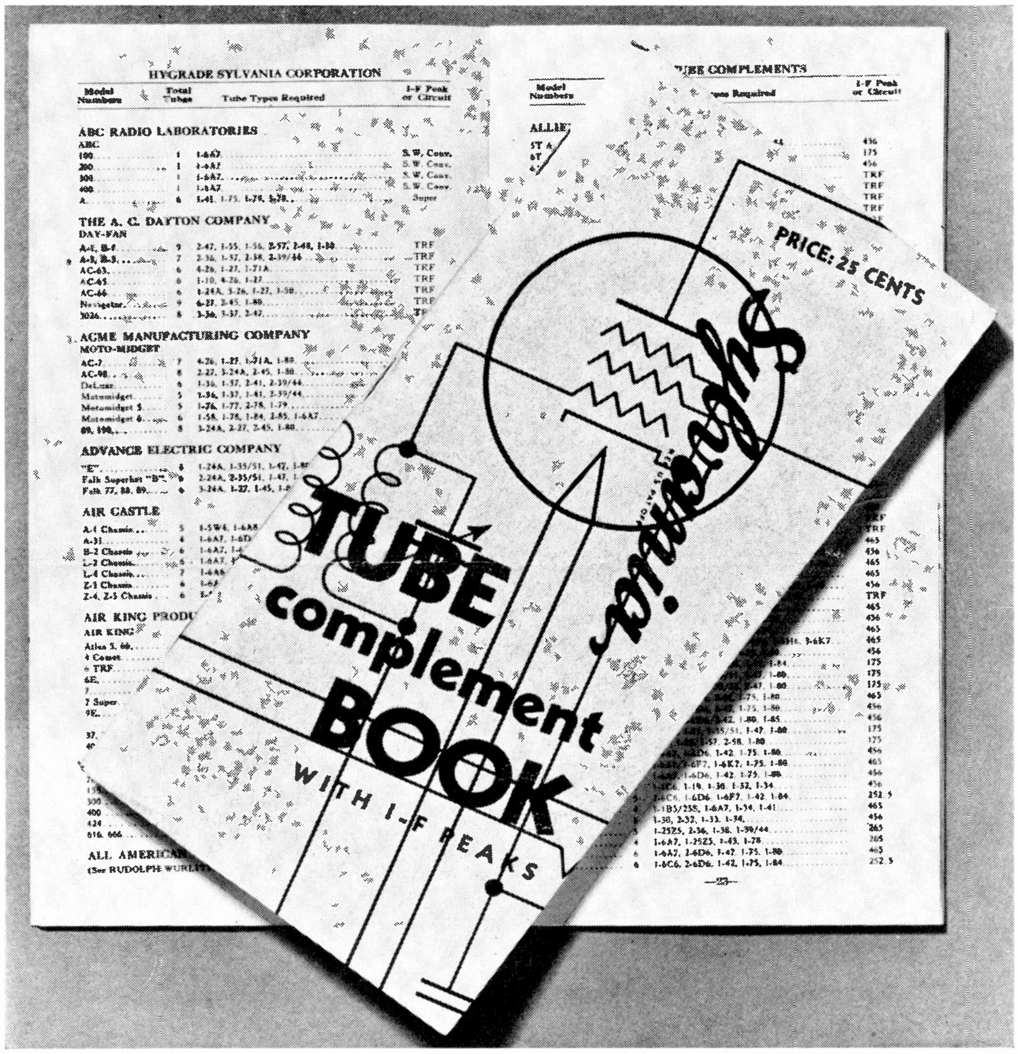
TUBE COMPLEMENTS FOR ANY SET

How much valuable time would you save if you had a pocket-size book in which you could find tube complements for practically any radio set now in use? How often do you cuss because you don't know where to find information about an old model?

Nuf said! We have the book—to our knowledge the only one of its kind in existence, and the fruit of many months of research. In it are listed tube complements for 10,386 receiver models, made by 259 manufacturers. With the exception of a few "orphans", it includes every set still able to bring in signals, right up to and including many of the new 1938 models. It contains information on replacing tubes in approximately 75,000 sockets, and the largest and most complete compilation of i-f peaks available.

It gives you trade names ("Skylark" "Radiokeg", etc.) of 560 sets, with the names of the manufacturers. It gives you the names and complete business addresses of 144 set manufacturers now actively in business. It contains many helpful articles on such subjects as alignment, substituting new tubes for old types, tube testers, panel and dial light bulbs, and interchangeable tube data.

Would this book be worth dollars to you? It's yours for two bits—25c. Order it through your Sylvania jobber, or use the coupon in main section.



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Pep Up for Fall Profits

See Pages 2 and 3

Main Section for

Sales and Technical

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Servicemen on Coin-Operated Machines

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OSCILLATOR PERFORMANCE IN SUPERHETERODYNES

(Continued from last Issue)

GEORGE C. CONNOR

Pentagrid Converters

This is the concluding article in the series entitled "Oscillator Performance in Superheterodynes." The operation of a well designed pentagrid converter stage is so dependable, and the number of circuit components required so few, that it is easy to gain the mistaken impression that if the performance of this stage is unsatisfactory the trouble must be due to the tube. This remark is not intended as absolving the tube of all responsibility, since it is realized that the pentagrid converter is harder worked than any other tube in the receiver with the possible exception of the power tube, but rather to point out at the beginning that making a set work by replacing the pentagrid converter tube—only to have the set again quit operating one to four months later—cannot be considered a reliable method of service procedure. To guarantee service work the serviceman must be satisfied that the method he has employed to correct the trouble really effects a permanent cure, and does not just supply a crutch that permits the circuit to limp along under a heavy handicap of power loss or unfavorable circuit adjustment.

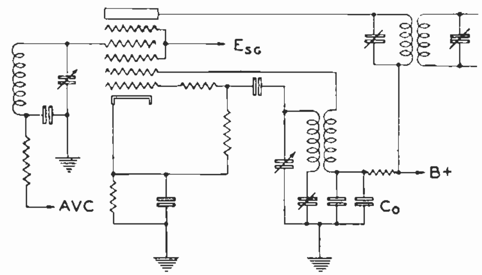
We found in the previous types of oscillator circuits discussed that the set engineer designed the oscillator circuit to give the best compromise between several conflicting considerations—the same thing is true of the pentagrid converter circuits. An intelligent appreciation of these factors, their theory, cause and cure will make service work much easier and certainly, by eliminating some of the return calls, more profitable.

PART IV
Pentagrid Converter Theory

SYLVANIA tube types 1A6, 1C6, 1D7G, 1C7G, 2A7, 6A7, 6A8, 6A8G, and 6D8G are all pentagrid converters designed to function as a combined first detector and oscillator to "convert" the incoming signal frequency to an intermediate for the purpose of securing selectivity and sensitivity without fear of interlocking and tetrode section grid current. The word "pentagrid" is a compound word made up of the Greek prefix "Pente" (or "penta" in the English translation) meaning five, and grid—literally, 5-grid. These five grids, numbering from the cathode, are: 1. the oscillator control grid, 2. the oscillator anode, 3. the inner screen grid, 4. the signal control grid, and 5. the outer screen grid. There are of course beside these grids a heater or filament, plate and, in the indirectly heated tubes, a cathode. Grids 3 and 5 are connected together inside the tube. Grid #2, the oscillator anode, is made in current practice without horizontal wires and consists only of the two side rods. These two side rods are called the oscillator anode (meaning plate) but in circuit diagrams are shown schematically as a grid for simplicity.

The pentagrid converter may be considered as operating very much like a conventional variable mu tetrode first detector with an associated triode oscillator, except that the oscillator triode grid is located next to the cathode and is common to both the first detector variable-mu tetrode and the oscillator triode. The tetrode section of the tube is modulated by the control grid voltage on the oscillator triode in such a manner that there is no danger of driving the control grid of the tetrode positive. Electrons emitted from the cathode surface are influenced by the various grid and plate voltages and divide up so that grid #1 receives 7 per cent of the electrons, the oscillator anode receives 37 per cent of electrons, grids 3 and 5 (screen grid) receive 28 per cent of the electrons, and the plate receives the remaining 28 per cent.

Because of the oscillator grid's strategic position next to the cathode, any oscillator voltage on this grid will modulate the entire electron stream regardless of the ultimate destination of the electrons. Referring to diagram 4A, it is interesting to observe the action that takes place within the tube when it and the associated circuit components are operating normally.



4-A

When the set is first turned on, the #1 grid is at zero potential because it is tied to the cathode by the 50,000 ohm grid leak. As the cathode heats up and starts to emit electrons, the feedback between oscillator anode and grid causes regeneration which immediately starts the triode circuit to oscillating. When the oscillator circuit is oscillating, the #1 grid is driven alternatingly positive and negative. While the grid is positive, grid current flows through the grid leak in such a direction as to make the #1 grid negative with respect to the cathode. This grid swing may make the grid negative by as much as 30 to 40 volts, and this becomes the grid bias point about which the grid varies in amplitude alternately in a positive and then a negative direction under the influence of plate circuit feedback. From this it can be seen that the maximum instantaneous negative voltage on the #1 grid may be 60 to 80 volts. This voltage would ordinarily be more than sufficient to reduce the tetrode plate current to zero were it not for a secondary source of electrons available to the #4 grid. This second electron source is referred to as a virtual cathode because it is employed exactly as though it were another electron emitting cathode. The reason for its existence is that most of the cathode's supply of electrons go through the #1 grid while it has a positive or slight negative charge, and are accelerated out of the #1 grid's field of influence by the relatively high positive potential on the #3 grid. The next grid—tetrode section control grid—has at all times a negative bias on it so that a great many of these electrons are slowed down and form a cloud of electrons between the #3 and #4 grid. It is from this cloud of electrons (virtual cathode) that most of the plate current is secured during that portion of a cycle that the #1 grid is at its maximum negative potential. It is easy to see from this action that the tetrode section works independent of the triode section, except that the tetrode plate current is modulated by the triode grid voltage. The #3 grid shields the triode section from the tetrode section and prevents interaction. The tetrode grid #4 is shielded from the plate by the other screen grid #5. Grids 3 and 5 are connected together inside the tube. Automatic volume control bias may be applied to the tetrode section without affecting the performance of the oscillator section, since the oscillator triode secures its plate current first direct from the cathode.

OSCILLATOR COIL COUPLING

The value of heterodyning voltage developed by the triode section of the tube is largely determined by the degree of coupling between the tank or grid circuit, and the tickler or plate circuit. On the long wave band 150 to 350 kc. and to a lesser extent on the broadcast band little trouble is encountered in securing sufficient coupling. In fact, care must be taken to prevent too much feedback in order to avoid causing the tube to oscillate so strong that parasitic oscillation will result. By "parasitic" oscillation is meant the generation of extraneous frequencies, besides the fundamental desired, that are usually higher in frequency than the fundamental. These usually occur at the high frequency end of the band and may make the receiver sound as though some other part of the receiver system were oscillating. This condition may be difficult to trace to its source if the true reason for its existence is not suspected, because any change in circuit constants that affects the voltages on the various elements of the pentagrid converter will change the frequency or amplitude or both of its characteristics. The proper cure for this trouble is to either space the two coils farther apart or reduce the number of turns on the tickler winding—the latter method is preferable because it has the least effect on the tracking of the oscillator since very little change is made in the capacity to ground of the tank circuit. This change may be necessary on the long wave and broadcast band of sets that were manufactured shortly after the 2A7 and 6A7 were introduced, because it was found necessary to increase the triode section mutual conductance of these tubes in order to provide satisfactory operation on the short wave receivers that were just becoming popular at that time. The first sign of this condition will occur when a new tube is used to replace the one originally supplied with the receiver. If the receiver is designed for broadcast only, any trace of parasitic oscillation may be eliminated by connecting a 500 to 1000 ohm resistor from the oscillator grid terminal of the socket to the common point of the grid leak and condenser as shown in figure 4-A. This suppressor resistor will tend to equalize the developed oscillator voltage over the broadcast band. It should not be used on receivers having short wave bands. The reason for this is that it is almost impossible to secure too much coupling between oscillator coils on the higher frequencies. This problem is just the reverse of that encountered on broadcast and long wave bands. Here every effort is made to secure the greatest mutual inductance between the two coils so that the developed oscillator voltage will be as great as possible. The problem is even more acute on those receivers that use a large capacity tuning condenser to secure the greatest frequency coverage on each band, since it is usually true that the greater the band width covered the lower the oscillator voltage will be and hence the lower the converter stage gained. For the high frequency bands the tickler and tank coils are placed very close together and often the two windings are interwound to secure the maximum possible coupling. When the maximum band width is to be covered, stray capacities must be kept at a minimum, and in order to reduce the coil distributed capacity to minimum only a few turns of the tickler can be interwound with the low potential end of the tank coil. This necessitates a compromise between developed oscillator voltage and the band width that can be covered. A practical compromise is to adjust the oscillator voltage (by means of the coupling between tickler and

Continued on Page Four

THE SERVICE EXCHANGE

THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility with respect to results. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please indicate preference when submitting hints. Don't send routine or generally known information. Please specify tube choice.

Atwater-Kent Model Q Chassis. 7 Tube Battery Set. Audio howl is often due to an unbalanced push-pull input transformer secondary. To eliminate this howl, shunt the secondary with a 150,000 ohm resistor and also shunt the first a-f transformer secondary with about 100,000 to 120,000 ohms. This will improve tone immensely with very little decrease in volume. A method of ascertaining for certain, an unbalanced push-pull transformer, is to connect one terminal of a regular magnetic speaker to the positive speaker supply terminal on the speaker socket and the other terminal alternately to each power tube plate. Clear tone will result from one plate, whereas distortion and audio howl will be heard from the other plate.

This hint can of course apply to any set having a push-pull circuit.—Norman E. Nelson, Clifford, N. D.

* * *

Atwater-Kent Models 70, 74, 75 and 76 Types L, F, F, Q and D Chassis. Oscillation at certain spots of the dial is caused by the dial rubber being worn so as to cause the dial gear to climb and pull the gang condenser rotors out of alignment. Tightening of all rotor spring clips isn't enough to prevent this. A permanent cure is made by installing a rubber grommet (cut in two with a steel washer on each side) on the round pin fastened to the large dial gear placing it between the dial gear and the pointer control arm.—Norman E. Nelson, Clifford, N. D.

* * *

Crosley Model 517T. Distortion seemingly due to open filter is caused by the 16 mfd. filter can. In these sets it is insulated from the chassis by means of two washers. The condenser is located in the rear center of the chassis and is handy for holding the chassis when moving the radio and hence it is misused and slips just enough to short the can to ground causing distortion. Re-center the can in the hole and tighten—Radio Service, Baltimore, Md.

* * *

Connecting Output Transformers. When installing universal type output transformers, the proper tap connection is often a matter of guesswork unless the speaker impedance is definitely known. The correct tap can be determined by means of the a-c bridge and an audio oscillator. At first glance the engineer might frown upon this idea but a little thought or experience will show that practical results can readily be obtained.

The transformer (with speaker connected to its secondary) is inserted in the "X" arm of the bridge and is balanced against the bridge's resistance standard using a frequency of 300 or 400 cycles.

It will not be possible to obtain an exact balance since the speaker will not present a pure resistive impedance. However, its impedance will be so nearly resistive at the above frequencies that by varying the transformer taps, a point will quickly be reached which will show a close balance to the desired impedance (to which the bridge is set).

Since output transformers are designed to give all the necessary impedances with the general run of speakers, the tap which shows the closest match in the above procedure will be the correct tap.—George H. Koether, Jr., Round Bay, Maryland.

* * *

General Motors Model 251. To prevent cross-modulation from very strong nearby stations in this model, install a shielded lead from the antenna post to the antenna coil. Also switch the lead from the antenna coil to the lug next to the coil, and use the old antenna coil lug to connect the oscillator condenser.—Anderson Radio Hospital, N. B. Anderson, Seattle, Wash.

Gulbransen Models 200, 291, 292, 295, 9950. Leads from Coils on power transformer are attached to lugs riveted to posts on terminal plate. Complaints of fading and weak reception may be due to poor contacts of rivets. Solder each lug to its post for permanent cure.–Anderson Radio Hospital, N. B. Anderson, Seattle, Wash.

* * *

Kennedy 670 Auto Set. Only three or four stations across the entire dial and all tune very broad, and cannot be separated from each other. Check the second i-f transformer secondary, which feeds diode plates of the second detector. This particular winding opens and seems to be a common fault. I-F replacement can be obtained from Belmont Radio Corp., Chicago.—Louis J. Long, Indianapolis, Ind.

* * *

Line Noise. A careful check of the basement house wiring often shows that the BX cable is ungrounded. In many spots this cable passes near pipes. Walking on certain parts of flooring causes slight vibration of the beams on which the cable is nailed. This causes noises which are very disturbing in the radio. Grounding the BX cable securely to drain pipe will cure all the trouble.—Al Sorgenfrei. St. Louis, Mo.

* * *

Majestic Auto Set Model 66. When working on this set do not replace the grid caps on the 89 output tube and the 6C7 first audio stage in the wrong order. Unless this is guarded against it is the most natural connection since these leads must be **crossed** for proper results. Otherwise the first a-f stage will be cut out causing very weak response with everything apparently in good order.—George H. Koether, Jr., Round Bay, Maryland.

* * *

Philco Model 70. If this receiver develops oscillation that cannot be eliminated with the usual methods, bypass the filaments of the r-f and i-f tubes to ground using a bypass condenser .005 to .25 mfd. The exact value is best determined by experiment.—Harold Clark, North Plainfield, N. J.

* * *

Philco Model 97 (Temporary Repair). Complaint is unusually high interstation noise. Trouble is usually due to a leaky winding in the r-f transformer feeding the plate of the r-f tube. With a station tuned in the noise is hardly perceptible, but off station, with a-v-c not functioning, the noise level is terrific. Temporary repair to give customer use of his set can be effected by winding a layer of tape over the secondary of the broadcast section of the coil. Then wind six turns of 22 gauge wire on the tape, directly over the secondary, cut out the defective primary and connect the new winding in its place.

The sensitivity is impaired but little and the noise ceases. The only drawback is a slight broadness of tuning most noticed on the lower end of the band due to close coupling. Incidently the shortwave bands are not affected by the new winding. The defective winding being the broadcast band primary, of course. This kink can also be used on any set using the same general type of coil.—P. K. Pate, Atlanta, Ga.

* * *

Philco Model 71. A frequent complaint is that this set cuts out on strong local stations and lower powered stations can be heard weakly in the background. The trouble is usually in the oscillator of the set. Changing the autodyne oscillator bias resistor from 15,000 to 10,000 ohms is the cure.—Al Sorgenfrei, St. Louis, Mo.

* * *

Radiola R-11. If this set is found to have an open primary winding in the audio transformer between the 27 detector and the push-pull 47 output stage, disconnect the primary leads and connect a 40,000 ohm resistor between the points from which the leads were removed. Also connect a 0.1 microfarad condenser between the high end of the 40,000 ohm resistor and the grid of one of the 47's.

This method of connection gives a voltage step up of 2:1 which is the same as the transformer ratio, and due to the low value of plate current in the 27 detector, the voltage drop across the 40,000 ohm resistor is very low. Thus, the performance of the set is the same as with a new transformer.—Ralph T. Morgan, Jr., Springfield, Pa.

* * *

Rubber Insulation. I have found that for an extremely high grade insulation and new rubber for phono "pick up" hoods, nothing surpasses the thin sheet rubber known as "dental dam." It is obtainable from dental supply houses in strips about 6 inches wide. By coating with rubber cement it can be laminated or rolled to any thickness.—H. B. Reynolds Radio and Equipment Laboratory, Oneida, New York.

* * *

RCA Model R-55. Fading in these models is almost invariably caused by the .0024 mfd. condenser across the plate and cathode of the a-v-c, developing leakage or opening.

It is often advisable to replace the 27 a-v-c tube with a Sylvania type 56 which draws less filament current.

Fading in these models is also caused by a high leakage condenser by-passing the control grid return of the a-v-c tube (this is located in the power pack).—Robert E. Altomare, Washington, D. C.

* * *

Simplex Model D A. I have found a number of these sets with the i-f coils open from moisture. To repair, carefully remove coil, unwind about two layers of the inside winding holding wire in either hand. Pull gently and insulating will part at break. Repair form with cement, replace coil and realign set.—Lester Wycoff, Radio Service, Marmaduke, Arkansas.

* * *

Zenith Model 52. In these models, the interstage transformer becomes defective. Disconnect the primary and secondary leads and check for leakage between them, that is, between the primary and the secondary. Usually either a high resistance short or a low resistance leak will be found. A replacement of the transformer is necessary.

A temporary repair may be effected if one side of the primary is open by eliminating the open half, and one of the 27 tubes used in the first a-f. —Robert E. Altomare, Washington, D. C.

WANTED

Service Hints on coin-operated phonographs. Win a steel card index file. **See page 1, this section.**

ANY OLD TUBE WON'T DO

We are interested in helping servicemen to develop every opportunity for more business. Recent development of the coin-operated phonograph indicates a promising new field, with certain technical and servicing problems of its own. Tubes used in this equipment must be carefully selected for both performance and long life. By permission of Coin Machine Journal we reprint the following article, which offers an excellent explanation of these requirements.

Some fellow, writing not long ago, said that he was at the point in life where he realized that only "God could make a tooth."

There is one thing in automatic phonographs that the operator seldom ever sees that is as vital to its success as one's own molars, and that is the tubes.

Tubes are so efficient that if hooked up to the proper wiring, one rarely has occasion to know that they are part of the machine. Yet when one goes wrong the operator realizes, how important they are. When a tube goes the phonograph stops or its reproduction is of such a quality that the tube must be replaced to function normally. Since phonographs came back along with repeal there has been very little need for tube replacements until now when the aggregate number of units in operation has reached the point that the total volume of tube replacements is now a sizeable figure. Operators, and service departments are having to give more attention to this problem. Unless servicemen know exactly what they are doing, they may exchange the wrong tubes and impair the quality of reproduction. Every serviceman should have a diagram of the wiring of each model and should know something about what this wiring means.

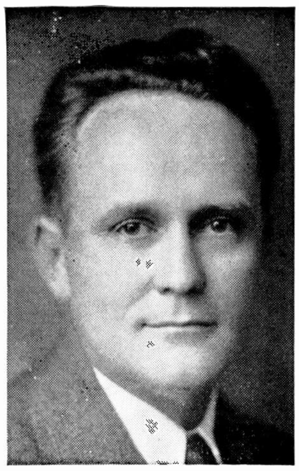
In the first place, one pulls current from the power line through the wall socket. This is split into two uses, one for permanent light on the machine and to turn the motor. The other to furnish the power for amplification of the pickup. For that reason, there are two or three kinds of tubes in a machine. All the tubes do is pick up sound and distribute it into whatever direction one desires. Still, one could pick up sound with tubes and they could not broadcast. Hence the use of amplifier tubes.

Manufacturers of phonographs have taken great care to design their hookups to get the finest reproduction possible. Everything is scientifically correct and the tubes selected from the best known manufacturers under properly licensed patents. Yet, there are a great many cheap tubes on the market and operators should beware of inferior products. The record companies have worked with manufacturers and produced records that carry the finest tones, tone qualities that formerly were impossible for reproduction on mechanical instruments. Today through the use of tubes and frequencies the best symphonic music or the cleverest novelty music is pressed into a record and regenerated for audition on location.

Not satisfied with all these precautions, manufacturers have developed cabinets that give proper resonance and tone carrying value.

When organizations the size of those producing phonographs today and the big record companies go to such pains to make fine recordings and machines to reproduce them the operator is only being fair to himself by replacing worn out tubes, or any other equipment for that matter, with the finest he can obtain.

A CHAT WITH ROGER WISE



Chief Tube Engineer
Hygrade Sylvania Corporation

Recent changes made in some battery tube types have been a source of confusion in the renewal trade. Types such as 1A4, 1B4, and the corresponding octal base tubes, 1D5G, 1E5G, were originally introduced in tetrode construction. Later, interest developed in the operation of these tubes with battery voltages of 90 volts or lower. With such low voltage operation it became desirable to operate the plate and screen at the full B voltage available, making it necessary to incorporate a suppressor grid in the tube to avoid impairment of characteristics. This additional grid, of course, would make the construction pentode instead of tetrode.

At the time this matter was under consideration it seemed perfectly feasible to change the tubes without changing the type number, thus avoiding the addition of four type numbers. The change-over took more time than was expected, and during this time a number of receivers were manufactured with neutralization provided, using the tetrode tubes. The neutralizing effect was obtained from the screen grid. The introduction of a suppressor between the screen and plate impaired the neutralization, and this affected the operation of such receivers adversely. On the other hand, the older tetrode tubes, those without the suppressor, cannot be used in receivers operated on 90 volts or less except where the screen voltage has been dropped by means of a battery tap to a voltage well below that of the plate.

Fortunately, in the case of the sharp cut-off tubes—types 1B4 and 1E5G—no difficulty is experienced in using the pentode construction. It will, therefore, be possible to supply all tubes of these two types in pentode construction only, in the future and to use such tubes for renewal in all older sets. For convenience, tube manufacturers are designating these types as "1B4P" and "1E5GP". In case the question arises as to whether it is possible to use the original tetrode 1B4 and 1E5G for renewal in a given set, that question can be answered by noting the relative voltage applied to screen and plate. If the screen voltage is dropped the tetrode construction will operate satisfactorily.

As far as 1A4 and 1D5G are concerned, it is necessary to differentiate between the constructions by marking the tubes which are provided with a suppressor and are, therefore, pentodes, with the subscript "P"—namely, 1A4P and 1D5GP. Tubes bearing this marking are required for receivers having low battery voltage and may also be used in older receivers unless screen neutralization has been used. In this case the tubes of the original tetrode construction and marked "1A4T" or "1D5GT" must be provided.

Dealers and servicemen can decide which types of tubes in the above group should be stocked by noting whether any of their customers have sets which are critical or not. In case all the receivers in their territories are of more conventional design and do not employ either screen neutralization or low B battery voltage, no attention need be paid to the marking on the tubes as they will operate interchangeably, as originally intended. Thus, in a non-critical receiver type 1A4, 1A4P or 1A4T and 1D5G, 1D5GP or 1D5GT will operate interchangeably, as will any of these other tubes in the same group. (As, for instance, 1B4, 1B4P or 1B4T and 1E5G, 1E5GP or 1E5GT.)

Summarizing the above, the subscript markings on sharp cut-off tubes of the 1B4 and 1E5G types may, in general, be disregarded and the tubes used interchangeably. The remote cut-off types must be carried in both styles to be sure of meeting all of the customers' requirements.

OSCILLATOR PERFORMANCE IN SUPERHETERODYNES

Continued from Page Two

tank coils) to give about .1 ma. grid current through the oscillator grid leak and at the low frequency end of the short wave band and then reduce wiring and circuit capacities to give the greatest spread between the minimum and maximum frequencies that can be secured with the variable condenser being used. In the absence of a vacuum tube voltmeter, this method is the most reliable method of determining the developed oscillator voltage. Connect a 0-1 ma. meter in series between cathode and 50,000 ohm grid leak so that d-c current flowing through the resistor will indicate on the meter. The oscillator a-c voltage is then equal to the current multiplied by the resistance of the grid leak. For A.C.-D.C. receivers this current may vary between .05 ma. and .25 ma. depending upon the frequency at which the oscillator is set. The minimum current will flow at the low frequency end of the highest frequency band and the maximum current will be around 1200 to 1600 kc in the broadcast band. For a-c receivers this grid current will vary from .1 to .75 ma. If the oscillator stops oscillating at the low frequency end of the short wave band and the suggestions mentioned under "Grid Blocking Condenser*" and "Grid Leak Resistor*" do not eliminate this trouble, the coupling between tank and tickler coils should be increased. Usually it will not be possible to add more than one or two turns to the tickler coil to effect this increase in coupling or the tickler coil will resonate within the band and cause trouble. If this increase is insufficient to correct the difficulty make sure the coil is dry and that the "B" supply voltage is normal, then push the two coils as close together as possible and accept the slight loss in band coverage that will result. Such drastic action is seldom necessary unless new replacement coils are unobtainable for the set. Varying the size of the grid blocking condenser will often prove effective in increasing the developed oscillator voltage.

*See Next Issue

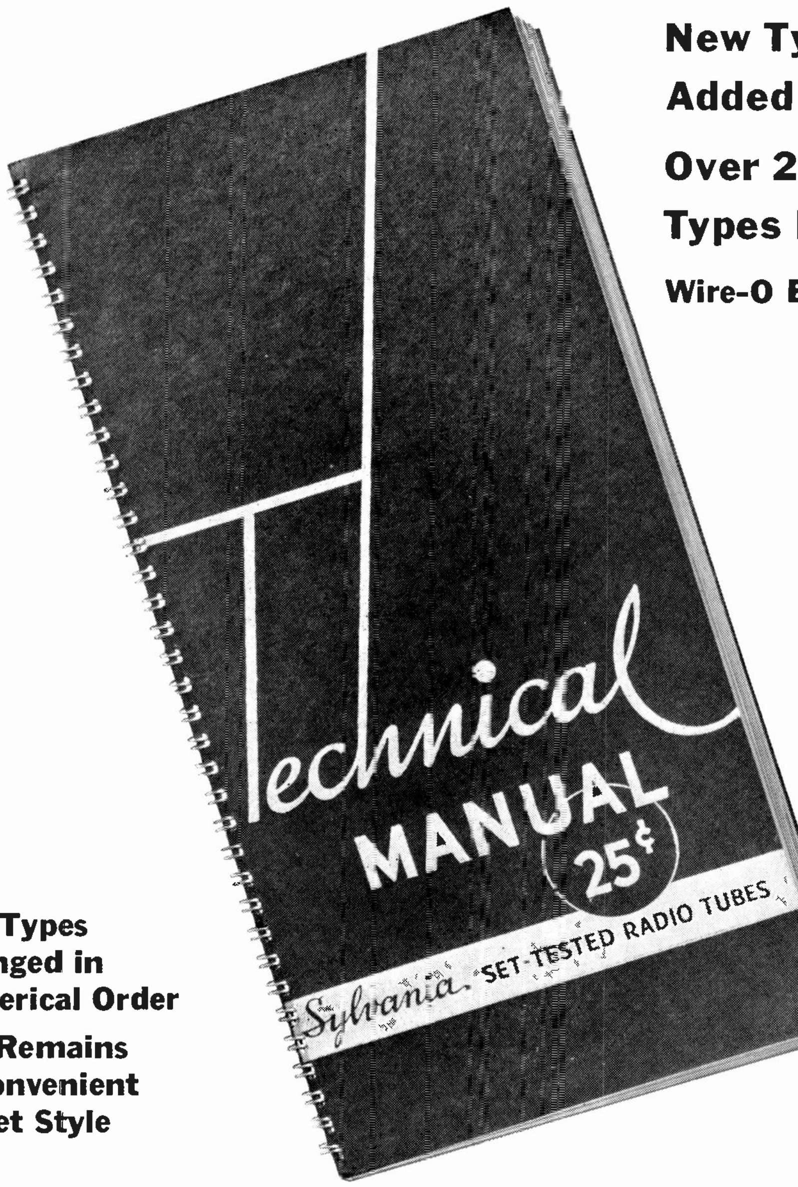
(Concluded in Next Issue)

SYLVANIA NEWS

TECHNICAL SECTION

October, 1937 EMPORIUM, PENNA. Vol. 7, No. 4

Technical Manual Brought Up-to-Date



New Types Added

Over 200 Types Listed

Wire-O Binding

"G" Types Arranged in Numerical Order

Size Remains In Convenient Pocket Style

If you've ever wished for a third hand to keep your place in a manual while the other two hands are busy on a job, you'll appreciate the new Wire-O binding of the latest edition of the well-known Sylvania Technical Manual. It lies flat wherever it is opened.

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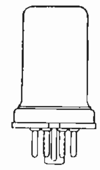
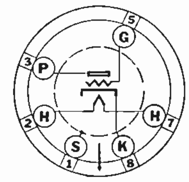
NEW TUBES



Type 6J5 Triode Amplifier



6-Q

Type 6J5 is an all-metal general purpose triode tube enclosed in a new style metal bulb. This new tube may be used in circuits of conventional design as an amplifier, detector, or oscillator. In general, the applications and operating conditions will parallel those for such tubes as types 6J5G, 6C5, 6C5G, 37 and 76.

This new tube is very similar to the 6J5G except for a slight difference in capacitances. Like the 6J5G there is a substantial increase in mutual conductance with a corresponding decrease in plate impedance over previous triodes of this design. The output capacity and the tube design is such that this tube should be especially applicable in high frequency equipment.

When operated with a plate supply voltage of 250 volts and a plate load resistor of 50,000 ohms the 6J5 should have a negative grid bias of minus 5.5 volts (cathode bias resistor of 2300 ohms). When the plate supply voltage is 100 volts and the load resistor is 30,000 ohms the bias should be minus 2.3 volts (cathode bias resistor of 1500 ohms).

Characteristics

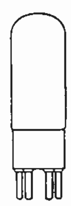
Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
Maximum Over-all Length	2⅝ Inches
Maximum Diameter	1 5/16 Inches
Bulb	Metal
Base	6-Pin Octal No. 6-Q
Grid to Plate	3.4 $\mu\mu f$
Input	3.4 $\mu\mu f$
Output	3.6 $\mu\mu f$

Operating Conditions and Characteristics

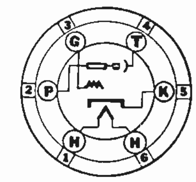
Class A Amplifier

Heater Voltage	6.3 Volts
Plate Voltage	250 Volts
Grid Voltage*	−8 Volts
Plate Current*	9.0 Ma.
Plate Resistance	7700 Ohms (Approx.)
Mutual Conductance	2600 μmhos (Approx.)
Amplification Factor	20

*These are rating values only and not operating points with coupling resistor. See "Circuit Application."



Type 6U5 Tuning Indicator



6-R

Type 6U5 is a tuning indicator tube having characteristics identical with those of 6G5, but with the mount enclosed in a T-9 bulb. The circuit applications parallel those for type 6G5 so that in circuit use the varying negative voltage for controlling the shadow may be obtained from some point in the a-v-c system. Like the 6G5 action, indication of resonance is noted when the unlighted portion of the target is at a minimum.

Continued on Page Two

NEW TUBES

Continued from Page One

Type 6U5 Tuning Indicator

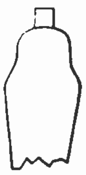
Characteristics

Heater Voltage	6.3 Volts
Heater Current	0.3 Ampere
Maximum Overall Length	4⅛ Inches
Maximum Diameter	1⁹⁄₁₆ Inches
Bulb	T-9
Base	Small 6 Pin No. 6-R

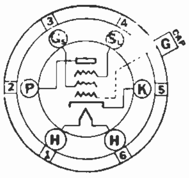
Operating Conditions and Characteristics

Heater Voltage	6.3	6.3 Volts
Plate Supply Voltage	100	250 Volts
Target Supply Voltage	100	250 Volts
Plate Current (Triode Unit)*	0.2	0.24 Ma. Max.
Target Current (Approx.)	2.0	3.0 Ma.
Grid Voltage (Triode Unit)#	0.0	0.0 Volts
Grid Voltage (Triode Unit)##	-8.0	-22.0 Volts
Triode Plate Resistor	0.5	1.0 Megohm

*With triode grid voltage of zero volts.
#For shadow angle of approximately 90 degrees.
##For shadow angle of approximately zero degrees.



Type 1221 Special Non-Microphonic Pentode



Sylvania type 1221 is a sharp cut-off pentode with low microphonic response. It is identical in characteristics to type 6C6 and has the same base pin arrangements. Because of special design features this new tube is recommended especially for use where a tube of low microphonic response is necessary.

Characteristics

Heater Voltage AC or DC	6.3 Volts
Heater Current	0.3 Ampere

Direct Interelectrode Capacitances

Grid to plate (with tube shield)	0.010 μμf Max.
Input	5.0 μμf
Output	6.5 μμf
Maximum Over-all Length	4¹⁵⁄₁₆ Inches
Maximum Diameter	1⁹⁄₁₆ Inches
Bulb	ST-12
Cap	Small Metal
Base	Small 6-Pin 6-F

Operating Conditions and Characteristics:

AMPLIFIER

	Triode	Pentode	
Heater Voltage	6.3	6.3	6.3 Volts
Plate Voltage	250	100	250 Max. Volts
Grid Voltage	-8	-3	-3 Volts
Screen Voltage		100	100 Max. Volts
Suppressor		Tie to Cathode	
Plate Current	6.5	2.0	2.0 Ma.
Screen Current		0.5	0.5 Ma.
Plate Resistance	0.01	1.0	1.5 Min. Megohms
Mutual Conductance	1900	1185	1225 μmhos
Amplification Factor	20	1185	1500 Min.

Operating Conditions as Biased Detector

DETECTOR

Heater Voltage	6.3	6.3 Volts
Plate Voltage	100	250 Volts Max.
Grid Voltage	-1.8	-4.3 Volts Approx.
Screen Voltage	30	100 Volts Max.

Plate Load—250,000 ohms or 500 h. choke shunted by 0.25 megohm. For resistance load plate supply voltage will be voltage at plate plus voltage drop in load caused by specified plate current.

CIRCUIT APPLICATION

Biased Detector

The 1221 is particularly useful as a biased detector because of its ability to deliver a large audio-frequency voltage with little distortion when a small radio-frequency signal is applied to the control grid, provided the coupling device is satisfactory.

Radio Frequency Amplifier

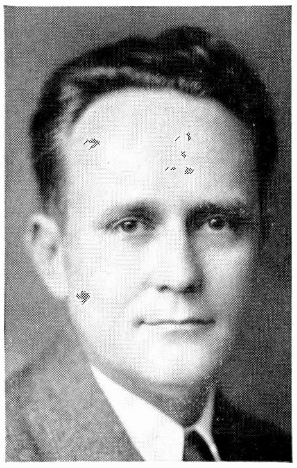
Type 1221 may be used satisfactorily in applications where the r-f signal applied to the grid is relatively low, that is, of the order of a few volts. In such cases either screen or control grid voltage (or both) may be varied to control the receiver volume. When larger signals are involved, a super-control amplifier tube should be employed to prevent the occurance of excessive cross-modulation distortion.

The plate circuit load should be as high as is practicable. A tuned impedance load will be satisfactory for intermediate-frequency amplifiers, operating at a fixed frequency. The gain per stage can be made as high as 200 or more with ordinary care in design. For other applications requiring uniform sensitivity over a wide band of radio frequencies, coupling devices to meet the specific requirements will be necessary.

Modulator or First Detector

The 1221 may be employed as a superheterodyne first detector but a tube having super-control characteristics is to be preferred if signals of large magnitude are to be received, and if supplementary volume control is to be obtained in this stage.

A CHAT WITH ROGER WISE



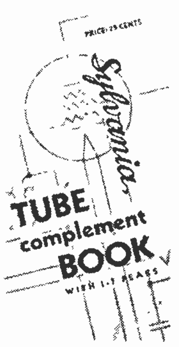
Chief Tube Engineer
Hygrade Sylvania Corporation

Inquiry from the field on 2 volt types such as 1A4, 1B4, 1D5G and 1E5G indicates that one question was not fully answered in the previous discussion of the differences involved in tetrode versus pentode construction. A few dealers and jobbers have inquired as to the construction of tubes not identified by the designating letter "T" for tetrode and "P" for pentode, advising that they wish to be able to supply 1A4 and 1D5G in the construction for which the set manufacturer designed the particular receiver in which the tubes are to be used.

Fortunately no confusion has occurred in Sylvania production, all of the undesignated tubes having been supplied in tetrode style. Thus 1A4 and 1A4T may be used interchangeably, also 1D5G and 1D5GT, as these types are identical. All pentode construction tubes in these two types are being supplied with the marking 1A4P and 1D5GP, and these types will be required only where the receiver is designed for operation of the screen and plate at the same voltage—usually 90 volts. This has occurred generally only where 90 volts is the highest voltage supplied by the "B" batteries, and is nearly always the case when the maximum available voltage is lower, as for instance, 67.5 volts.

In last month's discussion it was made clear that since 1B4 and 1E5G tubes are interchangeable in either pentode or tetrode construction in all sets for which data is available, the special marking can be disregarded. All tubes of these types are now manufactured as pentodes and are being designated 1B4P and 1E5GP.

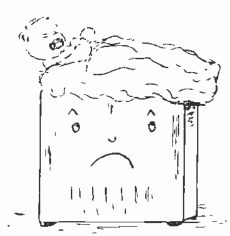
Two Bits Well Spent



That's what servicemen are saying about the Sylvania Tube Complement Book, announced last month. It's the only place where servicemen can find complete information on tube complements for receivers during the past ten years, and includes the greatest compilation of i-f peaks ever made. When you need the address of a set manufacturer, or wonder who made that orphan set, the Tube Complement Book is right there with the information.

No fooling, we kept the printer racing to catch up with the orders that came in last month, but we're all set now to supply your copy immediately. See your Sylvania jobber, or send 25 cents to Hygrade Sylvania Corporation, Emporium, Pa. Better make it four bits, and get your copy of the new edition of the Technical Manual at the same time.

DEAR RADIO



From birth to death, radio has become an important part of the lives of Mr., Mrs. and Miss America. Comedy, tragedy and romance can be traced between the lines of fan letters. Witness these quotes from letters to NBC, printed in the May 22 issue of Literary Digest (Now incorporated with Review of Reviews as "The Digest").

* * *

"Last night our baby was born during the Victory Hour. We are going to raise him on the radio."

* * *

"I am a young girl of nineteen. Please dramatize something that will send chills down my spine."

* * *

"At 10 o'clock on Saturday night two friends and I are planning a shuffle off this mortal coil by way of the gas pipe. Will you sing or play 'Abide With Me' to ease our dying hours?"

N.B. No name was signed, and the local station, unable to interfere otherwise, broadcast a one-minute appeal to the would-be, might-have-been, or possibly only spoofing, suicides.

* * *

"Please make several announcements of the following: Will the young lady who sat next to me in the 10:30 P.M. bus, Washington to New York, last Wednesday, please get in touch with me. I crave to know her whereabouts."

Revised Service Helps

The following free Sylvania service helps have been revised to include the latest technical information: Base Chart, Interchangeable Tube Chart, Characteristic Sheet, Pocket Price Card. These may be obtained from your Sylvania jobber.

THE SERVICE EXCHANGE

THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility with respect to results. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please indicate preference when submitting hints. Don't send routine or generally known information. Please specify tube choice.

Cadillac Car Radio Model 06W. Poor tone when volume is turned to low level. Replace the volume control. The resistance in original control usually increases to a few megohms, should be 500,000 ohms.—Harold Fread, Maplewood, New Jersey.

* * *

Carrying Kit Stock. As a serviceman who does not drive a car yet gets a class of trade which has already been taken over by so called cut price servicemen, it is hard to convince customers that there is a radio repair man who is on the level. I have managed to build up a clientel on "Honesty is the best policy," without price cutting. I use the best quality parts and only tubes that I won't have to go back and replace. Needless to say I use Sylvania tubes exclusively. As I do 90% of my work in the customer's home, I am enclosing a list of parts I carry with my tube tester-analyzer combination. This list of parts covers 75% of the average repair jobs.

1 Watt Resistors (one each): 100, 350, 500, 750, 1,000, 1,250, 1,500 2,000, 2,500, 4,000, 5,000, 10,000, 12,000 15,000, 20,000, 25,000, 35,000, 50,000, 60,000, 75,000, 100,000, 150,000, 250,000, 500,000, 750,000 1,000,000 and 1,500,000 ohms.

10 Watt Resistors: 150, 250, 750, 1,000, 2,000, 10,000 ohms.

Condenser: one each of the following: .00025, .0005, .002 600V., .25 400V., .5 400V., 4 mfd. Elec. 450 WV., and one each 4-5-6 prong sockets. Two each .01 600V., .05 600V., 8 mfd. Elec. 450 WV. Also 6-0.1 400V., 4 pilot lights, 2 house fuses, 5 auto fuses. 1-a-c plug and 1 single throw switch.

Most of the time I find out from the customer the make and model of the set so that I have some idea as to which tubes I should carry. If not, I take with me one each 80, 25Z5, 43, 45, 24A, 78 and 58 tubes.—Samuel Fels, Brooklyn, New York.

* * *

Chevrolet Receivers. In Model 985254 with oscillation over the entire dial; touch the finger to grid cap of the 6U7G i-f tube. If a loud pop results replace with a Sylvania 6U7G. Distortion in Model 985254 can often be traced to the volume control. If defective replace with 300,000 unit. For eliminating motor noise in all '37 cars, after the regular recommended methods have been incorporated try bonding the muffler to the frame. Also try disconnecting the ammeter condenser.—R. H. Baldwin, Olean, New York.

* * *

Common Complaint. A common trouble is weak reception with considerable distortion. The principal symptom is that when the volume is turned more than half way up the signal dies out yet when turned clear to the top comes back in with the same volume as before when half up. This indicates a possible volume control defect but it is usually perfect. The original 6H6 or 6H6G is giving the trouble due to gas, but of such a small amount that it will not rectify properly, but will check OK in a checker.—Donald W. Slattery, Chadron, Nebraska.

* * *

Crosley Model 158. Intermittent reception may be caused by an open in the .02 condenser which is from the high side of the 3 megohm resistor on the antenna coil to ground. Low volume may be caused by the falling off in capacity of the electrolytic condensers.—Tim W. Shaw, Vernon, Texas.

* * *

Crosley Model 515. If this set operates intermittently and strong hum also occurs the trouble is from dirty contact points and shorts of the electrolytic. To cure, unsolder and test for shorts or opens, resolder and set will operate correctly. This same set also experiences quick wear out of the 6B5 tubes. Longer operation can be had by replacement of a Sylvania type of the same number. We have also had several of these same models that refused to turn on. The trouble is in the switch connected on the volume control. We usually put on a separate switch, using the same volume control, when we have the owner's consent. This saves a great deal of work, causes less trouble and satisfies the owner much more.—Charles S. Bear, Omaha, Nebraska.

* * *

Farm Receivers. Many of the 1936 farm sets used a 6 volt storage battery and 2 volt tubes. Some of these sets had the 2 volt leads coming from the set in the cable with the 6 volt A minus and A plus leads. If the owner hooked the lead wire to the wrong post the tubes would be damaged. We got around this by painting the posts red, blue and yellow and the clips on the cable to match. Thus all that was necessary was to match colors which saved a lot of grief.—B. Greene, Petersburg, Virginia.

* * *

Ford Philco 1937. At occasional installation will show motor noise even with all condensers in place. A quick and permanent remedy is to connect another condenser to the ignition switch grounding it to the radio receiver case. Leave the original ignition condenser in place. Don Blair, Franklin, Pennsylvania.

* * *

Gable 1937. If you have a call on a Gable '37 job and you find it dead with an unusual blue glow in the 83—don't dive for the filters. Examine the wire on the low side of the choke. You no doubt will find that the insulation has broken down and the wire is shorting to ground. Clip the wire and run it through a piece of spaghetti, resolder and the job is OK. We have serviced about 30 of these machines in the last 2 months for the same trouble.—B. Greene, Petersburg, Va.

* * *

Gloritone Model 27. The simplest way to squelch inductive hum originating in the audio section is to insert a resistance of about one-half megohm between the grid of the power tube and ground. Too high a value will have no effect; too low a value will stop the hum but will also impair tone. Don't connect the resistor across the audio transformer secondary. When it becomes necessary to replace the power tube bias resistor in this model, use one with a 20-watt rating as this resistor carries the total output of the power supply.—B. E. Wenstrom, Ashtabula, Ohio.

* * *

Grunow Models 9A, 901, 902. Fading especially when the volume control is touched is most likely not the volume control, but a .04 condenser which connects from center tap to ground. Replace with a .05 condenser.—Samuel Fels, Brooklyn, New York.

* * *

Keeping Tubes In Stock. Whenever I sell a Sylvania tube (I have been selling them for ten years) I pull the inside of the sealed carton out from the bottom. This brings out the upper flap with the tube number on it, I tear this away from the rest of the carton and it has a round hole in it, so I file it on a nail in the shop. When the distributor's salesman comes along, I get the numbers I need to reimburse my stock. By using this method you need not be out of the tubes you trust your memory to recall, then forget, losing your profit.—W. W. Brackenridge, Harrison, Ohio.

* * *

Midwest Model G-10. Recently I was servicing one of these receivers and upon checking the tubes I found that a 58 was taking the place of the 57 shown in the wiring diagram. Rider's and Gernsback Manuals show a 57 in the tube line up. In writing the manufacturer I was informed that a 58 is taking the place of the 57. When making replacements the 58 should be used.—R. D. Dawson, The Dalles, Oregon.

* * *

Packard 1938. In order to completely eliminate motor noise in these cars using the under-car antenna, it is necessary to ground the shield from the antenna at two places. First at the bolt holding the antenna to the running board and also on the frame to which the running board is fastened. In other words, it is necessary to ground the left running board to the frame. I have found the above suggestion necessary and to be the most effective.—Edwin H. Harrji, Dumont, New Jersey.

* * *

Philco Transitone Model 5. Poor a-v-c action, distortion and very broad tuning; replace the volume control. The resistance should be 350,000 ohms, but increases to as much as 8 megohms.—Harold Fread, Maplewood, N. J.

* * *

Philco 116 Code 122. Distortion at low volume, which acts like a defective volume control is a common trouble with this set. Try replacing 77 first detector and 77 first audio tube with Sylvania 77's before replacing the volume control. This often clears up the trouble.—Kenneth A. Trites, Melrose, Mass.

* * *

Philco Model 38-22. In this new 1938 Philco radio the resistor shunted across the pilot light often blows. This resistor is contained in a can together with the line resistor in series with the filaments of the tubes in this set. Since it is only the shunt resistor that blows it is best to use a fifteen ohm resistor and shunt it across the pilot light. This is the best remedy. I use ten watt resistors for this purpose. It is not necessary to use such high wattage resistor but I use them feeling that there will be no more pilot light shunts blowing.—Wilbert L. Misner, Vintondale, Pennsylvania.

* * *

RCA Victor Model 118. Electrical noise in this model can be greatly reduced by putting a .01 mfd. 200 volt condenser from each side of the power line to ground. The set can be further improved by installing a wave trap, as interference is rather bad.—Louis Wiech, New Castle, Pennsylvania.

* * *

Universal Joint Static.—A noise similar to wheel static which will not respond to the usual cures may be originating from the universal joint. This trouble was cured on an Essex by bonding over the universal joint. The bond must be light and snug fitting or the centrifugal force will pull it loose.—Foster King, Rio Vista, California.

Automatic Phono Hints

The offer made last month on coin operated phonograph hints is still good until the first of December. So hurry with your practical tips on these machines. For the first hint accepted you will receive a card index file, or, if you prefer, your choice of any Sylvania receiving tube. Each additional hint accepted will entitle the writer to his choice of any receiving tube. Do not send routine or generally known information. Please specify tube choice. Address the Technical Editor, Sylvania News, Hygrade Sylvania Corporation, Emporium, Pa.

OSCILLATOR PERFORMANCE IN SUPERHETERODYNES

GEORGE C. CONNOR

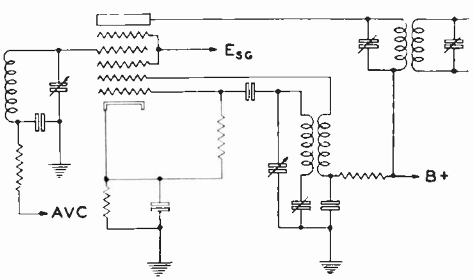
Part IV

(Continued from last Issue)

GRID BLOCKING CONDENSER

The oscillator grid blocking condenser has three major functions. These are:–1. it separates the a-c and d-c circuits so that the d-c path (from grid to ground) may have a resistance of 25,000 to 50,000 ohms to develop grid bias and the a-c circuit may be a non-conductor for d-c which is desirable when we wish to use a padder condenser for alignment as is usually the case; 2. it stores up electrons during that portion of a cycle that the grid is driven positive and releases them during the time the grid is negative to maintain an almost constant negative grid bias, and 3. it reduces the reflected capacity within the tube to a smaller value in order that the tuning range of the band may be increased. This reduction in capacity is simply a matter of placing a condenser in series with the effective grid-cathode capacity of the tube (two capacities in series are of course equal to less than the smaller of the two.)

The usual value of .00025 mfd. or 250 mmf. for this capacitor has been found too large for some all wave sets where it is necessary to secure the greatest tuning range on each band in order to reduce the number of hands required. Its value varies in different sets between 50 mmf. and 250 mmf. depending on the design of the oscillator coil. Unfortunately when we reduce the value of this condenser we also reduce the percentage of total oscillator voltage (appearing across the tank circuit) that is applied to the control grid of the oscillator. Here again we must compromise between the tuning range and the developed oscillator voltage. When the oscillator refuses to oscillate on the low frequency end of the short wave band increasing the capacity of this condenser will often correct the trouble at the cost of a slight sacrifice in tuning range on that band. Care must be taken to see that this added capacity does not cause parasitic oscillation on the high frequency end of the broadcast or long wave band.



4-B

GRID LEAK RESISTOR

The grid leak resistor is fairly well fixed by oscillator grid bias requirements and should be of such value that:

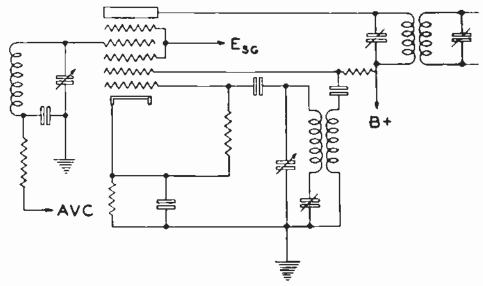
1. The electrons stored in the condenser do not all leak off before the oscillator grid is again driven positive.

2. It does not provide too low a shunt resistance across the tank circuit so that ample A.C. voltage cannot be developed.

3. It will not cause motor boating or "super regeneration" due to the time constant of the resistor and condenser combination.

A value of 50,000 ohms is a very satisfactory compromise between these three considerations, and if trouble is encountered in a receiver having a lower value than this it is well to change this resistor to 50,000 ohms.

In pentagrid converter circuits having a-v-c voltage applied to the tetrode control grid the oscillator grid leak resistor should be returned to the cathode rather than ground. If it is connected to the ground the oscillator grid bias will vary with the a-v-c voltage because of the varying current through the cathode resistor.



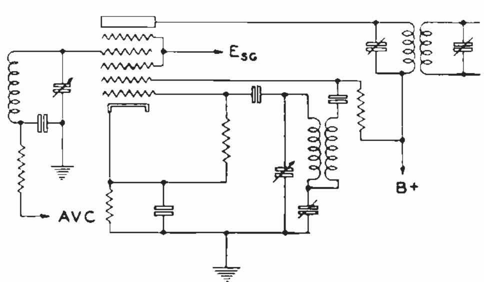
4-C

OSCILLATOR ANODE RESISTOR

A 20,000 ohm resistor is recommended in series with the anode "B" voltage supply on a-c receivers having 250 volt B supplies to prevent excess anode current should the oscillator stop oscillating or should the receiver be operated for any length of time at a frequency where the developed oscillator voltage is low. When the oscillator voltage is low the oscillator grid bias is low and the oscillator anode current is higher than normal—this may have an injurious effect on the tube if continued for any length of time. The 20,000 ohm resistor eliminates this trouble by dropping the anode voltage to a safe value during periods of excess anode current. Often the value of this resistance is increased and a condenser added to provide a hum filter to permit the oscillator anode voltage to be secured ahead of the regular power supply choke. The advantage of this is to make the oscillator anode voltage less dependent on the d-c drop through the choke which of course varies with the plate current of the power tubes. This method of securing a more constant anode voltage is especially useful on the short wave band. The effect of a varying oscillator anode voltage on high frequencies is to tune out the signal until the plate current on the power tube drops to normal—which returns the anode voltage to normal which then tunes in the signal. This sequency of events makes the receiver "motorboat". Any hum appearing on the oscillator anode will modulate the oscillator which in turn will modulate the signal causing "tunable hum" which can of course be cured by proper filtering.

VOLTAGE ON ELEMENTS

As may be expected in such a complicated tube structure, the use of other than recommended voltages on the various elements will result in improper electron distribution patterns within the tube and will cause unsatisfactory circuit performance. For example reducing the screen voltage will adversely affect oscillator performance and will make the plate current cut-off point lower which will result in a loss in sensitivity and cause more "hiss" for a given input signal. A heater voltage 0.5 volts or more below normal may, in critical sets, cause the oscillator to stop oscillating on the low frequency end of the short wave band. Too low a tetrode control grid bias may cause poor performance on strong local signals.



4-D

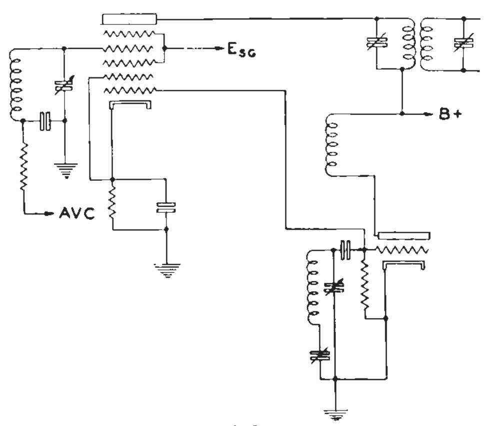
The total cathode current should not exceed 14 ma. maximum and will usually average about 11 ma.

TYPICAL CIRCUITS

Figure 4-B indicates the average pentagrid converter circuit with AVC voltage applied to the tetrode section control grid. Figure 4-A is the same circuit with suppressor resistor and an anode hum filter added The capacity of the electrolytic condenser will depend upon the amount of filtering required and is usually shunted with a paper condenser, and on short wave sets also with a mica condenser for more effective high frequency by-pass action.

To make wave band switching problems easier the shunt fed circuit of figure 4-C is often used. One end of the tickler is grounded and the other end is connected to the oscillator anode through a blocking condenser.

A method of maintaining more constant oscillator voltage over the band is shown in figure 4-D. In this circuit, the tickler coil is shunt fed and the low potential end is connected to ground through the padder condenser to increase the coupling on the low frequency end of the band.



4-E

In figure 4-E is shown a method sometimes used to increase the oscillator voltage—a separate tube is used as an oscillator and the oscillator grid is used as an injector grid. This provides a worthwhile gain in sensitivity especially on the high frequency bands where the oscillator, because of increased grid circuit losses and insufficient coupling between oscillator grid and plate coils develops a much smaller voltage. The usual oscillator anode is not used and is connected to the cathode screen grid or ground.

CONCLUSION

In the series of articles on super-heterodyne oscillator considerations we have tried to bring together the engineering and service viewpoints so that the service man may better appreciate the reasons behind some of the compromises made in receiver design, and in understanding these reasons will repair the receiver so that its performance is according **customer's needs** rather than follow blindly in all cases the service manual which of necessity is written to cover **average** conditions.

There are many other types of oscillator-detector circuits which we have not covered such as the 6L7 type and automatic frequency control, but we hope to return to these at a later date. In the meantime, in answer to many requests, we will run a series of articles beginning with the next issue of Sylvania News covering the theory, construction, calibration and use in service work of vacuum tube voltmeters.

SYLVANIA NEWS

TECHNICAL SECTION

November-December, 1937 | EMPORIUM, PENNA. | Vol. 7, No. 5

YOURS FOR EFFICIENCY

SYLVANIA SERVICE HINT CROSS INDEX

Sylvania News Vol._____No._____
Sylvania News Vol._____No._____
Sylvania News Vol._____No._____
Service Hints Vol._____Page_____
Service Hints Vol._____Page_____

Shown here are two new Sylvania aids for the serious-minded serviceman who believes in using efficiency methods to make his work easier and more skillful.

The sticker at the top (actual size) is intended for use as a cross index to service hints published in Sylvania News and in the Service Hints booklets. It can be pasted on circuit diagrams on the various pages of Rider's or other technical manuals. Properly filled in, it gives immediate reference to service data dealing with that particular receiver. These stickers may also be pasted on file cards, or used wherever a quick reference is most convenient.

Pads of 50 stickers, gummed back, are offered to servicemen at 5 cents each.

At bottom, in actual size, are shown both sides of a new reference file card. Its usefulness is obvious, since it offers on one side a convenient cross index to service hint sources on a particular receiver, and on the back, space for the most needed technical data on the same receiver.

These cards fit the Sylvania Card Record File, or any standard 3 x 5 card file. Used in connection with the Sylvania News Technical Section binder (complete with all back copies), the Sylvania Job Record cards, the indexed cards supplied with the Sylvania file cabinets, they provide a complete business and technical reference equipment that will save hours of time for servicemen.

These cards are offered at quantity printing cost—$1.50 per thousand, $1.00 per 500. Order stickers and cards from Hygrade Sylvania Corporation, Emporium, Pa., or through your Sylvania jobber.

VOLTAGE READINGS

Tube Type	Tube Function	SOCKET TERMINALS No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	Top Cap	Ma. or Misc. Readings

Li

RECEIVER _____ MODEL NO. _____

CROSS INDEX RECORD

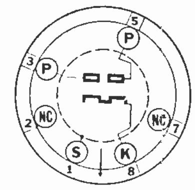
Reference			Symptom
Sylvania News	Vol. ____	No. ____	____
Sylvania News	Vol. ____	No. ____	____
Sylvania News	Vol. ____	No. ____	____
Service Hints	Vol. ____	Pg. ____	____
Service Hints	Vol. ____	Pg. ____	____
Auto Hints Book	Vol. ____	Pg. ____	____

Other Data_____

Hygrade Sylvania Corporation - Emporium, Pa.

NEW TUBES

Type 0Z4G Full Wave Rectifier



4-R

Type 0Z4G is a full-wave rectifier tube of the gas-filled type. No heater supply is required since the tube is of ionic heated cathode design. This feature makes it popular as a rectifier tube for auto receivers where the economy of battery current is a factor. This new Sylvania tube may be used to replace any 0Z4 or 0Z4G tubes.

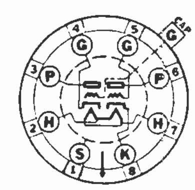
Characteristics

Maximum Over-all Length .... 2½ Inches
Maximum Diameter .... 1⁵⁄₁₆ Inches
Bulb T7NIG
Base .... Small G Type Octal No. 4-R

Operating Conditions and Characteristics

A-C Voltage per Plate RMS .... 350 Volts
D-C Output Current.... 75 Ma. Max., 30 Ma. Min.
Peak Inverse Voltage.... 1250 Volts
Peak Plate Current..... 200 Ma. Max.

Type 6F8G Duotriode Amplifier



8-G

Type 6F8G is a 6.3 volt double triode which consists essentially of two type 6J5G mounts in the same bulb. The electrical characteristics for a single section closely parallel those of Type 6J5G so that the application notes on the latter type are applicable to the 6F8G. The plate, grid and cathode of each triode section are brought out separately thus permitting adaptations to special designs. The voltage between heater and cathode should be kept as low as possible if direct connection is not made.

For phase inverter service the effective plate voltage is the supply voltage minus the voltage drop in the plate resistor. The self-biasing resistor will not require a by-pass condenser when the tube is utilized for phase inversion. The values given for voltage amplifications are the voltage as measured from plate to plate for a signal of one volt applied to the grid of the input section. The maximum output voltage is also given for the entire tube, measured from plate to plate when the maximum peak signal is applied to the input grid.

The value of grid return resistance of the succeeding audio amplifier should be governed by the type of tube employed in that stage but should never be less than twice the plate resistance of the 6F8G in order to avoid serious distortion.

Because of its dual features this tube tends to have a higher operating temperature than most tubes with the same bulb size. For this reason it is recommended that it be located in a well

Continued on Page Two

NEW TUBES

Continued from Page One

ventilated position. Where excessive heating is encountered due to insufficient ventilation special attention must be given to the grid bias and grid resistor values employed to restrict the possibilities of grid emission.

When used as a cascade amplifier it is recommended that the triode section with the grid connected to the top cap be used as the first stage to minimize the possibility of hum pickup.

Characteristics

Heater Voltage A-C or D-C	6.3 Volts
Heater Current	0.6 Ampere
Maximum Over-all Length	$4\frac{17}{32}$ Inches
Maximum Diameter	$1\frac{9}{16}$ Inches
Bulb	ST-12
Base	Small G Type Octal No. 8-G

Direct Interelectrode Capacitances:

Grid to Plate	4.2*	4.5# μμf.
Grid to Cathode	3.0*	3.3# μμf.
Plate to Cathode	2.0*	1.5# μμf.
Grid to Grid		0.13 μμf.
Plate to Plate		1.2 μμf.
Top Cap Grid to Plate of Other Triode		0.2 μμf.

*—Triode section with grid connected to top can.
#—Triode section with grid connected to base pin.

Operating Conditions and Characteristics

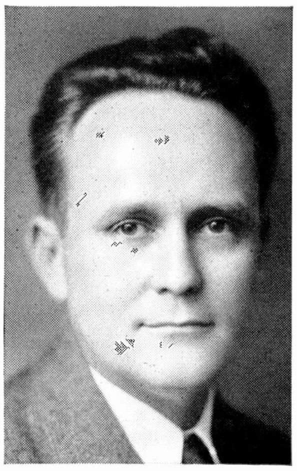
Class A Amplifier—One Triode

Heater Voltage AC or DC	6.3 Volts
Plate Voltage	250 Volts
Grid Voltage	-8 Volts
Plate Current	9.0 Ma.
Plate Resistance	7700 Ohms (Approx.)
Mutual Conductance	2600 μmhos (Approx.)
Amplification Factor	20

Typical Operation as Phase Inverter

Plate Supply Voltage	100	250 Volts
Grid Voltage	-2.25	-5.5 Volts
Plate Current per Section	1.5	2.4 Ma.
Plate Load Resistor per Plate	30,000	50,000 Ohms
Self-Biasing Resistor	750	1,150 Ohms
Voltage Amplification (Approx.)	26	29
Maximum Output Voltage (RMS)	20	65 Volts (Approx.)

A CHAT WITH ROGER WISE



Chief Tube Engineer
Hygrade Sylvania Corporation

Although business during the last quarter of 1937 has fallen below expectations as far as the radio tube industry is concerned, development and research work is being carried on at full speed. This is due to the fact that it is desirable to have new types of tubes ready for set manufacturers at this time, well in advance of the introduction of spring models, so that the necessary development work can be done by the engineers responsible for circuit design.

Current releases by Hygrade Sylvania include a new converter, which is, in many respects, similar to tubes which have been available in Europe for one or two seasons. This tube combines a triode oscillator element with a heptode converter section, and the design is worked out in such a way as to avoid oscillator frequency drift with change in applied AVC voltages. As compared with 6A8G, the reduction in some of the inter-electrode capacities is an important advantage. High conversion gain is maintained at frequencies of 18 m.c. and above, and the ratio of signal to noise is materially improved. The plate resistance is exceptionally high, making it possible to use a high quality i-f transformer to marked advantage as far as gain is concerned. The selectivity of a high Q tuned circuit is not appreciably impaired by shunting the plate resistance of this tube across it. High input impedance is maintained under all normal operating conditions.

The fact that a triode section is required in this tube means that the cost of the tube is moderately high as compared with 6A8G, but is felt that the advantages obtained are important enough to make the tube attractive to set manufacturers as well as experimenters who are interested in performance at high frequencies.

A special voltage regulator gas discharge tube, type VR-150, has been made available to experimenters. This tube is somewhat like the 874 regular tube, but is improved in a number of respects. A lower minimum current is required to maintain the glow (5 to 7 ma.), and the voltage change with load and also during life is much smaller. The uniformity from tube to tube is also quite satisfactory. The tube is supplied in an ST-12 bulb and develops a voltage of 150 volts across its terminals. Maximum current is 30 ma. The tube may be fed from a high voltage source through a series resistor, and will then stabilize the voltage supplied to an oscillator or other tube load at the indicated terminal voltage of 150 volts. This makes it possible to compensate for fluctuating supply voltages within very narrow limits. It is possible to supply this tube in other voltage ranges, but the demand has not been large enough to warrant this step at this time.

From time to time other special tubes may be made available as the development work now under way is completed.

THE VACUUM TUBE VOLTMETER AS A SERVICE TOOL

By GEORGE C. CONNOR

This is the first of a series of articles describing the theory, construction, calibration and use of vacuum tube voltmeters in service work. An instrument of this type, capable of measuring d-c voltages or a-c voltages of any frequency encountered in modern receivers, is becoming increasingly necessary in service work—not only because it can measure voltages across high impedance circuits without drawing current from the circuit, but because it may be used to measure resistance, inductance, capacity, leakage, transformer rations, stage gain, power output, percentage of modulation and coil "Q"—or virtually everything the serviceman must know about a receiver or any of its component parts (except how much to charge the customer). Its versatility is only limited by the skill of the operator, and it is the major purpose of this series of articles to describe in detail the many uses the serviceman will have for a vacuum tube voltmeter.

PART I

A-C VERSUS D-C TESTING

The servicing of a radio receiver may be considered as consisting of circuit repairs and adjustments to permit the tubes in a set to function properly. In the final analysis the radio tubes do all the work of amplifying the signal; providing a locally generated signal which—beating with the incoming signal—changes its frequency; amplifying this intermediate frequency; and removing the a-f component, and in turn amplifying this to the point that it will operate the loud speaker. The balance of the parts in the set serve to couple the tubes together and to supply them with the recommended heater, plate and various grid voltages.

Because of the long life of tubes and the ease with which they may be removed from the set, tested and replaced, few tough problems are encountered in this connection. However, it is much more difficult to give most of the other parts of the receiver a thorough test. To be accurately tested, all parts should be checked in the chassis at their operating frequency—which will be between 25 cycles per second and 25 megacycles for the average "all-wave" receiver, and over 90 megacycles for a television receiver. The latter requirement must be kept in mind when building test equipment if we wish to be sure that it will not become obsolete in the future. Since the parts should be tested in the chassis at their operating frequency, it is certainly logical that the best instrument to test them with is a vacuum tube voltmeter since the V.T.V.M. has essentially the same characteristics as the tube usually associated with the part under test. Not all V.T.V.M. circuits are well suited for service work, however. Some are not sensitive enough, others draw too much current from the circuit under test, several types are too complicated or unstable, and some require such delicate meters that they are too costly to purchase and keep in repair for service work. Before deciding on any one type we will consider the more important basic types, and give detailed construction data on the one best suited for service work.

THE DIODE VACUUM TUBE VOLTMETER

The first vacuum tube voltmeter was of the Diode type, and dates back beyond the age of radio to the year of 1883 when Thomas A. Edison placed a plate in one of his first carbon filament lamps and noticed that—when the plate was made positive with respect to the filament—a current would flow between plate and filament. This was called the "Edison effect" after its discoverer. For over twenty years its use was

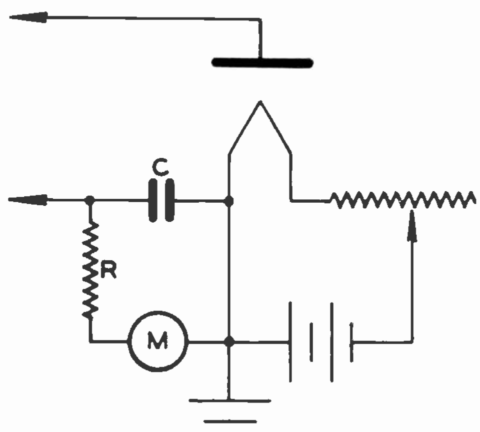


FIG. IA

limited to laboratory experiments in rectification until Fleming introduced it to replace the crystal detector, in which function it was called the "Fleming Valve." The reason for calling it a

Continued on Page Four

THE SERVICE EXCHANGE

THE information presented in the Sylvania Service Exchange is contributed by servicemen as the result of practical experience. It is very carefully considered before being accepted, and we believe it to be correct and authentic. However, we assume no responsibility with respect to results. Each hint accepted entitles the writer to his choice of one Sylvania receiving tube. Please indicate preference when submitting hints. Don't send routine or generally known information. Please specify tube choice.

Airline Model 62-236 (Auto). Distortion: Connect a 25,000 ohm resistor to the volume control (first lug on control as you look into the set from the bottom) connect the other side of resistor to ground.—T. Henshaw, Marysville, Kans.

* * *

Crosley Model 154. When a very low signal is heard and it is spread over the band you will usually find that the first detector-oscillator cathode bias resistor has greatly increased in resistance, putting 50 volts instead of 14 volts on the grid. Replacement with a proper resistor gives normal reception.—M. J. Socha, Brooklyn, New York.

* * *

Crosley Model 154. If very weak on low frequency end of dial, 550-1000 kilocycles look for 5 meg. grid leak changing value to about 3000 ohms after five minutes of playing. If distortion is evident after warming up, check the plate coupling resistor (150,000 ohm) for changes in value.—Fels Radio Service, Brooklyn, New York.

* * *

1937 Diamond-T Truck Radio Installation. When installing a radio in these trucks make sure the following is done. A condenser should not be connected at generator but should be placed on the battery side of the ignition coil. Bond the steering post to the frame. A suppressor is necessary in the distributor lead.—AAA Radio Service, Iowa City, Iowa.

* * *

Electric Lamp Interference. After installing a Zenith radio in a house we found that there was a crackling noise. After checking aerial, etc. we found that the crackling was due to an ordinary house lamp with a poor filament. A good policy is to always check all lamps in the house for defects and for best results replace with a Hygrade Lamp.—William J. Langton, Troy, New York.

* * *

Erla-Sentinel Model 60BT. In several of these radios, I have found the following trouble: The volume is very low on all stations, although all voltages test all right. I have found this trouble to be caused by a partial short in the volume control. The center terminal tests about 500 ohms to ground. Sometimes the short disappears during the testing process, but it is safer to replace the volume control anyway. This is the first thing to look for in this and similar models.—Robert Smith, Olds, Iowa.

* * *

Fada Model 25. The push-pull input in 2nd audio stage has a .00025 condenser across the grids. By connecting a larger condenser at this point .005 to .01 mfd., hum is reduced and tone improved, removing that harsh hollow sound associated with regeneration.—C. T. Vermillion, Baltimore, Md.

* * *

Ford Philco Model FT-9. This set occasionly develops a loud "squawk" when driving over rough roads. After replacing the vibrator and checking set thoroughly, check the condenser with a Neon checker. Usually one of the .25 condensers (one of the 4" part No. 30-4374) causes the trouble. Replace entire block as all condensers will open one after another.—K. Luckey, New Lisbon, Wisconsin.

* * *

General Electric J Series. If a General Electric of the "J" series (J107, etc.) is encountered with a complaint of motorboating, poor sensitivity, oscillation, etc., replace the entire filter block. If one or two filters are replaced the bad condensers, which cannot be taken from the block, affects the others capacitively and the set will not operate properly. These filters, when defective, will not always test defective.—Radio Service, Baltimore, Md.

Grunow Model 670. When distortion, especially noticeable on low volume is the trouble, it can be corrected by the following method. Replace .02 condenser connected between the plate of the 75 tube and the control grid of the 42 tube. This condenser often has a high resistance leak detectable only by the use of a good measuring device.—Walter Kocal, East Chicago, Indiana.

* * *

Hudson Model DB-37. These sets have a short wire connected from the gang condenser to the automatic volume control bypass condensers returning from the antenna coil and first detector radio frequency coupling coil. This wire should be replaced because it will break sooner or later and may cause the serviceman a profitless job. Replace with a short flexible pig tail lead. The condensers are the small black bakelite encased condensers located between the bases of the 6D6 and 6A7 tubes. I have serviced a number of these sets for this trouble.—Donald W. Slattery, Chadron, Nebr.

* * *

Majestic Model 200. A common complaint in this model is noisy reception while all voltages check OK. The trouble is high resistance in the first i-f transformer plate circuit. Check with low range ohmmeter. Replace the unit.—J. Acker, Fordyce, Arkansas.

* * *

Midwest Model 16, 35. Distortion when volume control is turned on more than ¼. Look for broken lead on 0.1 condenser connected from plate of first audio tube (76) to tone control. Distortion at resonance. Realign i-f transformer between 76 and 6B7 tubes.—T. Henshaw, Marysville, Kans.

* * *

Norco Model 178. This receiver, manufactured by Remler is a single band 5 tube Super which receives broadcast and low frequency police bands. These sets employ a coil which is tapped for the high frequency police bands as well. By connecting the idle tap on the mixer coil to ground through a single pole single throw switch you can increase the enjoyment and entertainment for the customer. A few minutes work which will please your clients.—Walter T. Walsh, San Francisco, Calif.

* * *

Philco Model 20. Oscillation when the station is being tuned in, on these models can be permanently cured by inserting a fixed condenser of .05 mfd. from the heater of one of the 24A tubes to chassis. The volume is not decreased and the tone is slightly improved.—Wise Brothers Radio Service, N. S. Pittsburgh, Pa.

* * *

RCA Victor Model T8-13. When you run into distortion in one of these receivers or any other receivers using audio coupling condensers shielded in metal and can't seem to find it try checking the audio coupling condensers for leakage. Do not check from terminal to terminal only, but also from each terminal to ground as these units often develop a leakage in the order of megohms and thus cause distortion.—Walter Neal Pike, Hendersonville, N. C.

* * *

RCA Model 120. Motorboating, when tuning condenser is turned to the higher frequencies on the broadcast band, or the wave change switch is in the short wave position, is common. Try connecting an electrolytic condenser of two mfd. or higher value from screen of 2A5 to chassis.—Tim W. Shaw, Vernon, Texas.

* * *

RCA Model T 5-2. Complaint: Intermittent reception. Check the soldered leads within the i-f shields. The solder lugs are rather close to the shield with the result that the leads intermittently short circuit to the shield.

Complaint: Noisy reception. Replace the 20,500 ohm Candohm (Cat. No. 4721, R-17, 18, 19, 20) tapped resistor. The taps become loose due to heat dissipated by its use as a bleeder —Harold Clark, North Plainfield, N. J.

* * *

REMLER HINTS

Remler Model 28 AC-DC "Scottie" (1937). When set breaks into motorboating, with no signal anywhere on the dial, check the insulating fibre washers on screws holding the dial plate on metal baffle. The dial plate is insulated from chassis with these fibre washers. Quite often, when screws are too tight, these washers break and thus short the insulated dial plate to ground. To remedy the situation simply replace fibre washers.—M. Margossian, Oakland, Calif.

* * *

Remler Model 45 (1936 and 1937 Models). The set becomes dead intermittently when shaken or jarred. Check the tone control condenser (.05 mfd. 600 volt) and you will find it shorting intermittently when shaken, thus shorting the plate of the 6F6 to ground. Replace this condenser to cure trouble.—M. Margossian, Oakland, Calif.

* * *

Remler Model 64. When the set breaks into high pitch oscillation at the high end of the short wave band, change the 100,000 ohms (#8 resistor-Rider) resistor on the oscillator input control grid prong of the 6A8 tube to 50,000 ohms. If oscillations persist reduce said resistance to 25,000 ohms and all such painful-to-ear oscillations will disappear improving the short-wave band of the set considerably. Incidentally, if you happen to have the Rider Manual No. 7, make the following correction in the diagram of this set: Interchange the wiring connections (on your diagram) of 6A8 Nos. 6 and 7 prongs.—M. Margossian, Oakland, Calif.

* * *

Remler Model 71. When the set is noisy on short wave band, or subject to mircophonic noises, ground thoroughly the braided flexible wire which connects the rear end plates of all the three sections of the tuning variable condenser (ganged) to ground. This will provide a positive direct connection from the rotor section to ground. A complete soldering job, several places along the braided wire is necessary in all short wave sets. A poorly grounded rotor will always cause microphonic noises, particularly on short wave.—M. Margossian, Oakland, Calif.

Victor R 32. This receiver will operate normally with the exception of bad hum in the detector circuit. Replace 20 ohm resistor across heater of the 27 tube. The original resistor usually changes its value. Quite a few of these sets have this complaint.—Charles S. Sutton, Toledo, Ohio.

* * *

RCA Victor 110, 111 and 115. If the volume intermittently changes between a high and low level, and while operating at the low level the signal is distorted, the trouble is probably due to an intermittent open circuit in the coupling condenser between the 57 second detector and the 2A5 output tube.—Ralph T. Morgan, Jr., Springfield, Pa.

Everyone's Happy. I wish to thank you for the fine spirit of cooperation which you have shown the servicemen and assure you that I for one intend to do my part in making the continuation of this service possible by the use of Sylvania tubes in my replacements. —Tim W. Shaw, Vernon, Texas.

THE VACUUM TUBE VOLTMETER AS A SERVICE TOOL

Continued From Page Two

valve is obvious since it will pass current only in one direction—when the plate is positive—and shut it off as the plate is made negative. Since that time, all radio tubes are "valves" to the British experimenter and servicemen. The Greeks of course gave us a word for it—"**Diode**" —meaning dual element. The diode is used today in most radio receivers as a second detector and source of a-v-c, a-f-c and volume expansion control voltage. The diode vacuum tube voltmeter shown in figure 1A is possibly the simplest type which is about its only virtue. Any glass or metal type of tube may be used as the rectifier, provided it will stand the maximum peak a-c voltage to be measured. If batteries are to be used for a source of heater voltage, a tube of the 1A4T type is a good choice because the control grid is brought out to the top cap and this can be used as the diode plate. The screen grid and plate in this case may be grounded and will serve as an internal shield to minimize external pickup. The capacity of the condenser "C" must be large enough to present a very low reactance to the lowest frequency to be measured—or to

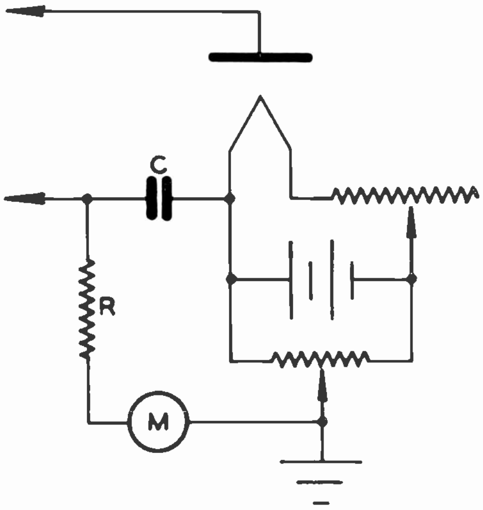


FIG. 1B

write this another way, we can say that there should be no a-c voltage drop across this condenser at the lowest frequency we expect to measure. This requires a good paper condenser of at least 4 mfd. with a voltage rating equal to the largest peak voltage to be measured. The resistor "R" and meter "M" may be a standard 1000-ohms-per-volt voltmeter with its internal multiplier.

When the V.T.V.M. is connected across a circuit through which an alternating current is flowing, the plate will of course be alternatingly positive and negative by an amount equal to the a-c voltage flowing in the circuit under test. When the plate is positive it will attract electrons from the filament and a d-c current will flow through the external circuit under test and back through the meter and multiplier resistor to the filament. You will notice that the meter circuit will contain only d-c voltages since the a-c voltage is by-passed by the condenser "C". During that portion of a cycle when the plate is negative, no d-c current will flow because its negative potential will repel the negatively charged electrons being emitted from the filament. From this we can see that our diode V.T.V.M. will not draw current from the circuit under test when the plate is negative, so we can say it has infinite resistance during this portion of the cycle. When the plate is positive, however, the resistance of the diode will drop so that it may have a resistance of 1000 ohms or less, depending on the tube used. We can see from this that the diode V.T.V.M. will draw almost as much current from the circuit under test as a direct current voltmeter of similar sensitivity when measuring a d-c voltage. The obvious way to avoid this serious current drain is to use a more sensitive meter such as a 0-10 microammeter, which, with a multiplier resistor "R" of 500,000 ohms, would give us a meter resistance of 100,000-ohms-per-volt for the 5 volt range. Such a meter however is both expensive and delicate, and is not very practical for general service work. Moreover, even if we decided to use such a meter we would find another difficulty when we attempted to measure below 0.5 volts. In this range we might find that a point would be reached where no indication would be secured on the meter even though we knew that an a-c voltage existed in the circuit under test. Or, on the other hand, we might find that the meter would read 0.5 volts or less with the test prods short circuited. This error is due to "contact potential," which because of electronic action makes the plate appear as though it had an initial d-c potential of approximately plus 0.5 volts or minus 0.5 volts on it. To avoid this difficulty we can use the circuit shown in figure 1B and with the test prods short circuited adjust the potentiometer until the meter just reads zero. This will enable us to read more accurately below 0.5 volts.

So far we have said little about the main advantage of the diode V.T.V.M.—the fact that it is self-calibrating. This is a considerable advantage in that a d-c voltmeter is used for indication and the a-c voltage is read directly on the d-c voltmeter scale. The accuracy of this reading, however, is subject to considerable error, especially on the low voltage range because the diode resistance may be an important percentage of the meter multiplier resistance—and as a consequence the two will act as a voltage divider across the d-c generated voltage. Were it not for this source of error, which may be minimized by the use of a very high resistance voltmeter, we would find that the readings on the d-c meter would correspond to the average a-c voltage across the circuit under test, provided the current drawn from the circuit did not introduce a further error. At higher d-c voltages the diode V.T.V.M. d-c meter may read nearer to RMS values of a-c voltage, and at still higher a-c voltage ranges—because of the higher meter multiplier resistance —a value nearer to the peak a-c voltage may be

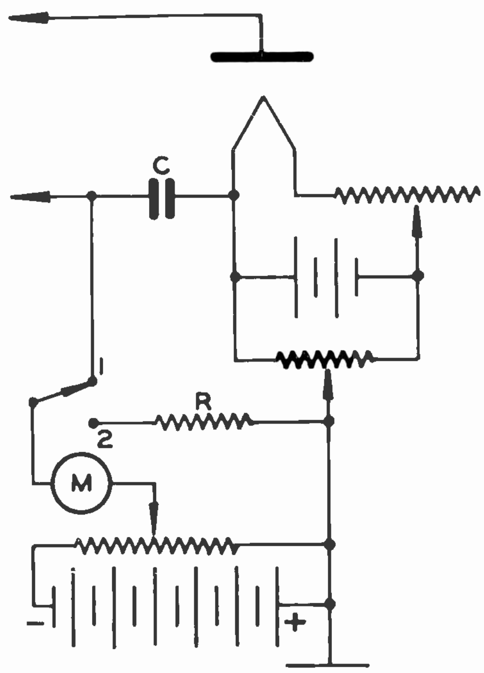


FIG. 1C

indicated. No law can be given for this action because it depends upon the frequency as well as the a-c voltage, which is the penalty we pay for having a condenser in the input circuit across which d-c current must flow. This effect is the same as that called "time constant" in a-v-c and resistance coupled amplifier circuits. There are two methods of surmounting this difficulty. One is to follow the diode with another tube so that no current will be drawn from the diode circuit, and use this tube as a d-c amplifier with a milliameter in its plate circuit to indicate plate current change. The other is to use a "slide back" diode voltmeter such as the circuit shown in figure 1C. The first method will be discussed further under "Triode V.T.V.M.," and the second method depends upon a system of bucking out the d-c voltage generated by the diode. This is called a "slide-back" diode V.T.V.M. As shown in figure 1C a potentiometer is used across the filament battery to correct for "contact potential" and an additional battery is supplied to furnish the "bucking voltage." In operation the test prods are first short circuited and the filament potentiometer varied until the current through the meter is just reduced to zero with the meter switch in the No. 1 position and the sliding arm of the bucking battery potentiometer adjacent to the ground terminal. The test prods may then be connected to the circuit to be tested, and the slide back potentiometer adjusted until the meter agains reads zero. The meter switch is then thrown to the No. 2 position and the d-c voltage read on it will be equal to the peak a-c voltage measured. Resistor "R" will, of course, be the meter multiplier resistor and condenser "C" should be a 4 mfd. or larger paper condenser. The only trouble with this circuit is the difficulty of locating the exact zero current point and the necessity of having available a bucking voltage equal to the peak voltage to be measured. It is however, recommended as the best diode type of

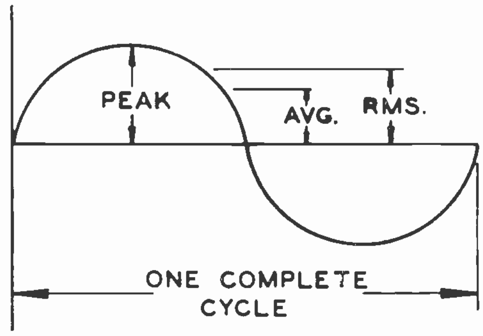


FIG. 1D

V.T.V.M. because in the truest sense of the word it is self-calibrating, and because it does not draw current from the circuit under test. This last advantage follows from the fact that when the negative bucking voltage is exactly equal to the peak positive voltage applied to the plate, the V.T.V.M. circuit will have an infinite resistance to the a-c voltage and no current will flow in the diode from filament to plate (with the exception of the very small current drawn to charge the plate to filament capacity of the diode—which we may ignore for service work). We have mentioned "average," "RMS" and "peak" volts a-c and it may be well before going further to show how these three terms are related for a sine wave type of wave form. The peak voltage of course means the voltage between the zero potential point and the very peak of the a-c wave; RMS volts is equal to .707 times this value; and average volts is equal to .604 times the peak voltage. This relationship is shown graphically in figure 1D. In service work it is not important which of these readings we secure, for most applications, as long as we know what it is. Since all of our service meters are calibrated in RMS volts and we must use RMS volts in measuring power, it is somewhat of an advantage to have our V.T.V.M. calibrated in RMS if a choice is to be made.

A further advantage to consider is the use of such a V.T.V.M. circuit as will permit us to use the tube on a cable so that it can be connected to the circuit under test with very short leads. This will permit us to measure high frequencies with the minimum amount of error due to standing waves on the leads and capacity between leads because the V.T.V.M. tube can be placed very close to the circuit part to be tested, and in most applications the leads need be only 2 or 3 inches long. To reduce still further r-f losses, a tube having a grid connection brought out the top should be selected. If a diode type of V. T. V. M. circuit is being used, this grid as mentioned before can be employed as the diode plate.

The next issue of the Technical Section and following issues will carry articles on the theory, use, construction and calibration of the vacuum tube voltmeter in service work. Be sure to follow these articles for a thorough understanding of this helpful service instrument.