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Eleventh Year *570th Consecutive Issue*

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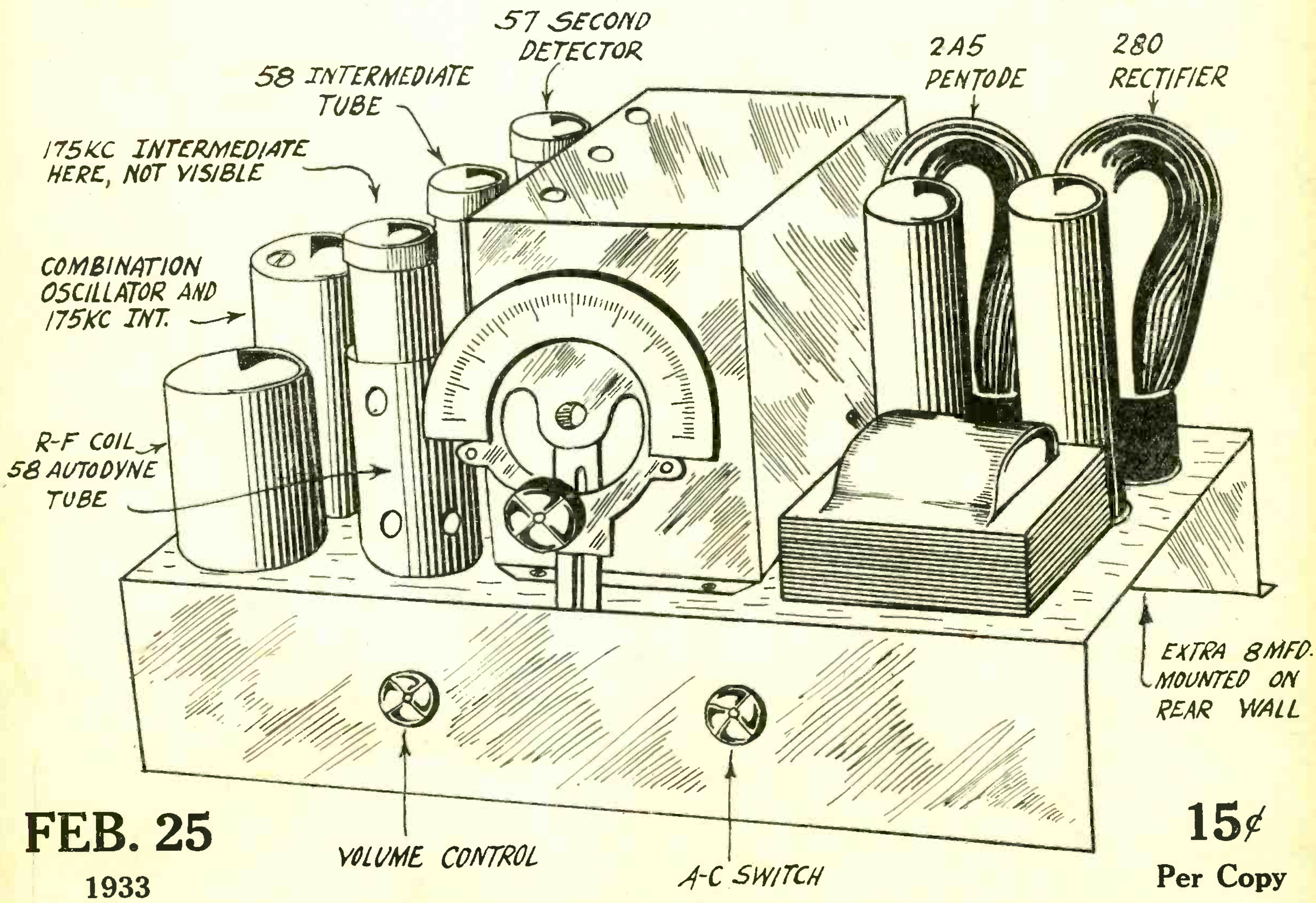
Clarion, Zenith and Bosch Circuits

5-TUBE QUALITY SUPER



FEB. 25
1933

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Per Copy

A simple, effective circuit is used for real tone from a 5-tube super.
See pages 6 and 7.

NEW SERVICE EQUIPMENT

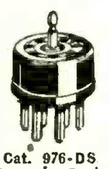
Cat. 907 WLC De Luxe Analyzer Plug, with 5-ft. 8-lead cable attached. Price $3.23

De Luxe Analyzer Plug, with new seven-pin base, with 5-ft. cable (not shown), two alternate grid connector caps and stud socket at bottom that connects to both grid caps. Eight-wire cable assures adaptability to future tube designs, including tubes with 7-pin bases and grid cap soon to be released to the public (2A7, 6B7, 2B7 and 6A7).

The eighth lead connects to the two grid caps and stud socket which is a latch lock. Standard adapters for the De Luxe Analyzer Plug are 7 top to 6 bottom, 7 top to 5 bottom and 7 top to 4 bottom, thus reducing to required number of pins and enabling testing of circuits using all popular tubes. Special adapters, as for UX-199, UV-199, etc., obtainable.

Latch in Analyzer Plug base grips adapter studs so adapter is always pulled out with Analyzer Plug (adapter can't stick in set socket). Pressing latch lever at bottom of Analyzer plug releases adapter. Analyzer Plug is of smaller diameter than smallest tube and thus fits into tightest places. Made by Alden.

Analyzer Plug, 7 pin, with 8-lead 5-foot cable attached, (adapters extra). Cat. 907-WLC @.....$3.23

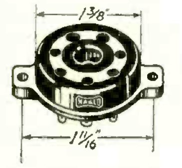


Cat. 976-DS
New plug-in adapter, 7-hole top, 6-pin base, with locking stud that fits into 907-WLC latch. Price .... .73

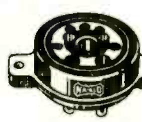
Cat. 975-DS
New plug-in adapter, 7-hole top, 5-pin base, with locking stud that fits into 907-WLC latch. Price ...... .73

Cat. 974-DS
New plug-in adapter, 7-hole top, 5-pin base, with locking stud that fits into 907-WLC latch. Price .... .73

Above three adapters essential for 907-WLC to test UX, UY and 6-pin tubes, including such tubes with grid caps.



CAT. 456-E
In the Analyzer end, use a 9-hole universal socket, that automatically takes UX, UY and six-pin tubes, with errorless connections. Price...... .35



CAT. 437 E
To accommodate 7-pin tubes, which will not fit into Cat. 456-E universal socket, use Cat. 437 E, a seven-pin companion socket, same size. Price .24

If instead of using two sockets, the universal Cat. 456-E and the Cat. 437, the universal alone may be used, with an adapter that has six-pin bottom and 7-hole top to enable putting 7-pin tubes into the universal socket. A 6-inch lead with phone tip is eyeleted to the side. A pin jack you put on Analyzer, connected to seventh lead of 907-WLC cable, picks up control grid of 7-pin tube through the eyeleted lead. Cat. 976-SL ....$ .73

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For switching to nine different positions, enabling current, voltage and other readings. Any one position opens a circuit and closes another. Thus the opener, by interruption, gives access to plate, cathode, etc., leads, for current readings, while the closer puts the current meter in the otherwise open circuit. Opener is disregarded for positions used for voltage measurements. Switch has detent for "snappy" action. Cat. 2NS9-KP-9. ....$ 2.65

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2A5	1.60	.96	'39	1.80	1.08
5Z3	1.50	.90	'40	2.00	1.20
11	3.00	1.80	'41	1.60	.96
12	3.00	1.80	42	1.60	.96
112-A	1.30	.78	43	2.50	1.50
'20	3.00	1.80	44	1.80	1.08
'71-A	.95	.57	45	1.15	.69
UV-'99	2.25	1.35	46	1.55	.93
UX-'99	1.50	.90	47	1.50	.90
'00-A	4.00	2.40	48	3.00	1.80
'01-A	.80	.48	'50	4.00	2.40
'10	5.00	3.00	55	1.60	.96
'22	2.00	1.20	56	1.20	.72
'24-A	1.40	.84	57	1.65	.99
25Z5	2.00	1.20	58	1.65	.99
'26	.85	.51	59	2.00	1.20
'27	1.05	.63	79	2.60	1.16
'30	1.30	.98	'80	.90	.54
'31	1.30	.98	'81	3.50	2.10
'32	1.90	1.14	82	1.20	.72
'33	2.10	1.26	83	1.55	.93
'34	2.15	1.29	84	1.75	1.05
'35	1.50	.90	85	1.60	.96
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'37	1.40	.84			

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Bosch	11	2.75	copper coil.	10¾	1.95
Bosch	10	1.90	copper coil.	12	2.10
Brunswick D.	9¾	2.25	copper coil.	14½	2.85
Brunswick B.	14½	2.75	Peerless wire-		
Brunswick E.	14½	2.75	wound coil.	8½	2.85
Colonial 33...	12¼	2.25	wound coil.	10¾	1.65
Decatur	9½	1.90	wound coil.	14½	2.75
Eveready ...	12¾	2.25	Philco 65-90..	11	1.50
Eveready ...	10	1.90	Philco 20		1.50
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Farrand			RCA 104.....	8	2.00
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First Nat'l ..	10	1.90	Symington ...	12¾	2.25
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NR 80-87...	10	2.75	Stromberg-		
Majestic G1..	9	1.80	Carlson	12½	2.75
Majestic G2..	9	1.80	Carlson	9	2.25
Majestic G3..	11	1.80	Sparton 737..	9	2.25
Majestic G5..	14	2.75	Steinite	10	1.90
Jensen			Temple	9	2.75
D9, D15 ...	8½	1.50	Temple	11	2.75
D4	9½	2.25	Temple		
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Hawley	9	2.25	RE32-45 ...	9	1.35
Oxford	9	1.95	Wright-		
Oxford	8¼	2.25	De Costa ..	10	2.25
Peerless			De Costa ..	12	2.75
copper coil.	8½	1.60	Zenith 52....	12¼	2.25

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AN 8-TUBE UNIVERSAL

Utilizes the New 25z 5 Rectifier

By J. E. Anderson

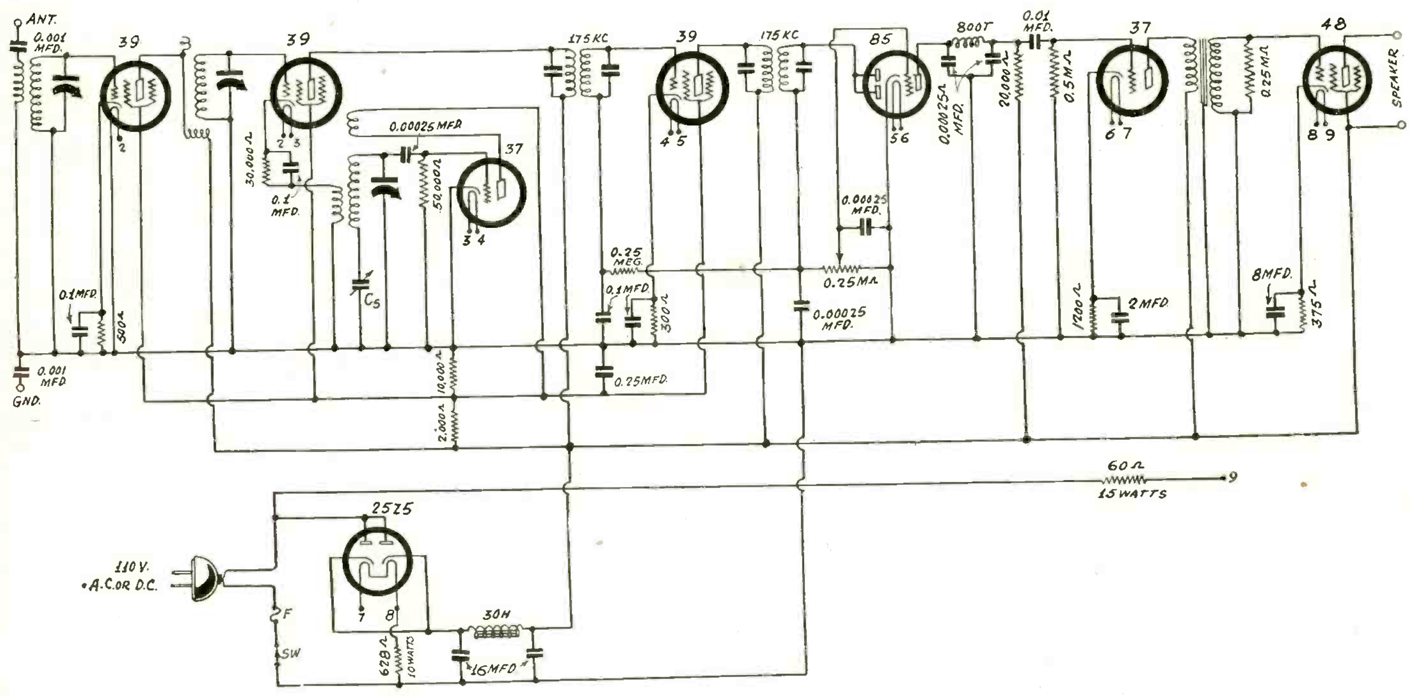


FIG. 1.

This superheterodyne has been designed so that it is universal, that is, so that it can be used on either a-c or d-c lines without any changes.

THE appearance of the 25Z5 rectifier tube has made a real advance in the design of universal receivers possible, because this new tube can deliver sufficient current to accommodate a real power tube in the last stage of the receiver.

The most suitable power tube is the 48, which has been designed especially for d-c operation. It is a low plate voltage tube that will give as much as 2.5 watts undistorted output with only 100 volts on the plate.

An Eight-Tube Super

In Fig. 1 is a typical eight-tube superheterodyne arranged so that it can be connected to either an a-c or d-c line without any change in the wiring. That is, it is a universal circuit.

As in all universal receivers the heaters of the tubes are connected in series. The series begins at the chassis to which one side of the heater of the first tube is connected. The other side of the heater is connected to one side of the heater of the next tube, the two terminals numbered (2) being joined. After that the connections are as indicated by the numbered terminals. Note that at (7) the connection jumps from the amplifier to the rectifier. The reason it does not jump to the 48 is that the 48 takes 0.4 ampere whereas the 25Z5 and the other tubes only take 0.3 ampere. A compensator resistor of about 628 ohms is connected from (8) on the rectifier tube to ground to take the extra 0.1 ampere required by the 48 tube.

Values Computed

The value of 628 ohms was arrived at as follows: Each of the first six tubes in the circuit takes 6.3 volts, making a total of 37.8 volts. The heater of the 25Z5 takes 25 volts. Hence the voltage drop in the first seven tubes in the heater series is 62.8 volts. Any resistor connected in parallel with this will also drop 62.8 volts. Since the current that is to pass through the resistance is 0.1 ampere, the value of the resistance must be 628 ohms. Of course, it is not extremely critical.

The filament of the 48 takes 30 volts and 0.4 ampere. Since a shunt passing the extra 0.1 ampere has been provided we need only determine the ballast resistor between the line and terminal (9). Since the voltage drop in the 0.3 ampere portion of the circuit is 62.8 volts and that in the 48 heater is 30 volts, the total drop in the heaters is 92.8 volts. If the line voltage is 115 volts the drop in the ballast resistor is to be 22.2 volts. The current through it will be 0.4 ampere. Hence the ballast resistor should be 55.5 ohms. If the voltage were 117 volts the required ballast would be about 60 ohms. A few ohms more or less is of little significance, but the resistance should be chosen to fit the average voltage at the place where the receiver will be used.

The shunt resistor is specified at 10 watts whereas the ballast is specified at 15 watts. The normal dissipation in the ballast will be about 10 watts, and if a resistor of this rating is available it can be used safely. The normal dissipation in the shunt resistance is 6.28 watts. The large safety factor is needed because if any one of the tubes in the parallel branch should be removed from the socket or if it should burn out, the dissipation in the shunt resistor will rise to nearly 15 watts.

The Speaker

The loudspeaker offers the only problem in the design of a universal receiver of this kind. There is not enough voltage available to excite the field properly as a choke. Neither is there enough current capacity to excite the field properly if it were attempted to connect the field in parallel with the voltage divider. For d-c the field could be connected directly across the line, but then we would have no provision for a field on the a-c line. Hence if the same speaker is to be used for both a-c and d-c operation, it is best to use either a magnetic speaker of good quality or a permanent field dynamic speaker.

The Rectifier

The 25Z5 tube has two plates, two cathodes, and two heater terminals. Thus the tube requires a six-contact socket. For the purpose of this receiver the tube is used as a half-wave rectifier, the two plates being connected together and also the two cathodes. The plates are connected to one side of the line, which should be the positive in the case of d-c. The two cathodes are connected to an 8 mfd. by-pass condenser and a 30-henry choke coil. Another 8 mfd. condenser is put across the line on the output side of the filter. All this filtering is not needed when the supply voltage is unidirectional, but it is needed when the supply is alternating. The rectifier tube is not needed when the supply is d-c, but it is not convenient to switch it out when not needed and it does no harm to leave it in the circuit.

It should be pointed out that there is no danger to the electrolytic filter condensers from wrong polarity. The cathodes are always plus and if the anodes of the condensers, that is, the red-painted or the central electrodes, are connected to the cathodes, or to the choke, the polarity will always be right. This does not exclude the possibility of plugging the set into a d-c socket in the wrong way. But if it is, nothing will happen and there will be no danger to the condensers.

LIST OF PARTS

Coils

One antenna coil for 350 mmfd. condenser.
One high-gain interstage r-f coil for 350 mmfd. condenser.
One three-winding oscillator coil for 350 mmfd. condenser and 175 kc i-f.
Two doubly tuned 175 kc i-f transformers.
One 800-turn r-f choke (about 10 millihenries).
One audio-frequency transformer.
One 30-henry choke, 100 milliampere rating.

Condensers

One gang of three 350 mmfd. tuning condensers.
Two 0.001 mfd. mica dielectric condensers.
Three 0.1 mfd. by-pass condensers.
Five 0.00025 mfd. condensers.
One 0.01 mfd. condenser.
One 0.25 mfd. condenser.
One 2 mfd. by-pass condenser.
Three 8 mfd. electrolytic condensers.
One 850-1,350 mmfd. padding condenser.

Resistors

One 500-ohm bias resistor.
One 300-ohm bias resistor.
One 30,000-ohm bias resistor.
One 50,000-ohm leak.
One 1,200-ohm bias resistor.
One 375-ohm bias resistor.
One 20,000-ohm resistor.
Two 0.25-megohm resistors.
One 0.25-megohm potentiometer.
One 0.5-megohm grid leak.
One 2,000-ohm resistor.
One 10,000-ohm resistor.
One 628-ohm, 10-watt resistor.
One 60-ohm, 15-watt resistor.

Other Requirements

Five five-contact sockets.
Three six-contact sockets.
Four grid clips.
One one-ampere fuse with holder.
One line switch (may be attached to potentiometer).
One a-c plug with cord.
One eight-tube chassis.
One vernier dial with pilot light.

Protection

The chassis of the set will be "hot" in most instances. This calls for protection against possible shorts in the ground connection or in the antenna. A condenser of 0.001 mfd. is connected in the antenna lead and another of the same value in the ground lead. This eliminates danger.

However, it is well to fuse at least one side of the line. In the drawing a fuse is shown in the chassis side of the line, in series with the power switch. That is the danger side. In the other side of the line the rectifier tube is in series in one branch and the ballast resistor and all the heaters in the other. A one ampere fuse is ample.

There are two r-f tuned circuits in the set. The first coil is a regular antenna r-f transformer while the second is a high-gain coupling coil. Each is tuned with a 350 mmfd. condenser. The oscillator coil is designed for an intermediate frequency of 175 kc and for a tuning condenser of 350 mmfd.

The intermediate amplifier consists of one 239 tube and two 175 kc, doubly tuned transformers. The gain in this tube is automatically controlled by the rectified output of the diode detector.

Half-wave rectification is used in the 85 diode detector, the load resistance being a 0.25 megohm potentiometer. The slider, which is connected to the grid of the triode, is used as a manual volume control in the audio amplifier.

R-F Filtering

There is considerable r-f filtering about the detector and the automatic volume control. In the plate circuit of the triode is a filter consisting of one 800-turn choke (about 10 millihenries) and two 0.00025 mfd. condensers. This filter is to remove r-f ripple that gets into the triode. There is also a 0.00025 mfd. condenser across the load resistance and another of the same value from the grid to the cathode. A 0.25 megohm resistor in the grid return of the i-f amplifier and a 0.1 mfd. condenser across it are used to prevent i-f feedback. The 0.25 mfd. condenser from the screens to ground also serves as an r-f by-pass for it applies only to r-f and i-f circuits.

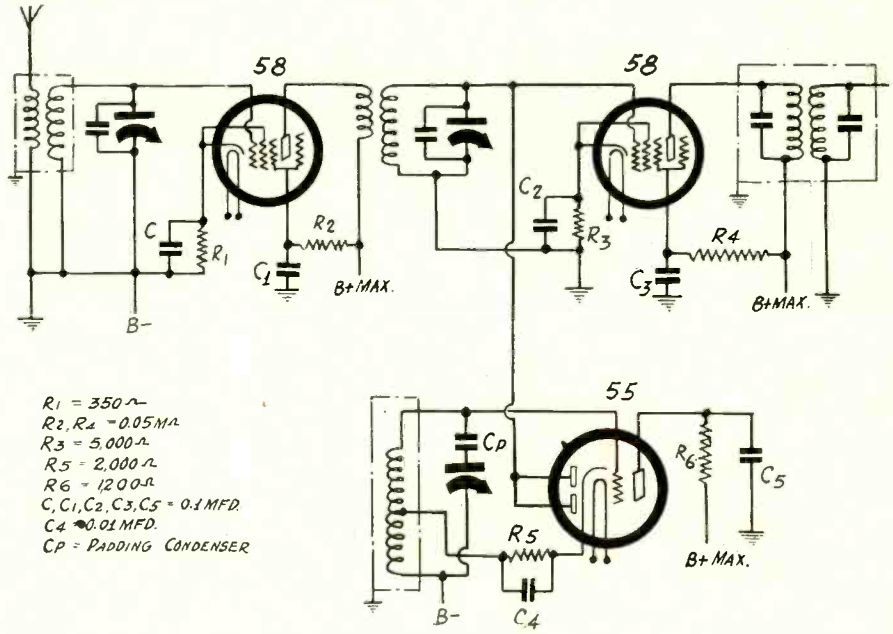
Rather large by-pass condensers are used across bias resistors. Thus in the three 239 tubes there is a 0.1 mfd. condenser across the bias resistance, in the 37 audio tube the condenser is 2 mfd., and in the output tube it is 8 mfd.

The bias resistors are 500 ohms in the first tube, 30,000 ohms in first detector, 300 ohms in the i-f amplifier, 1,200 ohms in the first audio tube, and 375 ohms in the 48 power tube.

ANODE CAPACITY COUPLING

in the Mixer of a Superheterodyne, Using 55 Tube

By Percy Warren



WHEN great sensitivity is required from few tubes, as when the oscillation and modulation functions are combined in one mixer tube, the coupling is necessarily tight. The advantage sought is realized. However, if a tube or two extra makes no difference to the user or constructor, much looser coupling may be resorted to, which requires segregation of the two functions. Selectivity is increased. The negative bias on the oscillator may be made high enough to avoid grid current in that circuit, and likewise the bias may be raised on the modulator for the same purpose.

It so happens there is a small capacity between the anodes of the 55 and the grid of the triode section, so that if the triode is used as oscillator, biased about 20 volts negative on the grid, if the plate voltage applied is 250 volts or a little more, one anode, or two anodes in parallel, may be connected directly to grid of the modulator. The capacity value is not stated in the tube data, but it is assumed to be less than 1 mmfd., and comparing the output when 1 mmfd. was substituted for the anode coupling, the assumption is borne out.

Quieter Operation

While sensitivity is of course less, this may be atoned for by voltage increases on screens and plates, or more audio amplification may be used. Anyway, the circuit is much quieter and even the squeals at the few broadcast frequencies that are harmonics of the intermediate frequency likely will disappear.

A system that insures oscillation is to connect the cathode to a tap on a single oscillator winding. This is shown in the diagram, with the biasing resistor between cathode and tap, bypassed by a condenser. Unless a grid leak and condenser are used, this is the only place to put the biasing resistor, and still have the coil returned to grounded B minus. Also, the lifted position for the padding condenser is requisite. It is not possible to ground the padding condenser with such a hookup.

The confinement of the oscillator coil to three connections, one of which is grounded, has another favorable side, the elimination of danger of having too high a minimum capacity. The distributed capacity in oscillator circuits sometimes renders it impossible completely to cover a desired band, but with a system such as shown, and a condenser with minimum not exceeding 20 mmfd., it is possible to tune in signal frequencies from 530 kc to even higher than 1,800 kc, and thus bring in some police calls, television and amateurs.

Oscillation Voltage Limit

If the intermediate frequency is 175 kc, then the oscillator would tune from 705 kc to 1,975 kc. This can be done with a padded 0.00035 mfd. condenser, or even a greater frequency span covered with a somewhat higher capacity, say, 0.00041 mfd. Of course the t-r-f tuning must support this span, too, i-e-, there must be tracking.

The values used are shown on the diagram. It is intended that the bias voltage on the 58 used modulator be 10 volts, but as the 58 tubes do not run as uniform as some other tubes, the actual bias may be a little more or less. You may measure it directly with the usual voltmeter.

The oscillation voltage should not be as large as the bias voltage on the modulator, and the usual recommendation is to limit it to 1 volt less, here 9 volts. Since an oscillator may develop an oscillation voltage in the grid circuit of 100 volts without the constructor displaying any ingenuity at all, some idea should be obtained of what the actual biasing voltage is. If a C battery is connected in the modulator circuit, between coil return and B minus, with negative to B minus, the return may be moved to various positive battery voltage values, say, 1.5, 3, 4.5, 6, 7.5, 9, etc., and the current in the plate circuit of the modulator noted. This current will be greater, than without the battery in circuit, for the bias is actually being decreased, since the battery voltage bucks the cathode-drop potential. In fact the grid may become positive, after the 9-volt connection, and current will rise sufficiently to warrant the exercise of care about the safety of the sensitive meter. Use a lower sensitivity meter setting them.

Use of Modulator as VTVM

A curve may be plotted, plate current against grid voltage. In determining the grid voltage the biasing battery voltage should not be subtracted from the normal voltage drop in the cathode resistor, because as the bias is decreased the current through this resistor is increased, so each time the plate current is noted for a battery voltage introduction, the voltage across the biasing resistor should be measured, and the actual bias voltage computed as the difference.

When and if the bias voltage becomes positive the cathode resistor voltage should be subtracted from the battery voltage. This point can be determined by the indication of large increase in plate current.

Oscillation Amplitude

Then, of course, if the oscillator is disconnected from the modulator, and the plate current read, then oscillator connected, and plate current read again, the oscillation voltage may be determined from the chart by the equivalent amount of decreased bias voltage represented by the increase in plate current. Thus the modulator is used as a vacuum tube voltmeter.

Oscillation Amplitude

Another measurement that can be made this way is the determination of how much of a change in oscillation amplitude takes place throughout the sweep of the oscillator dial. To make this measurement disconnect stator of the modulator tuning condenser, connect oscillator as in diagram (anode to grid of modulator), and note the change in plate current and corresponding grid bias voltage. Many probably will be surprised at being unable to discover any change. This would be a tribute to the amplitude stability of this type of oscillator.

Any who change an existing superheterodyne mixer to conform to the present plan should be prepared for diminished sensitivity, and if greater sensitivity is desired should use an extra stage of intermediate amplification or an extra stage of audio frequency amplification.

Standard Resistor Code

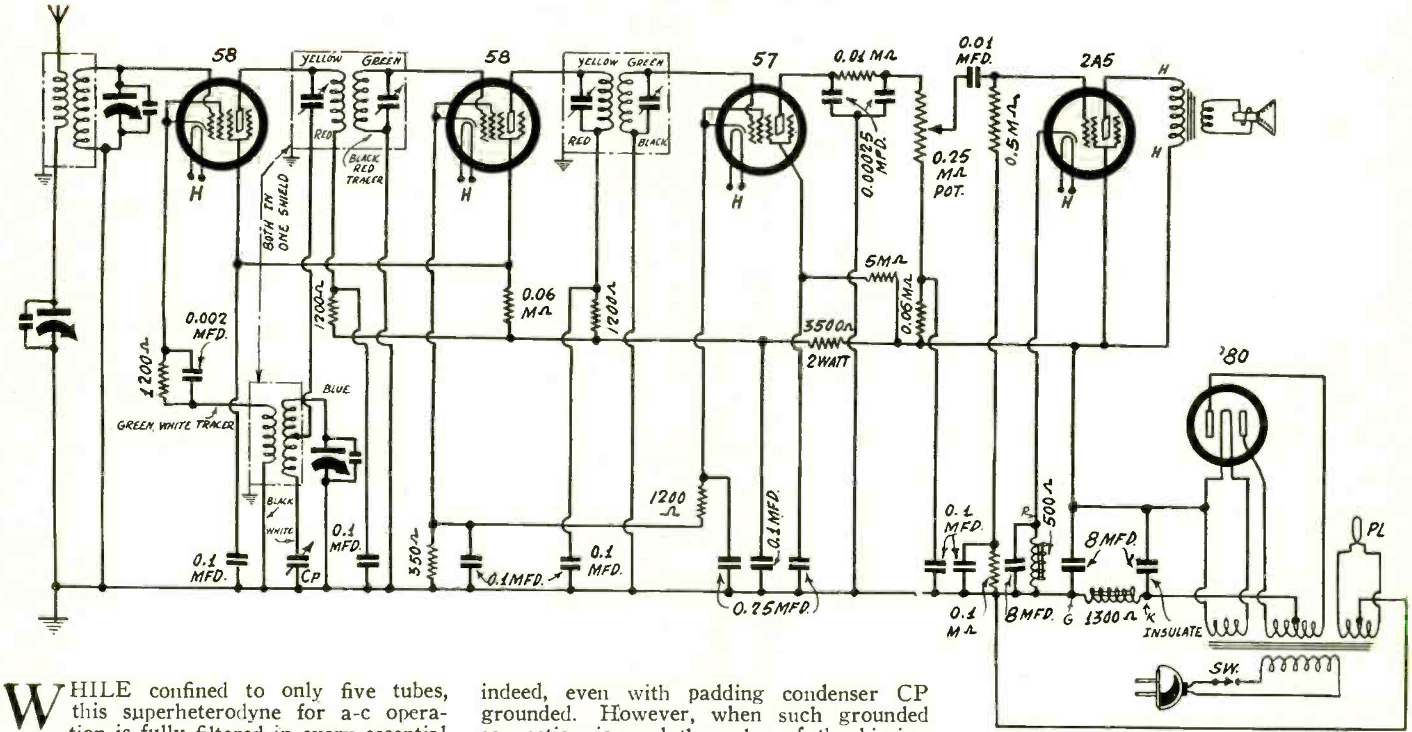
For First or Second Significant Figure		*Number of Ciphers After the Significant Figures*
Black	0	None
Brown	1	0
Red	2	00
Orange	3	000
Yellow	4	0000
Green	5	00000
Blue	6	000000
Violet	7	——
Gray	8	——
White	9	——

The color for the first or second significant figure follows this code: body color denotes first significant figure; end color denotes second significant figure; dot denotes number of ciphers after the first two significant figures.

TONE IN SMALL SUPER

Five-Tube Set Has New 2A5 Output

By Randolph Blickensdorfer



WHILE confined to only five tubes, this superheterodyne for a-c operation is fully filtered in every essential particular and has a tuning arrangement that makes the response virtually uniform over the broadcast span of frequencies.

There are two tuned circuits, one for the antenna coil secondary, the other for the oscillation, although a three-gang condenser is used. The extra section of the gang is a series condenser that increases the input at the low radio frequencies and thus tends to level out the response. Otherwise, due to the t-r-f section, there would be somewhat higher amplification at higher frequencies.

Since the common rotor of the three-gang condenser is grounded the section used for series adjustment of input must have its rotor grounded, and therefore the one must connect the stator to the return of the antenna coil. Thus the antenna winding does not go to ground directly but through this section of the tuning condenser.

58 As Autodyne Tube

The 58 is used as the combination modulator (first detector) and oscillator. The tuned input in the control grid circuit accounts for the signal frequency. Since an intermediate frequency of 175 kc is to be used, the oscillator must tune to frequencies higher than the signal frequencies by 175 kc. By padding the oscillator's tuned circuit, and using suitably smaller inductance for the coil in this circuit, the tracking becomes excellent.

The oscillation coil and the first intermediate frequency transformer are in a single aluminum shield, 4.5 inches high, and in the factory construction of this coil the condenser that tunes the primary of the intermediate has one side to the center tap of the oscillation winding. Thus plate circuit current is delivered to the oscillation winding, and oscillation results because the grid circuit is coupled to the tuned winding of the oscillator by the pickup coil in the cathode leg. The cathode circuit is in both the grid and plate circuits, as in all amplifier tubes.

The autodyne, or combination oscillator and modulator tube, a 58, this works well indeed, even with padding condenser CP grounded. However, when such grounded connection is used the value of the biasing resistor must be less than if the padding condenser were "lifted" (between stator and coil), and less also if the biasing resistor were put between pickup return and ground, instead of, as shown, between cathode and pickup coil.

The Biasing Resistor

The biasing resistor is shown as 1,200 ohms, as that will provide oscillation infallibly. However, higher value of resistance may be used here, but one soon reaches the point where oscillation becomes incomplete. At 3,500 ohms, for instance, oscillation would stop entirely, but at around 2,500 ohms it might prevail up to about 600 kc, with silence from 600 to 540 kc. That would be incomplete oscillation and would indicate the necessity of reducing the resistor to 2,000 ohms. Since 2,000 ohms is fairly safe, any who have that value of resistor may use it.

The 58 is an excellent tube for the purpose, as it reduces the tendency to cross-modulation, as compared to the 57, especially in a circuit that has only one stage of real tuning to the signal level. The desired extra selectivity is obtained through the use of the series capacity in the antenna circuit and by confining oneself to a short aerial, as a long one will not be needed, anyway. The circuit is sensitive enough to produce room volume on distant stations with a short aerial, due to the gain in the modulator circuit (equal to about 30 times), to the 100-gain in the first intermediate amplifier tube (second 58 from left) and to the inclusion of the highest-mu output tube so far offered to the public, the 2A5, with an amplification factor of 220, as compared to 150 for the 59 and 100 for the '47.

The Highest Mu Tube

As pentodes are used as output tubes when high sensitivity is essential, it is well to select the most sensitive pentode, and the 2A5 is it. The tube is just beginning to be available in the general market, although laboratories have had it for from several months to several weeks. It is like the '47, but the mu is more than twice as great, and the independent heater type of construction is used, instead of the filamentary cathode system present in the '47. The bias is the same requirement, 16.5 volts negative, but may be a little higher, and the output impedance required is the same, so that '47 type speakers may be used. The socket required is of the six-spring type, whereas the '47 required a UY (five-spring) type.

It is important that the oscillation be not too great in the first tube, otherwise self-overload would result, with strong second harmonic distortion, but by using a relatively small capacity for bypassing (0.002 mfd.) the biasing resistor, instead of 0.1 mfd. or the like, the oscillation intensity is kept within required limits. The whole circuit may become unstable and erratic if this bypass condenser is of too high a capacity.

The 57 Detector

The tuned plate circuits have resistor-capacity filters, to prevent the currents in one circuit from being back-coupled, a condition of feedback that would result in squealing. The maximum voltage, which may be 275 volts between filament of rectifier and ground, is reduced to around 160 volts by a 3,500-ohm 2-watt resistor, which because bypassed also serves as part of a filter. The screen voltage on the 58's is high compared to the plate voltage, or around 100 volts, to keep the sensitivity high.

Because of the plate voltage of around 150 volts, the 350-ohm resistor biasing the intermediate will develop a bias voltage, or drop, of around 3 volts, which is sufficient, especially since the amplification is high when approximately this biasing voltage is used. This resistor, too, must be bypassed, and 0.1 mfd. serves the purpose.

The 57 as detector is very sensitive, hence

LIST OF PARTS

Coils

Two r-f coils, in aluminum shields, 2⅛" diameter x 2½" high
One combination oscillator and 175 kc intermediate coil in aluminum shield 2⅛" diameter, 4½" high
One 175 kc intermediate transformer
One power transformer for five-tube pentode output receiver.

Condensers

One three-gang 0.00035 mfd. tuning condenser, with trimmers built in
One shielded block containing seven 0.1 mfd. and two 0.25 mfd. condensers
One padding condenser, 850-1,350 mmfd
Three 8 mfd. condensers, one of which should be dry and have bracket so as to be mounted horizontally underneath chassis
One 0.01 mfd. stopping condenser
One 0.002 mfd. fixed condenser
Two 0.00025 mfd. fixed condensers.

Resistors

One 350-ohm pigtail resistor
Four 1,200-ohm pigtail resistors
One 0.01 meg. pigtail resistor
One 3,500-ohm 2-watt pigtail resistor
Two 0.06 meg. pigtail resistors
One 0.1 meg. pigtail resistor
One 5.0 meg. pigtail resistor
One 250,000-ohm adjustable voltage divider.

Other Requirements

One drilled chassis, 13¾ x 3 x 8.5 inches
One vernier dial with travelling light escutcheon
One a-c switch
Two knobs, one for switch, one for volume control
Six sockets, e.g.: four six-spring, one four-spring, one five-spring. (The UY socket is for speaker plug)
One a-c cable and attachment plug
One dynamic speaker, 1,800-ohm field coil, tapped at 500 ohms; output impedance, 7,000 ohms
Three insulated bushings tapped at both ends for 6/32, and two lugs for use on bushings for high-voltage lead and for autodyne biasing resistor
One roll of hookup wire.

is included, but it is not worked in the manner consistent with greatest sensitivity but rather consistent with best tone. When the screen has a high resistance load, here 5. meg., hence a low voltage, the detecting quality is improved, although the radio frequency sensitivity is reduced. That is, the tube handles both intermediate and audio frequencies, and if the 5 meg. were of smaller value, say, 0.25 meg., the signals would be louder but nothing like the fine quality obtainable from the receiver would be enjoyed. The low screen voltage has an extremely beneficial effect on quality, a point restated and emphasized because many do not realize what splendid quality reproduction can be obtained from this detector tube.

Hum Cures

The bias on the 57 is about the same as that on the intermediate tube, because for quality the 57 should be worked at small actual negative bias. While this increases the danger of overloading the second detector, a suitable short aerial, also required for other reasons, will overcome the difficulty. The plate-screen-suppressor currents in the 57 will be small, around 0.1 ma. so the drop in the 1,200-ohm resistor, adding to the bias obtained from the 350 ohms common to the two cathode circuits, is negligible, and the 1,200 ohms is included only because it serves as part of a filter that prevents the 57 from becoming microphonic. This resistor and 0.25 mfd. capacity constitute the filter.

In the plate circuit of the 57 is a resistor of 0.01 meg. (10,000 ohms), used only to provide two different potentials for bypassing the radio frequencies in the plate circuit to ground. The effective load on the plate circuit is an adjustable voltage divider, 0.25 meg., with arm connected to one side of an 0.01 mfd. stopping condenser, and used thus as a volume control. This type of volume control does not produce any detuning.

As a precaution against undesired feedback, including hum, in the detector circuit, the plate reaches the positive voltage finally through a resistor of 0.06 meg. (60,000 ohms), bypassed by 0.1 mfd., so that the signal is substantially removed from this resistor. Also for hum-eradication reasons a filter is in the grid circuit of the 2A5, consisting of 0.1 mfd. and 0.1 meg. In some instances this intended hum filter increases hum, but that does not happen often, and also when it does happen, hum is then at its lowest level anyway with the filter out.

Sometimes But Not Always

The connections to primary of the output transformer should be reversed experimentally, and it may be found that when they are connected one way there is less hum with the filter in, and when they are connected the opposite way there is less hum with the filter out. This is because the grid circuit filter is a phase-shifter, and reversing primary connections also shifts the phase, so application of both intended remedies sometimes works to the end of making no improvement where there is considerable hum, but always the grid circuit hum filter will help when hum is bad, while the primary reversal sometimes does not assist at all.

As the circuit is intended for those particular about tone, and as hum militates against best tone, the precaution for obtaining the smallest amount of hum (less than 3 per cent.) are given.

In the same connection, and in line with tone quality considerations, a part of the field winding of the dynamic speaker is used for biasing the 2A5. As the plate current and screen currents will be around 40 ma, suitable bias for the tube is obtainable from the drop in a resistor of 500 ohms, for 20 volts is a satisfactory bias, especially as the signal reduces the bias. The d-c resistance of part of the field winding is used for biasing, but across this section is a dry condenser of 8 mfd., also in the interest of best tone.

Speaker Plug Connections

Especially in a high mu tube must there be a large capacity across any such biasing resistor, for the degenerative effect of capacity total omission is proportional to the mu of the tube. So the field coil consists of a total of 1,800 ohms, of which 1,300 ohms is used as B supply choke in the negative leg, and 500 ohms for biasing. The field coil is therefore rated at 1,800 ohms tapped at 500 ohms.

The five leads from the speaker terminate in a UY plug, and the speaker socket connections for the present use are, as diagrammed: H and H interchangeably to plate and B plus, G to ground, P to cathode of power tube, and K to B minus of power transformer.

Compared to T-R-F Set

The values specified throughout the diagram should be followed as closely as possible, except that perhaps a higher value of resistance may be used in the grid circuit of the power tube, where 0.5 meg. is specified, and the 1,200 ohms in the autodyne cathode leg may be increased. It is generally preferable to have a higher value of resistance, but if any grid current flows, the higher resistance tends to make the power tube lose bias quickly, and the plate current might run very high, due to positive grid. It might reach 70 or 80 ma or more on occasions. If you have a 0-100 milliammeter, put it in the plate circuit of the power tube if you try out higher resistance values, say, 1 to 5 meg., and notice whether the current in that tube increases greatly on loud signals. If it does, revert to 0.5 meg. Higher values of resistance in this position tend to reduce hum, but the new tube is of the low hum-level type, due to heater construction, and there should be no trouble whatever from hum.

The seven 0.1 mfd. condensers and the two 0.25 mfd. condensers are obtainable in a convenient small assembly as one unit, with wire leads emerging. The black lead goes to ground, while the seven similar blue leads go to the designations shown for 0.1 mfd. and the two similar leads of a different shade of blue go to the destinations shown for 0.25 mfd. The two 8 mfd. condensers in the B filter go atop the chassis, and may be wet or dry, but be sure that one of them is insulated from the chassis. Some types of 8 mfd. condensers are automatically insulated because provided with two wire outleads, red for positive, black for negative. In that case connect the black for the "insulated" position to B minus, and the black of the other condenser to ground. Both reds go to B plus. This lead, by the way, may be taken from one side of the rectifier filament winding or, if that winding is center-tapped, then from the center.

The 8 mfd. for bypassing the 500 ohms of the field coil should be a dry electrolytic with bracket, mounted horizontally underneath the chassis.

The five-tube superheterodyne, generally speaking, is superior to the five-tube t-r-f set in both sensitivity and selectivity, not so much in sensitivity as in selectivity. In the present instance the same holds true, but there is the added advantage that tone is given front-rank rating, and there is no reason to suppose that the tone will not be as good as from a t-r-f set, provided the padding is done properly. One result of improper padding is to cut down the low-frequency audio response, making a circuit sound raspy, a condition often wrongly ascribed to the effects of the power tube.

The procedure for padding has been given several times in recent issues of this magazine, and details at the present are out of order. See "Detailed Procedure for Accurate Padding," by Herman Bernard, in the February 11th, 1933, issue, pages 3, 4, 5 and 6.

Padding Summarized

A summary of the procedure follows:

(1)—Line up the intermediate channel accurately at 175 kc. Connect output of test oscillator, which is set at or for 175 kc. to plate of the autodyne, with tube in socket. Use a clip if necessary but take precautions against shorting to chassis. Short the r-f input by putting a wire from grid cap of first 58 to chassis or ground. Tune intermediates for loudest response or, if an output meter is used, for greatest deflection of the needle.

(2)—Remove shorting strap, remove oscillator connection, set test oscillator at 600 kc. and put oscillation voltage into antenna post of the receiver, and adjust padding condenser for greatest response. Adjust the trimmer on r-f input tentatively.

(3)—Reset the test oscillator for 1,450 kc, turn the receiver dial until the oscillator's modulation is tuned in, and readjust both the oscillator and the r-f trimmers until response is greatest.

(4)—Do not touch either trimmer again, but set test oscillator at 600 kc, return to previously padded point, and determine if readjustment is necessary to increase response, as previous padding may have been upset by trimmer adjustments.

In addition, as a new suggestion, after the set is working well, you may be able to improve the i-f alignment by readjusting the channel on the basis of tuning in a distant station that is only 10 kc removed from a strong local. Tune for clearest reception of the distant station, and then slightly, ever so slightly, readjust the condensers across the intermediate coils, to determine whether selectivity can be improved that way, indeed, interference from the local blotted out. The reason for this suggestion is that the test oscillator may have delivered a strong modulated signal that rendered fine adjustment less easy than when one uses a weak distant station.

1933 RULING TOPIC
is Frequency Stability, an Esoteric Subject

By Adam Forthworth

FREQUENCY stability promises to be the outstanding subject of 1933. It is being investigated by the most prominent physicists and scarcely a text book or report that is at all comprehensive is published without giving some space to frequency stability. Not only is it important in short-wave work, but it applies to the broadcast frequencies and no doubt to the lower frequencies as well, the importance being about in proportion to the relative frequencies concerned.

In short-wave work a complex situation is developed, due to the numerous transmissions on unsteady frequencies. With transmitters "wobbling" considerably, it seems to be a drawback to have a frequency-stabilized local oscillator and a selective receiver throughout, as the wobbulation causes the signal to tune itself out, so to speak, and the receiver is not at fault. So for such reception a grid leak type of oscillator, with the leak in shunt with the tuned circuit for the greater damping effect, seems preferable. Moreover, in double detection systems, the intermediate amplifier would have to be less selective that could be attained were it worth while.

Much Recent Help

However, it is more important that the transmitters themselves be held to a better constancy, than that receivers be made broad enough to cope with wobbulation of carrier frequencies. While crystal control may not be available for many of the short-wave transmitters, as so many such plants are not commercially supported, better methods of organizing tube circuits, to afford real stability, may be applied, and recently investigators have reported on systems that do produce stable results. Llewellyn showed capacity and inductive balancing, in grid current oscillators, producing a most exceptional degree of stability, applied principally to fixed frequency tuning, and therefore excellent for monitoring. Dow contributed the electron coupling method at the same time, designed to make the frequency immune from detuning effects of the fed circuit. Arguimbau treated of a constant output circuit, using a triode and a rectifier, whereby the plate impedance was held constant due to bias control by the oscillation-driven rectifier in a circuit linear as to modulation characteristics and fairly stable as to amplitude.

The subject of frequency stability is being investigated in several countries by their leading scientists in the radio field, the Radio Research Board, Department of Scientific and Industrial Research, Great Britain being at present deep in its studies and laboratory work on this very topic. The Bureau suggests that change in the elemental capacity of the tube has much to do with frequency changes, a point not raised before, as the American scientists have been working on the theories of changes in d-c resistance and impedance.

British Have a Circuit

However, the British group, in conjunction with the National Physical Laboratory, is taking up the matter on a large scale, and already has applied remedies for night errors in direction finders, and correlated problems, although the more usual transmission and reception purposes in which constructors are interested have not yet been made the subject of a report. A circuit has been devised and built. Evidently a practical checkup of theoretical determinations is being made.

A constant-frequency oscillator of the variably-tuned type evidently was sought in the dynatron circuit, but abandoned, for the Britishers came to the same conclusion as the Americans, that the dynatron's frequency instability is one of its outstanding blemishes. The degree of accuracy aimed at was high, but if one will tolerate less accuracy, as the Board points out, the dynatron will serve useful purposes. Variations in the supply voltages caused the trouble.

The Board was at a loss to understand the large changes, for the accepted theory, having to do largely with either d-c resistance or impedance, could not account for them.

"It was thought that they could be accounted for by an actual variation, with operating conditions, of the inter-electrode capacities of the valve, and experimental results were found to be consistent with this theory," says a recently-issued report of the Board.

Suspect Other Contributants

"A further analytical investigation has, however, suggested the possibility that variation of amplitude and consequent variation of harmonic content may contribute to the frequency variation, and this point will be further investigated experimentally.

"It has been shown analytically that the condition that the frequency of a valve-maintained oscillator shall be independent of the valve characteristics is that the action of the valve shall be equivalent to the introduction of a pure negative resistance into the oscillating circuit. Existing types of oscillating circuit in which it is sought to eliminate the effect of the valve characteristic are found to be particular applications of this general principle. Pure sine wave form is a further condition that needs to be satisfied, but which can not be fully satisfied in practice.

"The National Physical Laboratory has been requested by the Board to undertake the development of a simple constant-frequency oscillator, free from the usual methods of frequency control, and the work on this subject is proceeding on two parallel lines: (a) investigation of circuit conditions which minimize the effect of valve characteristics on the frequency; (b) design of an oscillatory circuit (inductance and capacity) of which the natural frequency shall be independent of environmental changes (temperature, pressure, etc.).

New Compensation Method

"The work on item (a) has now reached the stage where experimental oscillators are being examined for variation in frequency due to battery voltages and other causes, while a considerable amount of preliminary analytical work has been done on item (b). The possible frequency errors due to temperature and pressure have been examined and work has commenced on checking these errors experimentally by subjecting the various oscillators to temperature and pressure changes.

"A tentative design of an oscillatory circuit has been produced and tests will shortly be made on this system when built. The general principle is to compensate both the inductance and the capacity for temperature by a bi-metallic system in which the unequal expansion of dissimilar metals gives rise to a change which compensates for the linear expansion of the coil and the plates of the condenser. The pressure variations may be eliminated by enclosing the tuned circuit in a hermetically-sealed box."

Work on Tuning Forks

It can be seen therefore that the British are applying themselves to the topic in a firm and sweeping manner, and have set for themselves a somewhat higher goal than have the Americans, who dismiss the temperature topic by using a temperature oven for the inductance stability but seem to have forgotten a bit about the plates of the condensers. However, the British aim may be inferred from the goal sought in another frequency-stable circuit, that of a driven tuning fork. Tests have been made in cooperation with the Post Office Engineering Research Station at Dollis Hill, where a standard tuning fork is maintained in continuous operation within a thermostatic enclosure. Comparisons every few minutes were made over a five-hour period. The difference between the Post Office and the National Physical Laboratory tuning forks over the five-hour period was 20 parts in 100,000,000. Later tests showed a greater disparity, due to barometric changes and room temperature effects. A slight earthquake in southeast England caused a small change in the rate of the pendulum clock—about 4 parts in 10,000,000—revealed on the tuning fork chronograph, but the tuning fork itself was not affected by the shock.

"The experience gained in the design and installation of tuning forks has been passed on to an instrument maker," says the Board's report, "who has made a first model of a temperature-controlled and pressure-constant tuning fork, which, with phonic motor, will constitute a primary frequency standard or clock of accuracy considerably better than 1 part in 10,000,000, i.e., 0.02 to 0.03 second per day."

How to Stabilize a Fork

As part of the work on tuning forks it has been found that to attain frequency stability it is necessary to balance the two prongs so that no rotary vibration is transmitted to the base. Heavy clamps used for such balance make possible the actual frequency stability of laboratory forks whereby the change is only 3 parts in 10,000,000.

Since the radio science, as such, is concerned with audio frequencies, the frequency-stable tuning fork is interesting, although the audio frequencies in radio need not be held to any such constancy.

The report of the Research Board is obtainable from the British Library of Information, 270 Madison Avenue, New York, N. Y. (55 c).

Short-Wave Book

Another good work from the British domain is "Short-Wave Wireless Communication," by A. W. Ladner, superintendent of instruction, Marconi's Wireless Telegraph Co., Ltd., and C. R. Stoner, formerly of the research department of the same company, now a lecturer at East London college. The book ($3.50) is published in this country by John Wiley Sons, Inc., New York.

The authors have been given the run of the Marconi works, circuits, maps, plans and systems, and have embodied in their book therefore much that has been experimentally determined in the great British commercial radio institution. The peculiarities of short waves, the needs for transmission and reception to gain desired ends, a history of short and ultra waves, with detailed treatment of short-wave specialties, such as reflectors and aerial arrays, and a great practicality embodied in the writing of all details, make the book valuable to those interested in short waves. Enough is there to interest the experimenter and home constructor, even though much of the book concerns itself

(*Continued on next page*)

BUZZER MODULATION

Easily Adapted to R-F Oscillators

By C. W. Lyon

ONE of the simplest modulated radio frequency oscillators is the buzzer-excited tuned circuit. The buzzer is a well-known device. It is similar to a bell but has no clapper. It consists of an electromagnet, a battery, and an armature-switch. When the circuit is closed the current through the magnet winding causes the armature to be pulled toward the magnet. This operation breaks the circuit and permits the armature to return. But just as soon as it does so it closes the circuit again and once more the armature is pulled and the circuit is broken. This goes on as long as the power is allowed to be on.

The frequency of the buzzing depends on the length of time it takes the armature to move back and forth between the contact point and the magnet pole face, which in turn is really determined by a spring of some kind. It mav be the natural springiness of the armature or it may be the springiness of a steel helix controlling the armature.

Avoiding Sparking

Failure of buzzers is often due to sparking at the contact, that is, the point where the circuit is opened and closed by the armature. The sparking is directly due to the discharge of the magnet field coil every time the circuit is broken. All the energy stored in the field must be dissipated suddenly and the dissipation takes the form of a hot spark. The heat is so intense that the contact surfaces become corroded or melted. Failure of operation is only a matter of a short time.

As a means of killing the spark a resistance may be connected in shunt with the field winding. Then as the circuit is broken the energy does not have to dissipate in the spark gap but can dissipate slowly in the resistance.

Suppose now that the circuit be cut and that a coil and a condenser, connected in parallel, be connected in the gap. The buzzer circuit is practically the same as before because the d-c resistance added by the r-f coil is negligible. But now the making and breaking of the circuit will excite radio frequency oscillation in the coil and the condenser. While the circuit is made, energy is stored both in the field winding and in the inductance of the r-f coil. When the circuit is broken the energy stored in the field magnet will dissipate in the resistance connected across it, while the energy stored in the r-f coil will dissipate slowly in the resistance of the radio frequency coil.

If this resistance is small, there will be an oscillatory current flowing in the coil and the condenser. This oscillation will start suddenly when the circuit is broken by the magnet and it will continue until all the energy stored in the r-f coil has been dissipated in the coil resistance. This may occur before the magnet breaks the circuit again. At any rate, the magnet will start radio frequency oscillations in the condenser and coil circuit at every break, and the amplitude of oscillation will die down between the breaks. The radio frequency current generated, therefore, will be modulated by the characteristic spark, or at a rate equal to the frequency of the armature of the magnet. It is clear, therefore, that a little steel helix can be used for modulating the radio frequency current in a coil, provided the helix controls the rate of making and breaking an exciter circuit.

Series Connection of Circuit

The r-f circuit can also be connected in series. That is, the condenser and the coil are connected in series and then put in the buzzer circuit. The closing of the magnetically operated switch completes the r-f circuit as well as the magnet circuit. Opening of one opens both. While the circuits are closed a field is built up in the magnet and the high frequency oscillations take place. When the switch is open the field energy discharges through the shunt resistance and the condenser in the r-f circuit charges up to a voltage of the battery in the magnet circuit.

Broadness of Tuning

When the signal generated by a buzzer-excited circuit is tuned in with another resonant circuit, the signal appears to be broad even though the receiving circuit is selective. How is this? Is it possible that the buzzer signal contains many frequencies? Yes, it is possible and an actuality. The modulated current can be represented by a Fourier series in which the frequency of the buzzer is the fundamental. If the buzzer frequency is 1,000 per second and the radio frequency circuit is resonant to 1,000 kc the 1,000th harmonic of the buzzer frequency will be equal to the resonant frequency of the r-f circuit. But the receiving circuit will accept with almost the same facility the other harmonics near the 1,000th. Certainly it will accept the 1,005th and the 995th and all between, for these will differ from the resonant frequency by about the same amount as the side frequencies of speech differ from a 1,000 kc carrier.

But why are not all the harmonics of about the same strength? That is, the harmonics between, say the 950th and the 1,050th? Because the buzzer-excited oscillator picks out that of its own natural frequency and enhances its value. Those harmonics that are relatively close to the natural frequency are also picked out more or less and intensified.

High Resistance Circuit

Another reason for broadness is that the resonant circuit is likely to have a high resistance. The higher the value of R the more quickly will the oscillations die down after they have been started. And the quicker they die down the more energy will be contained in the harmonics of the buzzer frequency.

Close coupling is still another cause for broadness. The receiving circuit used for detecting the buzzer-excited oscillation should be coupled just as loosely as practical to the source. Just what the coupling should be depends on the detector circuit and it can always be determined quickly by moving one coil with respect to the other.

The buzzer-excited oscillator raises a practical problem in connection with vibrating rectifiers in automobile sets. The buzzer there used for obtaining the high voltage is exactly of the same type as that used in buzzer-excited oscillator. If there should be a tuned circuit attached to the buzzer which might well happen by chance, there will be a broadcast station right in the car, and it will give rise to a great deal of interference. As a matter of fact, the spark itself is a source of interference and may induce noises into the signal. For that reason the spark should be killed. As was suggested in connection with the buzzer, this may be done by connecting a resistance across the magnet winding, a resistance that will take the energy contained in the field and dissipate it slowly. A condenser of rather large value in series with the resistance will usually improve the spark-killing effect.

Superheterodyne Liked for Short Waves

(*Continued from preceding page*)

with practice in the commercial message field.

The book has a good word to say about the super-regenerative receiver for short waves, although this particular hookup has been associated with much "trouble" in this country and has never gained popularity here. The authors say of it that it is more sensitive than the more usual type of regenerative hookup, but note that the noise level is high. These two companion statements are practically the same thing.

As between the super-regenerator and the superheterodyne, the book does not take sides particularly, although the superheterodyne is lauded for the gain at a fixed frequency level, permitting stability because of a low frequency of amplification, whereas for still greater sensitivity two local oscillators and two intermediate frequencies may be used, as in commercial practice, state the authors.

The Radio Research Board, by the way, in its report for 1931, from which excerpts have been quoted in the earlier part of this article, finds the superheterodyne far superior, the super-regenerator good, and the simple regenerative receiver pretty good at that. Both commend the Barkhausen-Holtz oscillators, and recent improvements thereon, for the ultra frequencies.

The grid leak type of oscillator is cited by Messrs. Ladner and Stoner as rendering itself more workable as an autodyne oscillator for short waves, than the negative grid bias type where the bias is supplied through a battery or drop in a bleedor or cathode resistor. The reason stated is that a grid leak oscillator requires no more power to start it oscillating than to continue it oscillating, whereas the other negative bias type takes much more power to start than would be required to continue. As a result, the negative bias oscillator in action may oscillate far too much for the requirements.

Many practical observations such as these are in the book, which consists of 348 pages, is extremely up-to-date and affords an excellent review of short waves and ultra waves, with quite some space devoted to frequency stability. Unstinting acknowledgement is given to Americans, not often found in British or any other foreign radio text books. However, that attitude by foreigners may be turn about to constitute fair play, as American text book authors also prefer to quote one another rather than go afield for their citations. The language barrier may be the reason sometimes, but it can't be raised as to the British and the Americans, and possibly the Ladner-Stoner book will encourage American authors to be a bit more liberal too.

4-Tube
A Simple Variometer
SET FOR BEGINNERS

By Paul C. Erwin

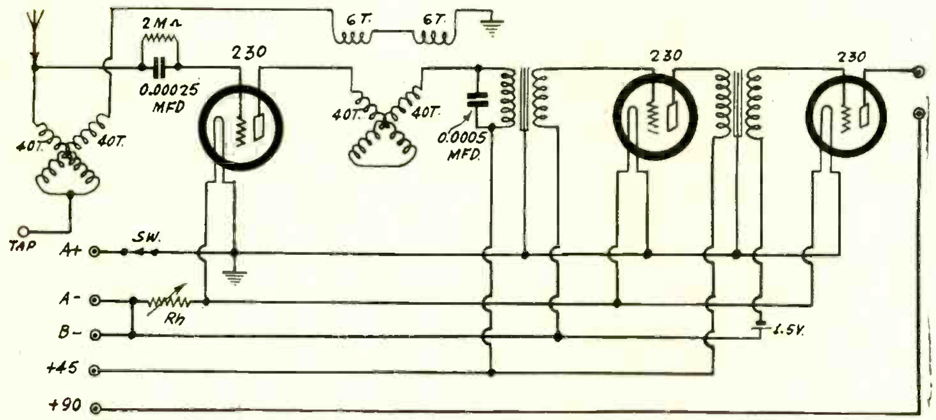


FIG. 1
The circuit diagram of a three-tube, variometer-tuned, regenerative receiver employing the new 2-volt tubes.

ONCE there was a favorite regenerative receiver consisting of a single tube and two variometers. A reception range of 2,000 miles with this receiver was not unusual, and that was in the days when the greatest power of transmitters was 500 watts. The corresponding stations use 50,000 watts today. The simple variometer receiver ought to do well among all these powerful stations. If a two-stage audio amplifier is hooked to this regenerative detector there should be enough power to work a loudspeaker.

The advantage of such a receiver now is that it can be constructed with very little cost, and for that reason fits in well with conditions due to the depression. It should be understood clearly that a receiver of this kind is not very selective, and although it may be sensitive enough to pick up a 500-watt station 1,000 miles away it will not do so through a 50,000-watt local if the frequency separation is less than 50 kc.

The Circuit

The circuit diagram of a three-tube variometer-tuned receiver is given in Fig. 1. All the tubes may be of the 230 type, although larger tubes were in the receiver when the photographs were taken. The tuner consists of a variometer in the grid circuit and the tickler consists of another variometer in the plate circuit. As an aid in inducing regeneration a few turns that are in inductive relation with the plate variometer are connected in the grid circuit.

The two variometers are wound on one piece of cardboard tubing, 3½ inches in diameter and 7½ inches long. There are two rotors, one at each end of the main form, and the diameter of each is 2½ inches. At the left end the stator winding contains 40 turns of No. 24 single silk covered wire, 20 turns on each side of the rotor shaft. The rotor also contains 40 turns of this wire, 20 turns on each side of the shaft. This variometer is used in the grid circuit.

At the right end of the coil form is the plate variometer, which is constructed in exactly the same way as the grid variometer, except that it has 12 extra turns on the stator, 6 turns on each side of the rotor shaft. These 12 turns are connected in series with the grid circuit variometer and are only inductively coupled to the plate coil.

Two-Range Tuner

The grid circuit variometer has a tap at the midpoint to which the antenna may be connected. When the antenna is connected so as to include the entire variometer the broadcast band is covered, and when so connected that only one-half is in the circuit, the police waves are covered.

There is no variable condenser in the circuit, and only two small fixed condensers. The tuning depends on the capacity of the antenna. For this reason a long antenna is needed, one that has capacity enough to balance the inductance of grid circuit variometer.

The usual 2 megohm grid leak and 0.00025 mfd. condenser are used in the detector, and a 0.0005 mfd. condenser is across the primary of the first audio transformer. This by-pass condenser is necessary in order to make the tickler variometer effective.

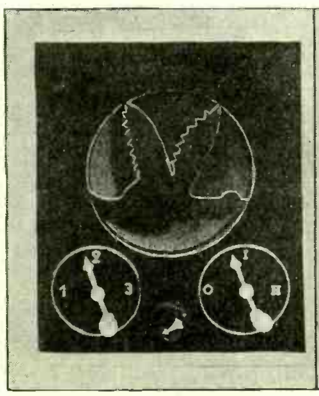


FIG. 2
Front view of the three-tube set. Left dial is for tuning, right for regeneration, and central knob for controlling the filaments. The grille design is sawed wood.

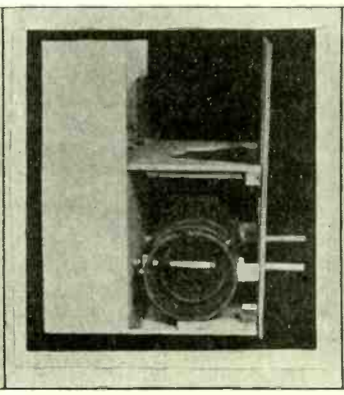


FIG. 3
Side view of the chassis, showing variometer at the bottom, the tube, speaker and filament battery shelf at top, and the plate battery nook.

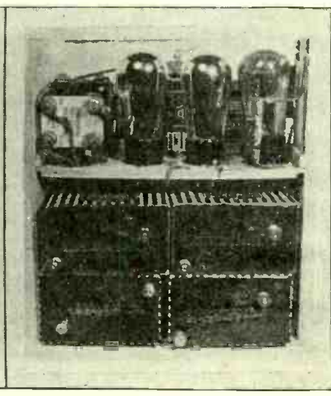


FIG. 4
Rear view of chassis showing tubes, transformers and batteries. This receiver is sensitive but hasn't much selectivity.

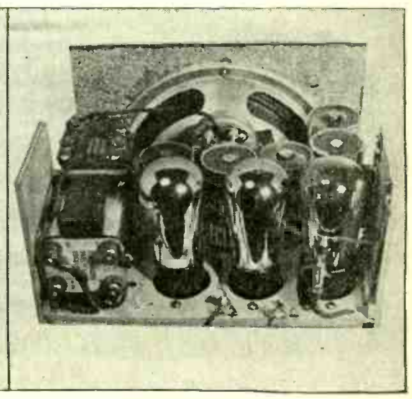


FIG. 5
Close-up of tube and speaker compartment showing the location of the audio transformers, the tubes and the filament batteries.

TUBE CHARACTERISTICS

236

Type of tube—Heater tetrode.
Socket—Five contact.
Purpose—R-F amplifier and detector.
Overall height—4 11/16 inches.
Overall diameter—1 9/16 inches.
Grid-plate capacity—0.010 mmfd., maximum.
Grid-cathode capacity—3.7 mmfd.
Plate-cathode capacity—9.2 mmfd.
Heater voltage—6.3 volts.
Heater current—0.3 ampere.

Bias Detector

Plate supply voltage—180 volts.
Plate load resistance—0.25 megohm.
Screen voltage*—67.5 volts.
Grid bias—6 volts.

Amplifier, 90-Volt Plate

Plate voltage—90 volts.
Screen voltage—55 volts.
Grid bias—1.5 volts.
Plate current—1.8 milliamperes.
Bias resistance—625 ohms.
Amplification factor—215.
Plate resistance—0.25 megohm.
Mutual conductance—850 micromhos.

Amplifier, 180-Volt Plate

Plate voltage—180 volts.
Screen voltage—90 volts.
Grid bias—3 volts.
Plate current—3.1 milliamperes.
Bias resistance—725 ohms.
Amplification factor—370.
Plate resistance—0.35 megohm.
Mutual conductance—1,050 micromhos.
Socket No. 9, Jan. 21 issue.

*Screen voltages as low as 7.5 volts may be used and better quality is usually obtained with the lower screen voltages.

237

Type of tube—Heater triode.
Socket—Five contact.
Purpose—Detector and amplifier.
Overall height—4¼ inches.
Overall diameter—1 9/16 inches.
Grid-plate capacity—2 mmfd.
Grid-cathode capacity—3.5 mmfd.
Plate-cathode capacity—2.2 mmfd.
Heater voltage—6.3 volts.
Heater current—0.3 ampere.
Amplification factor—9.2

Bias Detector

Plate supply voltage—180 volts.
Grid bias—20 volts.
Load impedance—High resistance or transformer.

Amplifier, 90-Volt Plate

Plate supply voltage—90 volts.
Grid bias—6 volts.
Plate current*—2.5 milliamperes.
Bias resistance*—2,400 ohms.
Plate resistance—11,500 ohms.
Mutual conductance—800 micromhos.
Maximum undistorted output—30 milliwatts.
Optimum load resistance—17,500 ohms.

Amplifier, 180-Volt Plate

Plate supply voltage—180 volts.
Grid bias—13.5 volts.
Plate current*—4.3 milliamperes.
Grid bias resistance*—3,000 ohms.
Plate resistance—10,000 ohms.
Mutual conductance—900 micromhos.
Maximum undistorted output—175 milliwatts.
Optimum load resistance—20,000 ohms.

*The give bias resistances apply only when the specified plate currents flow. If the load on the tube is a high resistance a higher value of bias resistance must be used.
Socket No. 8, Jan. 21 issue.

238

Type of tube—Heater power pentode.
Socket—Five contact.
Purpose—Power amplifier.
Overall height—4 11/16 inches.
Overall diameter—1 9/16 inches.
Heater voltage—6.3 volts.
Heater current—0.3 ampere.

Amplifier, 100-Volt Plate

Plate voltage—100 volts.
Screen voltage—100 volts.
Grid bias—9 volts.
Plate current—7 milliamperes.
Grid bias resistance—950 ohms.
Amplification factor—80.
Plate resistance—85,000 ohms.
Mutual conductance—950 microhos.
Maximum undistorted output—250 milliwatts.
Optimum load resistance—13,500 ohms.

Amplifier, 135-Volt Plate

Plate voltage—135 volts.
Screen voltage—135 volts.
Grid bias—13.5 volts.
Plate current—9 milliamperes.
Bias resistance—1,200 ohms.
Amplification factor—100.
Plate resistance—100,000 ohms.
Mutual conductance—1,000 micromhos.
Maximum undistorted output—525 milliwatts.
Optimum load resistance—13,500 ohms.

Amplifier, 165-Volt Plate

Plate voltage—165 volts.
Screen voltage—165 volts.
Grid bias—17 volts.
Plate current—12 milliamperes.
Grid bias resistance—1,000 ohms.
Amplification factor—100.
Plate resistance—80,000 ohms.
Mutual conductance—1,200 micromhos.
Maximum undistorted output—850 milliwatts.
Optimum load resistance—13,500 ohms.
Socket No. 9, Jan. 21 issue.

239

Type of tube—Heater pentode.*
Socket—Five contact.
Purpose—R-f. amplifier and detector.
Overall height—4 11/16 inches.
Overall diameter—1 9/16 inches.
Grid-plate capacity—0.007 mmfd., maximum.
Grid-cathode capacity—4 mmfd.
Plate-cathode capacity—10 mmfd.
Heater voltage—6.3 volts.
Heater current—0.3 ampere.

First Detector

Plate voltage—90 to 180 volts.
Grid bias—7 volts, approximately.

Amplifier, 90-Volt Plate

Plate voltage—90 volts.
Screen voltage—90 volts.
Grid bias—3 volts.
Plate current—4.4 milliamperes.
Bias resistance—500 ohms.
Amplification factor—360.
Plate resistance—375,000 ohms.
Mutual conductance—960 micromhos

Amplifier, 180-Volt Plate

Plate voltage—180 volts.
Screen voltage—90 volts.
Grid bias—3 volts.
Plate current—4.5 milliamperes.
Bias resistance—500 ohms.
Amplification factor—750.
Plate resistance—750,000 ohms.
Mutual conductance—1,000 micromhos.

*The suppressor grid is permanently connected to the cathode inside the tube.
Socket No. 9, Jan. 21 issue.

41

Type of tube—Heater power pentode.
Socket—Six contact.
Purpose—Power amplifier.
Overall height—4 11/16 inches.
Overall diameter—1 13/16 inches.
Heater voltage—6.3 volts.
Heater current—0.60 ampere.
Plate voltage—167.5 volts.
Screen voltage—167.5 volts.
Grid bias—12.5 volts.
Plate current—17 milliamperes.
Bias resistance—550 ohms.
Amplification factor—215.
Plate resistance—120,000 ohms.
Mutual conductance—1,800 micromhos.
Maximum undistorted output—1,200 milliwatts.
Optimum load resistance—11,000 ohms.
Socket No. 15, Jan. 21 issue.

52

Type of tube—Filamentary two-grid power tube.
Socket—Five contact.
Purpose—Classes A and B power amplifier.
Overall height—4 11/16 inches.
Overall diameter—1 13/16 inches.
Filament voltage—6.3 volts.
Filament current—0.3 ampere.

Class A Amplifier

Plate voltage—100 volts.
Grid bias—Zero volts.
Plate current—42 milliamperes.
Amplification factor—5.
Maximum undistorted output 1,500 milliwatts.
Optimum load resistance—2,000 ohms.

Class B Amplifier

(Average for two tubes)
Plate voltage—180 volts.
Grid bias—Zero volts.
Plate current—6 to 40 milliamperes.
Maximum undistorted output—6,000 milliwatts.
Optimum plate resistance—9,000 ohms, minimum.
Socket No. 7, Jan. 21 issue.

85

Type of tube—Heater duplex diode triode.
Socket—Six contact.
Purpose—Detector and amplifier.
Overall height—4 17/32 inches.
Overall diameter—1 9/16 inches.
Heater voltage—6.3 volts.
Heater current—0.3 ampere.
Amplification factor—8.3.

Amplifier, 135-Volt Plate

Plate voltage—135 volts.
Grid bias—10.5 volts.
Plate current—3.7 milliamperes.
Grid bias resistance—2,800 ohms.
Plate resistance—11,000 ohms.
Mutual conductance—750 micromhos.
Maximum undistorted output—75 milliwatts.
Optimum load resistance—25,000 ohms.

Amplifier, 180-Volt Plate

Plate voltage—180 volts.
Grid bias—13.5 volts.
Plate current—6 milliamperes.
Grid bias resistance—2,250 ohms.
Plate resistance—8,500 ohms.
Mutual conductance—975 micromhos.
Maximum undistorted output—160 milliwatts.
Optimum load resistance—20,000 ohms.

Amplifier, 250-Volt Plate

Plate voltage—250 volts.
Grid bias—20 volts.
Plate current—8 milliamperes.
Grid bias resistance—2,500 ohms.
Plate resistance—7,500 ohms.
Mutual conductance—1,100 micromhos.
Maximum undistorted output—350 milliwatts.
Optimum load resistance—20,000 ohms.
Socket No. 13, Jan. 21 issue.

89

Type of tube—Heater power pentode.
Socket—Six contact.
Purpose—Power amplifier.
Overall height—4 17/32 inches.
Overall diameter—1 9/16 inches.
Heater voltage—6.3 volts.
Heater current—0.4 ampere.

Class A Triode

(Grid No. 1 is control grid. Grids Nos. 2 and 3 tied to plate.)
Plate voltage—180 volts.
Grid bias—20 volts.
Plate current—17 milliamperes.
Bias resistance—1,200 ohms.
Amplification factor—4.7.
Plate resistance—3,000 ohms.
Mutual conductance—1,570 micromhos.
Maximum undistorted output—300 milliwatts.
Optimum load resistance—7,000 ohms.

Class A Pentode

(Grid No. 1 is control grid. Grid No. 2 is screen. Grid No. 3 is tied to cathode.)
Plate voltage—180 volts.
Screen voltage—180 volts.
Grid bias—18 volts.
Plate current—20 milliamperes.
Bias resistance—800 ohms.
Amplification factor—135.
Plate resistance—82,500 ohms.
Mutual conductance—1,635 micromhos.
Maximum undistorted output—1,500 milliwatts.
Optimum load resistance—8,000 ohms.

Class B Triode

(Grids Nos. 1 and 2 tied together. Grid No. 3 tied to cathode.)
(Average for two tubes)
Plate voltage—180 volts.
Grid bias—Zero.
Plate current—6 to 50 milliamperes.
Maximum undistorted output—6,000 milliwatts.
Optimum load resistance 9,000 ohms, minimum.
Socket No. 14, Jan. 21 issue.

Type LA

Type of tube—Filamentary power pentode.
Socket—Five contact.
Purpose—Power amplifier.
Overall height—4 11/16 inches.
Overall diameter—1 13/16 inches.
Filament voltage—6.3 volts.
Filament current—0.3 ampere.

Amplifier, 135-Volt Plate

Plate voltage—135 volts.
Screen voltage—135 volts.
Grid bias—9 volts.
Plate current—12 milliamperes.
Amplification factor—100.
Plate resistance—53,000 ohms.
Mutual conductance—1,900 micromhos.
Maximum undistorted output—700 milliwatts.
Optimum load resistance—9,500 ohms.

Amplifier, 165-Volt Plate

Plate voltage—165 volts.
Screen voltage—165 volts.
Grid bias—11 volts.
Plate current—17 milliamperes.
Amplification factor—100.
Plate resistance—48,000 ohms.
Mutual conductance—2,100 micromhos.
Maximum undistorted output—1,200 milliwatts.
Optimum load resistance—8,000 ohms.
Socket No. 7, Jan. 21 issue.

A THOUGHT FOR THE WEEK

THE old-time Radio-Keith-Orpheum bookers have gone into the radio field in the same capacity. They are not hand in glove with grand opera singers and high-brow professors and scientists but what they don't know about the entertainment field in general isn't worth knowing. Advertising agencies with radio connections should tie up with one of these chaps. They're worth their weight in saleable show contacts and knowledge of the game.

Up-to-date Set Tester

SET analyzer intended to meet existing requirements, and that anticipates the requirements of tubes soon to come out, is diagrammed herewith. It provides for current, voltage and resistance measurements, and a receiver may be tested when operating or non-operating. All the standard requirements are taken care of, but unusual type of tubes will require special adapters to permit putting the analyzer plug into the receiver socket by way of these adapters. That is, receivers using tubes with seven-hole, six-hole, UX or UY sockets may be tested, but sets with UV-199, UX-199, Kellogg overhead heaters, and other unusual tubes will require the extra adapters, which are obtainable.

The analyzer plug is of the latest pattern, having a seven-pin base, latch lock connecting to alternative grid caps, and an eight-lead cable. There are seven leads for the seven positions of a seven-hole socket, while the eighth lead runs from the internally joined grid caps, and is used for all overhead grids.

Analyzer Plug Removable

Instead of having the analyzer plug permanently attached to the analyzer it is removable, so as not to be dangling in the way when the device may be used for independent testing, such as resistance measurement or separate use of the meter. To accomplish this a plain handle plug with at least an eight-pin base is required, also a socket to receive this plain-handle plug, distinguished from the analyzer plug by absence of latch lock and grid caps.

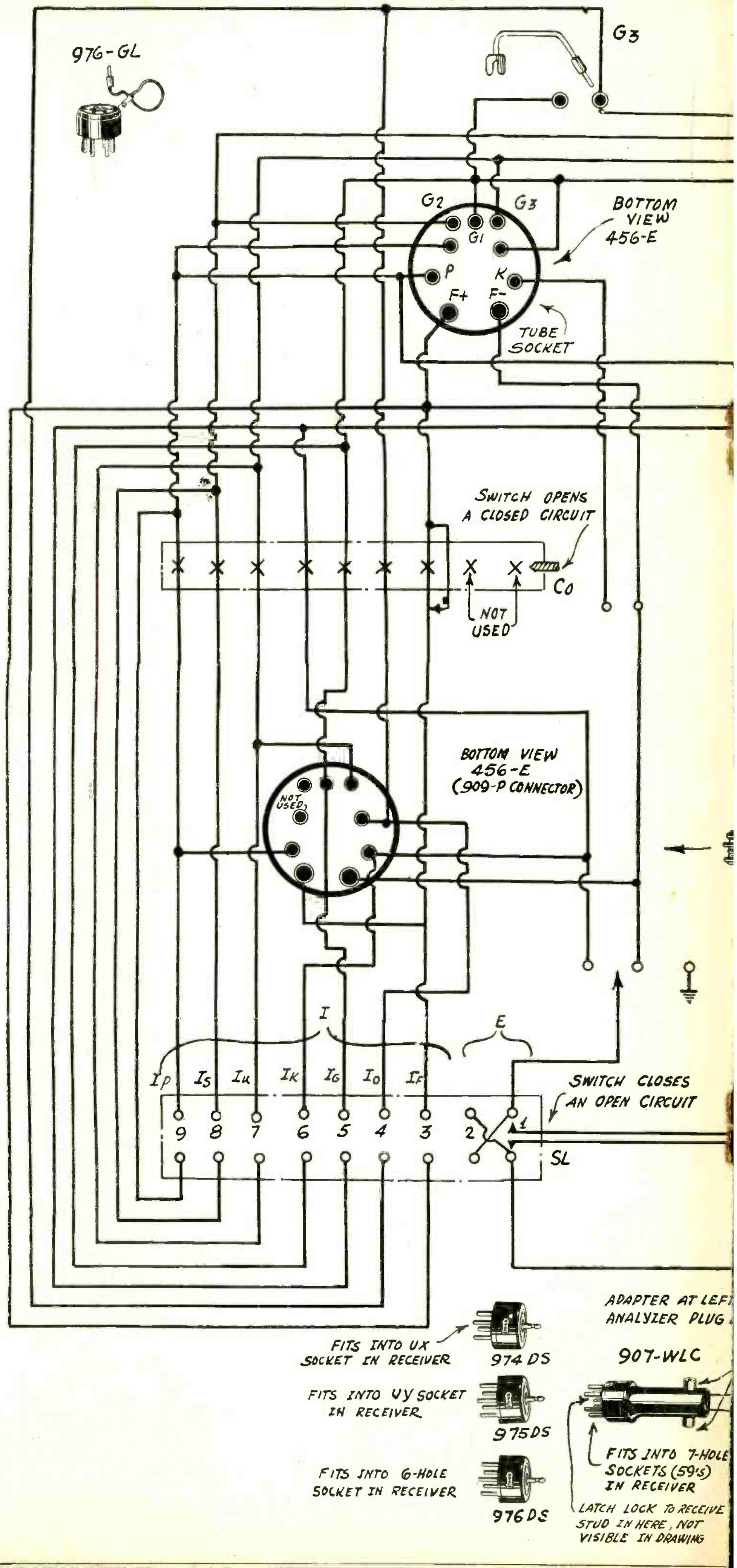
However, there is about to be marketed a nine-pin base plain-handle plug, and as there is a socket with nine holes, the universal, ordinarily used for receiving UX, UY and six-pin tubes with automatically errorless connections, that plug, with the universal socket, is used, with one prong and one socket connection blanked.

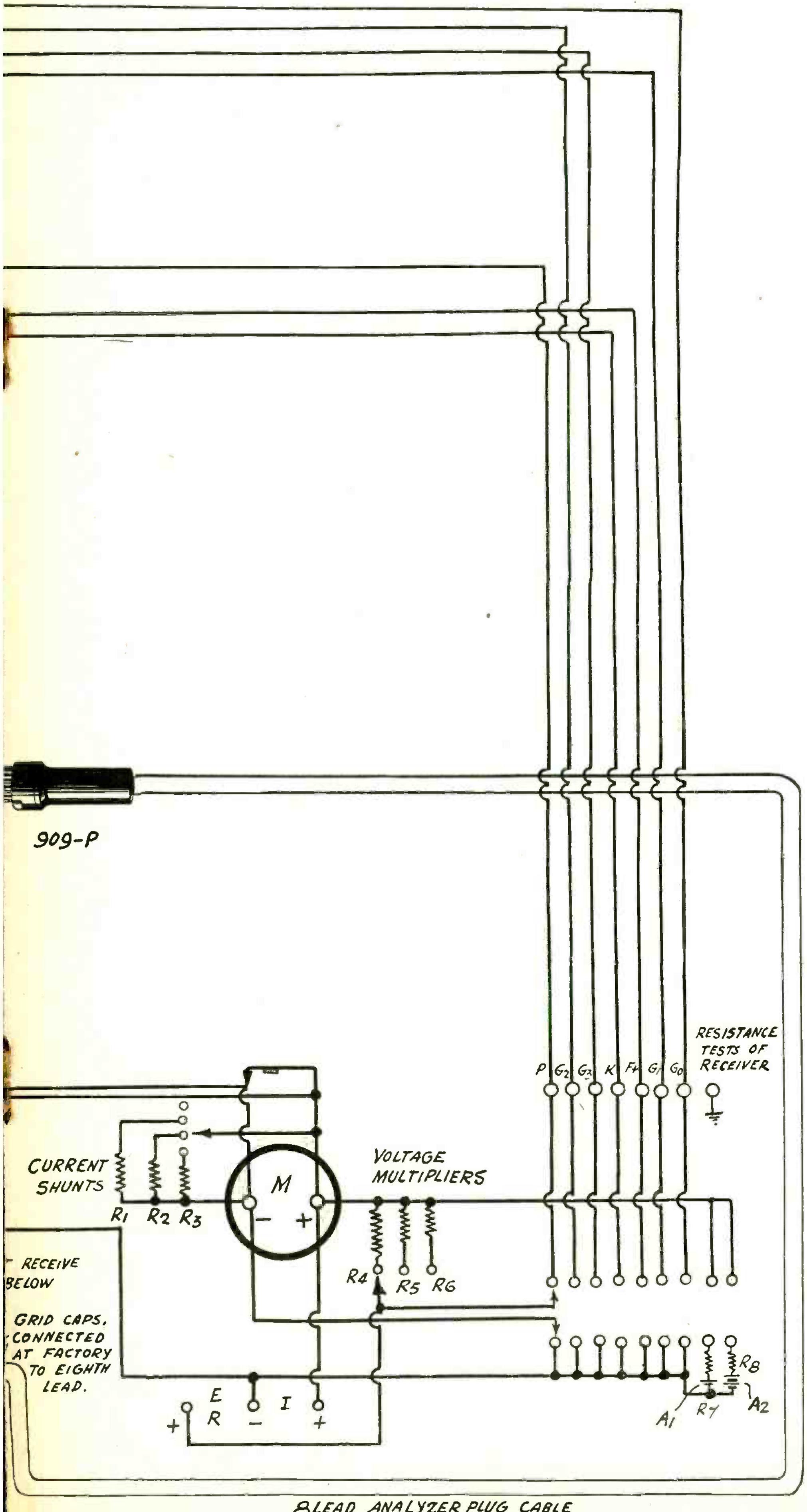
The universal type socket, besides serving as receptacle for the plain-handle plug, is used again (second socket) for receiving the tube taken from the receiver. Since it will take UX, UY and 6-pin bases only, an adapter is necessary to permit insertion of a 7-pin tube. This is of the 6-pin bottom, 7-hole top type. The seventh lead is the control grid, brought out through the socket to a lead terminating in a pin jack plug. This pin jack on the analyzer picks up the general control grid positions of the six-pin universal socket where such grid is other than the overhead grid.

The above method of adaptation is used in lieu of providing an extra or third socket of the 7-pin type on the analyzer panel.

Switching Operations

Most of the operation is by switching, once the plug connections are made and the tube inserted in the analyzer. The main switch is for seven different current circuit readings, with two positions for voltage reading, one of these two obverse the other reverse. That is, two positions afford reversing switch service.





A Switching Analyzer

Suppose that current is to be measured. It is necessary to open a closed circuit to insert a meter between the switch points. Thus if a switch is used that is of the double-pole seven-throw type, and if across two companion poles the circuit-opening switch is connected, and if at any one of these positions the double-pole circuit is closed while the single-pole circuit is opened, the current meter will be put in series with the line. For the two remaining positions the single-pole, single-throw action afforded by the circuit-opening switch is not used.

So as the switch is moved from any one position to the next of the seven, the circuit in which the meter formerly was is closed, and continuity prevails. The action is simultaneous, that is, any one position of the multiple switch closes two circuits at the same time it opens one. Two sliders SL are necessary for the closing operation, but an insulated element CO simply moves between the single circuit sections to pry them apart, so no connection is made to the circuit-opener, but only to the pertinent lugs on the switch. These lugs are on the same plane in the rear, and there are two of them for each position. The two other lugs at front are for the circuit-closing operation, that is, to interpose the meter between the otherwise opened points, except for the two voltage positions.

Shunts and Multipliers

Besides being able to slide the meter in series with a circuit it is necessary of course to have the meter adjusted to the proper sensitivity. Therefore the current shunts should be properly selected, and either a switch used, as shown, or the binding posts of an existing multi-range meter. One of the current shunt positions should be zero shunt, so that the meter is available for external or internal use as a 0-1 milliammeter (if that is its highest sensitivity).

Two switches, ordinarily closed, but opened when the key is depressed, are protective. One is shown across the circuit-opening section of the filament current reading. Since filament or heater current will be much higher than the other currents, the meter is shorted out when the multiple switch is in position for this reading, as a warning that the meter must be at very low sensitivity (will handle much current), otherwise an accidental inclusion would ruin a sensitive meter. Depress the key, after proper meter adjustment, to obtain the reading. Moreover, the current readings at all times are obtainable only by depressing the key of the general protective switch.

Cathode Differences

The voltage readings may be taken with either the cathode or the negative filament as datum. In a-c tubes, or tubes of the automotive series, combination a-c and d-c type as used in universal receivers, the reading is taken between cathode and higher voltage. This is the correct method, since the other elements are voltaged in respect to cathode. Only B minus normally would be negative in respect to cathode. In battery-operated sets, and in a-c sets using filamentary cathodes, voltages are in respect to F minus, or for the a-c cases, either side of the filament, since heater is assump-

(Continued on next page)

CLARION MODEL 300

14-Tube Superheterodyne with Class B Audio

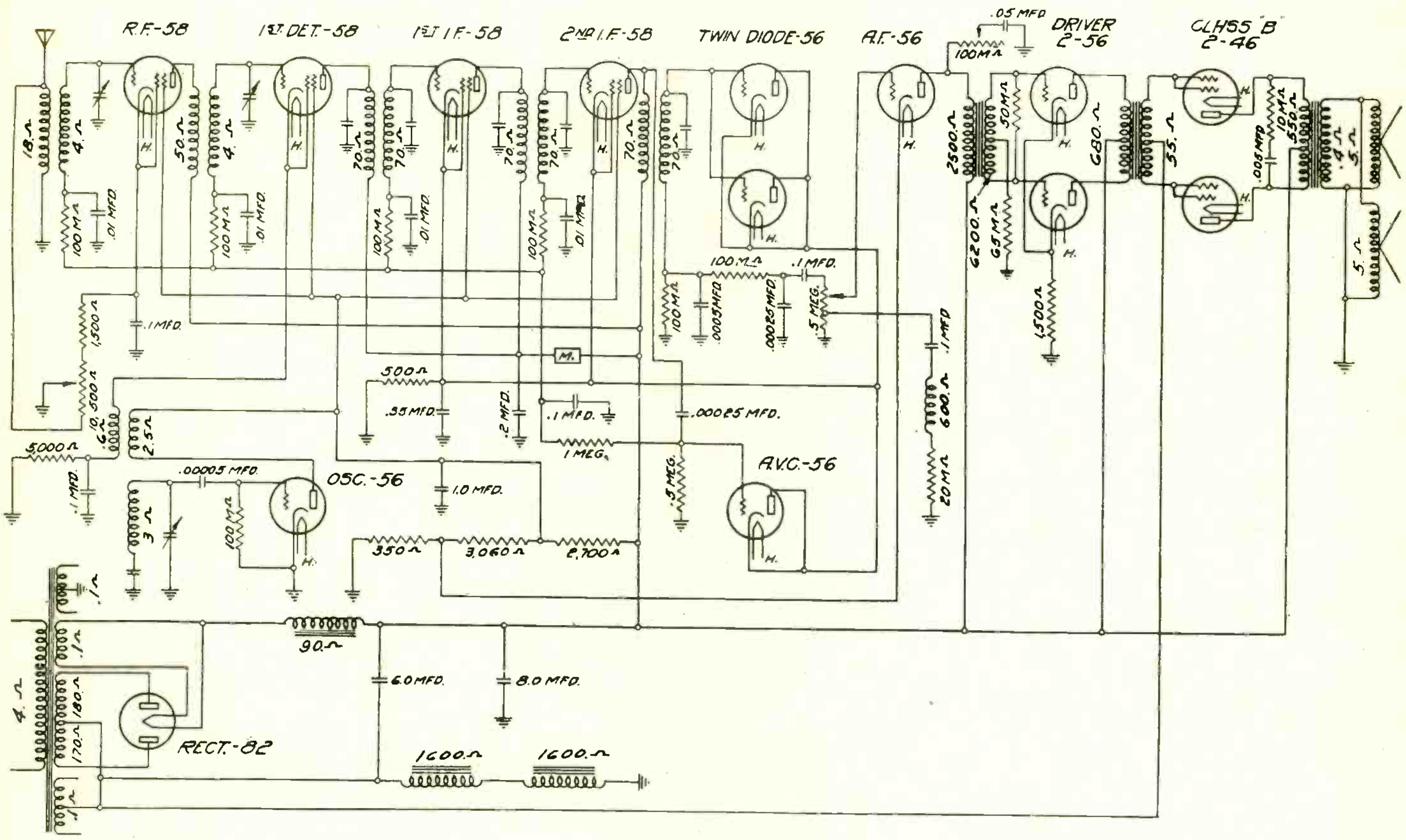


FIG. 1

The circuit diagram of the Clarion, Model 300, fourteen- tube superheterodyne. Class B amplification and push-pull driver are features.

THE Clarion Model 300 superheterodyne is a fourteen-tube, two-speaker receiver incorporating such recent features as Class B amplification, diode detection, automatic volume control, tone control, and tone compensation. It uses two r-f tuned circuits and one r-f amplifier. Its oscillator is entirely separate from the mixer tube except for the intentional coupling between the two. Following the mixer are two 58 type i-f amplifiers, two doubly tuned i-f transformers and one with tuned secondary.

The i-f amplifier feeds into a diode detector consisting of two 56 tubes connected in parallel, the grids acting as anode and the cathode and plates acting as cathode. The load resistance on the diode is only 100,000 ohms, and it is followed by a resistance-capacity filter consisting of one 0.0005 mfd. shunt condenser, a 100,000 ohm resistor in series, and a 0.00025 mfd. in shunt. The termination of this filter is a 0.1 mfd. condenser and a 0.5 megohm potentiometer, the slider of which goes to the grid of the first audio amplifier. A tone corrector consisting of a resistor, a radio frequency coil, and a condenser, all in series, is connected

(*Continued on next page*)

Set Analyzer That Covers The New 8-Connection Tubes

(*Continued from preceding page*)

tively grounded at center, although in some instances the a-c filamentary tube is positive at filament, in respect to B minus, including, of course, power tubes in sets that do not provide bias for these tubes from negative leg rectifier choke drop. In any event, actual cathode, whether in heater or filamentary tubes, may be positive or negative, hence the reversing function of the current switch's voltage positions is necessary. The single-pole double-throw switch picks up either independent cathode or filamentary cathode.

The cathode voltage itself could not be read by this method, for lack of access to negative, so a ground post is used for connection to receiver.

But to read the voltages the proper multipliers must be in service. It was assumed that three current ranges of less sensitivity than the meter's would be used, and again it is assumed that three different voltage scales will be required, but if it is desired to increase these, the change may be made readily, by including extra positions on the switch and providing the extra resistors.

So to read voltages, the best plan is to have the voltage multiplier set for least sensitivity (highest voltage), and adjust the circuit-selector switch for voltage to be read. The voltage multiplier of lower resistance always may be used as desired, but the precaution about using the highest resistance is naturally the protection of the meter.

The only other purpose is that of resistance measurement. If the single-pole, triple-throw voltage multiplier switch is set at any of the three positions, the resistance of one of the multipliers is always in circuit, which is some protection. When the double-pole-nine-throw switch (at right), used for voltage source pickup, is set at any position there must always be a voltage multiplier resistance in circuit, yet none is desired now except the special ones for resistance scaling. Hence connecting the one switch to the other, as diagrammed at lower right, shorts out the multiplier that may be in the voltmeter circuit, and the battery and series resistor specially selected therefore are in circuit. The resistance measurements R for external use are made between the positive and negative output pin jacks, the same positions where voltage E is read, but for resistance measurement in a cold receiver, cathode or filament may be used for which purposes two pin jacks are included, while the other points are picked up by jacks interposed in the voltage-selection line.

(*Continued from preceding page*)

across a portion of the potentiometer resistance.

The A-V-C

For automatic volume control another 56 is used as a diode. The input to this tube is taken from the plate of the second i-f amplifier tube, the coupling device being a 0.00025 mfd. condenser. The load resistance on this rectifier is 0.5 megohm. The full rectified voltage developed across the load resistance is applied to the grids of the r-f amplifier, the mixer, and the two i-f amplifiers.

In addition to the a-v-c there are two manual volume controls. One is in the antenna-cathode circuit of the first tube. There is a fixed bias resistor of 1,500 ohms in the cathode lead, which serves to limit the bias, and between this fixed resistance and the antenna is a 10,000-ohm potentiometer, the slider of which is connected to ground. This serves as a manual control of the input to the set. The second manual control is in the input circuit of the first audio tube, and it was mentioned before in conjunction with the diode detector.

A tone control consisting of a 0.05 mfd. condenser and a 100,00 ohm variable resistor is connected between the plate of the first audio tube and ground.

Push-pull Driver

The driver stage for the Class B amplifier consists of two 56 tubes in push-pull, coupled by transformer to the first stage of audio. Across the secondary of this transformer, or from grid to grid, is a 50,000 ohms resistor, which serves to level out the transmission characteristic and to eliminate undesired effects due to grid current. The 65,000 ohm resistor from the center tap of the winding to ground serves a similar purpose. A resistor of 1,500 ohms serves to bias the two 56s. This is not by-passed because the stage is push-pull.

Between the driver stage and the Class B amplifier is a step-down transformer of a special kind. Both windings are center-tapped and the secondary has comparatively few turns.

The two 46 tubes in the Class B power stage are operated at zero bias and with a plate voltage of 400 volts. This is about twice the highest voltage on any of the other tubes. The difference is due to the fact that the drop in two series-connected field coils, each with a drop of 100 volts, is utilized on the power tubes while it is not on the other tubes.

Two Speakers

The presence of two field coils in the filter suggests that there are two speakers in the receiver, and that is a fact. One of these, of course, is designed to be efficient on the low frequencies and the other on the high. The two voice coils are connected in parallel to the secondary of the push-pull output transformer.

Across the primary of the output transformer is another device for limiting the output on the extremely high frequencies, mainly the hiss which is prevalent in supersensitive receivers, especially of the superheterodyne type. This device is a 0.005 mfd. condenser in series with a 10,000-ohm resistor between the two plates of the Class B amplifier.

The two field coils serve as filter chokes for all the tubes except the two final power tubes. The cathode returns of all these tubes are grounded and so is one side of the two field coils. The plate current must return to the high voltage winding center tap through the chokes. In the case of the two power tubes, however, the chokes are not a part of the filter, for the filaments of these tubes are connected directly to the center tap.

This method of connection is necessary because the regulation of the supply to the Class B amplifier must be very good, and it could not be if the two field coils were part of the filter. The only choke used for the power tubes is a 90-ohm choke in the positive lead of the B supply. Most of the filtering for the Class B supply is obtained from the by-pass condensers.

The additional choking afforded by the two field chokes is necessary for the Class A amplifiers and detectors, for if it were not used there would be considerable hum.

The manufacturer's service manual sets forth the following:

General: The shipping weight of the Model 300, when packed, is 132 lbs. The dimensions are height, 44½ inches, width 25 inches, depth 14 inches. The tube complement is as follows: Four 58, seven 56, two 46, one 82. Power is 129 watts at 115 volts.

Antenna: A standard outside aerial of at least 60 ft. including lead-in should be used. It is important that the antenna be well insulated and spaced away from objects which would tend to shield it and cause loss of power through high capacity effects, if peak performance is expected, ordinarily, however, an inside aerial can be used.

Ground: A good ground should be used to assist in eliminating noises, which might otherwise spoil the signal.

Operation: The set has four controls. The right hand lower knob switches the set off and on and controls the tone; the left hand lower knob controls the volume; the upper center knob is the station selector, and the lower center knob is the noise suppressor control. The tuning meter located directly above the dial indicates by the peak swing of the pointer when a station is tuned to exact resonance.

This set can be tuned in two distinct ways, as suits the user; first the volume control can be turned back to the minimum position, and the noise suppressor control advanced to its maximum position. Absolute silent tuning can be accomplished by merely watching the indicating meter, and the volume control can be advanced when the peak swing is recorded and the program brought in. The second method is to adjust the noise suppressor control for local noise conditions by advancing the volume control and tuning between stations, then retarding the noise suppressor control until local interference noises are reduced to a comfortable minimum. The noise suppressor control can then be left in this position, permanently, and stations then tuned in either by audibility alone or by audibility and indicator readings. The tone control will of course be set by the owner to suit the taste.

Tests: By popular demand of service men and service organizations, the continuity test tables used in previous manuals is being replaced by an accurate circuit resistance analysis. These readings were

(*Continued on next page*)

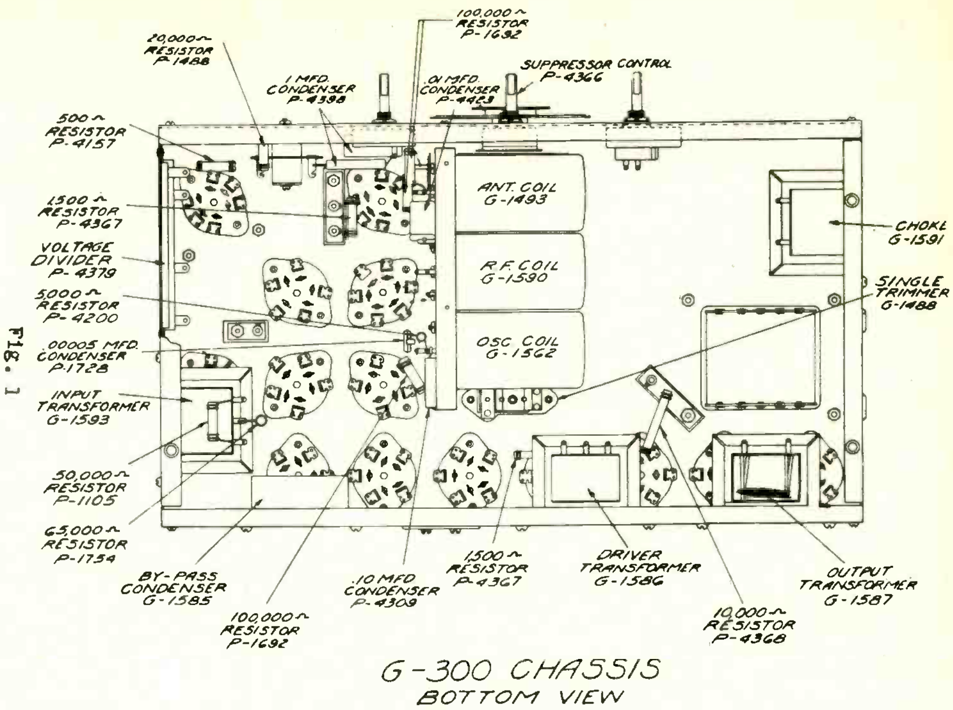


FIG. 2
Plan of the Clarion Model 300 superheterodyne.

CIRCUIT RESISTANCE ANALYSIS

Model 300, socket to ground

Stage	*Grid*	*Cathode*	*Heater*	*Plate*	*Screen G*	*Suppr. G*
R. F.	Infinity	1,450	.1	6,100	3,350	1,480
1st Det.	Infinity	5,000	.1	6,600	3,350	5,000
1st I. F.	Infinity	500	.1	6,600	3,350	500
2nd I. F.	Infinity	500	.1	6,100	3,350	500
Oscillator	100,000	.07	.1	3,400	....	....
A.V.C.	500,000	500	.1	500	....	....
1st diode	100,000	500	.1	500	....	....
2nd diode	100,000	500	.1	500	....	....
A. F.	500,000	350	.1	8,600	....	....
Driver 1	68,000	1,500	.1	6,400	....	....
Driver 2	68,000	1,500	.1	6,400	....	....
1 Class "B"	3,250	....	3,250	6,300	....	....
2 Class "B"	3,250	....	3,250	6,300	....	....
Rectifier	....	....	6,100	3,400	....	....

Note: Readings of one megohm and over are given as "infinity." The first three significant figures, only are interpreted from the ohmmeter in each reading: the individual resistance in the circuit can be readily checked upon removal of chassis.

VOLTAGE OF ANALYSIS
Model 300

No.	*Stage*	*Tube*	*A*	*B*	*C*	*K*	*Sc. G.*	*1 p.*	*Su. G.*
1	R. F.	58	2.2	180	.5	7.	85	.7	7.
2	1st Det. ...	58	2.2	180	1.	7.	85	1.2	7.
3	Oscillator ..	56	2.2	100	0	0	0	10.	..
4	1st i.f.	58	2.1	190	.4	4.	90	3.	4.
5	2nd i.f.	58	2.0	190	.2	4.	90	2.	4.
6	A.V.C.	56	2.0	0	0	4.	..	0	..
7	Diode	56	2.1	0	0	4.	..	0	..
8	Diode	56	2.1	0	0	4.	..	0	..
9	A. F.	56	2.2	180	0	10.	..	2.	..
10	Driver 1 ..	56	2.3	185	0	8.	..	3.	..
11	Driver 2 ..	56	2.3	185	0	8.	..	3.5	..
12	Class "B" 1	46	2.2	400	0	0	..	5.	..
13	Class "B" 2	46	2.2	400	0	0	..	5.	..
14	Rectifier ...	82	2.3	300	..	..	..	..	..

Vol. control "full on."
Noise Suppressor "full open."
Tested with Weston model 565 *analyzer.*
Line: 115 *volts.*

(*Continued from preceding page*)
taken with an accurate ohmmeter connected between ground on the chassis and the various prongs at the sockets. The schematic diagram of the receiver circuit is given with complete resistance values across the r-f coils, audio transformer windings, choke coils, etc., and we are sure you will find this up-to-date method of service analysis, practical and accurate. The readings were taken with the volume control and noise suppressor in the "full on" position, all tubes and pilot light removed. The tolerance for resistors is ten percent, plus or minus. When taking low resistance readings such as cathode or heater, be very sure you have made good contact at socket and ground or an erroneous reading will almost certainly result.

We cannot neglect the fact, however, that circuits are sometimes tampered with, when a simple tube replacement, installation adjustment, or power supply correction is required. The average fault can be located readily by reference to the Resistance Analysis or to the Voltage Analysis given in this manual. The following resume may be helpful:

Fading: Since this receiver employs the automatic volume control circuit, fading would be due to a defect around the a-v-c circuit or in the a-v-c type 56 tube.

Weakness: Since the tuning meter on the front panel indicates plate current for the first detector and first i-f tubes, a weakness in the r-f first detector, or first i-f will cause the meter pointer to have a restricted swing, whereas if weakness has developed in a circuit subsequent to those mentioned, the needle will swing freely, although the output of the set is weak.

Harmonics: A broadcasting station, at exactly one-half the frequency of a desired station that has been tuned in, can set up a harmonic that might interfere if the harmonic wave were powerful enough. Use a wave trap for individual cases or change the direction of the aerial.

Image Frequency Signals: A signal 350 k.c. lower than that tuned in, if very powerful, may be impressed upon the first detector and amplified. The set has excellent "image ratio" characteristics and this type of complaint will be rare. Change the direction of the aerial or reduce the size or use a wave trap.

Oscillation: May be due to an open circuited by-pass condenser or a high resistance connection to a by-pass, also to disarrangement of wiring in the r-f end of the chassis.

Hum: The set has the minimum commercial hum in operation. A loud hum might be due to a defective filter choke or condenser, an open audio grid, or a defective type 82 tube.

Noise: Other than static or interference, noise might be due to tubes, poor connections or speaker voice coil rubbing.

Poor Sensitivity: Might be due to a high resistance connection in the coils of the antenna, oscillator, first detector or intermediate frequency stages. Go over the connections with a hot soldering iron. Rough handling in shipment will not ordinarily jar the trimmer condenser out of setting, and they should be adjusted only as a last consideration. See trimmer adjustment instructions. As mentioned previously, the tuning meter pointer will have a restricted swing if the "insensitivity" is due to a defect in the circuits prior to and including the first i-f stage. A defective connection in the grid cap of the type 58 tube is a common cause.

Poor Selectivity: Where poor selectivity develops in use, the instructions for poor sensitivity above would apply.

Program Cutting Out: A test of circuit voltage and current values will ordinarily indicate the stage affected. Where voltage and current values are O. K. while the set intermittently cuts out, check the grid circuits of the first detector, r-f, oscillator, and intermediate frequency stages, particularly at the connections to grid and ground, and go over the joints with a hot soldering iron if any defect is found. We might mention that if the voltage and current values are measured while the set is tuned to constant signal, defective grid connections at the r-f, oscillator, or i-f stages WILL show a change in voltage and current values when the defective component is tapped; this provides a more dependable test.

Poor Tone: This condition is usually found in the speaker; tubes developing defects, or improper voltage and current values in the second detector.

Two New Special Autodyne Tubes and a Duo-Diode-Pentode Coming

Four special-purpose tubes are to be announced soon and all four will have seven-pin bases with overhead grid cap. One will be the 2A7, for use as an autodyne tube, and providing electron coupling of the oscillator unit to the modulator unit of mixer as a part of the internal construction. This is a 2.5-volt heater type tube, for a-c operation, and the companion tube of the automotive series will be the 2B7, with 6.3-volt heater for a-c or d-c operation.

The other model, in two forms, will be a duplex diode with a very high mu pentode, and will be designated the 6A7 for 2.5-volt a-c heater and the 6B7 for 6.3-volt a-c or d-c heater. Thus this tube classification represents a further development of the 55 and 85.

The 2A7 will have a conversion conductance of 475 micromhos at specified operating conditions. This is defined as the ratio of the intermediate frequency component of the mixer output to the radio frequency voltage input. The control grid, 4, should have at least minus 3 volts bias, and when the bias is as high as minus 50 volts the conversion conductance is 2. So the tube is of the remote cutoff type and may be subjected to automatic volume control, or automatic bias control, along with other tubes in a receiver.

Unipotential Cathode

The tube may get very hot under certain conditions of operation and therefore provision should be made for cooling by radiation and convection. The cathode preferably should be connected to the midtap of the filament winding, so there is no bias between the heater and the cathode, and any resistance interposed between the heater and the cathode should be as low as possible to prevent hum. If it is necessary for certain circuit requirements to have a resistance between them, as for biasing, there should be across it a bypass condenser of large capacity (4 mfd. minimum) and the potential difference should be as low as possible.

The Duplex-Diode Pentodes

While official information about the four tubes has not yet been released, this preliminary and unofficial statement of the characteristics and purposes is close to what the official data will reveal.

The 2A7 may take 250 plate volts, screen (combined grids 3 and 5) 100 volts, anode grid (2) 250 volts and control grid (4), minus 3 volts minimum. The parenthetical numbers are the official ones to indentify the various grids. A resistor is needed in the oscillator grid (1), not critical, but around 50,000 ohms in general, and depending on voltages used on other elements. Total cathode current will be 11 ma typically, but under no circumstances should be permitted to exceed 14 ma. The plate resistance will be 300,000 ohms. High gain features the tube for combined mixer service.

The code for the socket will be, assuming bottom view with heaters toward you, going around to the left from the left-hand bottom-view heater: plate, combined grids 3 and 5, grid 2, grid 1, cathode. The cap is grid 4.

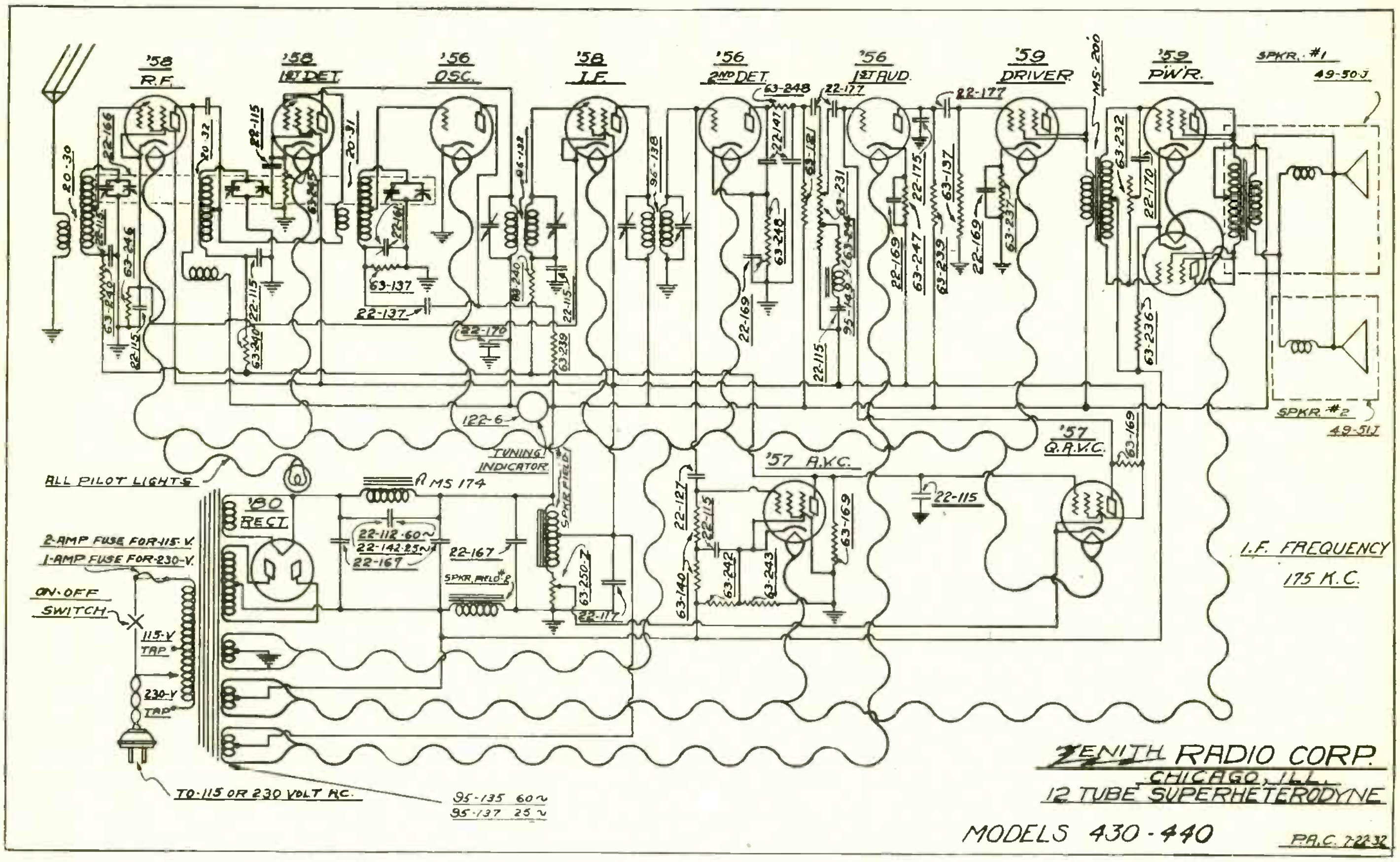
The a-c duo-rectifier with pentode amplifier will take 250 plate volts, 50 screen volts and minus 4.5 grid bias volts, whereupon 0.65 ma will flow. The plate resistance will be 200,000 ohms. Under these conditions the mu will be 730, but at 180 plate volts and other voltages lower accordingly, the mu runs as high as 840. These represent by far the greatest mu values in receiver tubes.

The mutual conductance at 250 volts on plate and other voltages accordingly will be 1125 micromhos, the screen voltage then 125 volts, the bias minus 3 volts, the screen current 2.3 ma, the cathode current cutoff point minus 21 volts.

While such a tube may not be given a power output rating, nevertheless the tube may be used by economical manufacturers of small sets so that the detector and output tube are in one envelope, thus making possible a three-tube set, including a-c rectifier, However, since the pentode is obviously a voltage amplifier, the pentode would be used more respectably to drive an output stage.

The socket connections, bottom view, starting from the left from left-hand heater, are: plate, screen, diode, diode, cathode. Control grid is the overhead cap.

ZENITH 430 AND 440



The circuit diagram of the 12-tube Zenith superheterodyne, using twin speakers in parallel. The 59 tubes are used as triodes in push-pull output.

PARTS FOR MODELS 430 and 440 (Chassis 2033)

Dial and Meter Assembly

- 11-3 Dial string
- 26-37 Dial Strip
- 34-23 Large Hypoid Gear
- 34-24 Small Hypoid Gear
- 59-16 Volume Control Pointer
- 59-17 Tone Control Pointer
- 80-69 Dial String Tension Spring
- 80-84 Volume and Tone Control Pointer Spring
- 80-86 Volume and Tone Control Friction Spring
- 83-272 Volume Control Dial Strip
- 83-273 Tone Control Dial Strip
- 83-277 Pointer Guide Strip
- 100-18 Pilot Lamp
- 122-6 Shadowgraph Meter
- S-2255 Tone Control Pointer Cam
- S-2256 Volume Control Pointer Cam
- S-2265 Dial Drum Asembly

Condensers

- 22-112 .1 mfd. 300 volt (Filter)
- *22-115 .1 mfd. 200 volt (Eight used, see footnote)
- 22-117 .5 mfd. 300 volt (Filter)
- 22-127 .000025 mfd. 600 volt (A. V. C. Grid)
- 22-137 .05 mfd. 400 volt (Oscillator Plate)
- 22-142 .4 mfd. 300 volt (Filter—25 cycle only)
- 22-147 .0005 mfd. 600 volt (2nd Detector Plate)
- 22-161 Padder
- 22-166 Three Gang Variable
- 22-167 8. mfd. 500 volt (Filter)
- 22-169 8. mfd. 50 volt (2nd Detector Cathode, Driver Cathode, and 1st Audio Cathode)
- 22-170 .1 mfd. 400 volt (1st Detector Plate, Tone Control)
- 22-175 .002 mfd. 600 volt (1st Audio Plate)
- 22-177 .2 mfd. 400 volt (2nd Detector Plate, 1st Audio Grid, 1st Audio Plate)

Resistors

- 63-121 100M Ohm, 1 Watt (2nd Detector Plate)
- 63-169 400 Ohm, ½ Watt (A.V.C. and Q.A.V.C. Plates)
- 63-231 Volume Control and Switch Assembly
- 63-232 Tone Control Assembly
- 63-236 500 Ohm (wide metal) (Power Tube Bias)
- 63-237 1500 Ohm (narrow metal) (Driver Tube Bias)
- 63-137 250M Ohm, ½ Watt (Driver Grid)
- 63-239 24M Ohm, 1 Watt (Oscillator and 1st Audio Plate)
- 63-240 1900 Ohm, ¼ Watt (R.F., 1st Detector and I.F. Grid)
- 63-242 2500 Ohm, ½ Watt (A.V.C. Cathode)
- 63-243 18M Ohm, 1 Watt (A.V.C. Cathode)
- 53-244 500 Ohm, ¼ Watt (Acoustic Filter)
- 63-245 1500 Ohm, ¼ Watt (1st Detector Cathode)
- 63-246 150 Ohm, ¼ Watt (R.F. Cathode)
- 63-247 8M Ohms, ¼ Watt (1st Audio Cathode)
- 63-248 50M Ohm, 1 Watt (2nd Detector Plate and Cathode)
- 63-250 Sensitivity and Quiet Control
- 63-140 1 megohm, ½ Watt (A.V.C. Grid and Cathode)

Coils

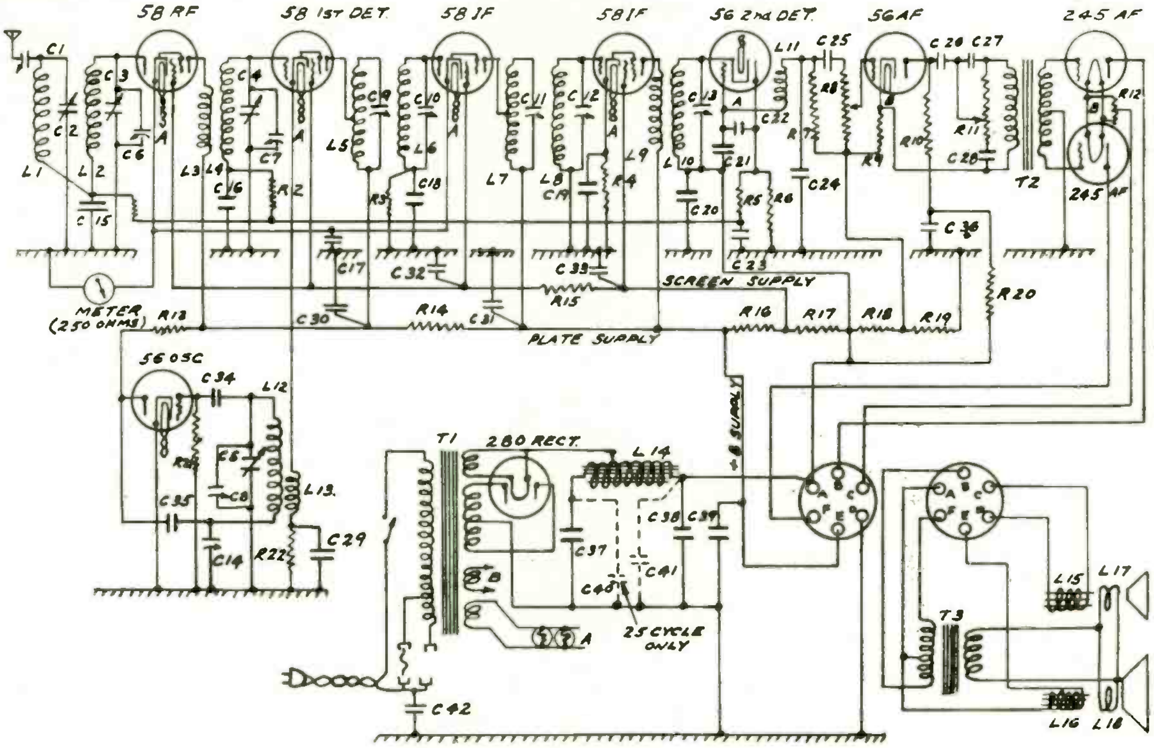
- 20-30 Antenna Coil
- 20-31 Oscillator Coil
- 20-32 Detector Coil
- 95-132 1st I.F. Transformer with Grid Lead
- 95-138 2nd I.F. Transformer without Grid Lead

Miscellaneous

- 46-49 Large Control Knob
- 46-55 Small Control Knob
- 49-50 Dynamic Speaker (without transformer)
- 49-51 Dynamic Speaker (with transformer)
- 52-33 Speaker Multicord
- 57-341 Escutcheon Plate
- 78-56 Seven Prong Socket type 59
- 78-57 Five Prong Socket type 56
- 78-58 Six Prong Socket type 58
- 78-59 Six Prong Socket type 57
- 78-60 Four Prong Socket type 80
- 93-167 Upper Cushion Washer for Chassis Mounting
- 93-168 Lower Cushion Washer for Chassis Mounting
- 95-135 115 volt 50-60 cycle Power Transformer
- 95-137 115 volt 25-30 cycle power Transformer
- 126-109 Small Tube Shield
- 136-2 2 amp. Fuse for 115 volt sets
- 136-4 1 amp. Fuse for 230 volt sets
- MS-174 Power Choke
- MS-195 Large Tube Shield Assembly
- MS-200 Audio Transformer

[Layout diagram on next page]

BOSCH 250 AND 251



The United American Bosch models 250 and 251 use a chassis following this diagram. The circuit is a 10-tube superheterodyne.

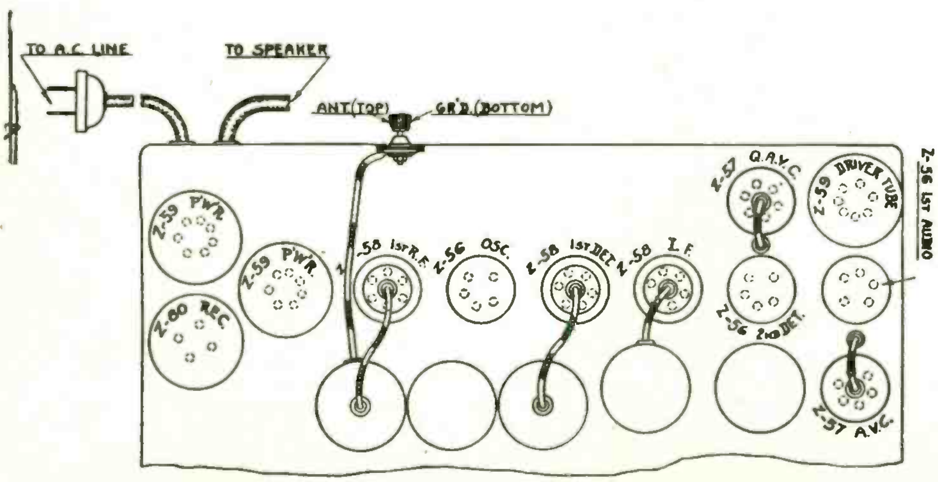
R1 —100,000 ohms
R2 —100,000 ohms
R3 —100,000 ohms
R4 — 500 ohms
R5 —500,000 ohms
R6 —100,000 ohms
R7 —100,000 ohms
R8 —500,000 ohms
R9 — 1,500 ohms
R10— 25,000 ohms
R11—100,000 ohms
R12—Center Tap
R13— 30,000 ohms
R14— 1,000 ohms
R15— 1,000 ohms
R16— 3,700 ohms
R17— 2,270 ohms
R18— 230 ohms
R19— 1,280 ohms
R20— 10,000 ohms
R21—100,000 ohms
R22— 5,000 ohms

C1 —Trimmer
C2 —Tuning
C3 —Tuning
C4 —Tuning
C5 —Tuning
C6 —Alignment
C7 —Alignment
C8 —Alignment
C9 —I-F
C10—I-F
C11—I-F
C12—I-F
C13—2nd Det.
C14—Alignment
C15—0.05 mfd.
C16—0.05 mfd.
C17—0.05 mfd.
C18—0.05 mfd.
C19—0.05 mfd.
C20—0.05 mfd.
C21—100 mmf.
C22—0.05 mfd.

C23—0.05 mfd.
C24—100 mmf.
C25—0.05 mmf.
C26—0.5 mfd.
C27—0.05 mfd.
C28—0.05 mfd.
C29—0.05 mfd.
C30—0.05 mfd.
C31—0.05 mfd.
C32—0.05 mfd.
C33—0.05 mfd.
C34—100 mmf.
C35—0.05 mfd.
C36—4 mfd.
C37—8 mfd.
C38—8 mfd.
C39—4 mfd.
C40—8 mfd.
C41—8 mfd.
C42—0.01 mfd.

L1 —R-F coil
L2 —R-F coil
L3 —R-F coil
L4 —R-F coil
L5 —I-F coil
L6 —I-F coil
L7 —I-F coil
L8 —I-F coil
L9 —I-F coil
L10—I-F coil
L11—Choke
L12—Osc.
L13—Osc.
L14—Choke
L15—Field
L16—Field
L17—Voice
L18—Voice

T1 —Power
T2 —Input
T3 —Output



Where the tube sockets and some other parts are located in the Zenith 430 and 440 receivers. Article is on preceding page.

Temporary Condensed Service Parts List for Model 250 and 251 Receivers

Main Assemblies

103562 Chassis with tubes (250)
104064 Chassis with tubes (251)
103796 Two speakers on baffle
103731 Speaker only (small)
103669 Speaker only (large)
103882 Cabinet with plates (Model M)

Coils

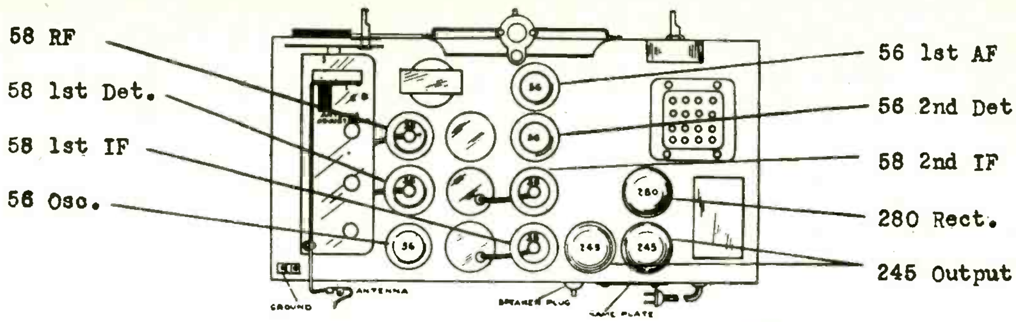
103712 Field coil (small speaker)
103675 Field coil (large speaker)
103586 1st. and 3rd I-F transformer
103587 2nd I-F transformer
103519 Oscillator coil
103525 R-F transformer (single)
103526 F-F transformer (double)
103588 Coil for 1st I-F transformer
102463 Coil for 2nd I-F transformer
103584 Choke coil (small)
103554 Choke coil (filter)

Condensers

103950 Housed filter (250-251) 6 wire
103740 Housed filter (251) 5 wire

(Continued on next page)

Top view of the chassis of the Bosch models 250 and 251. The tubes are identified in the drawing, as well as antenna, ground and speaker plug positions.



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101143 Cond. 0.0001 mfd.
103695 Cond. 0.01 mfd.—4 ply.
102493 Cond. 0.05 mfd.—2 ply.
102492 Cond. 0.05 mfd.—3 ply.
102498 Cond. 0.05 mfd.—3 ply.
104060 Antenna trimmer cond.

Fuse

101723 Fuse (2 amp.)

Knobs

103625 Dial knob
101445 Mute switch knob
102272 Antenna trimmer knob

Meter

103296 Tuning meter

Miscellaneous Parts

103560 Dial scale only
102282 Diaphragm (small)
102283 Diaphragm (large)
98713 Lamp for dial

Resistors

103539 Volume control (Round)
103858 Volume control (Square)
103548 Tone control
99583 500 ohms
100729 1,000 ohms
102095 1,500 ohms
100824 5,000 ohms
100825 10,000 ohms
100197 25,000 ohms
101722 30,000 ohms
100727 100,000 ohms
100194 500,000 ohms
100815 1 megohm
99412 Mid tap resistor
103614 Tapped resistor

Sockets

103686 Socket (4 prong)
103514 Socket (5 prong)
103513 Socket (6 prong)

Switch

103901 Mute switch

Transformers

103236 Power for RS 250
104144 Power with laminations for RS 251
103232 Output transformer
103578 Input transformer

Socket Voltages, Bosch 250 and 251

Stage	*Tube*	*Fil.*	*Plate*	*Screen*	*Cathode*	*Grid*
R-F	58	2.4	200	100	4.5	0
1st Det.	58	2.4	200	100	8.5	0
Osc.	56	2.4	85	—	0	7.8
1st I-F	58	2.4	200	100	4.5	0
2nd I-F	58	2.4	200	100	4.5	0
2nd Det.	56	2.4	0	—	47	0
1st A-F	56	2.4	175	1	47	0
2nd A-F	245	2.4	350	—	—	55
2nd A-F	245	2.4	350	—	—	55
Rect.	280	4.8	—	—	—	—

Note: These values are readings of a high resistance voltmeter to ground with the exception of the filament voltages. Cathode voltages are given for those tubes having the grid at ground.

TRADIOGRAMS

By J. Murray Barron

A. Y. Tuel, Vice President and General Manager of the Mackay Radio and Telegraph Company, announces that the Union Oil Company of California has awarded the radio contract for equipment and service on its entire fleet of eleven ships to Mackay Radio. Some of the Union Oil ships had previously been equipped and served by Mackay Radio.

* * *

At Luxembourg's International Industrial Exposition the "diplome d'honneur," the highest award of the fair of united industries, hsa been awarded to Fada Radio.

* * *

From the Laboratory of the Universal Microphone Co., Inglewood, Cal., comes an item entirely new and of interest to the radio amateur. This is a "4-in-1" unit power supply (voice or c.w.) for short-wave transmitters, and has been designed specially for the new 47 tube crystal controlled transmitter.

* * *

With the growth of the Arcturus Radio Tube Company's export business, T. P. Feeney has been selected as export manager. Mr. Feeney has been associated with Arcturus since its inception in several executive positions.

* * *

In keeping with the readjustment of commodity prices, Thor's Bargain Basement passed on to the radio experimenter and set builder the benefit of these savings. An entirely new and especially attractive window display has been made in the street store. In the parts and service basement there are on demonstration the three kits that have proven so popular.

* * *

All sections of the country are keenly alive to the adaptability of the universal ac-dc receiver. The construction is so simplified that many are building them. In fact, many who heretofore have never attempted any radio construction are buying the assembled chassis and making the few necessary connections.

* * *

The show windows of the leading radio stores are now featuring some excellent buys in full-sized receivers. Standard names of national repute are on display with types and prices to suit everybody. The buying is on the up grade as in this type of a receiver the bottom has been reached for the winter, with indications of a higher price later on.

* * *

The demand for short-wave receivers and converters is on the increase and gives every indication of a greater briskness during the balance of the Winter and during the Spring. The reception from all over the world is so frequent that those not familiar with short-wave reception or those who experimented years ago would hardly credit the present real catches on the air.

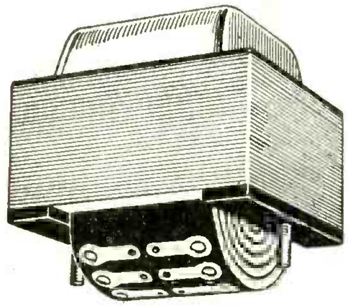
* * *

Postal Radio Corp., 137 Liberty Street, New York City, reports a steady demand for parts for the construction of the small handy universal receiver. As the demand is from all sections of the country, including Canada, it is a good indicator that there is considerable money to be spent on radio provided you have a live number.

* * *

A number of servicemen and set builders have written in regarding the mail order catalogue of the New York houses, but some are interested in any reliable organization that issues a regular catalogue with a good selection of merchandise from any section of the country.

Resistance Reveals Identity of Windings



A power transformer with unmarked leads may be identified by the resistance of the windings. The highest resistance, usually a few hundred ohms, is the high voltage, center is at half the total resistance. The primary may measure tens of ohms. The 2.5 and 5-volt windings are of low resistance, the 2.5 being the lower.

Literature Wanted

P. D. Nauta, C/o Nauta's Radio Service, 1353 Kalamazoo Ave., S.E., Grand Rapids, Mich.
J. W. Kountz, 1018 Grant Ave., Baxter Springs, Kans.
T. J. Dunn, 36 Lincoln St., Wilkes-Barre, Penna.
Donald E. Dunn (P. A. Equipment and Microphones), South Bend, Wash.
J. I. Rhea, 204 N. 15th St., Fort Pierce, Fla.
Dr. R. Baribeau, Banque de Montreal, Pres de la Traverse, Levis, P. Q., Canada.
A-An-N Radio Service, W. R. Newcomb, 196 Tache Ave., Norwood, Winnipeg, Canada.
Willard's Radio Hospital, 2237 Rice St., Chicago, Ill.
George Manta, Jr., 4328 N. Sacramento Ave., Chicago, Ill.
John Scorby, 4616 N. Racine Ave., Chicago, Ill.
John P. Petroskey, 2828 West 38th Place, Mc-Kinley Park Sta., Chicago, Ill.
Sam Kurlandsky, 561 Broadway, South Haven, Mich.
E. K. Campbell, 1008 Delaware St., Mobile, Ala.
James Werner, Box 926, Breckenridge, Texas.
Horace Friday, Cleveland, N. Y.
Alvoy Williams, 1300 W. Main, Oklahoma City, Okla.
Gaston Bloncourt, G.B.T., Box 833, San Juan, P.R.
Woodruff Radio Service, Rochester, Penna.
Lewis H. Myers, 310 Stillman Hall, Colgate University, Hamilton, N. Y.
William Trowell, R.R. 1, Bracebridge, Ont., Canada.
C. W. Herzog, 4046 4th Ave., Altoona, Penna.

Radio University

A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6, without any other premium.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Determining Bias Resistance

HOW is the bias resistance for an amplifier tube obtained? I know that the required bias is divided by a current but I do not know what current?—W. T. J., Seattle, Wash.

The required bias voltage is divided by the current that will flow through the resistance. If a table of tube characteristics gives a certain plate current for a given grid bias and plate voltage, then that current is used. For example, if the required bias is 20 volts and the rated current is 8 milliamperes, then the bias resistance is 20/0.008, or 2,500 ohms. In case the tube is of the screen grid type, then the screen current should be added to the plate current, for the screen current, too, will flow through the bias resistance. It is customary to assume that the screen current is 1/3 the value of the plate current in case the screen current is not given. Hence if the plate current alone is used in computing the grid bias resistance, ¾ of the value obtained should be the resistance to use. Thus if we get a value of 2,400 ohms by using the plate current alone, the actual resistance to use would be 1,800 ohms. Ordinarily, the grid bias resistance is not critical.

* * *

Vacuum Tube Micrometer

WHAT is a vacuum tube micrometer and for what purposes is it used? I have a problem requiring the measurement of extremely minute changes in length and I am wondering if the vacuum tube micrometer is adaptable to it. Please explain the principle of the device.—W. G. M., Providence, R. I.

As the name indicates, the vacuum tube micrometer is a device for measuring lengths. Whether or not it is adaptable to your problem depends on that problem. You can easily measure small displacements, angular and linear, by means of the device. The angular displacement would have to be translated into a linear displacement. The principle of the device is the measurement of a change in capacity by means of a change in a heterodyne frequency, when the change is due to a movement of one condenser plate with respect to another. Two oscillators are used, one of fixed frequency and the other variable. If the frequency of the oscillator is F, the change in frequency dF, the distance between the two condenser plates X, and the change in distance dX, then dX = 2XdF/F. If, therefore, the frequency is 10,000,000 cycles per second, the change in frequency is one cycle, and the original distance between the plates is one millimeter, then dX = 0.2 of one millionth millimeter. The detection of a change of one cycle or less is not impossible, the production of a frequency of 10 million cycles is relatively easy, and the placing of two condenser plates within one millimeter of each other is not at all difficult. Hence the measurement of a distance of 2/10,000,000 of a millimeter is quite possible. That is a shorter distance than a wavelength of visible light.

* * *

Stopping of Superheterodyne

MY SUPER WORKS fine up to about 1,300 kc but from there to 1,500 kc is completely dead so far as signals go. However, it makes plenty of noise. What do you think is wrong with the set?—W. E. R., Minneapolis, Minn.

The symptoms indicate that the circuit starts to block at 1,300 kc. Put in a lower value of grid leak in the oscillator and the trouble will probably be over. Of course, it may be that you have to touch up the padding adjustments a little.

* * *

Tracking Condenser versus Padding

WHICH is better, using a tracking condenser or padding in the oscillator of a superhetrodyne? Which is easier to use?—T. H. N., Baltimore, Md.

If the tracking condenser has been designed correctly and if the correct inductance coils are obtained for both the r-f and the oscillator, better results can be expected with the tracking condenser than with padding. Obtaining close tracking by the padding method is easier because it is not necessary to hold the i-f tuning, the r-f inductance, and the oscillator inductance to quite as close limits. In the padding method we have two independent variables, the trimmer and the padding condenser. In the tracking condenser we have only one, the trimmer.

* * *

Improving Quality

WHY is quality of an amplifier improved when a high resistance is connected across the secondary of a coupling transformer? There is a slight loss in volume but this is more than offset by the improvement in quality.—T. W. C., Fall River, Mass.

One thing is the matching that the resistor effects. A transformer should work between two definite impedances, depending on the ratio of turns. If there is no grid leak across the secondary the transformer works into an open circuit. Then there is no match. If the mutual inductance between the two windings is equal to the geometric mean of the two inductances and this is usually the case in audio transformers, the square of the ratio of turns should equal to the ratio of the two resistances. Suppose that the transformer has a ratio of 3-to-one. The square is 9. Also suppose that the plate resistance of the tube ahead of the transformer is 10,000 ohms. The grid leak should therefore be 90,000 ohms. If the ratio of turns is five-to-one the resistance across the secondary for the same plate resistance should be 250,000 ohms. This is the condition for the transfer of greatest power to the grid leak from the tube, not the condition for getting the highest voltage on the grid.

* * *

Removing Hiss

THERE is a strong hiss in the output of my superheterodyne receiver. What is the cause of this and how can it be remedied?—R. E. D., Lancaster, Pa.

The cause of the hiss is somewhat uncertain but there are probably many things responsible. Gas in the tubes produces hiss. Irregular emission of electrons does also, and the irregularity is unavoidable. Even irregularity in the conductivity of copper wire will cause hiss. Remedies consist mainly of by-passing the hiss before it reaches the loudspeaker. In many sets you will find a condenser of 250 mmfd. or more across the load resistance in the diode detector where a condenser of 50 mmfd. would be better were it not for the hiss. Sometimes there is an r-f choke or two in the circuit to take out some more hiss. Sometimes a condenser of 0.006 mfd., connected across the loudspeaker primary, is used for cutting out the racket. Any condenser across the line, that is, from the plate to ground or from the grid to ground, will help to cut it out. Also choke in series with the line will cut out some. Tight coupling between coils will increase it because the higher side frequencies come through better. Loose coupling and high selectivity will reduce it.

* * *

A Kerr Cell

WHAT is a Kerr cell? I have heard that it is used in television in place of the neon tube. If that is correct it must be a kind of light source.—E. S. D., Newark, N. J.

A Kerr cell is a light valve, not a light source. In the first place there are two polarizing Nicols placed so that the light from an arc lamp passes through. Then there is a cell containing a special fluid which has the property of turning the plane of polarization of light when an electric force is applied across it. And the rotation of the light is proportional to the force. The light passes one Nicol and becomes polarized. Then it passes through the cell. Finally it passes through the second Nicol, if it can. If there has been no rotation of the plane of polarization then it passes through the second Nicol as easily as the first. If the rotation has been 90 degrees no light passes through the second and the light is completely cut off. The arc light, the two Nicol prisms, and the cell take the place of the neon tube. The Kerr cell enables the use of white light for television, and a great deal of it.

* * *

Parallel and Series Resonance

WHAT is the difference between series and parallel resonance? Are the two not exactly the same in so far as the relation between inductance and capacity and frequency goes?—E. W. R., Hartford, Conn.

The difference between series and parallel resonance relates to the location of the driving voltage in respect to the elements of the circuit. If the voltage is in series with either the coil or the condenser and these are connected in series, the circuit is a simple series one and the resonance is of the series type. At resonance the only impedance offered by this circuit is the resistance, which is very small in most cases. At resonance the current is maximum and the voltage across the coil and the condenser together is extremely small. In parallel resonance the coil and the condenser are connected in parallel and the driving voltage is also connected across them. The circuit formed consists of the voltage in series with the coil and the condenser in parallel. If we define resonance as that condition when the current is in phase wih the voltage, the impedance of the parallel circuit is L/RC, which is a very large number. The resonance current is extremely small. In series resonance the frequency at which the current is in phase with the voltage is determined by LC but in parallel resonance it is determined also by the resistance in the coil. The square of the parallel resonance frequency divided by the square of the series resonance frequency is $(1 - R^2C/L)$. If the inductance in the tuned circuit is 250 microhenries, the capacity 250 mmfd., and the resistance of the coil is 10 ohms, the two freqencies would differ by only 50 parts in one million. If the resistance in the circuit were 100 ohms, the inductance and capacity remaining the same, the two frequencies would differ by 5 parts in one thousand.

* * *

Harmonic Response

IF THE signal frequency is doubled and also the second harmonic of the oscillator frequency is produced strongly, would the signal be received by beating of the two? Would it come in at the same setting of the oscillator as if the two fundamentals were beating in the regular manner?—H. J. L., Brooklyn, N. Y.

The regular signal comes in when the oscillator is set so that $F_0 = F + f$, in which F_0 is the oscillator frequency, F the signal

(*Continued from preceding page*)

frequency, and f is the intermediate frequency. If harmonics of both the signal and oscillator frequencies were strong they would beat and they would produce the intermediate frequency if $F_o = F + f/2$. This oscillator frequency is a little less than the regular oscillator frequency. As an example, let us assume that the intermediate frequency is 400 kc and that the signal frequency is 600 kc. The regular oscillator frequency would be 1,000 kc and the frequency that would bring in the signal on the harmonic would be 800 kc. There is another combination possible. Suppose we use the lower oscillator setting to bring in the station. Ordinarily the oscillator would be set at 200 kc to bring in 600 kc with the 400 kc super. The signal would also be brought in at 400 kc. Or, using frequencies that would be more likely to occur, 1,500 kc would be brought in by setting the oscillator at 1,100 kc and the harmonic by setting it on 1,300 kc. The signal on the harmonic would not be clear because all the frequencies in the signal would be doubled, that is, all the modulation frequencies as well as the carrier.

* * *

Determining I-F

IF THE intermediate frequency of a superheterodyne is not known is it possible to determine it from the two settings of the oscillator condenser at which a given signal comes in? If there is a formula for this will you kindly publish it? I understand that it is necessary that the oscillator condenser be independently tunable from the r-f tuner.—S. R. W., Springfield, Ill.

Yes, there is a formula. If f is the intermediate frequency sought, F the signal frequency brought in at the two places on the oscillator dial, C1 and C2 the values of capacity in the oscillator circuit at the two settings, and Co is the setting at which F is tuned to zero beat on the oscillator, then $f = C_oF(C_2 - C_1)/4C_1C_2$. Three capacity observations are necessary and the signal frequency F must also be known. If the oscillator dial is calibrated in frequency the intermediate frequency is obtained by dividing the frequency difference between the two settings by 2. For example, a signal of 1,000 kilocycles may come in at 820 and 1,180 kc, as indicated by the frequency-calibrated oscillator dial. The frequency differences is 360 kc. Hence the intermediate frequency is 180 kc. It is easier to calibrate the dial in frequency than in capacity, and when the oscillator is calibrated in frequency no computation is needed other than dividing by two.

* * *

Antenna Shortening Condenser

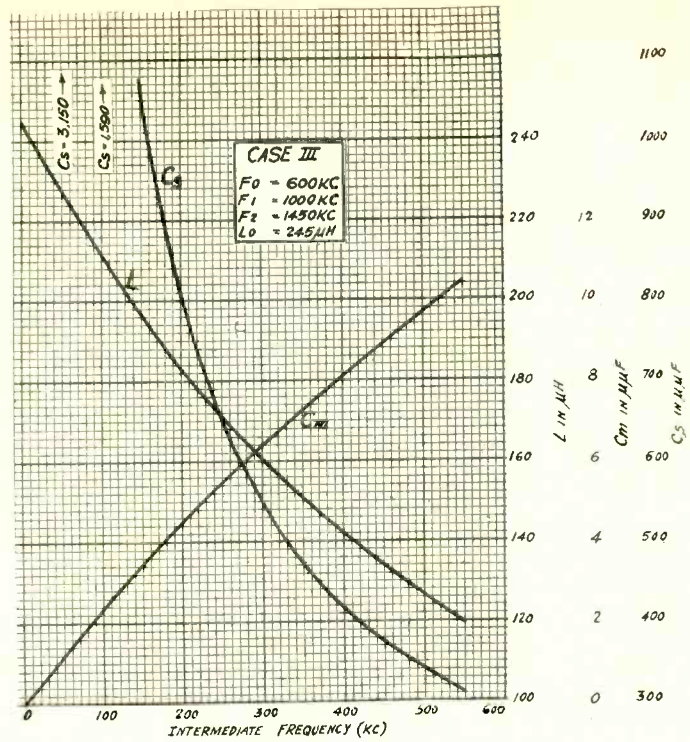
WHAT is the purpose of the small antenna condenser often used with short wave sets? It has been my observation that the larger the value of this condenser the greater the signals. If that is true generally it would be best not to use it at all.—C. O. L., Albany, N. Y.

One thing the antenna condenser does is to keep the antenna resistance out of the tuned circuit. If the first tuned circuit is of the regenerative type, no oscillation will usually occur unless the antenna condenser is very small. The circuit is also more selective when the condenser in the antenna circuit is small. That is a matter of resistance again. As a rule, results all around will be better when a small condenser is used in series with a long antenna. If the antenna is short in the first place the use of the condenser is not so important.

* * *

Padding Data

WILL you kindly publish data on the values of inductance and padding capacity for different intermediate frequencies? For example, what should the inductance of the oscillator be when the intermediate frequency is 130 kc and what should the padding condenser be? It is assumed that the broadcast band will be covered.—T. A. N., Denver, Colo.



These curves show at a glance what the oscillator inductance and the series padding capacity should be in a superheterodyne for different values of intermediate frequency.

The actual values of oscillator inductance and padding capacity depend on the inductance in the r-f circuit for it is a matter of ratios. In the graph reproduced here the oscillator inductance L, the padding capacity Cs, and the minimum oscillator capacity Cm are given for the case when the r-f inductance is 245 microhenries. The intermediate frequency varies between zero and 550 kc. The oscillator trimmer condenser is supposed to be adjusted at 1,450 kc and the padding condenser at 600 kc.

If the r-f inductance used has a different value than that in the figure the oscillator inductance should be increased or decreased by the same ratio. The series capacity should also be changed, which can be done most easily by experiment.

* * *

Stopping Intermediate Oscillation

AS I HAVE BUILT the 7-tube Super Diamond and am experiencing motorboating, I am writing to ask the cure, as directed in the constructional articles. Otherwise the set is first-rate. Moreover, I get plenty of DX. I might add that the motorboating is present sometimes, not always.—P. L., Akron, O.

The so-called motorboating is really intermediate frequency oscillation. The sound is the same as if there were oscillation at an audio frequency, hence the confusion. The occasional presence confirms the frequency estimate. The easiest way to stop the oscillation, or motorboating, if you want to call it such, is to return the plate of the second intermediate amplifier not to the B plus line as originally diagramed but to the lower voltage screen feed. This will stop the trouble presto. The d-c voltages will be changed somewhat from those stated in the tables accompanying the constructional text, but this change may be disregarded.

* * *

Audio Howl

IN CONSTRUCTING a frequency-stabilized oscillator, using the 55 tube, since at least part of the rectifier load resistance is common to the rectifier anode and amplifier grid circuits, I find that there is an audio frequency oscillation, which I do not desire, of course. Turning the tuning condenser changes the frequency slightly, thereby giving the result as would be obtained from a large capacity changed by a small series capacity. Please explain the cause and state the remedy.—U. W. D., Fort Wayne, Ind.

The cause is audio frequency oscillation, due either to the time constant of the resistor-capacity circuit in the rectifier load, or, what amounts to the same thing, to the audio-frequency tuned circuit resulting. This is changed slightly by the series capacity effect of the tuning condenser. The remedy is to use a smaller value of resistance between the grid return and the cathode. You may return the rectifier load resistor to ground, instead of to cathode, and the circuit may be left thus if rectified current flows, which you can determine by using a 0-1 milliammeter in series with the rectifier load resistor. If the total rectifier load resistance is around 251,000 ohms, the part between return of pick-up winding and grid return may be 250,000 ohms and that between the junction and ground may be 1,000 ohms. This constitutes reduction of the common resistor to 1,000 ohms. However, the remedy might lie also in using a smaller capacity to bypass both the total rectifier load resistor and so much of the resistor as is between junction and ground (or cathode). Either one, or possibly if necessary a combination of both of these recommendations, will cure your trouble.

* * *

200 kc. Intermediate

IN THE CONSTRUCTION of a short-wave superheterodyne is it permissible to use so low an intermediate frequency as 200 kc? I have the transformers.—P. O., Venice, Calif.

Yes. This is somewhat lower than usually employed, and the image interference suppression will not be quite so effective as if the frequency were higher, still 200 kc is not taboo, by any means, and a Marconi short-wave set made in England uses just that frequency. The benefit of extra image suppression by higher intermediate frequency is soon lost, anyway, and it becomes tweedle-dum-tweedle-dee between 200 kc and, say, 450 kc. Go ahead building the set.

STATION SPARKS

By Alice Remsen

The House of a Friend

FOR JOE EMERSON,

"The Bachelor of Song"

(Every week day morning, 9:15 a.m., WLW)

When your heart's overburdened with care,
And you feel you have more than your share
Of trouble and worry and woe,
There's only one place you should go.

When the world seems a terrible place,
Full of troubles which you cannot face,
When you're sick and discouraged and blue,
There's only one thing you should do.

You must go where a welcome you'll find,
Where you can unburden your mind;
To a place where your troubles will end—
That place is the house of a friend.

—A. R.

* * *

AND WHEN YOU LISTEN IN TO JOE EMERSON you will feel that you have found the house of a friend, for Joe has just that grand friendly personality. His songs will help you to forget your cares and his beautiful voice will soothe your troubled mind. Listen to him; you'll like him!

* * *

The Radio Rialto

Quite a few contract renewals are reported from NBC and Columbia, but only one new account for NBC, and two for Columbia. . . . The renewals for NBC are Chevrolet, extension of time for Al Jolson, eight weeks; Borden Company, extension for twenty-six weeks, up to and including December 30th 1933; Wildroot Company, renewed for fifty-two weeks; Kellogg Company renewed for fifty-two weeks, four times weekly; and the new account, Williams Shaving Cream, for thirteen weeks. . . . At Columbia the renewals are Phillips Petroleum Company, daily, except Sundays, and Oxol, twice weekly; the new contracts are Fred Fears (Easter egg dies), a five-tie broadcast series just for the Easter business; and Horlick's Malted Milk. . . . It seems to me those renewals should prove to tardy advertisers that radio must be a good advertising medium —with particular reference to the Wildroot and Kellogg Company with their fifty-two week renewals. . . .

There are so many timid business folk who can't seem to realize that the only way to sell goods in these poor times is to advertise more than ever, and the only way to advertise via radio is to give the listener good entertainment; by that I don't mean out-of-date comedy, or high-brow stuff that half the listeners find impossible to understand. Of course, the poor sponsor, who seldom knows anything of entertainment psychology, is up against a tough proposition; when he tries to please everybody he almost goes crazy figuring out what the listener wants; he listens to so many auditions that his brain becomes sated with bits of this and that, dancing around like an animated jig-saw puzzle; how to fit this puzzle together in order to sell his product is no mean task, but when he does get a good program, the trick is to hang on to it, for when listeners become real fans, they resent program changes. . . .

An announcement just over the air said we were to hear from Russia, a re-broadcast of the bells of the Kremlin. Then came several minutes of static, and then an apology; they'll try again later. . . . The latest news from WLW in Cincinnati, is the fact that the Federal Radio Commission has authorized the Crosley Radio Corporation to use added power for experimental broadcasts and the contracts for the bulk of the equipment to be used has gone to the RCA-Victor Company of Camden, N. J. These contracts call for building the radio frequency amplifier, the high-powered modulation unit, the power supply, and the controls of what will be, when completed, the world's most powerful radio broadcasting transmitter; construction of new buildings to house the 500,000 kilo-watt transmitter, and of the huge 840-foot all steel "vertical radiator" antenna structure are already under way at the Crosley transmitter plant located at Mason, Ohio, twenty-two miles north of Cincinnati; it is expected that within a few months WLW will be using its new transmitter during the hours from 1:00 to 6:00 a.m., E.S.T.; as viewed by Mr. Crosley and by members of the Radio Commission, the new transmitter will serve as a practical laboratory for the scientific field of extreme super-power; this is a logical step for this pioneer organization, which has covered the entire power range from the original 20-watt transmitter, installed in Mr. Crosley's home in 1922, through increases to 50 watts, 500 watts, the pioneer remotely controlled 500-watt transmitter located at Harrison, and the first 50,000-watt broadcasting transmitter in the world, the present WLW. . . .

Heard a nice program by the two Grace's, Grace Brandt and Grace Clauve Raine, Wednesday, at 4:30. . . . Followed by that ever-popular and interesting "Low Down" with Mary and Jerry, the two mail-desk kids, this is one of the most popular programs on the station. . . . Have you ever heard Don Becker play ukulele? Well, I'm listening to him right now; he has a program with Larry Gruetter and Maurie Neuman. Don can certainly play that little box; Larry is a great accordionist; and Maurice knows how to put a song over; so what have we!—a good program. . . .

There was a lot of excitement over at the CBS outlet in Covington, Kentucky, the other afternoon; Station WCKY had quite a few distinguished visitors when the Sisters of the Skillet, Eddie East and Ralph Dumke, were made aide-de-camps to the Governor of Kentucky, with the ranking of Colonel—so now it's Colonel East and Colonel Dumke—and are the boys proud of their scrolls, tied with ribbon and stamped with the great seal of Kentucky signed by Governor Laffoon n'everything. L. B. Wilson, the president of WCKY, made the presentation on behalf of the Governor; they were also presented that same afternoon with two engraved skillets by Elmer J. Dressman, continuity editor of the station, on behalf of their thousands of followers in this vicinity. The Sisters of the Skillet have long been a feature of the National Broadcasting Company and were the vaudeville headliners at the Albee Theatre in Cincinnati last week. . . .

Singin' Sam, Columbia's Barbasol Man, is proudly displaying a shamrock watch charm made of silver and jade; it was sent to him by an Irish admirer who had heard his programs via W3XAU, Columbia's short-wave station in Philadelphia. . . . The one program which Morton Downey and the missus say they never miss is that of their old friend, Bing Crosby; both declare Bing is their favorite artist. . . . Ted di Corsia, who does the impersonations of President Hoover and other notables on the "March of Time" program, is a man of many avocations; he likes to paint landscapes, write poetry and compose music. . . . Coast-to-Coast switchovers will be made during the Guy Lombardo-Burns and Allen broadcasts during the next ten weeks. Guy and the orchestra will broadcast from New York, while the two popular dumbcrackers will face the microphone in Hollywood, where they have gone to film their two new feature movies. . . . Eddie Cantor was "Blondie of the Ballet" for his act on the Chase and Sanborn program on a recent Sunday night. He came to the studio with a mysterious suitcase, which disgorged a white and gauzy ballet skirt and blonde wig which Eddie donned before going out on the stage! But he couldn't manage without the assistance of Rosaline Greene, NBC dramatic star on the same program. Cantor had forgotten the fixings; not knowing much about skirts. Rosaline met the emergency with a collar pin commandeered from a bystander in the reception room and two brooches detached from her gown—while Cantor, staunchly girded, rolled his trousers up to the knees and went on and "knocked 'em out of their chairs." . . .

If you think the job of sound effect man is an easy one just listen to this: Ray Kelly, head of NBC sound activities, was required to produce the following articles for a recent Crime Club production: dish, tools, bromo-seltzer, glasses, water, three steam whistles, air tank, two revolvers and blanks, Diesel engine, public address system, iron door, flexible metal hose, water cradle, sound proof cabinet, light globe, ordinary door—and a whimpering baby.

* * *

Biographical Brevities

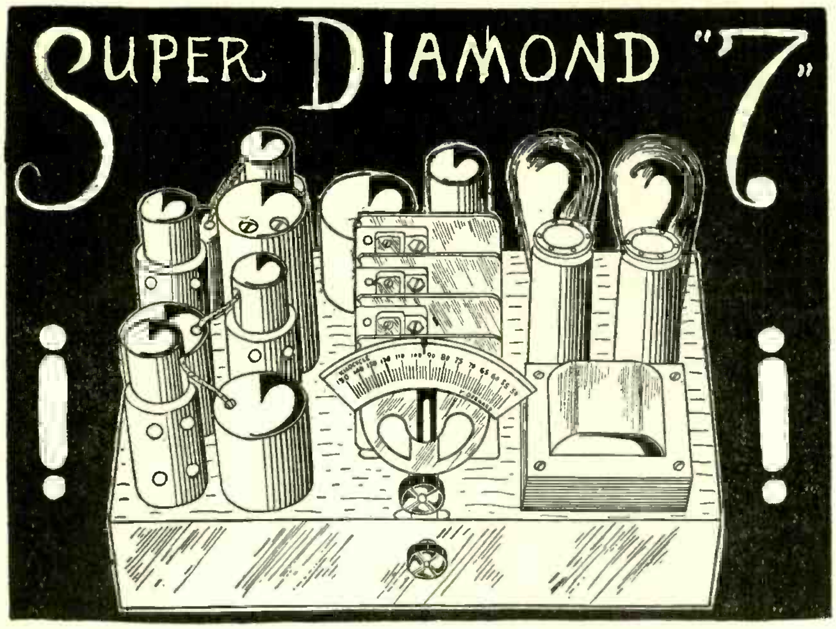
ABOUT FRANK CRUMIT

A few of my readers scolded me for not writing Frank Crumit's biography when I wrote Julia's. Of course, I did not intend to neglect Frank; just didn't have room; naturally we can't think of Frank without Julia or Julia without Frank—so here goes:

Frank was born in Jackson, Ohio; September 26th, 1889. Became popular at Jackson High smacking out home runs, making touchdowns, shooting basket ball field goals, and fast work on the track followed. Despite the early death of his parents, he forged ahead. He went to Culver Military Academy, where he proudly joined the Black Horse Troop and later matriculated at Ohio University. The Phi Delta Thetas initiated him. He majored in electrical engineering and was graduated in 1912.

Frank's uke pulled him into vaudeville more for fun than anything else, but finding he could make good money at it, he stuck at it. Calling himself the One Man Glee Club, Frank clicked big. He was featured in "Betty Be Good" in 1918. In 1920 he played with Howard Marsh and Mary Lewis in "Greenwich Village Follies" and that year he made many records and found himself nationally famous because of them.

In 1922 he accepted an offer to play the lead in "Tangerine." He met, at the very first rehearsal, a young woman who interested him from the start. She was Julia Sanderson, the leading woman and a girl with a funny little giggle, and a winning voice. "Well," says Frank, "it wasn't long before I found out that I couldn't get along without Julia and we've been together ever since!" Theirs is a genuine romance. Frank still declares the most thrilling moment of his life was meeting Julia and singing "Sweet Lady" to her. He still sings to her, even in the studio.



The Set That Brought In 96 Channels Out of 96!

A SEVEN-TUBE receiver, designed by Herman Bernard, with highly accurate padding, and using a frequency-calibrated dial, the Super Diamond 7 is just the thing for DX enthusiasts. The circuit has full automatic volume control, full-wave diode detection, diode-biased 55 triode, and, except for the second detector, triple-grid tubes throughout. Stations 10 kc apart sharply separated though antenna power input of one is 100 times that of other. A circuit with beautiful tone. Complete kit of parts for this receiver, including everything, even speaker, except cabinet, front panel and tubes. (Cat. CKSD7) **$19.62**

FOUNDATION UNIT

The Foundation Unit for the Super Diamond 7 consists of a shielded antenna coil, a shielded interstage r-f coil, a combination oscillator and 175 kc assembly in one high shield, a shielded regular 175 kc transformer, and a shielded 175 kc transformer with center-tapped secondary; also a 0.00041 mfd. tuning condenser, three-gang, with compensators; an 850 to 1,350 mmfd. padding condenser, a frequency-calibrated dial and a drilled chassis. Cat. FU-SD7 @ **$6.55**

[The coils for r-f and oscillator are wound exactly according to specifications of Herman Bernard and are of a higher order of accuracy than in commercial practice, and moreover provide for matching the tuning to the scale of the frequency-calibrated dial that bears Mr. Bernard's name.]

ADDITIONAL PARTS

The nine 0.1 mfd. and two 0.25 mfd. bypass condensers for the Super Diamond 7 are specially made up in one shield, with mounting brackets, and is the same as used in the designer's model. Cat. CU-SD7 @ **$1.20**

Three-gang 0.00041 mfd. tuning condenser, compensators. Cat. TC-SD7 @ **$1.80**

Drilled chassis for the Super Diamond 7. Cat. CH-SD7 @............. **$ .80**

The tubes used in this receiver are four 58's, one 55, one 59 and one '80. Total, 7 tubes. Tube kit is Cat. TK-SD7 @.. **$5.35**

850 to 1,350 mmfd. padding condenser, 50c; knobs for ¼ inch shafts, 7c each, four for 25c; Bernard's frequency-calibrated dial, 90c; electrolytic condensers, 8 mfd., 49c each; power transformer, $1.95.

SUPER DIAMOND 6

This is a 6-tube a-c receiver, like the "7," only there is one intermediate stage instead of two. Good sensitivity and selectivity, with finest tone yet developed in a super. Uses the same accurate padding system as the "7," same frequency dial. Gets plenty of distance, too.

Complete parts, including speaker (less tubes, less front panel, less cabinet). Cat. SD-CMP @ **$16.22**

Set of shielded coils, consisting of antenna coil, modulator input coil and combination oscillator and first 175 kc intermediate coil (latter two in one shield), and separate intermediate coil with center-tapped secondary. Cat. SDCK................. **$3.95**

Combination oscillator and 175 kc only, in one shield. Cat. OSN @.... **$1.80**

Three-gang 0.00041 mfd. condenser with trimmers built in; ⅝ inch shaft, 1⅛ inches long. Cat. DJ-41-T.......... **$1.98**

250,000-ohm potentiometer with switch. Cat. R25S @............... **$ .72**

Pigtail resistors, 9c each; Rola speaker, $3.83; tube shields, 11c each; UX, UY sockets, 10c; six-pin, 11c; 7-pin, 15c.

The tubes required for the "6" are two 58, one 57, one 55, one 59 and one '80. Cat. TK-SD6 @ **$4.53**

AUTHENTIC CIRCUITS

The Super Diamond series—the six-tube and seven-tube models—are most excellent circuits, carefully engineered and tested. "Everything fits." You will be amazed at what results these circuits yield. They are real "hot" and we unqualifiedly recommend them.

DIRECT RADIO COMPANY

143 WEST 45TH STREET NEW YORK CITY

SHORT-WAVE COILS and FORMS

Precision short-wave plug-in coils, wound on 1¼" diameter. Form has gripping flange. Four coils to a set for each tuned circuit. Approximate frequencies with 0.00014 mfd. are 1400-3080 kc, 3000-6600 kc, 6000-13200, 13000-30000 kc.

Two-winding coils, UX base. Cat. SWA (four coils) $1.20

Three-winding coils, 6-pin base (tickler interwound with part of secondary) Cat. SWB @ $1.40

UX sockets for use as coil receptacle, Cat. 5X. @ 10c each.

Six-spring sockets. Cat. SZ. @.......... 11c each.

SCREEN GRID COIL CO., 143 W. 45th Street, New York City

ANDERSON'S AUTO SET

Designed by J. E. ANDERSON

FOREIGN RECEPTION ON 6-INCH AERIAL

This new auto set is the most sensitive car receiver we have ever come across. Mexican and Canadian stations were tuned in from New York City on a 6-inch aerial. The circuit, an 8-tube superheterodwne, with automatic volume control.

The complete parts, including set chassis and set shield, battery box, remote control, battery cable, all condensers, resistors and coils, speaker with shielded cable; and a kit of RCA tubes (two 239, two 236, two 237, one 89, and one 85) are supplied less aerial. Cat. 898-K @........$34.60

Wired model, licensed by RCA, with complete equipment, less aerial, but including RCA tubes. Cat. 898-W $37.40

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143 West 45th St. N. Y. City

8 MFD. CONDENSER

Four for Only $1.47

We are able to offer brand-new 8 mfd. wet electrolytic condensers, with insulating washers, mounting nut and lugs at four for $1.47. These condensers are freshly made for us in quantity by Polymet Manufacturing Co. and are highly recommended by us for assurance of full capacity and for their ruggedness. They are of the inverted mounting type. Single condenser, lugs, washers, nuts. Cat. Poly-8 @......49c

Four for the price of three, i.e., $1.47

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FULL-SCALE PICTURE DIAGRAM OF TWO-TUBE 15-200-METER BATTERY RECEIVER—Printed in Radio World dated April 2, 1932. This is the diagram asked for by so many readers who were interested in the short-wave receiver described in issue of Feb. 27, 1932. Both copies mailed for 30c. RADIO WORLD, 145 W. 45th St., New York City.

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