OCT. 1
1932

ACCESSOR ANALYZER

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RADIO WORLD

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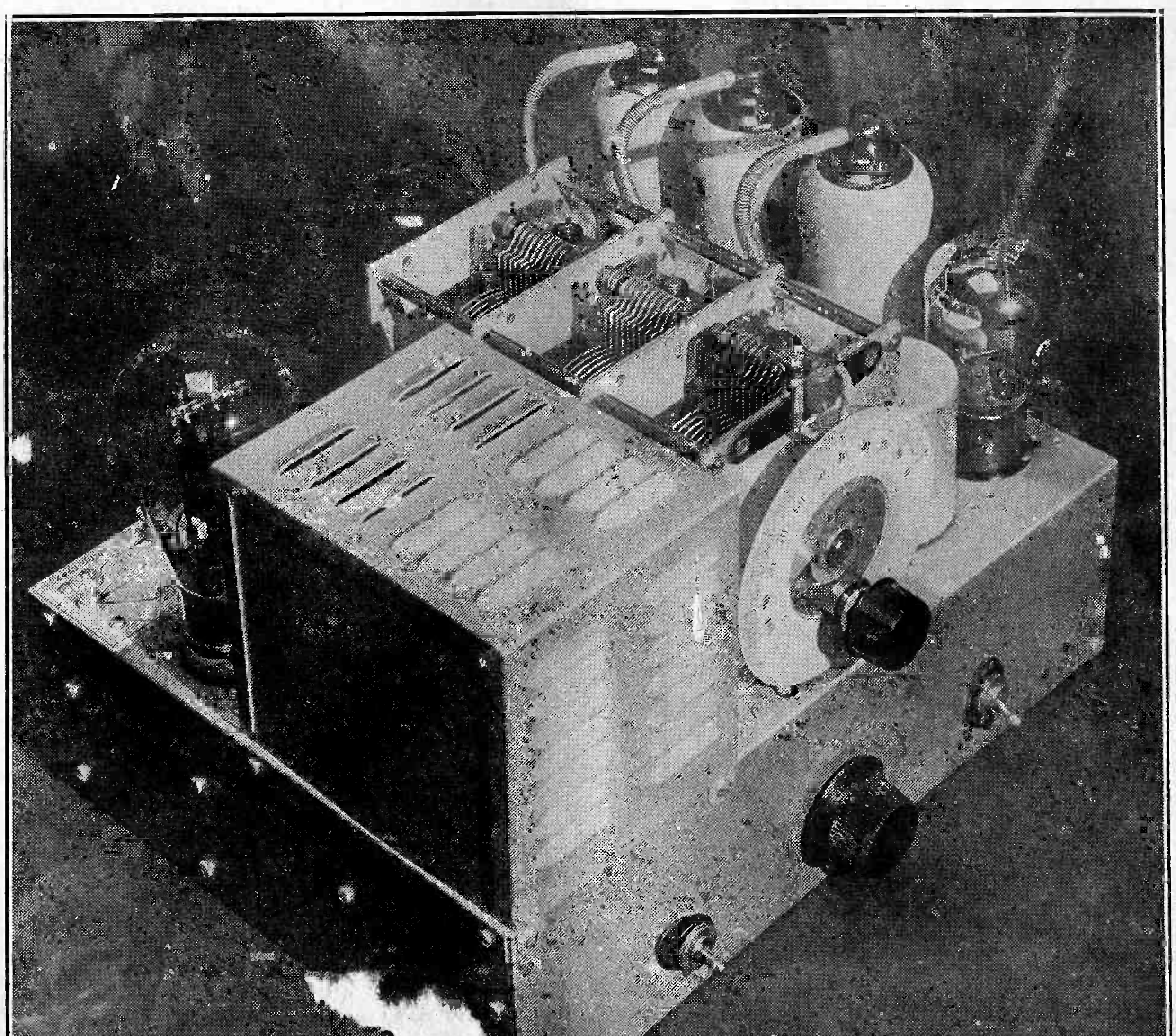
The First and Only National Radio Weekly

Eleventh Year—549th Issue

5-TUBE DIAMOND CONSTRUCTION

SW SUPER FOR BATTERIES

NEW VISION RECEIVER



Foreign Feature Photos

Television Receivers of this type are being exhibited at radio shows in Europe. See page 3.

Parts for the 1933 DIAMOND

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Cat. POLY-8, one 8 mfd., wet electrolytic condenser, inverted mounting, with two insulating washers and one special lug, 49c.

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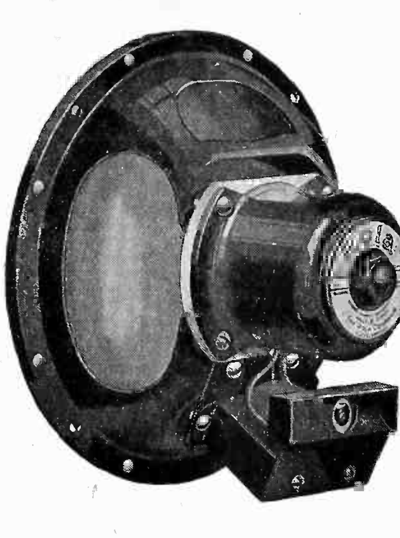

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Cat. EQ-100, 20-100 mmfd. Hammarlund equalizer.......................... .19
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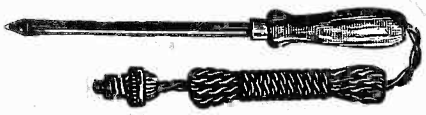

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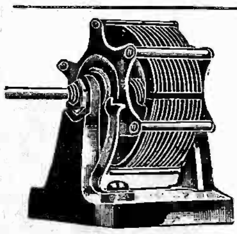

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FULL SCALE PICTURE DIAGRAM OF 4-TUBE DIAMOND

This full scale diagram, together with an accompanying article on wiring, adjusting and operating the Four-Tube Diamond, appeared in Radio World dated Sept. 17. Sent for 15c a copy. First and second installments of article on the 4-Tube Diamond appeared in issues of RADIO WORLD, dated Sept. 3 and 10. The three copies sent for 45c. Or send $1.50 for a three months' subscription and receive these three numbers free.
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DISCS IN EUROPE

French Inventor Offers Spiral with 30 Lenses, Each Adjusted

By Henri de la Falois

NOTABLE advancements in the perfection of radio and television apparatus were shown at the radio exposition inaugurated recently by M. Queuille, Minister of Postes, Telegraphs, and Telephones. On the front cover we reproduce a photograph of a radio chassis shown at the exposition. This is a six tube receiver comprising three screen grid tubes, and audio amplifier stage, a power tube and a rectifier. It is a tuned radio frequency receiver with three ganged tuned circuits. It is supposed to be applicable to reception of television signals as well as to reception of broadcast signals.

A Lens Scanner

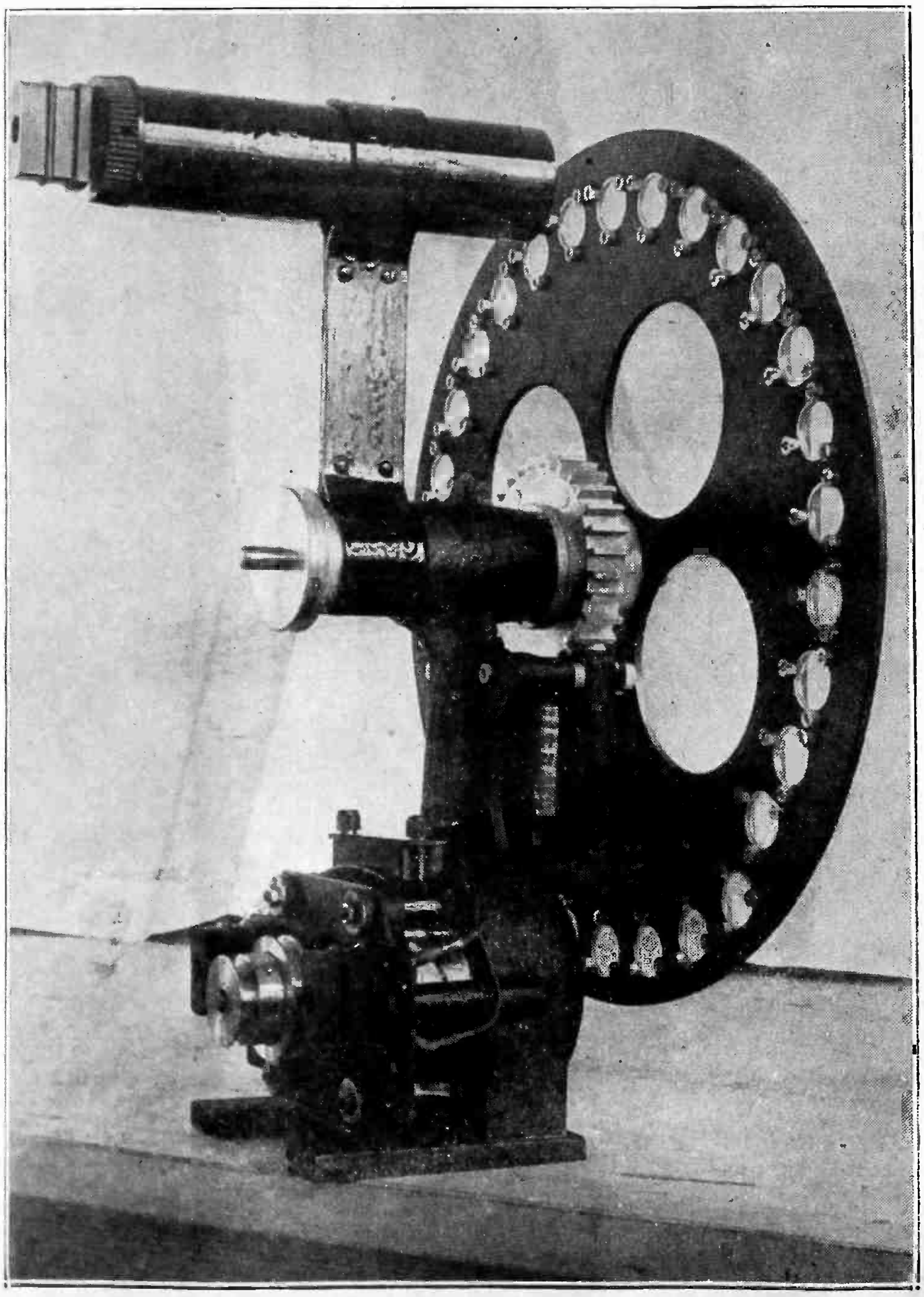
Herewith is photograph of a television transmitting scanner as demonstrated at the exposition. The French are known for the fine workmanship of their scientific instruments, and in the construction of this scanner they have lost none of their reputation. It is a fine looking mechanism.

The disc is apparently driven by means of a synchronous motor, which constitutes the base of the assembly. The toothed wheel on the main shaft directly in front of the disc and directly over what appears to be an audio transformer constitute the elements of a generator of a synchronizing signal which is sent as a modulation on the television carrier.

The Drive

This drive arrangement can also be used for receiving. In that case the driving motor in the base should be of the universal or induction types and the power supplied to it should be just sufficient to drive the disc at the required speed. The synchronizing signal received from the transmitting station is then impressed on the phonic wheel attached to the shaft through the coil underneath the toothed wheel. The synchronizing signal will then hold the disc in synchronism with that of the transmitter for as the disc tends to speed up, relatively to speed of the transmitter, the synchronizing signal will retard it a little, and conversely, when the

(Continued on next page)



GAIN
In Direct Coupled Circuits
Choice of Constants to Avoid Frequency Distortion

By Einar Andrews

THE voltage gain in resistance coupled amplifiers is easily determined if we know what is the amplification constant of the tube and the load impedance and the internal resistance of the tube. Suppose the amplification factor is u, the internal resistance r, and the load resistance R. The total resistance in the plate circuit is therefor r+R. If we impress a voltage of E volts on the grid, the effective voltage in the plate circuit resulting from this voltage is uE. The phase is reversed so that we should use the negative sign, but if we are only after the magnitude we need not consider it. Then we have a voltage of uE and a resistance of r+R in the plate circuit, and consequently the plate current will be uE/(r+R). This is the signal current and not the current that would be measured with a d-c instrument in the plate circuit.

The voltage drop in the load resistance, which is the output voltage, is the product of this current by the load resistance. That is, the output voltage is uER/(r+R). If we divide this by the input voltage we get the voltage gain. Hence the voltage amplification of the tube and the coupler is uR/(r+R). This is the result in the very simplest case. In any practical case, however, the load impedance is not a simple resistance but rather a complex impedance. First we have a shunt capacity between the plate of the tube and the cathodes. Then we have, in most cases, a stopping condenser between the plate of the tube and the grid of the next. Then we have a grid leak from the grid to the cathode, effectively, and finally we have a capacity between the grid and the cathode.

Effect of Capacities

If we were to compute the actual voltage amplification in any typical case we would have to take account of the capacities and the grid leaks as well as of the load resistance. The resulting formula is rather complex and for most audio frequencies the result of the complex formula is practically the same as that of the simple. There is a deviation at the two extremes of the frequency range. At the high frequencies the shunt capacities reduce the amplification and at the very low frequencies the stopping condenser reduces it. The effect of the shunt capacities and the stopping capacity is to make the transmission characteristic similar to that of a broadly tuned circuit. It is a matter of design to make this characteristic as broad as practical.

The amplification of the low frequencies can be kept up by making either the stopping condenser capacity or the grid leak resistance high or to make both of them high. The essential thing is to keep the product of them high. However, if we make the grid leak resistance low and make the product large by increasing the stopping condenser capacity, we reduce the amplification on all frequencies. The grid leak, therefore, should be made as large as practical and then the stopping condenser should be chosen so that the product of the grid resistance and the stopping capacity is sufficiently high. If the grid leak is made too large the grid will block as a result of grid current.

Drop in Stopping Condenser

The idea is that there should be just as little voltage drop across the stopping condenser as possible, and as much as possible across the grid leak, and this should be judged at the lowest frequency to be amplified without appreciable distortion. It can be shown that to get most of the drop across the resistance the value of RCw should be as large as possible, where w is two pi times the frequency. If 99 per cent. of the voltage drop is to occur across the grid leak at 20 cycles per second the product of R and C should be 0.056. Suppose, then that we select a grid leak of half megohm. Then C should be 0.112 microfarad. For broadcast reception it is not necessary to use a large value of RC than about 0.05. That is, if the grid leak is 0.5 megohm, it is not necessary to use a larger condenser than 0.01 mfd. But if it is necessary to use a larger value of RC than about 0.05. stop blocking, the condenser should be increased proportionately.

Compensation

It is more difficult to prevent loss at the high audio frequencies. While we can remove all external shunt capacities in most instances we cannot remove or reduce the internal capacities. In the plate circuit of the detector a by-pass condenser is usually required. This must be kept as small as possible in order to avoid loss of amplification on the high frequencies.

In case it is absolutely necessary to keep the amplification up to about 10,000 cycles about the only thing that can be done is to introduce some form of equalizer. A parallel tuned circuit in series with the load resistance is one way. We might adjust this tuned circuit so that it resonates at about 8,000 cycles. It should not be too highly resonant for then there will be a sharp peak at 8,000 cycles rather than a broad hump. Hence the coil used may be wound with fine wire. Suppose we use a coil of 0.5 henry inductance. Then the effective capacity across it should be 788 mmfd. If we use a coil of 0.05 henry inductance the capacity should be 7,880 mmfd.

This method does not completely compensate for the losses in the shunt capacities because the damage has been done before the tuned circuit comes into play. It is also possible to compensate by means of regeneration at the high audio frequencies, but this leads to complex circuits.

The need for building up the high audio frequencies is considerable because they are first suppressed to a high degree in the tuner and then they are further depressed in the audio amplifier. For all that, people have become accustomed to reproduction lacking in high notes and when there is a circuit that does well with the high notes listeners demand tone control, which is nothing but a device for cutting out the high audio notes. Of course, there are effects which tend to increase the strength of the high notes, particularly in connection with the 247 tube. When these effects are too strong there is a preponderance of high notes and there is a good reason for depressing them. However, there is a greater need for building up the low notes.

Test for High Notes

The test for the presence of high notes in about the correct degree is good articulation in speech. When some one is talking, is an effort required to understand what he says, or does understanding come without careful listening and straining of the ears? Particularly, do the hissing sounds come through the speaker or through the listener's imagination? Does "the" sound like a "the" or like a grunt?

Even in music the actual presence of the high notes is necessary. We remember in the early stages of radio broadcasting that the violin was about the only instrument that came trough well. The organ was a failure, largely due to absence of low notes and the presence of too much reverberation. The piano was also a failure, mainly due to absence of both high and low. Music lovers refused to listen to the "thumping." The low notes give a richness to the music and the high frequencies give life and sparkle. Both must be present in the output of the loudspeaker or the reproduction will not be natural.

French Television Scanner

(Continued from preceding page)
receiving disc slows down, relatively to the transmitting disc, the synchronizing signal speeds it up. Thus the transmitting disc governs the speed of the receiving disc although it does not drive it.

The disc has 30 lenses set in a spiral, each lens being carefully adjusted by three screws to correct alignment. The mask where the actual scanning takes place is located inside the telescopic tube and consists of a tiny hole in an otherwise opaque sheet in the focal plane of the lenses. Each lens forms a complete image of the scene to be transmitted but the images move relatively to the scanning spot. Hence as the disc turns around once all the elemental areas of the object are passed in review before the scanning spot.

The photo-electric cell is also inside the telescopic tube. Hence the light from the elemental areas passes directly into the cell.

In case this scanner is used for reception a crater lamp or some other modulable point source of light is located inside the telescopic tube. The image of this point source, reduced to a small intense spot of light, is thrown on the screen and distributed by the moving lenses.

The disc is made of thicker material than is the custom in this country and this fact tends to make the speed steadier, due to the greater moment of inertia. But it also requires a little more driving power. The greater thickness, of course, simplifies the mounting and adjusting of the lenses. Other features are the long shaft and the sturdy bearings.

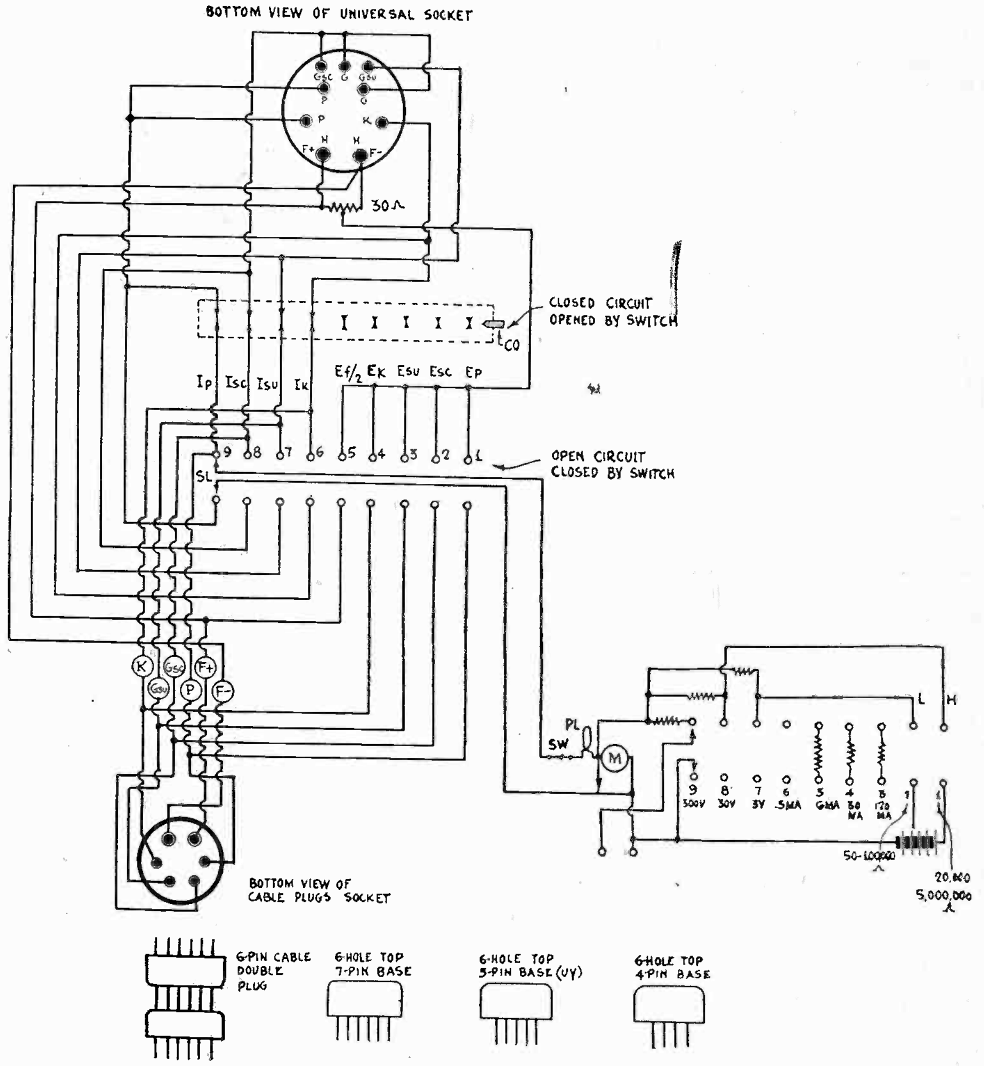
THE ACCESSOR-ANALYZER

Operating Receiver May Be Tested, Also a "Cold" One By Resistance Method

By Edgar Forbes

THE Accessor, described in these columns recently, and concerning which data were printed as recently as last week, may be combined with a voltage-current-resistance selector, so that you have a set analyzer, with additional resistance-measuring service, and independent use of the meter for external measurements.

What an Accessor does is simply to render accessible the current and voltages in a receiver. The panel is simplified by use of a universal socket, so that the same socket receives tubes of the UX, UY and six-pin types. For special type tubes, such as UV-199, WD-11, WD-12 and others, adapters are needed both for the Accessor panel and the Accessor plug (to fit into the set socket), and the 7-pin base tubes made by some of the smaller tube manufacturers are included in this category. It is not practical now to utilize a universal 7-spring socket, in fact, there isn't any such, and no present intention of making any, until such a type tube becomes the dominant one on the market, which it is very far from being.



The Seven-Prong Plug

On this subject the following statement from Milton Alden is interesting:

"Upon the advent of six-prong tubes, instrument manufacturers shifted almost immediately to six prong analyzer plugs.

"Now that a seven-prong tube has been announced, there is the question whether there is going to be a seven-prong analyzer plug available.

"We have designed such a plug to have ready at such time as seven-prong sockets become the dominant socket, or when a seven-prong tube is produced with a control grid cap on the top.

"In the meantime, there are some very definite disadvantages in having a seven-prong analyzer plug.

"It would mean that almost invariably the analyzer plug would have to be used with an adapter. This added length would in instances be a disadvantage in closely shielded sets and others built in limited space.

"In addition to this, new sets are appearing in accordance with the rules of the Board of Fire Underwriters in which there is a shield having only a 1-32 in. clearance between it and the tube base.

"To meet these conditions analyzer plugs made in co-operation with the engineers of the test equipment companies have been designed so that the analyzer plugs and the associate adapters in every instance will not have a greater diameter than the smallest tube base of a given number of prongs."

Socket Terminal

The purposes and wiring of the accessor have been explained (July 30th, September 3d and 24th). The switch used is of the nine-position type, four decks, whereby two decks of closed circuits have one of the four of the nine circuits opened by an insulated circuit-opener (CO) for current readings, the three not opened when one current is read, or four not in use when voltage is read, retaining the circuit continuity. At corresponding positions a two-point slider closes otherwise open points, enabling the meter to be cut in the circuits as they are opened for current readings or picked up for voltage readings.

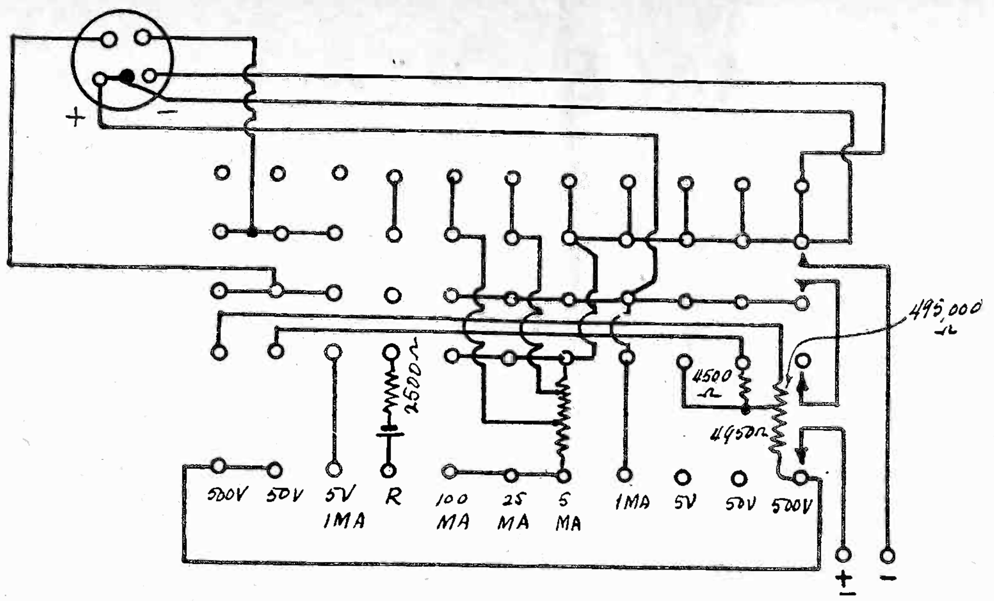
It was deemed advisable to terminate the accessor at a socket so that the cable would not have to be dangling there all the time. It is of use only in conjunction with receiver tests, and when other measurements are to be made it certainly is a cumbersome thing to have around, so a cable with six-pin plugs at both ends is used. Adapters permit access to sockets other than of the six-spring variety. They are as shown on the diagram.

Precautions

The meter is to be built into the present device, and therefore the multipliers and shunts are built in also, and the net result is that one switch is turned for picking up the desired points in the receiver (see September 3d issue), the other switch for using the right range and type of measurement. If the high voltage reading is at one extreme, and the instrument switch always turned to that position after use, then any accidental connection will be harmless, for the highest resistance is in series. Always guard against putting a current indicator between voltage points in the receiver as you value your meter.

No attempt is made to define fully what you are to do in regard to voltage and current ranges, as it is assumed you have a meter and want to use it. Of course, the meter ought to be fairly sensitive, and it is recommended that it be a 0-1 ma, if you have any choice, or a still more sensitive instrument. The device used was a 0.-0.5 ma, consequently the series resistor for 300 volts maximum was 600,000 ohms, that for 30 volts was 60,000 ohms, that for 3 volts was 6,000 ohms. The 6,000-ohm unit was used also in conjunction with 3 battery volts for resistance measurements (100 to more than 100,000 ohms) and the 60,000-ohm spool, with 30 battery volts, for 20,000 to more than 5,000,000 ohms. Other values should be selected according to the meter you have, a subject discussed in last week's issue, September 24th.

The switch SW is simply precautionary, so that if the cable is in a receiver that is turned on, if this switch is open you'll avoid trouble when trying external testing. The other switch, on the opposite side of the pilot lamp, PL, and pointing downward, is also precautionary, as a serious



short will burn out the pilot lamp, and the meter won't read if the switch then is closed when the lamp burns out, for if the meter is attempted to be put in circuit the circuit will be open and the meter protected. Also if the lamp lights at all do not open the switch, as a meter protection, unless measuring 100 ma or so, when a faint light may be emitted from the lamp, and yet no danger exist.

The switch used at the meter side is a double pole nine-throw and in this case, as in the case of the other switch, the shaft should be insulated from any and all contacts.

Another Valuable Device

A handy voltage-current-resistance meter, concerning which constructional data will be printed in an early issue, uses the Weston Universal Meter with a five-deck switch, eleven position and index per deck. The switch is the JA-100-578 12-point, 5-deck Jewell rotary switch.

It is not pretended that from the bare sketch above that much information can be obtained, as it is concededly rather difficult to interpret a diagram in terms of a switch one can't visualize. However, the uses of this device may be related **now:**

D-C Voltages: 5, 50, 500 volts
D-C Currents: 1, 5, 25, 100 ma.
A-C Voltages: 5, 50, 500 volts.
A-C Current: **1 ma.**
Resistance: Less than 100 ohms to more than 500,000 ohms.

The device consists of the meter and rotary switch built onto a panel, underneath which are the shunts and multipliers. The high practical value of the instrument is due to its sensitivity and its dual utility for a-c and d-c.

The Built-in Shunt

The switching arrangement makes for convenience, as all one need to do make any of the enumerated measurements is to turn the switch to the proper position, which may be marked numerically or otherwise. A calibration of the resistance values of the unknown in terms of scale divisions or current, when used with a 7,500-ohm series resistor and a 7.5-volt C battery, is necessary but this will be given later.

The meter itself has a sensitivity of a little better than 1 milliampere on the dc-side, but a built-in parallel resistor, to be connected only for d-c uses, and found on the back of the instrument as a speel, one side permanently connected to plus, has to have the other side connected to negative, but for a-c the dc- terminals are ignored. The reason for including the shunt resistor is to make the operation of the d-c and a-c input at the same sensitivity.

There are two scales on the meter, one for a-c and the other for d-c. They do not coincide. Therefore those who have been accustomed to work d-c instruments mostly, or a-c instruments separately from d-c instruments, should be careful to read the proper scale. Each scale is identified, so there should be no trouble, but habit will get folk into erroneous readings despite identifications.

The extreme utility of all the purposes outlined is obvious, except the a-c current, 0-1 ma. The a-c meter can not be used for higher currents because of resultant errors. But the a-c current up to 1 ma sometimes is handy indeed to read, one example being the taking of dynamic curves of a detector or amplifier tube, with 60-cycle input. The grid circuit may have an a-c input from a 20-volt or other secondary of a transformer that has primary connected to the line. If a potentiometer is put across the secondary, pointer to grid return and one extreme to grid, a-c input voltages from 20 volts down may be read, and also the a-c plate current.

Of course, the a-c output should be a-c only, that is, the d-c should be removed, which can be done by connecting a large condenser, say 4 mfd. or higher (paper, not electrolytic) one side to plate, other side to meter, remaining side of meter to plate return.

Output Meter

The voltage values of a-c that can be read are of ample range, and therefore the a-c voltmeter may be used as an output meter provided the same precautions have been taken as to segregating the a-c from the d-c. The dynamic and static curves of the tube therefore may be compared, and no doubt a better idea of detecting efficiency obtained from the dynamic curves than from the static one.

The method of applying the meter and a switch to the desired purposes was considered carefully, and the final result is embodied in the diagram. The switch, a wonderful instrument, that makes positive contact and does not have objectionable "play" at any setting, is 3.5 inches deep, so the cabinet that is to contain the instrument should have a 4-inch depth, which allows for any practical thickness of panel.

It is well that the container be metal rather than a wooden box, or if it is a box that the meter, except for the top where the scale is, be shielded, as it is possible the meter will be used somewhere near a power transformer. If it is too near a power transformer, even one such as used in a midget set, there is enough induced voltage in the meter coil to cause the needle to fly hard against the end stop, beyond full-scale position, and yet four or five inches from the transformer there is no such coupling. Since the instrument should be as fully protected as possible, the metal container or equivalent shield is recommended.

Same Multipliers

The d-c side of the meter is rather familiar, except for the necessity of putting in the shunt. The meter coil has a resistance of 50 ohms, so the voltage multiplier for d-c is 4,950 ohms. The sum of the two, 5,000 ohms, is in circuit for all d-c measurements, so that the multiplier for 50 volts is 45,000 ohms and for 500 volts is 495,000 ohms. Since the a-c instrument has an impedance of 5,000 ohms, the same multipliers may be used for the a-c part of the meter. Thus the advantage of the built-in shunt for d-c work, to enable economy of series resistors.

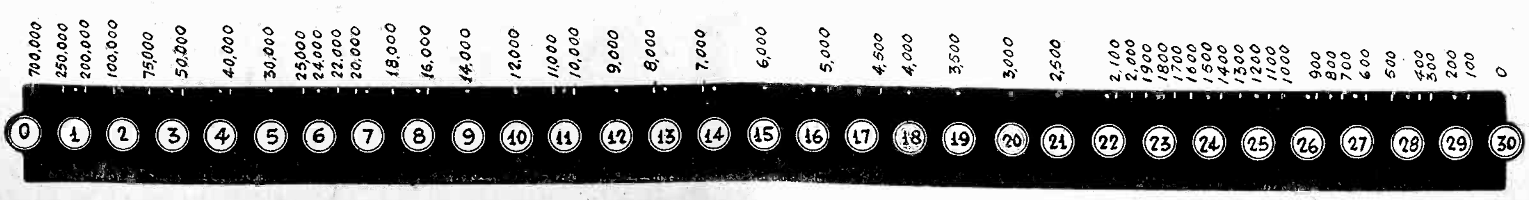
As for shunts, these may be series or parallel. Of course the shunt when in use, either type, is in parallel with the meter. But if individual shunts are used they are called parallel shunts because across the whole meter, whereas if the series type is used it consists of virtually a single resistance, tapped, the total across the voltage source always, so sometimes the meter is in series with part of the voltage shunt. A series shunt has to be across the voltage source all the time, at least the standard one for this instrument must be, and therefore a little ingenuity in the switching arrangement was required. It is believed that this switching problem, as well as some other incidental points, has been solved satisfactorily.

In the diagram the d-c terminals of the meter are the lower ones, positive at left, negative at right (bottom new), the intended shunt resistor (permanently connected at the factory to positive) being between positive and negative. The switch takes care of establishing the connection of the other side of the spool to negative when required.

Question of Accuracy

Extra pains were taken in the design of the voltage-current-resistor meter because the parts are of the highest grade ordinarily used in service work and experimenting, and even such laboratory work wherein the very highest degree of precision is not requisite. The sensitivity of the device is one indication of the degree of accuracy, the actual resistance of the spools used for multipliers and shunts are another. The accuracy of the instrument itself is greater than closest reading of the scale permits, and this is always an excellent test of satisfaction as to accuracy.

On the resistance score, however, if the scale were on the face of the meter the ac-



Resistance scale of a 0-0.5 ma, limiting resistor 6,000 ohms, voltage 3 volts. The meter is scaled to 30 divisions. If the actual meter scale is 5, register these points at 6, 12, 18 and 30, and subdivide into tenths.

curacy would be less, in reading resistance values, than if more room were taken elsewhere for this scale. Undoubtedly the scale-imprint is handier, for you read the resistance and call it quits. But with the other method you read the current and then consult the table or graph to determine the resistance value. The determination is more accurate. The higher resistance values, always crowded, are separated better, and so are the lumped low values, for the resistance curve on semilogarithmic plotting paper looks something like a long letter S. The steepness of the curve at both ends, the low resistance end due to the small changes in resistance desired to be read, the high end to the large changes in resistance with small changes in current, as always left much to be desired in direct reading of resistance values. Therefore many engineers compute the resistance each time they desire to ascertain it, using the current deflection and voltage application, solving by Ohm's law.

Meter Divisions

The next best thing is to have a precision instrument to read resistance values, such as a decade box, but it would cost much much more than the present entire set-up, and requires rather a corporation than an individual to finance. Next in line comes the resistance curve or other calibration done on a large scale, and this might be accomplished as an extension of the meter scale above the meter on the panel, in the direction the needle points.

A radius double that of the needle could be used, and at the outer area the resistance scale could be engraved, so that the eye would follow the needle readily, as in direct reading when the resistance scale is on the meter face, or, for somewhat greater accuracy (not needed at all in service work) the current equivalent could be read, and then the resistance value obtained from the resistance scale.

D-C Meter

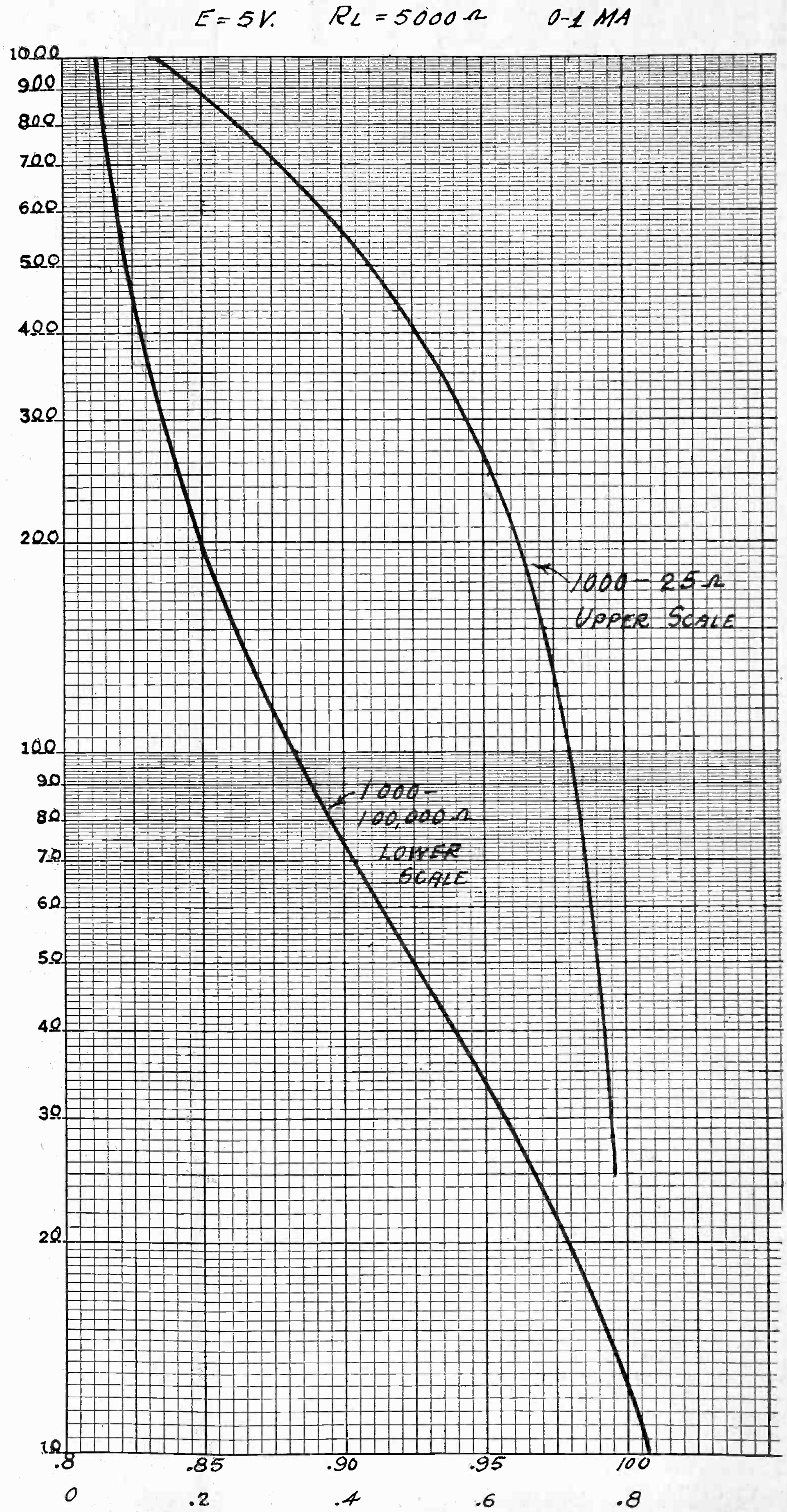
The d-c meter side of the meter, to which the resistance measurement applies, has five main divisions, ten subdivisions to each main division, so that there are 50 subdivisions. The numbers imprinted are 1 to 5. These are for main divisions. A longer line identifies half of a main division (5 subdivisions). So for each of the 50 subdivisions the equivalent current flow is 20 microamperes (.00002 ma), and main division (1) represents 10 x 0.00002, or 0.0002 ma, not 0.0001 ma.

Greater accuracy of reading than obtains on most meters of the same sensitivity is afforded because the scale is to 50 subdivisions, reducing the amount of estimating.

Tube List Prices

Type	List Price	Type	List Price
11	$3.00	'38	2.80
12	3.00	'39	2.80
112-A	1.55	'40	3.00
'20	3.00	'45	1.15
'71-A	.95	46	1.55
UV-'99	2.75	47	1.60
UX-'99	2.55	'50	6.20
'100-A	4.00	55	1.60
'01-A	.80	56	1.30
'10	7.25	57	1.65
'22	3.15	58	1.65
'24-A	1.65	'80	1.05
'26	.85	'81	5.20
'27	1.05	82	1.30
'30	1.65	'74	4.90
'31	1.65	'76	6.70
'32	2.35	'41	10.40
'33	2.80	'68	7.50
'34	2.80	'64	2.10
'35	1.65	'52	28.00
'36	2.80	'65	15.00
'37	1.80	'66	10.50

RESISTANCE CALIBRATION



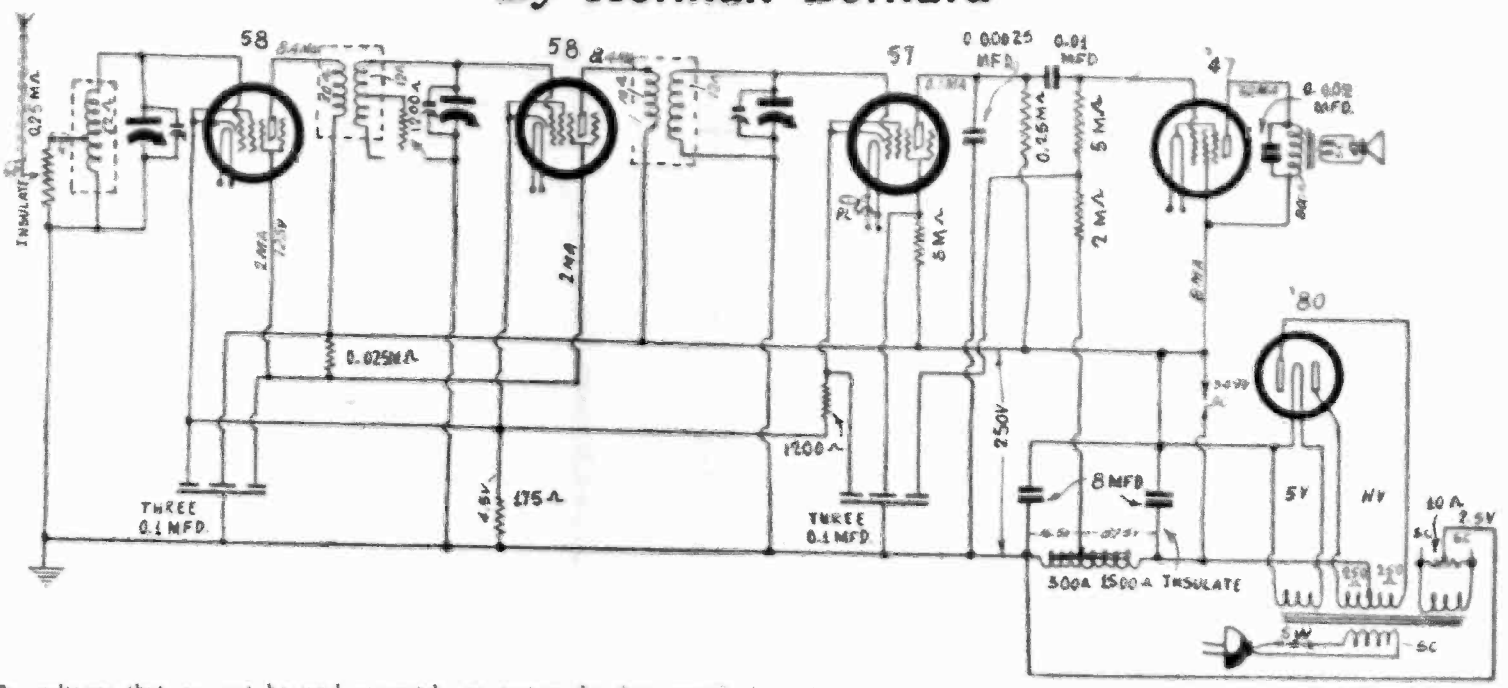
Calibration curves of a resistance meter. They are to be used with a 0-1 milliammeter with 5 volts and a limiting resistor of 5,000 ohms. The left curve covers the range from 1,000 to 100,000 ohms and the right curve from 25 to 1,000 ohms. For right curve read ordinates directly; for left curve multiply ordinates with 100.

1520 to 500 kc. on 5-Tube Diamond

BIG HOP ON HIGH WAVES

Tuning Curve of Highly Sensitive Receiver

By Herman Bernard



The voltages that can not be read accurately on meters drawing current from the measured source are the r-f (130) and detector screen (100) voltages and the detector plate voltage (225). The figures in parentheses are the actual voltages. The respective meter readings of 60, 12 and 90 volts apparent were taken, as were the other meter-measured voltages, on a 1000-ohms-per-volt voltmeter, 500 volts full-scale deflection for high voltage readings, 50 and 5 volts full scale for the lower readings, the most legible scale selected.

FREQUENTLY complaint is heard that a tuned radio frequency set is not selective enough, volume satisfactory; or that it is selective enough, but volume is unsatisfactory at the lower radio frequencies. The factors that make the volume satisfactory are the rather close coupling of aerial to antenna coil, large primaries on the r-f transformers, and application of rated voltages to the tubes. The tuner alone is being considered.

For instance, normally a five-tube t-r-f set will not bring in Windsor, Ont., Canada, 550 kc, in New York City with sufficient volume, if at all, unless the aerial is made extraordinarily long, and closely coupled to the antenna coil. If those conditions exist the selectivity will not be adequate at higher frequencies, because the practical selectivity depends considerably on the degree of coupling, whether in antenna stage or subsequent stages.

Antenna Series Condenser

Therefore it has been found very advantageous to include a series condenser in the aerial circuit, manually operated, and which may be used for effectively regulating the antenna input. Since really the object is to afford tighter coupling at the lower radio frequencies, the condenser may be set at minimum capacity for the high radio frequencies, and then there will be no detuning effect. Of course when full capacity is used there is some detuning, but it is small because the frequency is low, and it so happens that it can be corrected by the manual volume control, because the effect of this resistance on frequency, also small, is in the opposite direction. It could be arranged also as a local-distance switch.

Heretofore we have been concentrating on inductance and capacity in regard to frequency determination, but it is time that resistance be considered, also, as it is a frequency factor.

The result is that Windsor comes in very well indeed, and there is no interference between it and a local station 20 kc removed, i.e., WMCA, 570 kc. Then when the series condenser is at minimum there is no trouble either at the high frequency end. The small capacity of the minimum setting of the antenna series condenser is sufficient for coupling to almost any aerial for frequencies above 800 kc.

However, the same effect is gained by resistance control of the antenna input, and as detuning is less that method has been adopted.

There is no intentional oscillation control in the receiver, as one of the first considerations in the Five-Tube 1933 A-C Diamond of the Air is to have it squeal-proof. This is accomplished with a single resistor of 0.0012 meg. (1,200 ohms). The value was selected experimentally on the following basis: the volume control was set at minimum, which is virtually zero, and, starting at 10,000 ohms, different resistors, 100 ohms apart, were placed in this position in with the receiver oscillating, until oscillation stopped at 1500 kc.

Effect of Antenna Resistance

The reason it is necessary to stabilize the receiver with volume control at no input is that then no antenna resistance is introduced. Antenna resistance, like resistance elsewhere, acts as a damper on oscillation, and therefore if the selection were made of the stabilizing resistor on the basis of augmented resistance from the aerial, as with the volume control full on, when lesser volume was desired, since lesser antenna resistance would be introduced due to reduced coupling, the receiver would squeal.

When the circuit was discussed with a friend who has built several sets, and his attention was called to the stabilizing resistor, by showing him the diagram depicting it across part of the second transformer's secondary, he asked:

"But doesn't a resistor in part of a tuned circuit introduce a loss?"

He was thinking, no doubt, of the losses resistors introduce in stable tuned circuits, and was sympathetically concerned about the possible ruin of an otherwise excellent set by the introduction of some pet scheme that would cause trouble. No doubt there is much prejudice against resistance, due to the constant drumming of the doctrine that the resistance of the tuned circuit should be as low as possible, its impedance as high as possible. Theoretically the impedance of resonance is infinite. When a finite resistance is placed across part or all of the tuned circuit the precious delight of the theorist is offended.

How to Stabilize

However, the answer to the query has been given already, although not directly. It has been stated that various lower values of resistance beginning at 10,000 ohms were tried, while the receiver, tuned to 1500 kc, was oscillating. Now you really can't hear a station on any frequency at which a t-r-f set is oscillating. So if you introduce some part, be it a resistor or anything else, that permits reception where there had been none, certainly there is no loss but instead gain. If the r-f resistance of the circuit is negative the circuit is inoperative for the purpose intended—reception of signals from broadcasting stations—and the sole reason for introducing the stabilizing resistance is to effectuate a small positive value of resistance, so there will not be any oscillation.

The value of 1,200 ohms was found most suitable but since it is to be expected that

LIST OF PARTS

Coils

One tapped impedance coil for antenna stage, for 0.00035 mfd.
Two r-f transformers for interstage coupler, for 0.00035 mfd, secondaries tapped.
One 60 ma. power transformer.

Condensers

One three-gang shielded 0.00035 mfd.
Two shielded blocks, three 0.1 mfd. in each block (black leads are common, go to ground).
One 0.002 mfd. mica fixed condenser.
One 0.01 mfd. mica fixed condenser.
Two 8 mfd. electrolytic condensers, one with two insulating washers and a special connecting lug.

Resistors

One 10-ohm center-tapped.
One 175-ohm pigtail resistor.
Two 0.0012 meg. pigtail resistors (1,200 ohms).
One 0.025-meg. pigtail resistor (25,000 ohms).
One 0.25 meg. potentiometer (250,000 ohms); insulating washers; a-c switch built in.
One 2-meg. pigtail resistor.
One 5-meg. pigtail resistor.

Other Requirements

One chassis, 13¾ inches wide x 2½ inches high x 7¾ inches front to back.
One vernier dial, travelling light type, with bracket and pilot lamp; dial reads, left to right, 100 to 0.
Three knobs (one for dial, one for volume control-switch, one for antenna series condenser).
One dynamic speaker, 1,800-ohm field coil, tapped at 300 ohms; output transformer built in, has matched impedance for '47 tube.
One shelf 7¼ x 2½ inches, with two brackets.
Three six-spring, two five-spring (UY) and one four-spring (UX) sockets. The extra UY is for speaker plug.
One a-c cable and plug.
Three special aluminum shields for the 57 and 58 tubes.
One rubber grommet for a-c cable exit.
Three feet of shielded wire, 0.5" insulation diameter.
Tubes required: one 57, two 58, one '47 and one '80.

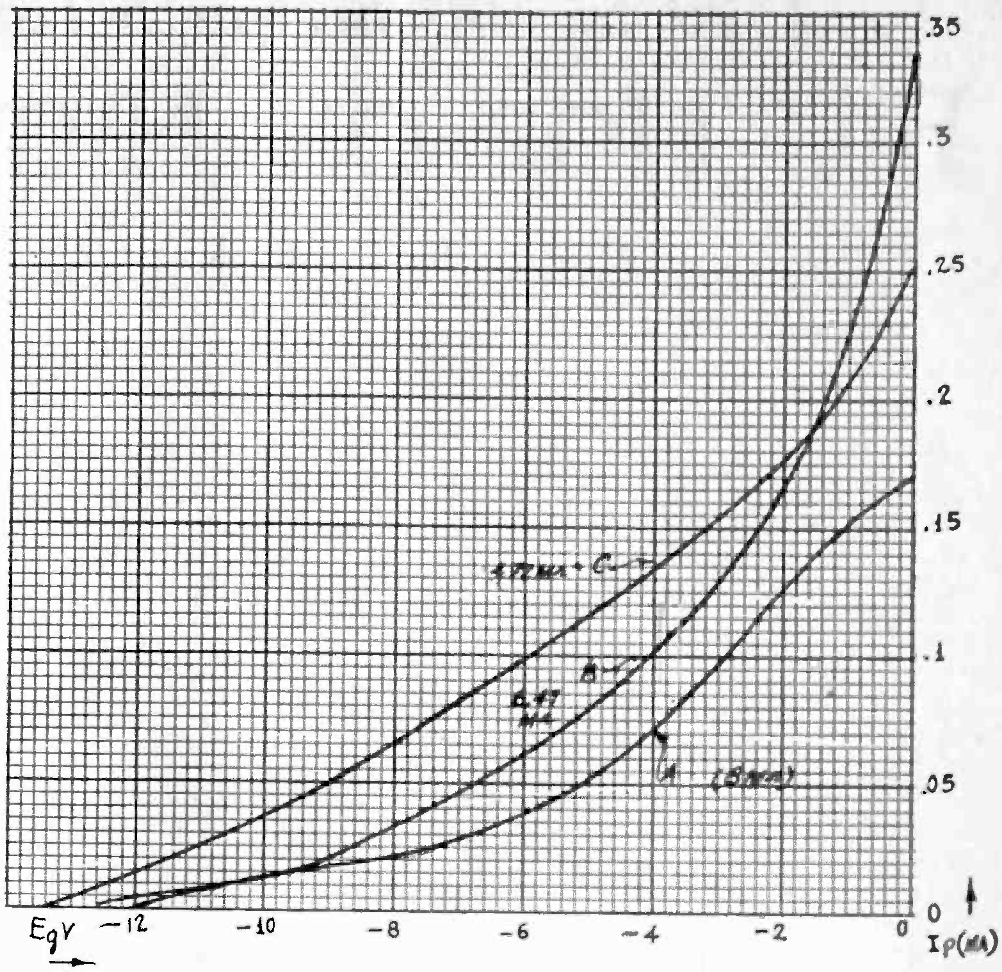


Plate current curves, current in milliamperes, grid voltages in volts, taken with three different values of screen resistor returned to 230 volts. The plate load, likewise returned, was 0.28 meg. Curve A is for 8 meg., Curve B, the preferred one, is for 6.47 meg., and Curve C for 4.12 meg. Curve B is used in the Five-Tube Diamond, so 0.1 ma plate current equals 4 volt negative bias.

some builders will use coils they wind themselves or have on hand, and will locate parts a little differently than prescribed, natural feedback may assume higher or lower quantitative values, requiring lower or higher resistance for stabilization. The rule is to make the resistance used for stabilization as high as practical, consistent with absence of oscillation at the highest broadcast frequency. One exception is that the resistor may have to be even lower than that if there is a strong local at a lower frequency, say, between 1,500 and 1,000 kc, for tuning in that local on a receiver stabilized at 1,500 kc, no signal, may start oscillations by shock excitation. Therefore stabilize at the frequency of the strong local. This does not apply to stations on frequencies lower than 1000 kc.

Sensitivity

The circuit is so extremely sensitive that the four powerful local stations in the New York area, WEAF, WOR, WJZ and WABC, were tuned in, with satisfactory volume, using no aerial other than the wire connecting the volume control to the antenna coil, being 9 inches long. Since such pickup is not desired, this lead should be shielded wire, insulation 0.5" diameter, shield grounded.

On a three-foot aerial, consisting of a piece of wire dropped from antenna binding post to floor, all stations brought in had adequate volume, and Windsor was one of them. However, due to the control of the input it is practical to use any aerial that you have, long or short, for in effect you lengthen or shorten it, in a coupling sense, by potentiometer adjustment. The point is that you don't have to erect an aerial to work this set. A good ground is helpful, but with a 3-foot aerial as described, and no ground, results were good. It is not recommended that the ground be omitted.

A report has been rendered on the voltage delivered to the detector of the Four-Tube A-C 1933 Diamond of the Air (last week, issue of September 24th), for WMCA, 570 kc; WEAF, 660 kc; WOR, 710 kc and WABC, 860 kc. The respective voltages were 0.2, 4.8, 6.8, 4.6 and 4.4. On the score of sensitivity the present five-tube model is considerably more sensitive at the lower radio frequencies, but no more sensitive on the higher radio frequencies. The selectivity is better at all frequencies, as is to be expected, since there is an extra tuned stage.

Detector Signal Voltages

Whereas for WMCA the detector voltage on the smaller set was 0.2 volt, on the present model it was 3.8 volt, or nineteen times as great. This is almost at the low frequency extreme of the broadcast band. However, 90 kc higher, at WEAF, the voltage was 4.8 as compared to 1 in the four-tube model, a gain of 4.8 compared to 19 previously, or only about 25 per cent. of the gain at this frequency compared to the gain at the other. Then for WOR the available figures are, five-tube, 6.8 volts, four-tube, 5 volts, a gain of 1.36, whereas for WABC the detector input voltages of the two are the same, 4.4 volts.

In making the measurements the detector tubes in the receivers under discussion were used as vacuum tube voltmeters. For the 4-tube model the aerial was 20 feet, fed to the first coil through 20 mmfd. series capacity, in the other instance 3 feet, fed directly, the volume control at maximum.

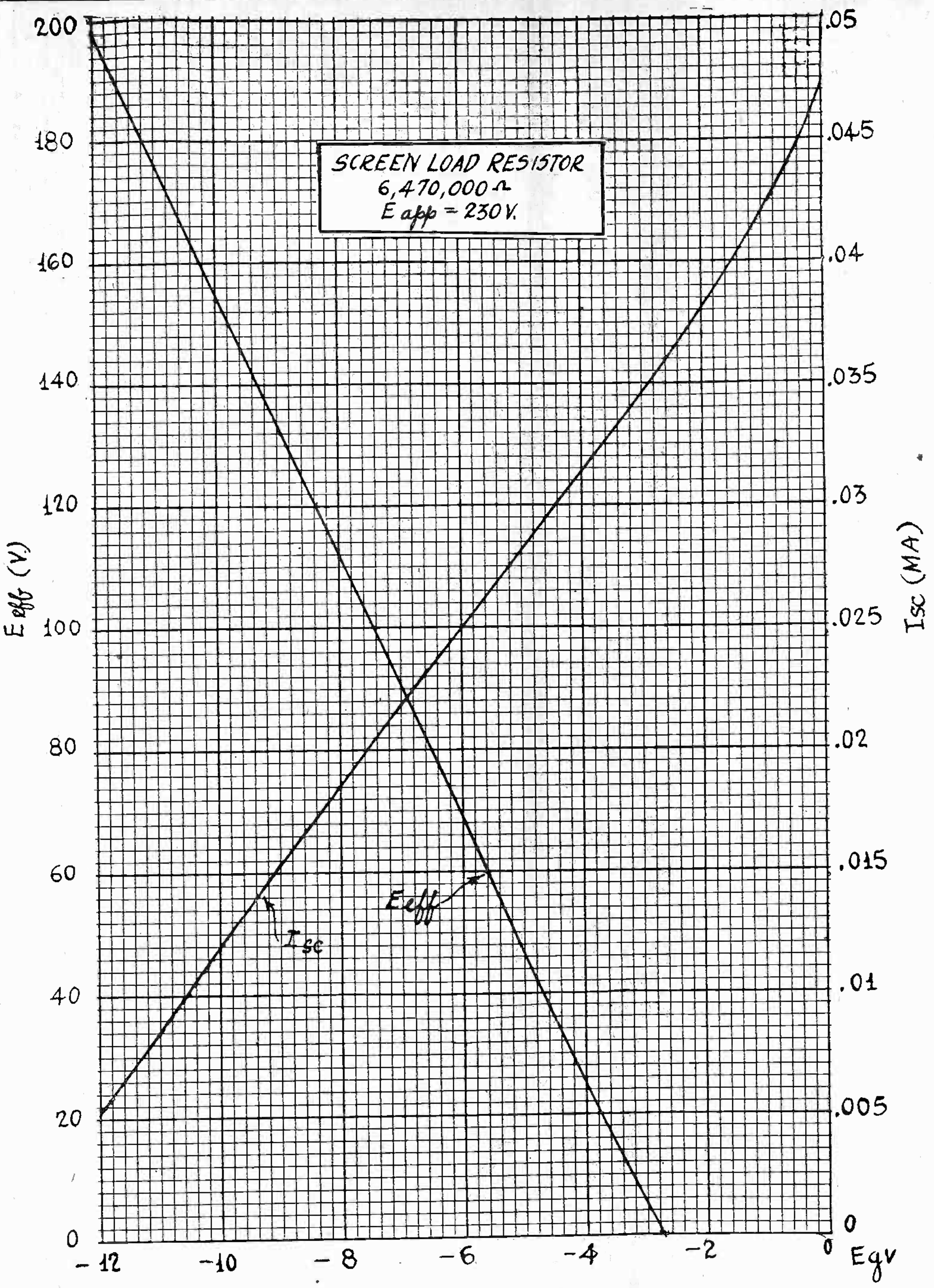
The 6.8-volt figure cited for WOR is an approximation, as the signal fed to the detector exceeded the bias voltage, and the tube was saturated. Since a voltage exceeding the no-signal bias voltage can not be read directly by this system, the excess was taken as the voltage reading equal to the current reduction due to saturation. That is, with volume control less than full-on the maximum reading obtained. Then the reading was taken at full-on position, and current was less, and the voltage equivalent was added, on the theory that it approximated the excess of the bias voltage.

Detector Adjustment

The necessity of having the detector working at its desired no-signal point has been stressed in previous discussions, and in the present receiver the detector may be regarded as operating at its best point when the plate current is adjusted to 0.1 ma.

There are only two load resistors, 0.25 meg. in the plate circuit, and 5.0 meg. in

(Continued on next page)



Two curves of the screen characteristics of the 57 detector, plate load 0.28 meg., screen load 6.47 meg., both resistors returned to 230 volts. The grid bias (EgV) voltages are on the abscissa. The curve from upper right to lower left shows screen current (Isc) in milliamperes, the one from upper right to lower left effective screen voltages (Eeff) due to changing voltage drops in the 6.47 meg. The linearity of these curves is remarkable. At the 4 volts negative bias used in the Five-Tube Diamond the effective screen voltage is higher than shown because the load resistor is less.

(*Continued from preceding page*)

the screen circuit, but these should be checked, so that you can feel certain that their values are within the 10 per cent. tolerance. In the case of the screen resistor, whether it is 5 meg. or not will largely decide what the actual operating point is. If it is 4,720,000 ohms the current will be 31.5 microamperes in the screen circuit, if the plate load and B voltage are standard, and plate current adjusted to 0.1 ma, no signal.

Resistance Measurement

The question will arise, how can one measure the value of these high resistors? If you have a fairly good voltmeter you can do it, provided the meter reads 250 volts or more. Here is the way: Connect one side of the unknown resistor to maximum B plus, connect the other side of the resistor to one side of your meter, with meter at the high-voltage scale, and other side of the meter to grounded B minus. If the needle moves downward, reverse the meter connections.

Now read the meter and determine the current. Since you should know the sensitivity of your meter you know its full-scale deflection current. For 2,000 ohms per volt it is 0.5 ma. for 1,000 ohms per volt it is 1.0 ma, for 500 ohms per volt it is 2.0 ma, etc. The proportion of the reading now afforded to the entire scale gives the current, which is directly proportionate to the scale reading at all times on these d-c instruments. Suppose the reading is 5 on a 500-volt scale having 100 main diisions, 1,000 ohms per volt. Then the current is 5 per cent. of 1.0 ma, or 50 mca. The meter has 500,000 ohms as multiplier in series with it, so the unknown resistance in ohms equals 500,000 ohms less than the voltage in volts divided by the current in amperes. Let us see what the answer is. The voltage is the total across the circuit, 250 volts. The current in amperes 0.00005, so dividing the voltage by the current we get 25,000,000 divided by 5, or 5,000,000. Subtract 500,000 and the answer is the value of the unknown resistance, 4.5 meg. It should not be lower than this, by the way.

The screen resistor should not be as low as 2 meg., for then the screen voltage is too high and the curve becomes erratic. The tonal effect is bad attenuation of the low notes, and the sensitivity effect is great sensitivity to strong signals, no sensitivity to weak ones. Be sure to use at least 4.5 meg. actual value, and if the resistor is higher than 5 meg., say by 1 meg. or so, this is all right.

Concentrate on Detector Current

A resistance value of 4,720,000 ohms was obtained from a stock metallized pigtail resistor of 5 meg. rated value, well within the 10 per cent. tolerance, you see, and moreover the resistance value has changed less than 2,000 ohms in three months of considerable use. Moreover, the resistance value changed less than 1 per cent. when two currents used in the measurement were as diverse as 1.5 ma and 0.000015 ma.

Bias May Be 4 Volts Actually

The detector adjustment to 0.1 ma plate current can be made at the biasing resistor that serves the three tubes. It is quite satisfactory to use such a common biasing resistor, even if the full 6 volts usually cited does not apply, that is, even if the voltage is somewhat less.

As all who have checked the 57 tube's characteristic must know, the voltages somewhat less than 6 afford more sensitive detection, therefore may be used, if the volume control is ahead of the detector. In the present instance, when the plate current was thus limited, the biasing resistor was 175 ohms, and through it flowed 21 ma (all plate and screen currents of tuner), hence the biasing voltage actually was 4 volts. The point should be borne in mind, moreover, that the standard recommendation for detection using the 57 tube is that the plate load be 0.25 meg., the screen voltage 100, and the plate current then adjusted to 0.1 ma. The actual voltage for biasing is not specifically recommended for arriving at the determination, but it is remarked that this voltage is approximately 6. If the screen voltage is higher than 100 volts, as it may be in the present set, the 0.1 ma point on the curve would coincide with a lower value of bias than 6 volts, as explained.

Resistance Selection

While the recommendation is made that the plate current in the detector be adjusted to 0.1 ma. since definite values of resistance are stated, the question arises as to how the adjustment is to be made. The answer is principally that there should be no need for adjustment, for duplicated tests resulted in just 0.1 ma when the voltages, loads etc., were as stated on the diagram. However, if it is desired to increase the plate current in the detector, because less than 0.1 ma, then another resistor, considerably higher, may be placed in parallel with the 175 ohms. This would be required only if the commercial value of 175 ohms actually happens to be too much in excess. Of if you have the proper resistance simply put it in. If the resistance has to be raised, to increase the bias and reduce the plate current because that current exceeds 0.1 ma, then another resistance may be placed in series with the one marked 175 ohms until the correct plate current flows.

The set will work all right even if you don't check up on this, provided the resistors have been measured and found within the 10 per cent. tolerance. However, total absence of any checkup in either respect entails certain risks of not attaining performance of the high standard of which this receiver is capable.

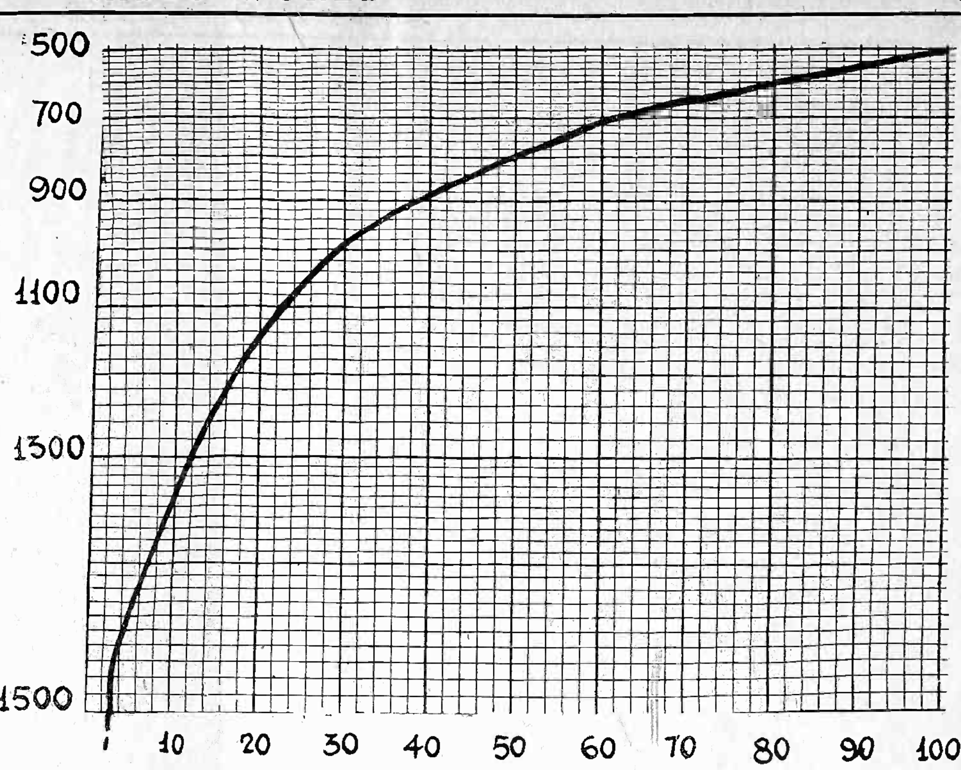
Currents as Measured

The currents in screens and plates of the r-f tubes become unimportant since they are affected by the same biasing resistor that controls the detector, and the adjustment is made, or condition developed, on the basis of the detector requirement. Nevertheless the total of these currents was measured and amounted to 20.8 milliamperes. The detector's contribution was too small to be read of itself on the coarser meter used for measuring milliamperes. The screens of the two tubes fed through the 0.025 meg. resistor, drew 4 ma, or assumptively 2 ma each, and the plates therefore 8.4 ma each. The pentode plate current was 30 ma, the pentode screen current for some reason not apparent, was 2.5 ma.

No Trimming Condensers Used

The tuning curve runs from 1520 to 500 kc, or 197.4 to 600 meters, and is reproduced herewith.

The present circuit permits tight coupling of antenna to the first coil, and therefore, as a general statement, the first tuned circuit then will not do much discriminating for more than an average of, say, 50 kc, hence need not be trimmed, whereas the two following circuits, using an excellent condenser, with brass plates soldered to tested positions, and with secondaries matched to 0.6 microhenry for their rated 240 microhenry inductance, the resonance condition prevails all through the scale in the two succeeding circuits mainly depended on for the selectivity. However, it is quite all right to use trimmers throughout, and in general preferable to do so.



The tuning curve of the 5-tube Diamond, frequencies at left, dial settings on base line. The curve ends at 500 kc at on extreme, 1520 kc at the other.

The Tuning Curve

In reading the tuning curve observe that the plotting paper used is semi-logarithmic, with abscissa or base line divided into 50 equal parts for the 100 scale divisions, two dial divisions to one scale division at the bottom or horizontal line. However, the ordinate, or perpendicular, denoting frequencies, has 10 kc separation between 1500 and 1300 kc, but 20 kc separation for the rest of the scale. If you use the official coils and condenser therefore you can determine the frequency from this curve by locating the dial setting, following the dial line upward to the point of intersection with the curve, and following the horizontal line from that point to the left to ascertain frequency. Due to the limited size of the engraving and the comparative thickness of the curve line it is not possible to attain extreme precision on the curve, but it will be substantially correct.

Regarding reading 0.1 ma on a 0-1 ma, since some of these meters have 0-5 main scale divisions, each division in 10 equal parts, be careful then to read 20 ma for each integral division, so that 0.1 ma would be read at the fifth integral division from extreme left.

Plate Current-Grid Voltage Curves

Three characteristic curves are given of the plate current-grid voltage characteristic with three different values of screen resistor. Curve B shows the best detecting characteristic, so far as this can be gleaned from static curves such as these, although the assumption was verified experimentally with the aid of an output meter.

These curves show principally that the value of the screen resistor is rather critical, hence the resistor should be measured, by the method already outlined or by other means, to see that it does not depart too much from the recommended value. Because the resistance is so high commercial resistors may be quite different in ohmic value from the color code or imprinted value. Indeed, all three resistors used—and note their diversity—were marked 5 meg. by the manufacturers. If the resistance is too low build it up with series resistors, if it is too high select a resistor more nearly of the prescribed value.

Gradual Change

The 0.1 ma plate current reading on curve B coincides with 4 volts negative bias, the most sensitive point and the one finally chosen for the Five-Tube Diamond. A particularly attractive feature of this curve is that the current changes gradually at low bias values, corresponding to high signal voltage input, offsetting to a degree the relatively low negative bias at the operating point (0.1 ma at no signal, 4 volts negative bias.)

Curve A is entirely too irregular to be dependable or to insure quality, and like curve C does not develop as great sensitivity. Curve B is preferable from virtually all viewpoints.

Screen Curves

Not only does the plate current change with the grid bias but so does the screen current. If anything, the change in screen current is more regular. The two curves on one piece of plotting paper show the changes in screen current, upper right to lower left, to be read in milliamperes at the right ordinate, and the change in effective screen voltage due to the change of current through the screen load resistor of 6.47 meg., the effective screen voltages at left ordinate. The plate load was 0.28 meg.

The screen current changes from 47 microamperes to 5 microamperes, and as 5 microamperes coincides with 12 volts negative bias, and we know from Ep-Ig curves that the plate current cuts off a little beyond that, we can realize that there is still some screen current flowing after the plate current has stopped.

The triangles formed by the ordinate at one side, and two sides, one taken from one curve and one from the other, are approximately equal. The linearity of both total curves is particularly good, although there is admittedly a slight error at lower part of the Eeff curve (page 10).

Low Screen Voltage

When we select the operating point of 4 volts negative bias, no signal, we find 31.5 microamperes flowing in the screen circuit, and the effective screen voltage may be low. In the case of the '24 tube we have been accustomed to the recommendation of such a low screen voltage, because of the secondary emission condition, but in the 57 we were not led to expect that a low screen voltage would make for such excellently sensitive detection.

It was the effective screen voltage that principally affected the Ip-Eg curves already discussed, and the two curves showing screen conditions are based on the selection of the most appropriate resistor values, commercially 0.25 meg. in the plate circuit 5 meg. in the screen circuit, corresponding to the closer values used, e.g., 0.28 meg. plate load, 6.47 meg. screen load, used experimentally. The screen performance is even better than the plate characteristic, which affords something to think about.

The curves will prove interesting to those who are especially interested in tube performance, for the Ip-Eg curves on the 57 have not been given much attention, and were lacking from the official data released just prior to the offering of the tubes to the public. Of course the curves could be reconstructed from other official curves (Ip-Ep), but, again, those curves represent usually battery operation throughout, and do not show the series resistor effect of screen loads particularly.

Results Assured

As to those interested only in building the set, the curves at least tend to confirm the basis of choice of voltage values and constants affecting the detector. While there has been some departure from orthodox recommendations, it is always backed up with experimental findings and also occasionally with actual curves, so it must be obvious that the circuit has been painstakingly prepared.

It is not assumed, but rather denied, that the best manner of using the 57 as detector is actually well known now, but circuits now being presented do not offer any better tonal and sensitivity results from this detector, in fact, the present use is deemed to be the most effective one so far. Constructors therefore are asked to follow the recommendations as given, and these will be found embodied in the diagram of the circuit. Whole-hearted satisfaction with results will follow as an inevitable consequence.

RESISTOR COLOR CODE					WAT'GE IN WATTS	
Ohms	Megohms	Body	Dot	End	Actual	Commercial
175	0.00025	Brown	Brown	Violet	0.64	1.0
1200	0.0012	Brown	Red	Red	—	1.0
25,000	0.025	Red	Orange	Green	0.192	1.0
250,000	0.25	Red	Yellow	Green	0.0025	1.0
2,000,000	2.0	Red	Green	Black	—	1.0
*5,000,000	5.0	Green	Green	Black	0.0726	1.0
**5,000,000	5.0	Green	Green	Black	—	1.0

* Detector screen resistor
** Pentode grid resistor.

*[This is the second instalment of the article on the construction of the Five-Tube A-C Diamond of the Air. The third and final instalment, with full scale picture diagram, will be published next week, issue of October 8th.—*Editor.*]*

1520 to 500 kc. on 5-Tube Diamond

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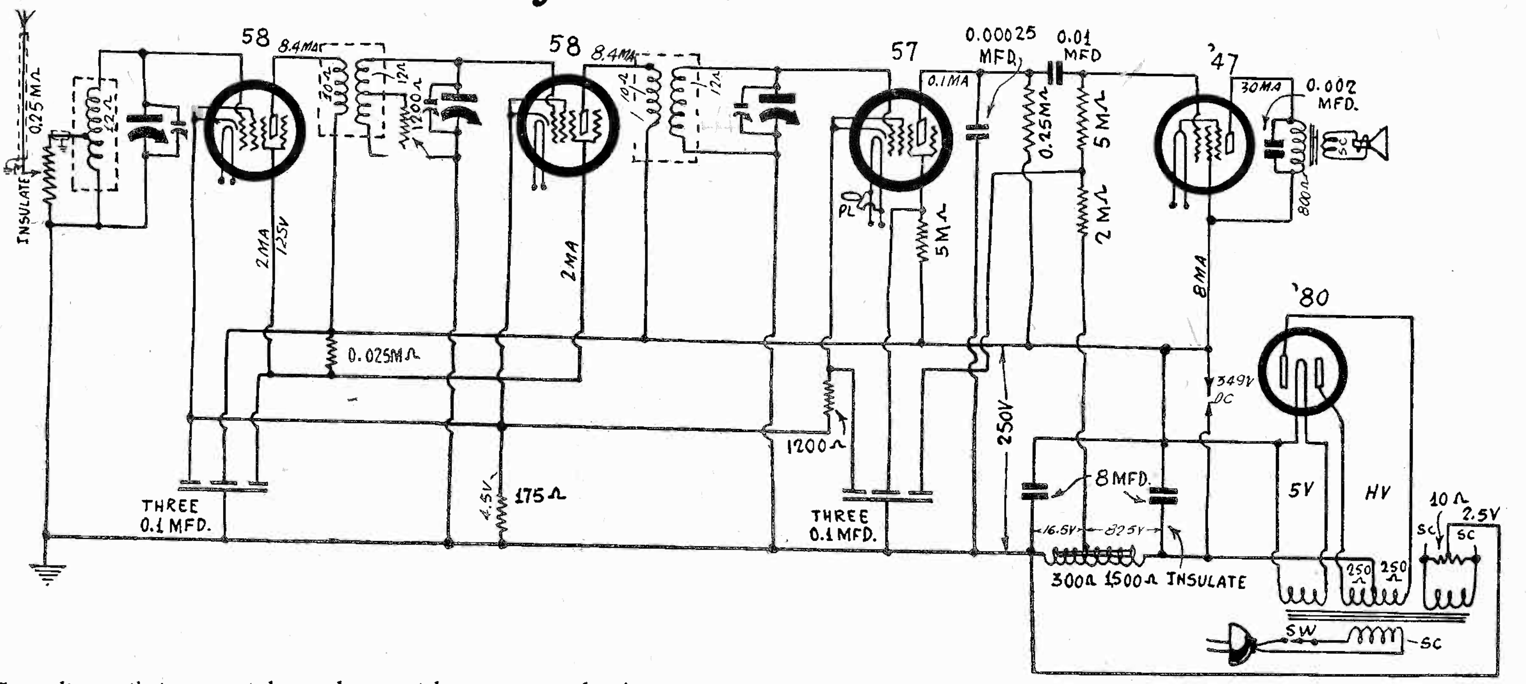
Tuning Curve of Highly Sensitive Receiver

By Herman Bernard



The voltages that can not be read accurately on meters drawing current from the measured source are the r-f (130) and detector screen (100) voltages and the detector plate voltage (225). The figures in parentheses are the actual voltages. The respective meter readings of 60, 12 and 90 volts apparent were taken, as were the other meter-measured voltages, on a 1000-ohms-per-volt voltmeter, 500 volts full-scale deflection for high voltage readings, 50 and 5 volts full scale for the lower readings, the most legible scale selected.

FREQUENTLY complaint is heard that a tuned radio frequency set is not selective enough, volume satisfactory; or that it is selective enough, but volume is unsatisfactory at the lower radio frequencies. The factors that make the volume satisfactory are the rather close coupling of aerial to antenna coil, large primaries on the r-f transformers, and application of rated voltages to the tubes. The tuner alone is being considered.

For instance, normally a five-tube t-r-f set will not bring in Windsor, Ont., Canada, 550 kc, in New York City with sufficient volume, if at all, unless the aerial is made extraordinarily long, and closely coupled to the antenna coil. If those conditions exist the selectivity will not be adequate at higher frequencies, because the practical selectivity depends considerably on the degree of coupling, whether in antenna stage or subsequent stages.

Antenna Series Condenser

Therefore it has been found very advantageous to include a series condenser in the aerial circuit, manually operated, and which may be used for effectively regulating the antenna input. Since really the object is to afford tighter coupling at the lower radio frequencies, the condenser may be set at minimum capacity for the high radio frequencies, and then there will be no detuning effect. Of course when full capacity is used there is some detuning, but it is small because the frequency is low, and it so happens that it can be corrected by the manual volume control, because the effect of this resistance on frequency, also small, is in the opposite direction. It could be arranged also as a local-distance switch.

Heretofore we have been concentrating on inductance and capacity in regard to frequency determination, but it is time that resistance be considered, also, as it is a frequency factor.

The result is that Windsor comes in very well indeed, and there is no interference between it and a local station 20 kc removed, i.e., WMCA, 570 kc. Then when the series condenser is at minimum there is no trouble either at the high frequency end. The small capacity of the minimum setting of the antenna series condenser is sufficient for coupling to almost any aerial for frequencies above 800 kc.

However, the same effect is gained by resistance control of the antenna input, and as detuning is less that method has been adopted.

There is no intentional oscillation control in the receiver, as one of the first considerations in the Five-Tube 1933 A-C Diamond of the Air is to have it squeal-proof. This is accomplished with a single resistor of 0.0012 meg. (1,200 ohms). The value was selected experimentally on the following basis: the volume control was set at minimum, which is virtually zero, and, starting at 10,000 ohms, different resistors, 100 ohms apart, were placed in this position in with the receiver oscillating, until oscillation stopped at 1500 kc.

Effect of Antenna Resistance

The reason it is necessary to stabilize the receiver with volume control at no input is that then no antenna resistance is introduced. Antenna resistance, like resistance elsewhere, acts as a damper on oscillation, and therefore if the selection were made of the stabilizing resistor on the basis of augmented resistance from the aerial, as with the volume control full on, when lesser volume was desired, since lesser antenna resistance would be introduced due to reduced coupling, the receiver would squeal.

When the circuit was discussed with a friend who has built several sets, and his attention was called to the stabilizing resistor, by showing him the diagram depicting it across part of the second transformer's secondary, he asked:

"But doesn't a resistor in part of a tuned circuit introduce a loss?"

He was thinking, no doubt, of the losses resistors introduce in stable tuned circuits, and was sympathetically concerned about the possible ruin of an otherwise excellent set by the introduction of some pet scheme that would cause trouble. No doubt there is much prejudice against resistance, due to the constant drumming of the doctrine that the resistance of the tuned circuit should be as low as possible, its impedance as high as possible. Theoretically the impedance of resonance is infinite. When a finite resistance is placed across part or all of the tuned circuit the precious delight of the theorist is offended.

How to Stabilize

However, the answer to the query has been given already, although not directly. It has been stated that various lower values of resistance beginning at 10,000 ohms were tried, while the receiver, tuned to 1500 kc, was oscillating. Now you really can't hear a station on any frequency at which a t-r-f set is oscillating. So if you introduce some part, be it a resistor or anything else, that permits reception where there had been none, certainly there is no loss but instead gain. If the r-f resistance of the circuit is negative the circuit is inoperative for the purpose intended—reception of signals from broadcasting stations—and the sole reason for introducing the stabilizing resistance is to effectuate a small positive value of resistance, so there will not be any oscillation.

The value of 1,200 ohms was found most suitable, but since it is to be expected that

LIST OF PARTS

Coils

One tapped impedance coil for antenna stage, for 0.00035 mfd.
Two r-f transformers for interstage coupler, for 0.00035 mfd, secondaries tapped.
One 60 ma. power transformer.

Condensers

One three-gang shielded 0.00035 mfd.
Two shielded blocks, three 0.1 mfd. in each block (black leads are common, go to ground).
One 0.002 mfd. mica fixed condenser.
One 0.01 mfd. mica fixed condenser.
Two 8 mfd. electrolytic condensers, one with two insulating washers and a special connecting lug.

Resistors

One 10-ohm center-tapped.
One 175-ohm pigtail resistor.
Two 0.0012 meg. pigtail resistors (1,200 ohms).
One 0.025-meg. pigtail resistor (25,000 ohms).
One 0.25 meg. potentiometer (250,000 ohms); insulating washers; a-c switch built in.
One 2-meg. pigtail resistor.
One 5-meg. pigtail resistor.

Other Requirements

One chassis, 13¾ inches wide x 2½ inches high x 7¾ inches front to back.
One vernier dial, travelling light type, with bracket and pilot lamp; dial reads, left to right, 100 to 0.
Three knobs (one for dial, one for volume control-switch, one for antenna series condenser).
One dynamic speaker, 1,800-ohm field coil, tapped at 300 ohms; output transformer built in, has matched impedance for '47 tube.
One shelf 7¼ x 2½ inches, with two brackets.
Three six-spring, two five-spring (UY) and one four-spring (UX) sockets. The extra UY is for speaker plug.
One a-c cable and plug.
Three special aluminum shields for the 57 and 58 tubes.
One rubber grommet for a-c cable exit.
Three feet of shielded wire, 0.5" insulation diameter.
Tubes required: one 57, two 58, one '47 and one '80.

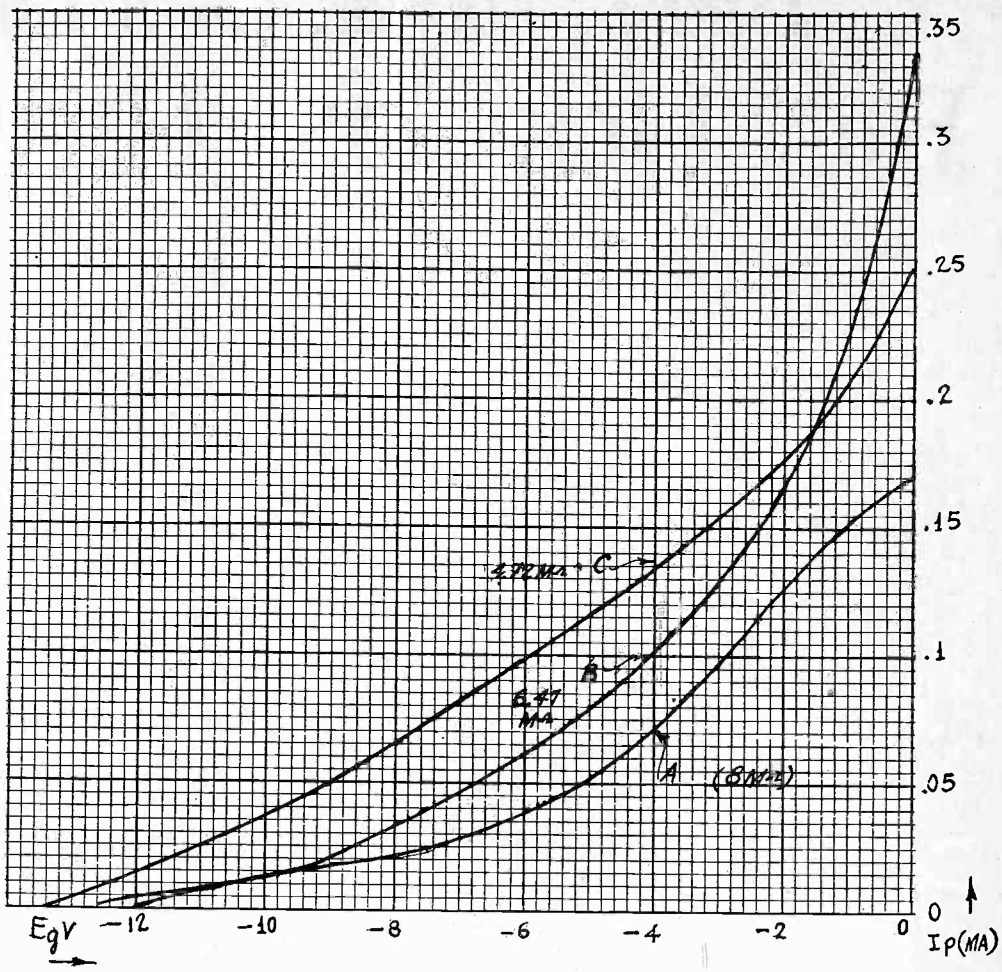


Plate current curves, current in milliamperes, grid voltages in volts, taken with three different values of screen resistor returned to 230 volts. The plate load, likewise returned, was 0.28 meg. Curve A is for 8 meg., Curve B, the preferred one, is for 6.47 meg., and Curve C for 4.12 meg. Curve B is used in the Five-Tube Diamond, so 0.1 ma plate current equals 4 volt negative bias.

some builders will use coils they wind themselves or have on hand, and will locate parts a little differently than prescribed, natural feedback may assume higher or lower quantitative values, requiring lower or higher resistance for stabilization. The rule is to make the resistance used for stabilization as high as practical, consistent with absence of oscillation at the highest broadcast frequency. One exception is that the resistor may have to be even lower than that if there is a strong local at a lower frequency, say, between 1,500 and 1,000 kc, for tuning in that local on a receiver stabilized at 1,500 kc, no signal, may start oscillations by shock excitation. Therefore stabilize at the frequency of the strong local. This does not apply to stations on frequencies lower than 1000 kc.

Sensitivity

The circuit is so extremely sensitive that the four powerful local stations in the New York area, WEAF, WOR, WJZ and WABC, were tuned in, with satisfactory volume, using no aerial other than the wire connecting the volume control to the antenna coil, being 9 inches long. Since such pickup is not desired, this lead should be shielded wire, insulation 0.5" diameter, shield grounded.

On a three-foot aerial, consisting of a piece of wire dropped from antenna binding post to floor, all stations brought in had adequate volume, and Windsor was one of them. However, due to the control of the input it is practical to use any aerial that you have, long or short, for in effect you lengthen or shorten it, in a coupling sense, by potentiometer adjustment. The point is that you don't have to erect an aerial to work this set. A good ground is helpful, but with a 3-foot aerial as described, and no ground, results were good. It is not recommended that the ground be omitted.

A report has been rendered on the voltage delivered to the detector of the Four-Tube A-C 1933 Diamond of the Air (last week, issue of September 24th), for WMCA, 570 kc; WEAF, 660 kc; WOR, 710 kc and WABC, 860 kc. The respective voltages were 0.2, 4.8, 6.8, 4.6 and 4.4. On the score of sensitivity the present five-tube model is considerably more sensitive at the lower radio frequencies, but no more sensitive on the higher radio frequencies. The selectivity is better at all frequencies, as is to be expected, since there is an extra tuned stage.

Detector Signal Voltages

Whereas for WMCA the detector voltage on the smaller set was 0.2 volt, on the present model it was 3.8 volt, or nineteen times as great. This is almost at the low frequency extreme of the broadcast band. However, 90 kc higher, at WEAF, the voltage was 4.8 as compared to 1 in the four-tube model, a gain of 4.8 compared to 19 previously, or only about 25 per cent. of the gain at this frequency compared to the gain at the other. Then for WOR the available figures are, five-tube, 6.8 volts, four-tube, 5 volts, a gain of 1.36, whereas for WABC the detector input voltages of the two are the same, 4.4 volts.

In making the measurements the detector tubes in the receivers under discussion were used as vacuum tube voltmeters. For the 4-tube model the aerial was 20 feet, fed to the first coil through 20 mmfd. series capacity, in the other instance 3 feet, fed directly, the volume control at maximum.

The 6.8-volt figure cited for WOR is an approximation, as the signal fed to the detector exceeded the bias voltage, and the tube was saturated. Since a voltage exceeding the no-signal bias voltage can not be read directly by this system, the excess was taken as the voltage reading equal to the current reduction due to saturation. That is, with volume control less than full-on the maximum reading obtained. Then the reading was taken at full-on position, and current was less, and the voltage equivalent was added, on the theory that it approximated the excess of the bias voltage.

Detector Adjustment

The necessity of having the detector working at its desired no-signal point has been stressed in previous discussions, and in the present receiver the detector may be regarded as operating at its best point when the plate current is adjusted to 0.1 ma.

There are only two load resistors, 0.25 meg. in the plate circuit, and 5.0 meg. in

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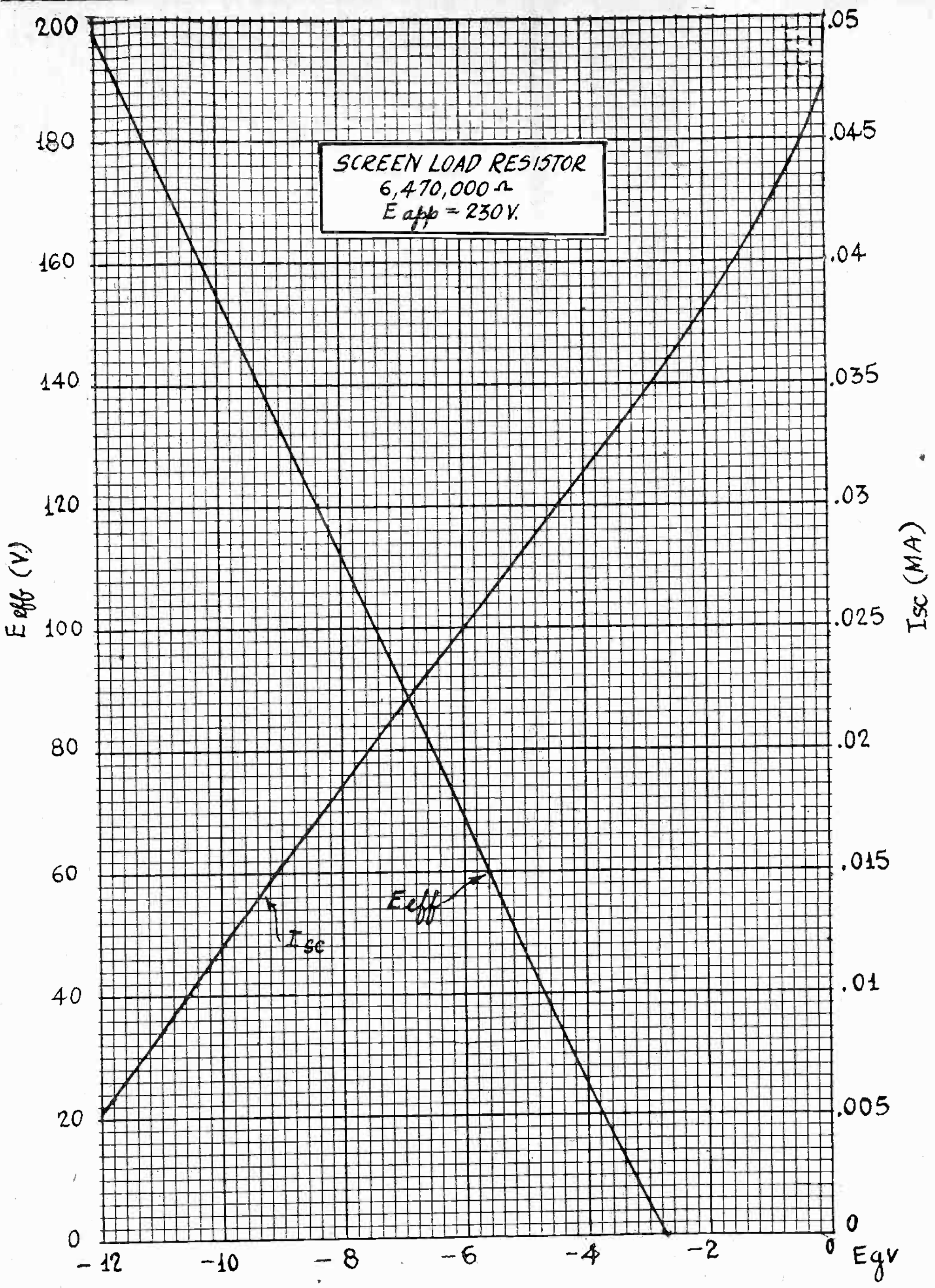


Two curves of the screen characteristics of the 57 detector, plate load 0.28 meg., screen load 6.47 meg., both resistors returned to 230 volts. The grid bias (EgV) voltages are on the abscissa. The curve from upper right to lower left shows screen current (Isc) in milliamperes, the one from upper right to lower left effective screen voltages (Eeff) due to changing voltage drops in the 6.47 meg. The linearity of these curves is remarkable. At the 4 volts negative bias used in the Five-Tube Diamond the effective screen voltage is higher than shown because the load resistor is less.

(*Continued from preceding page*)

the screen circuit, but these should be checked, so that you can feel certain that their values are within the 10 per cent. tolerance. In the case of the screen resistor, whether it is 5 meg. or not will largely decide what the actual operating point is. If it is 4,720,000 ohms the current will be 31.5 microamperes in the screen circuit, if the plate load and B voltage are standard, and plate current adjusted to 0.1 ma, no signal.

Resistance Measurement

The question will arise, how can one measure the value of these high resistors? If you have a fairly good voltmeter you can do it, provided the meter reads 250 volts or more. Here is the way: Connect one side of the unknown resistor to maximum B plus, connect the other side of the resistor to one side of your meter, with meter at the high-voltage scale, and other side of the meter to grounded B minus. If the needle moves downward, reverse the meter connections.

Now read the meter and determine the current. Since you should know the sensitivity of your meter you know its full-scale deflection current. For 2,000 ohms per volt it is 0.5 ma. for 1,000 ohms per volt it is 1.0 ma, for 500 ohms per volt it is 2.0 ma, etc. The proportion of the reading now afforded to the entire scale gives the current, which is directly proportionate to the scale reading at all times on these d-c instruments. Suppose the reading is 5 on a 500-volt scale having 100 main diisions, 1,000 ohms per volt. Then the current is 5 per cent. of 1.0 ma, or 50 mca. The meter has 500,000 ohms as multiplier in series with it, so the unknown resistance in ohms equals 500,000 ohms less than the voltage in volts divided by the current in amperes. Let us see what the answer is. The voltage is the total across the circuit, 250 volts. The current in amperes 0.00005, so dividing the voltage by the current we get 25,000,000 divided by 5, or 5,000,000. Subtract 500,000 and the answer is the value of the unknown resistance, 4.5 meg. It should not be lower than this, by the way.

The screen resistor should not be as low as 2 meg., for then the screen voltage is too high and the curve becomes erratic. The tonal effect is bad attenuation of the low notes, and the sensitivity effect is great sensitivity to strong signals, no sensitivity to weak ones. Be sure to use at least 4.5 meg. actual value, and if the resistor is higher than 5 meg., say by 1 meg. or so, this is all right.

Concentrate on Detector Current

A resistance value of 4,720,000 ohms was obtained from a stock metallized pigtail resistor of 5 meg. rated value, well within the 10 per cent. tolerance, you see, and moreover the resistance value has changed less than 2,000 ohms in three months of considerable use. Moreover, the resistance value changed less than 1 per cent. when two currents used in the measurement were as diverse as 1.5 ma and 0.000015 ma.

Bias May Be 4 Volts Actually

The detector adjustment to 0.1 ma plate current can be made at the biasing resistor that serves the three tubes. It is quite satisfactory to use such a common biasing resistor, even if the full 6 volts usually cited does not apply, that is, even if the voltage is somewhat less.

As all who have checked the 57 tube's characteristic must know, the voltages somewhat less than 6 afford more sensitive detection, therefore may be used, if the volume control is ahead of the detector. In the present instance, when the plate current was thus limited, the biasing resistor was 175 ohms, and through it flowed 21 ma (all plate and screen currents of tuner), hence the biasing voltage actually was 4 volts. The point should be borne in mind, moreover, that the standard recommendation for detection using the 57 tube is that the plate load be 0.25 meg., the screen voltage 100, and the plate current then adjusted to 0.1 ma. The actual voltage for biasing is not specifically recommended for arriving at the determination, but it is remarked that this voltage is approximately 6. If the screen voltage is higher than 100 volts, as it may be in the present set, the 0.1 ma point on the curve would coincide with a lower value of bias than 6 volts, as explained.

Resistance Selection

While the recommendation is made that the plate current in the detector be adjusted to 0.1 ma. since definite values of resistance are stated, the question arises as to how the adjustment is to be made. The answer is principally that there should be no need for adjustment, for duplicated tests resulted in just 0.1 ma when the voltages, loads etc., were as stated on the diagram. However, if it is desired to increase the plate current in the detector, because less than 0.1 ma, then another resistor, considerably higher, may be placed in parallel with the 175 ohms. This would be required only if the commercial value of 175 ohms actually happens to be too much in excess. Of if you have the proper resistance simply put it in. If the resistance has to be raised, to increase the bias and reduce the plate current because that current exceeds 0.1 ma, then another resistance may be placed in series with the one marked 175 ohms until the correct plate current flows.

The set will work all right even if you don't check up on this, provided the resistors have been measured and found within the 10 per cent. tolerance. However, total absence of any checkup in either respect entails certain risks of not attaining performance of the high standard of which this receiver is capable.

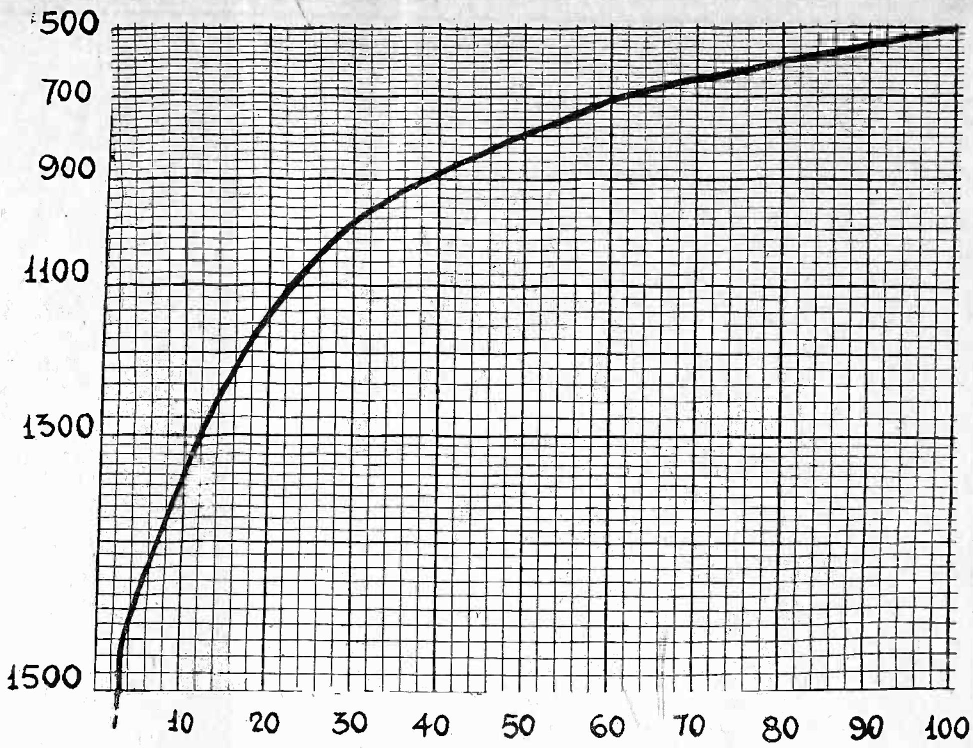
Currents as Measured

The currents in screens and plates of the r-f tubes become unimportant since they are affected by the same biasing resistor that controls the detector, and the adjustment is made, or condition developed, on the basis of the detector requirement. Nevertheless the total of these currents was measured and amounted to 20.8 milliamperes. The detector's contribution was too small to be read of itself on the coarser meter used for measuring milliamperes. The screens of the two tubes fed through the 0.025 meg. resistor, drew 4 ma, or assumptively 2 ma each, and the plates therefore 8.4 ma each. The pentode plate current was 30 ma, the pentode screen current for some reason not apparent, was 2.5 ma.

No Trimming Condensers Used

The tuning curve runs from 1520 to 500 kc, or 197.4 to 600 meters, and is reproduced herewith.

The present circuit permits tight coupling of antenna to the first coil, and therefore, as a general statement, the first tuned circuit then will not do much discriminating for more than an average of, say, 50 kc, hence need not be trimmed, whereas the two following circuits, using an excellent condenser, with brass plates soldered to tested positions, and with secondaries matched to 0.6 microhenry for their rated 240 microhenry inductance, the resonance condition prevails all through the scale in the two succeeding circuits mainly depended on for the selectivity. However, it is quite all right to use trimmers throughout, and in general preferable to do so.



The tuning curve of the 5-tube Diamond, frequencies at left, dial settings on base line. The curve ends at 500 kc at on extreme, 1520 kc at the other.

The Tuning Curve

In reading the tuning curve observe that the plotting paper used is semi-logarithmic, with abscissa or base line divided into 50 equal parts for the 100 scale divisions, two dial divisions to one scale division at the bottom or horizontal line. However, the ordinate, or perpendicular, denoting frequencies, has 10 kc separation between 1500 and 1300 kc, but 20 kc separation for the rest of the scale. If you use the official coils and condenser therefore you can determine the frequency from this curve by locating the dial setting, following the dial line upward to the point of intersection with the curve, and following the horizontal line from that point to the left to ascertain frequency. Due to the limited size of the engraving and the comparative thickness of the curve line it is not possible to attain extreme precision on the curve, but it will be substantially correct.

Regarding reading 0.1 ma on a 0-1 ma, since some of these meters have 0-5 main scale divisions, each division in 10 equal parts, be careful then to read 20 ma for each integral division, so that 0.1 ma would be read at the fifth integral division from extreme left.

Plate Current-Grid Voltage Curves

Three characteristic curves are given of the plate current-grid voltage characteristic with three different values of screen resistor. Curve B shows the best detecting characteristic, so far as this can be gleaned from static curves such as these, although the assumption was verified experimentally with the aid of an output meter.

These curves show principally that the value of the screen resistor is rather critical, hence the resistor should be measured, by the method already outlined or by other means, to see that it does not depart too much from the recommended value. Because the resistance is so high commercial resistors may be quite different in ohmic value from the color code or imprinted value. Indeed, all three resistors used—and note their diversity—were marked 5 meg. by the manufacturers. If the resistance is too low build it up with series resistors, if it is too high select a resistor more nearly of the prescribed value.

Gradual Change

The 0.1 ma plate current reading on curve B coincides with 4 volts negative bias, the most sensitive point and the one finally chosen for the Five-Tube Diamond. A particularly attractive feature of this curve is that the current changes gradually at low bias values, corresponding to high signal voltage input, offsetting to a degree the relatively low negative bias at the operating point (0.1 ma at no signal, 4 volts negative bias.)

Curve A is entirely too irregular to be dependable or to insure quality, and like curve C does not develop as great sensitivity. Curve B is preferable from virtually all viewpoints.

Screen Curves

Not only does the plate current change with the grid bias but so does the screen current. If anything, the change in screen current is more regular. The two curves on one piece of plotting paper show the changes in screen current, upper right to lower left, to be read in milliamperes at the right ordinate, and the change in effective screen voltage due to the change of current through the screen load resistor of 6.47 meg., the effective screen voltages at left ordinate. The plate load was 0.28 meg.

The screen current changes from 47 microamperes to 5 microamperes, and as 5 microamperes coincides with 12 volts negative bias, and we know from Ep-Ig curves that the plate current cuts off a little beyond that, we can realize that there is still some screen current flowing after the plate current has stopped.

The triangles formed by the ordinate at one side, and two sides, one taken from one curve and one from the other, are approximately equal. The linearity of both total curves is particularly good, although there is admittedly a slight error at lower part of the Eeff curve (page 10).

Low Screen Voltage

When we select the operating point of 4 volts negative bias, no signal, we find 31.5 microamperes flowing in the screen circuit, and the effective screen voltage may be low. In the case of the '24 tube we have been accustomed to the recommendation of such a low screen voltage, because of the secondary emission condition, but in the 57 we were not led to expect that a low screen voltage would make for such excellently sensitive detection.

It was the effective screen voltage that principally affected the Ip-Eg curves already discussed, and the two curves showing screen conditions are based on the selection of the most appropriate resistor values, commercially 0.25 meg. in the plate circuit 5 meg. in the screen circuit, corresponding to the closer values used, e.g., 0.28 meg. plate load, 6.47 meg. screen load, used experimentally. The screen performance is even better than the plate characteristic, which affords something to think about.

The curves will prove interesting to those who are especially interested in tube performance, for the Ip-Eg curves on the 57 have not been given much attention, and were lacking from the official data released just prior to the offering of the tubes to the public. Of course the curves could be reconstructed from other official curves (Ip-Ep), but, again, those curves represent usually battery operation throughout, and do not show the series resistor effect of screen loads particularly.

Results Assured

As to those interested only in building the set, the curves at least tend to confirm the basis of choice of voltage values and constants affecting the detector. While there has been some departure from orthodox recommendations, it is always backed up with experimental findings and also occasionally with actual curves, so it must be obvious that the circuit has been painstakingly prepared.

It is not assumed, but rather denied, that the best manner of using the 57 as detector is actually well known now, but circuits now being presented do not offer any better tonal and sensitivity results from this detector, in fact, the present use is deemed to be the most effective one so far. Constructors therefore are asked to follow the recommendations as given, and these will be found embodied in the diagram of the circuit. Whole-hearted satisfaction with results will follow as an inevitable consequence.

RESISTOR COLOR CODE					WAT'GE IN WATTS	
Ohms	Megohms	Body	Dot	End	Actual	Commercial
175	0.00025	Brown	Brown	Violet	0.64	1.0
1200	0.0012	Brown	Red	Red	—	1.0
25,000	0.025	Red	Orange	Green	0.192	1.0
250.000	0.25	Red	Yellow	Green	0.0025	1.0
2,000,000	2.0	Red	Green	Black	—	1.0
*5,000,000	5.0	Green	Green	Black	0.0726	1.0
**5,000,000	5.0	Green	Green	Black	—	1.0

* Detector screen resistor
** Pentode grid resistor.

[This is the second instalment of the article on the construction of the Five-Tube A-C Diamond of the Air. The third and final instalment, with full scale picture diagram, will be published next week, issue of October 8th.—EDITOR.]

A Battery Super

By J. E.

MANY have asked for a short-wave superheterodyne utilizing the two-volt battery tubes. A usual demand is that the circuit be the most sensitive possible. That is a very exacting specification and is practically impossible to meet, for no circuit can be built that is so sensitive that some other circuit still more sensitive cannot be built. Let us see what can be done with a 5-tube circuit.

The first of these tubes might be a 232 mixer, the second a 230 oscillator, the third a 234 intermediate frequency amplifier, the fourth a 232 detector, and the fifth a 233 power amplifier.

This combination of tubes allows us to use on r-f tuner in from of the first tube, an oscillator tuner, two i-f transformers, and a resistance coupler between the detector and the power tube.

The Tuners

The first tuning coil consists of a single winding with a 140 mmfd. condenser across it. The antenna is connected to the high side of this tuner through a small variable condenser that has a range from 100 mmfd. to as near zero as possible. A knob on the panel should be provided for this condenser so that the capacity may be varied according to the wave-length. By using a very small value of this condenser the first tuned circuit will be highly selective and there will be no appreciable loss in sensitivity as a result.

The oscillator coil contains three windings, one for the frequency-determining circuit, one for the tickler, and one for the pick-up. The circuit is arranged so that these windings may be put on a form provided with a 5-prong base. Of course, a six-prong base can be used also.

The intermediate transformers are adjustable to 450 kc and they are of the doubly tuned type, that is, the two coils are loosely coupled and both windings of each transformer are tuned to 450 kc. These transformers should be shielded well.

Modulator-Oscillator Coupling

Since the battery tubes do not have independent cathodes we cannot put the pick-up coil in the cathode lead, as is done with heater type tubes. The next best place to put it is in the screen lead. But it is desirable to arrange the circuit so that the oscillator coil have as few terminals as possible, for that makes the problem of switching from one wave band to another simpler, whether we use plug-in coils or switches. In this circuit one side of the pick-up coil is grounded and the other is connected to the screen through a 100 mmfd. condenser. The screen voltage is applied through a small r-f choke coil of about 10 millihenries.

With this arrangement the oscillator coil can be wound on a form provided with a 5-prong base, (or i-prong) and if switches are to be used for changing wave band there are only three leads that need be switched. Of course, that would be true even if the oscillator coil had six terminals.

The antenna coil has only two terminals. Hence for this we can use a four-prong form. If we are to use a switch we need only one for this coil. Hence if we are to use switches throughout we need one having four decks, one for the antenna coil and three for the oscillator.

The Filament Circuit

All the tubes take 2 volts on the filaments. In order to provide grid bias we use a 4.5 volt battery to supply the filaments. In the negative filament lead of each of the two 232 and of the 234 and in the positive lead of the oscillator a 25 ohm resistor is used as ballast. Since the current is normally 0.02 ampere, the drop in the ballast will be 1.5 volts. In the negative lead of the power tube a 3 ohm ballast resistor is used, and this too drops the voltage nearly 1.5 volts.

Now we have still another volt to drop, and this is done with a common bias resistor of 2 ohms, since the total current drawn by the circuit is 0.5 ampere. The 2 ohm ballast is placed with respect to the grid return of the first tube so that the drop is part of the bias on that tube. Therefore the bias on the first 232 is 2.5 volts.

In case a 4 volt storage battery is available for supplying the filament current it may be used, but in this case the 2 ohm ballast resistor should be changed to one ohm.

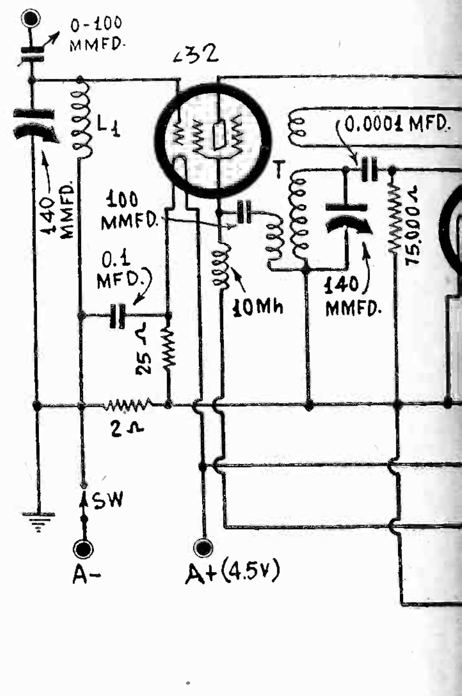
No bias is used on the oscillator except that due to the flow of grid current through the 75,000 ohm grid leak.

The bias on the intermediate amplifier tube is the sum of the drops in the 25 ohm ballast and the used part of a 25 ohm rheostat. This variable is used as volume control. It varies the bias at the same time that it varies the filament current.

The required bias on the 232 detector is 6 volts. Part of this is obtained from the drop in the ballast resistor and part from a grid battery. A grid battery is used because the power tube requires 13.5 volts and it is better to supply this voltage with a battery than to take voltage from the plate circuit. The required voltage of the grid battery is 12 volts, for the bias resistance supplies 1.5 volts. If this battery has a tap at 4.5 volts, the necessary bias for the detector can be obtained.

Plate and Screen Voltages

The plate voltage on all the tubes, with the exception of the oscillator, is 135 volts. With this voltage on the plates the screen voltage on the intermediate amplifier may have any value from 67.5 to 90 volts. In the circuit it is indicated as 67.5 volts. The voltage on the oscillator may have any value from 45 to 90 and for that reason the plate



The circuit ... plu...

return of this tube is connected to the same point as the screen of the intermediate amplifier.

The screen voltage on the two detectors should be less than the screen voltage on the amplifier. Hence the appropriate binding post is marked 22.5 volts. It may be raised to 45 volts if that gives better results. It is likely that a higher voltage than 22.5 will give less sensitivity and that a lower voltage will give greater, but there is no simple way of getting it since ordinary B batteries are not tapped at less than 22.5 volts. Dropping the voltage by means of resistors is not recommended.

It will be noted that the 2 ohm ballast resistor separates the rotors of the two tuning condensers. Thus it is not practical to

48 a New Power Tub

(From RCA Radiotro

The 48 is a power amplifier tetrode, having pentode characteristics at the recommended screen and plate voltages, for use in supplying exceedingly large power output from receivers designed for operation on the 115-volt d-c power line. This tetrode is exceptional in its ability to deliver power at the low plate and screen voltage obtainable in such service. Two 48's in a push-pull amplifier will supply several times the power obtainable from tubes hitherto available.

The large power-delivering ability of the 48 is made practical by the unique features of its electrical and structural design. Among these are the big cathode with its large emitting surface, the control-grid structure with its heat radiator, and the plate with a rib structure fastened to its inner surface. The rib structure serves to suppress the effects of secondary emission which limit the power output of four-electrode screen-grid types.

The heater of the 48 is designed for series operation at 30 volts d-c. It is possible, therefore, to operate the heaters of two of these tubes in series with the heaters of 6.3 volt types with a minimum of auxiliary resistance in the heater circuit, and with consequent reduction of heat-energy to be dissipated in the receiver.

TENTATIVE RATING AND CHARACTERISTICS OF THE 48

Heater Voltage (D-C)....		30 Volts
Heater Current		0.4 Ampere
Plate Voltage	95	125*max. Volts
Screen Voltage	95	100 max. Volts
Grid Voltage	—20	—22.5* Volts
Plate Current	47	50 Milliamperes
Screen Current	9	9 Milliamperes
Plate Resistance (approx.)	10000	10000 Ohms
Amplification Factor (approx.)	28	28
Mutual Conductance	2800	2800 Micromhos
Load Resistance	2000	2000 Ohms

for Short Waves

nderson

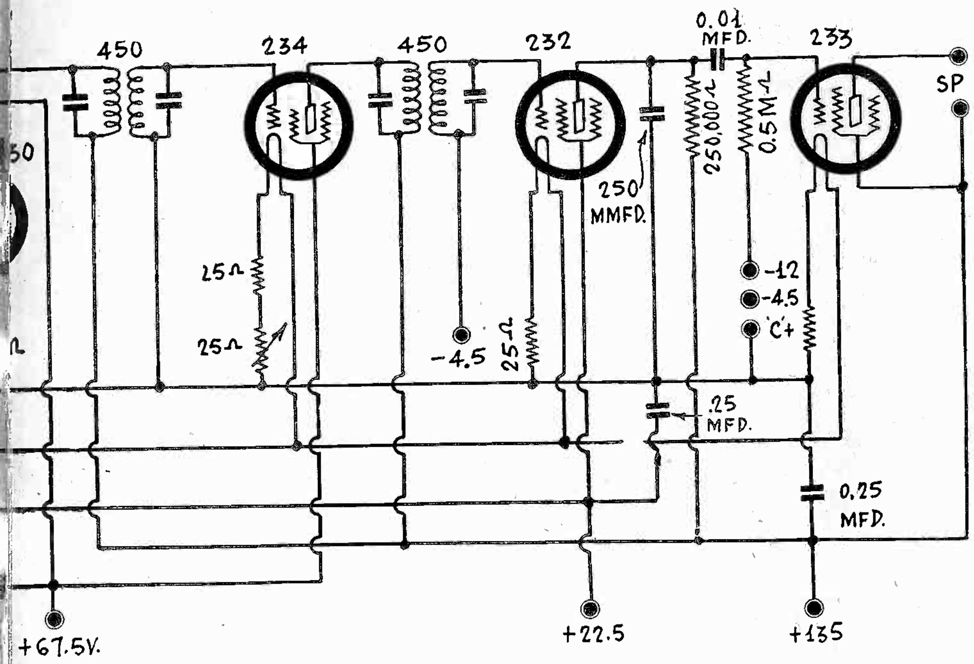


FIG. 1

five-tube short-wave superheterodyne designed for oils, battery operation, and two volt tubes.

ing the two condensers, since the rotors ust be insulated from each other. Ganging is not advisable anyway since it is not ractical to attempt to track them. Much tter sensitivity will be obtained if the consensers are separately tuned.

Plug-in Coils

Plug-in coils are recommended for the rcuit because this will simplify wiring and her construction. Also, plug-in coils can sually be made more efficient, and this more an compensates for the convenience of sing switches.

For tuning we have 140 mmfd. condensers nd the coverage should be from 1,500 kc p to about 20,000 kc. Also, the intermediate frequency is 450 kc. Hence the oscillator should go from 1,950 kc to 20,450 kc. If we assume a minimum capacity in the r-f circuit of 25 mmfd. the capacity ratio will be 165/25 and the frequency ratio will be nearly 2.5. The frequency ratio of the band to be covered is 13.3. Hence 3 coils will be necessary to cover the band.

A set of commercial coils are available that will fit this circuit. There are four coils in the set for each function, that is, four for the oscillator and four for the r-f. The r-f coils are wound on forms provided with four prongs and the oscillator coils on forms provided with six. The four coils are wound so with condenser specified the coverage will be from below 1,500 kc to considerably above 25,000 kc, and still there is ample overlap from one coil to the next.

These coils are wound on forms 1.25 inches in diameter and 2 inches high and they are threaded so that the turns will stay put. Moreover, each coil has a flange at the top to aid in shifting so there is no necessity ever to disturb the turns.

LIST OF PARTS

Coils

L1—One set of four short-wave plug-in coils on 4-prong bases.
T—One set of four short-wave oscillator coils on 6-prong bases.
Two 450 kc intermediate frequency transformers, doubly tuned and shielded.
One 10 millihenry choke coil (800 turn duolateral spool).

Condensers

One 100 mmfd. midget variable condenser with knob.
Two 140 mmfd. tuning condensers with slow motion dials.
One fixed 100 mmfd. condenser.
One 0.0001 mfd. condenser.
One 0.01 mfd. condenser.
One 250 mmfd. condenser.
One 0.1 mfd. by-pass condenser.
Three 0.25 mfd. by-pass condensers.

RESISTORS

Four 25 ohm ballast resistors.
One 6 ohm ballast resistor.
One 2 ohm ballast resistor.
One 25 ohm rheostat.
One 75,000 ohm grid leak (Violet body, orange dot, green end).
One 250,000 ohm resistor (Red body, yellow dot, green end).
One 0.5 megohm resistor (Green body, yellow dot, black end).

Other Requirements

Sw—One filament switch (may be combined with 25 ohm rheostat).
Four UX sockets.
One UY socket.
Three grid clips.
Nine binding posts.
Six No. 6 dry cells.
Three 45 volt dry cell batteries for B supply.
One 15 volt grid battery (two 7.5 volt batteries in series).
One magnetic or magnetic-dynamic speaker.

The Filament Supply

Since the circuit requires 0.5 ampere and a single No. 6 dry cell will give at the most 0.25 ampere, there should be two such cells, or more, in parallel. Also, since the voltage required is 4.5 volts and once cell gives 1.5 volts, the battery requires three cells in series. Therefore the filament battery should consist of 6 No. 6 dry cells connected three in series and two in parallel.

The tuning of the intermediate frequency amplifier may be done by ear since it is not required that the frequency be exactly 450 kc. Tune the r-f and the oscillator to any strong signal that can be picked up. Make the signal as strong as possible. Then without touching the high frequency tuners adjust the tuned circuits in the intermediate amplifier until the signal is as loud as possible. That is all that need be done.

for D-C Electric Sets

and Cunningham)

ower Output (9% total harmonic distortion) ...	1.6	2.5 Watts
laximum Overall Length		5⅝"
laximum Diameter		2-1/16"
ulb		ST-16
ase (Refer to Outline Dwg. No. 92S-4227).....		Medium 6-Pin

**Recommended conditions for operation with uxiliary C-battery which permits utilization of ull d-c power line voltage (110-125) for plate upply.*

Installation

The base pins of the 48 fit the standard ix-contact socket which may be installed o operate the tube either in a vertical or n a horizontal position. For horizontal peration, the socket should be positioned vith the plate pin opening at the top and he cathode pin opening at the bottom or ice versa. Base connections and external limensions of the 48 are given in Outline Dwg. No. 92S-4227.

The bulb of this tube will become very hot under certain conditions of operation. The surface temperature on the hottest part of the bulb should not exceed 150° F. as measured by a small thermo-couple. Sufficient ventilation should be provided so that air circulates freely around the tube.

The heater is designed to operate under the normal conditions of line voltage variation. Due to the heater-cathode design, the heater voltage may range between 26 and 34 volts during line voltage fluctuations without affecting to any great extent the performance or serviceability of this tube.

In a series-heater circuit employing several 6.3 volt types and one or more 48's, the heaters of the 48's should be placed on the positive side. Under these conditions, heater-cathode voltage must not exceed the value given below.

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.

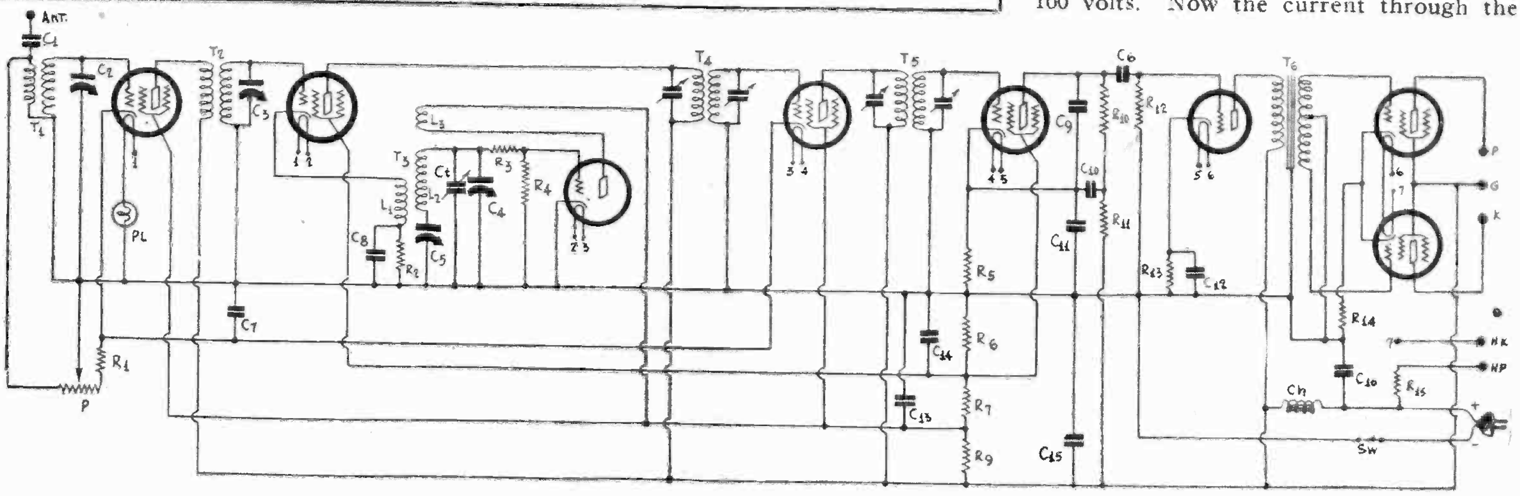


FIG. 1032

When the intermediate frequency in a superheterodyne is 175 kc it is practical to connect the series condenser so that it can be grounded, as has been done in this circuit.

Grounding the Series Condenser

WILL YOU kindly publish a circuit of a superheterodyne containing seven or eight tubes, with single or push-pull output? I desire particularly a circuit with 175 kc intermediate and one in which the series padding condenser is grounded. I have been told that it is not good practice to ground this condenser when the intermediate frequency is much higher than 175 kc. Is this correct?—J. H., Larchmont, N. Y.

You will find the circuit in Fig. 1032. If the series condenser is grounded it must be placed in series with the coil in such a manner that the voltage drop across only the variable condenser is impressed on the circuit. For some frequencies the series condenser and the inductance coil will form a resonant shunt across the tuning condenser, which might stop oscillation. This is not likely to happen in the range of the oscillator, but the oscillation might become weak at the low frequencies. The arrangement works all right when the intermediate frequency is 175 kc.

* * *

Electrical Music Instruments

FOR SOME TIME I have been considering the construction of a combination musical instrument that will contain a radio receiver, a phonograph, and a stringed instrument that may be played with a keyboard. I have in mind starting with a miniature piano. I would have no difficulty with the radio and phonograph because I have already built many of them singly and in combination. But I am doubtful about the piano part. What I want to do is to use the keys for actuating the strings but I want to pick up the vibrations of the strings with some kind of electrical pick-up and then play through the loudspeaker. What do you think of the practicability of the scheme?—W. H. A., New York, N. Y.

As you say, there is no difficulty about the radio-phonograph combination. There is no great difficulty about picking up the string vibrations electrically either. You can arrange a tiny pick-up and place its pole pieces near the vibrating string of the piano. A steel string vibrating between the pole pieces of the magnet would induce a voltage in the winding and this voltage could be impressed on the grid of an amplifier tube. No doubt, you would have to have one pick-up for each string, but there need be nothing complicated or costly about each one. Perhaps the greatest difficulty will be in getting all the voltage on the same grid, or on a few grids. You can connect windings in series if there are not too many of them or you can connect in parallel under certain conditions. Incidentally, instruments of this kind are commercial actualities in foreign countries. It would seem that it would be better, from the point of view of novelty at least, to arrange an instrument with entirely new tonal characteristics. Instead of using vibrating piano strings, you could use vibrating reeds, which could be put in much smaller space. These could be set in motion by striking or by electrical means. The possibilities along this line are unlimited, because anything that will give off a musical tone can be used as a vibrator. This includes purely electrical oscillator, mechanical vibrators, electromechanical vibrators, and purely synthetic vibrators. By synthetic we mean the reproduction as sound arbitrary waves recorded on film or on phonograph records. Synthetic vibrations may be given any desired timbre by selecting the proper wave form. The chirp of a cricket could be recorded and out of the one sound the entire musical scale could be reconstructed by recording at different speeds according to the requirements of the musical scale. The same could be done with any other natural sounds that have a musical quality.

* * *

Determining Resistance

IN MY receiver I have a high resistance in one of the screen leads, but I do not know the value. I have been trying to measure it by means of a voltmeter and an milliammeter but so far I have not got any consistent results. The resistor is connected to a voltage of 250 volts and the current through the resistance is 0.8 milliamperes. When I connect a 1,000 ohms per volt meter from the screen to B minus I get a reading of 90 volts. Full scale is 100 volts. From these data can you figure out what the resistance is? If so, please let me have it?—J. A. E., Kansas City, Mo.

The problem is not quite complete because you did not give the current through the resistor when the voltmeter is connected as you said it was. If we may assume that the current to the screen did not change we can get the value of the resistance as follows: The voltmeter takes 0.9 milliampere when connected and the drop in it is 90 volts. Since the voltage is 250 volts and 90 volts is dropped in the meter, the voltage across the resistor is 160 volts. Now the current through the resistor when the voltmeter is connected is 0.9 plus 0.8, or 1.7 milliampere. Hence the resistance is 160/0.0017, or 94,200 ohms. Since the meter draws more current than the screen, it is clear that the voltage on the screen is considerably higher when the meter is not connected. That is the reason the screen current may change when the meter is put across the resistor. This method of obtaining the value of the resistance is only fairly accurate when the meter across it takes a very small current. As an illustration, suppose that the voltmeter takes only 0.09 milliamperes when the voltage is 90 volts, and the current through the screen resistor is the same as before, namely, 0.8 milliamperes. In this case the total current through the resistance when the voltage across it is 160 volts is 0.89 milliampere. Then the value of the resistance would turn out to be 180,000 ohms. This is nearly twice as great as the preceding value, and that value is correct only in case the screen current did not change when the voltmeter was connected. To get a better value remove the screen grid tube so that no current can flow. Then connect the voltmeter from the screen end of the resistor to ground. Now we can get the resistance accurately. Suppose now that the voltmeter reads 90 volts, the full scale reading being 100 volts. Then the voltage drop in the resistance is 160 volts and the current through it is the same as the current through the voltmeter, namely, 0.9 milliampere. Therefore the resistance would be 160/0.0009, or 178,000 ohms. In case the full-scale reading of the voltmeter had been 500 volts instead of 100 volts, and the voltage had been 90 volts, the current would have been 0.18 milliampere and the resistance 890,000 ohms.

* * *

Cause of Blue Glow

ONE of the power tubes, a 245, in my receiver is all blue inside and since that happened the set has not played. What is the cause of the blue color and what can I do to remedy it? Incidentally, I have had all the tubes tested and they are all right.—L. M. M., Jamaica, L. I., N. Y.

The blue glow is undoubtedly due to the presence of gas in the tube. First switch the two 245s around and note whether the same tube behaves the same way in both sockets. By this test you can tell whether the tube is at fault or the circuit. If you find that the same tube behaves the same way in both sockets and the other tube is all right in both, get a new tube. Of course, if you have an extra 245 the quickest test is to put in the new tube in place of the one that is blue. Be ready with the switch to turn the power off in case that too turns blue, for then the fault is in the circuit.

* * *

Frequency of Audio Oscillators

THE CALCULATED frequency of an audio oscillator which I built is about 200 cycles per second but the actual frequency obtained is around 15 cycles per second. What do you think is the cause of the wide discrepancy? For transformer I use a 3.5 to one audio transformer, tuning the smaller winding.—M. C., New York, N. Y.

The most likely cause of the wide discrepancy is that the frequency is determined by the larger winding despite the fact that this is not tuned intentionally. There is considerable distributed capacity across this winding. This trouble often happens. There is also the possibility that the inductance of the intentionally tuned winding is much higher than what it is supposed to be. Moreover, the smaller winding also has distributed capacity so even if the inductance were right the frequency generated would be much lower than the calculated value.

* * *

Circuit Insensitive

I BUILT one of the eight tube automobile superheterodynes, but it is not as sensitive as I expected it would be, judging by the results of an equal circuit built by a friend of mine. The tracking is all right and the peaking of the intermediates seems to be all right too. Can you suggest a possible reason for the lack of sensitivity?—B. F. J., Detroit, Mich.

There are many possibilities. Perhaps all the tubes are not up to standard. It may be that you have the bias wrong. Or the effective filament voltage may not be quite high enough due to drop in the leads. Still another possibility is that the loudspeaker is insensitive. However, first of all, check the limiting bias on the r-f and i-f amplifiers. Sometimes the bias resistance is much too high so that the lowest bias is around 6 volts instead of 1.5 or 3 volts.

* * *

Effect of Automatic Volume Control

DOES an automatic volume control make a set less sensitive on weak signals? If so, is there any way of overcoming this? Will you please make suggestions? —F. W. L., Atlantic City, N. J.

Since an automatic volume control operates on the grid bias and the sensitivity depends on the bias, it is possible to arrange the circuit so that at no signal the circuit is just as sensitive when there is an automatic volume control as when there is none. As soon as a signal comes in the circuit becomes less sensitive, but the effect is not great until the signal becomes very strong. The circuit would seem less sensitive at all volumes but this does not mean that the same number of stations cannot be received. It means that strong signals cannot be received with the same strength, and that is just the purpose of automatic volume control. Of course, it is easy to arrange the circuit so that the sensitivity is actually less on weak signals as well as on strong. In that case there would be a reduction in the number of stations that could be received.

* * *

Common Bias Versus Separate

SOME circuits show a common bias resistor for two or more tubes while others show one resistor for each tube. Which is the better method?—C. W. O'B., Boston, Mass.

As a rule, it is better to have one bias resistor for each tube, with a separate condenser for each resistor. Of course, this method of construction makes the set cost more, but in most cases the extra cost is well worth while. However, there are cases where a combination is better electrically. Suppose, for example, that the bias resistance is very high and that the current through it is exceedingly small, which happens in resistance coupled audio amplifiers and in grid bias detection. In such cases the reverse feedback is very great and it requires a very large condenser across the bias resistor to reduce this feedback. If the bias for the detector is taken from another bias resistor, in whole or in a large part, there will be very little reverse feedback because the part contributed by the signal is a small part of the total current in the bias resistor. But this introduces another complication. If the bias resistor serves an audio tube this tube may feed back into the detector and the result may be motorboating, or if the phase is right, the feedback from the audio tube may be in reverse too.

* * *

Poor Quality

THE QUALITY of my receiver is very poor on strong signals but on weak signals it is all right. I have had the tubes tested and they are all right. The sensitivity and the selectivity are also very good. What could cause the poor quality?—H. G., Buffalo, N. Y.

In view of the fact that the tubes and the sensitivity are all right and that the quality is good on weak signals it seems that the trouble is due to overloading. This is undoubtedly due to incorrect voltages. First check up the grid bias on all the tubes, particularly on the detector and the audio tubes. Then check up on the plate voltages, and finally, on the screen voltages, if any screens are involved.

* * *

Design of Resistance Meters

HOW do you determine the limiting resistance in a resistance meter and after that the calibration of the current scale in ohms?—W. W. L., Troy, N. Y.

First of all decide on what meter to use, that is, what the current is at full scale. Then decide on the voltage you want to use in series with the circuit. Suppose the voltage is V and the full scale current is I amperes. The limiting resistance should be determined so that when the circuit is completed with it, that is, when the terminals of the unknown are shorted, the reading of the meter should be full scale. Then limiting resistance is Ro, we have $Ro = V/I$. Now in addition to the limiting resistance we put in an unknown resistance of Rx ohms, we have by Ohm's law, $V = Ix\ (Ro + Rx)$, in which Ix is the current flowing in the circuit when the unknown resistance is in series. The total resistance in the circuit is $Ro + Rx$. We can use the above formula either for determining the current for any given value of Rx or to find the resistance Rx for any given value of current. That is, we can find the resistance for every division of the current scale, or we can find the current for convenient values of resistance. Let us illustrate the use of the formulas. Suppose we have a O-1 milliammeter and we want to use a voltage of 7.5 volts. Then V equals 7.5 volts and I equals 0.001 ampere. Hence the limiting resistance should be 7.5/0.001, or 7,500 ohms. That is the value of Ro in the formula. Hence we have $7.5 = Ix\ (7{,}500 + Rx)$ for use in either finding Rx for known values of current or for finding Ix for known values of resistance. What will the current be if $Rx = 7{,}500$ ohms, for example? The total resistance is now 15,000 ohms and the current is 0.5 milliampere. That is one point on the resistance scale or on the calibration curve. Find others similarly. Again, suppose we want to know what the resistance is when the meter reads 0.8 milliampere. Substituting in the formula and solving for the resistance we obtain $Rx = 1{,}875$ ohms. If a resistance scale is to be constructed it is best to assign convenient values to Rx and then find Ix. Then the resistance values should be marked on the scale opposite the currents thus obtained. If a curve is to be constructed it does not matter which is assumed to be unknown.

Mme. Alda to Teach Microphone Technique

Mme. Frances Alda, whose long association with the Metropolitan Opera Company made her one of the great personalities in the musical world, will devote a large share of her activities to training young singers for broadcasting.

Mme. Alda opened studios at the Waldorf Astoria Hotel, New York City, where she will teach vocal aspirants. In addition to coaching singers for the radio she will teach prospective concert and operatic artists and beginners. Once each week she will broadcast by arrangement with the National Broadcasting Company.

"The course for radio pupils," Mme. Alda said, "will be particularly adapted to the specific requirements of broadcasting and will include instruction in the special vocal technique necessary for successful microphone reproduction. Some of the students in this group will be professional singers who have not yet learned to adapt their voices to the microphone."

TWO STATIONS FACE OUSTING FOR MYSTICISM

Denial of applications of two California radio broadcasting stations, Magnolia Park, Ltd., Burkank, and the Pickwick Broadcasting Corporation, td., Los Angeles is recommended to the Federal Radio Commision by Chief Examiner Ellis A. Yost, on the ground that the programs do not serve public interest, convenience or necessity.

The two stations at present share certain hours of their assignment together, but each sought unlimited hours of operation. Magnolia Park, Ltd., KELW, operates on a present assignment of 780 kilocycles frequency and 00 watts power and shares with the Pickwick Broadcasting Corporation, Ltd., KTM, whose present assignment is 80 kilocycles frequency, 500 watts power, and 1 kilowatt, local sunset.

Advertising Complaints

In addition to numerous complaints against KELW for its methods and manner in obtaining commercial broadcasts and the form and substance in which these broadcasts were made as compared with the form of advertisements proposed to be made and the financial handling of its sales, broadcasts of a business nature by KTM were censured as "of doubtful merit" and objectionable from the viewpoint of good business ethics, the report asserts.

Both stations were cited for putting on programs of an operator of a cancer clinic in Los Angeles who was not licensed by the California Medical Board to practice medicine. KTM refused after investigation to continue the broadcast but KELW continued them.

Astrological Forecasts

Chief Examiner Yost presented excerpts of astrological and numerological broadcasts of one Zandra described as "the eminent philosopher and psychologist," not held to be a fortune-teller with claims of the supernatural, but one who could apply his science in solving everyday problems of individuals and show them the way to prosperity and happiness. Listeners were told to write Zandra and obtain for $1 either his Astrological Revelations or his Mystery Guide, according to "The United States Daily." In answer to three questions and the date of the writer's birth, Zandra then offered to give the purchaser of either of the books a written answer to the questions "free."

The station also broadcast talks based upon horoscopial reading of one Zenda and answers to questions put to her which she answered by mail after which she advertised her horoscopial reading at $1. These broadcasts are no longer put on by KTM and will not be permitted in the future, the report of facts states.

Would Reduce Over-Quota

In his conclusion, the Examiner further stated:

"The delegation of KELW and KTM would reduce the present quota of the State of California from .38 to a unit over-quota to .34 of a unit under-quota, and reduce the present over-quota status of the Fifth Zone by .72 of a unit."

Metropotitan Opera to Be On the Air Again

Metropolitan Opera will be carried from the stage of the opera house in New York City to the homes of music lovers throughout the United States and Canada again this winter over National Broadcasting Company networks.

Continuing the arrangement with the Metropolitan Opera Company, whereby the National Broadcasting Company last season made the performances of the nation's leading opera available to radio listeners for the first time, portions of at least one regular performance will be broadcast each week during the season of 1932-33.

M. H. Aylesworth, president of NBC, said:

"The broadcasting of Metropolitan Opera is a privilege that the National Broadcasting Company has no intention of foregoing. The enthusiastic reception accorded last year's programs leaves no doubt that opera has a place on the air. Increased attendance at the opera house as a result of the broadcasts has proven also that radio equipment has a place in the opera house."

EUROPE'S TUBE CAP IS PLATE

Dr. E. A. Lederer, Research and Development Engineer of the National Union 7Radio Corporation, returned from a two-months trip which took him through the principal European radio manufacturing an ddevelopment centers, including London, Berlin, Vienna, Munich and Bremen.

Dr. Lederer said that the English situation is at present dominated by G. E. C. and Cossor. Radio business in the British Isles, says Lederer, is booming due, he believes, to the high tariff wall.

The German tube manufacture is controlled by an almost absolute monopoly of Telefunken, which company is the result of pooling the radio interests of Siemens, A. E. G. and Osram. Tube prices in Germany as a consequence are extremely high, tubes of a type corresponding to the 224 selling for about $4.40.

A relatively few tubes are made in Vienna, due to the limited population in Austria. The principal firms there, however, are Ganz: Schrack, which is believed to be now a Phillips subsidiary; and Kremenzeky which is a subsidiary of Tungsram in Ujpest near Budapest.

Dr. Lederer pointed out a peculiarity of European screen grid tubes in that the plate lead is brought out on top instead of the control grid leads like American tubes. There is considerable danger, as a person is likely to receive a terrific shock handling these tubes when the set is in operation; moreover possible short circuits create a considerable fire hazard.

Radio sets of foreign manufacture are small two, three and four-tube outfits which are capable of bringing in only stations located in the immediate vicinity of the receiver. Regeneration is used to a large extent. There is limitless variety of brands, as anyone can take out a license to make radio sets. Due to the inadequacy of Continental-made sets, those of American manufacture are rapidly increasing in popularity.

Such tubes as are manufactured abroad with high potential caps would not pass the Board of Fire Underwriters in this country.

MUST NOT TELL FORTUNES, NEW RULE BY BOARD

Washington.

Fortune telling and astrological programs over the radio have been prohibited by the Federal Radio Commission in a decision recently handed down.

In granting the renewal of the license of KFWI of San Francisco, which until shortly before application for renewal of license had featured a fortune telling program in which answers were given over the radio in response to inquiries by letter, and in which a chart was sold, the Commission ruled:

"Such fortune-telling programs, advertising the sale of astrological charts, might in many cases constitute a harmful trade upon the susceptibilities and emotions of listeners who may be in serious difficulties."

Assurances from Station

The renewal of the license, it was stated orally at the Commission, in a large measure depended upon the assurances of the station officers that programs of this nature will not again be presented.

That part of the decision dealing with fortune telling follows in full text:

"A considerable portion of the evidence in this case relates to certain broadcasts over the station by a so-called astrologer featured as 'Alburtus.' During the Spring and Winter of 1931 and in March of 1932 these programs were broadcast daily. They constituted a form of fortune-telling, answers being made over the air to those making inquiries by letter, usually concerning personal affairs. A so-called astrological chart in pamphlet form was advertised and sold at $1 each, although the answering of questions during these programs was not conditioned upon the purchase of a chart. Net returns from the sale of these charts were divided between the licensee and "Alburtus.'

Introduced as Entertainment

"Although thse astrological and fortune-telling programs were introduced by an announcement to the effect that they were entertainment features, the propriety and value of such broadcasts, considered in the light of the statutory standard of public interest, convenience and necessity, is extremely doubtful. It would appear that the practice of engaging in point-to-point communication in answering direct questions of individuals concerning their personal affairs during a broadcast ostensibly presented for the enjoyment and entertainment of the general public could not result in programs of real interest to a substantial number of the radio listeners.

"Moreover, it is our opinion that such fortune-telling programs, advertising the sale of astrological charts, might in many cases constitute a harmful trade upon the susceptibilities and emotions of listeners who may be in serious difficulties. However, these programs were discontinued by the applicant shortly before the hearing and the record contains the assurances of the officers of the Corporation that programs of this nature will not again be presented over the station. With the applicant's decision in this matter, it may be stated that the Commission is heartily in accord."

MEETING SEES RADIO USES IN WAR ON CRIME

New thrills in tracking criminals by radio were demonstrated at the annual convention of the National Identification Association in New York City.

Keen interest in these ultra-modern methods has been aroused among the delegates to the meeting, prominent in state and municipal police identification work throughout the country, by the success of the police radio alarm systems in daily use in many other large cities. These men, whose job it is to prevent and detect crimes, will see how a police radio alarm system works and learn of other ways in which it is possible for radio to serve them. The various uses of radio applicable to police work and crime detection were demonstrated with actual radio equipment supplied by the Radio Corporation of America.

Sketch Shows Action

The complete story was told in action in a dramatic sketch in the grand balroom at the Hotel New Yorker. The delegates to the convention watched a man impersonating a gem thief enter a jewelry store in which there was a safe containing famous jewels. As he reached out toward the safe he crossed a tiny beam of light playing on a photo-electric cell. The photo-electric cell ignited a flashlight and a camera trained on the safe took a picture of the intruder. He dashed out. A watchman, attracted by the flash, ran into the room. Seeing his man had escaped, the watchman took the exposed plate from the camera. A man from the street entered and said he saw someone run from the store and speed north in a light green sedan.

The scene shifted to the radio alarm room at police headquarters, where the uniformed operator was sending the alarm over a transmitter:

"Calling all cars. Calling all cars. General alarm for robber driving north on Brownway in light green sedan."

The spotlight was flashed across the stage, where a motor car patrolman received the message through the receiver mounted on the dashboard of his car. The message through the loudspeaker was heard also by the audience. For the information of the deelgates the alarm was repeated and received again, this time on a combination radio transmitter and receiver, called a transceiver, which is so light and compact that it can be used by mounted patrolmen.

Culprit Confesses

The audience next saw the jewel thief, caught by police radio patrolmen, brought onto the stage. His fingerprints and signature were obtained. The police questioned him. Confronted by his photograph in front of the safe, he confessed that he was a member of an international gang of gem thieves. His confession with all the questions put to him were caught word for word by a special recording phonograph, which employs radio-electric principles. This device is of great values in prosecuting criminals who repudiate confessions at trials and assert they were obtained by "third degree" methods. And at this point a hurried phone message from an inspector in a car equipped with a direction finder informed the police that radio signals between an apparently unauthorized radio station and a radio-equipped speedboat have been picked up telling men on the speedboat they had better "clear out" because "Jack" was caught getting the jewels he was to turn over to them.

The direction-finder on the cruising car, used to trace illegal stations, showed that the speedboat was loitering in the harbor and that the station communicating with it was in a certain block near the riverfront. Police were sent to round up the confederates of the robber at the outlaw radio station. This use on land of a radio-marine direction-finder was demonstrated with actual equipment to the members of the Identification Association.

Wanted Abroad

The dramatic sketch continued with the clinching of the identification of the captive at police headquarters. His photograph, fingerprints and signature were flashed to London by radio facsimile, the actual working of the process being made clear by the display of some of the equipment by which RCA Communications, Inc., accomplishes it. The audience watched also the sending of a radiogram to London telling of the arrest and confession and asking if the man is known there. Back came the answer. He is known and wanted there. His record, valuable to the police establishing the case against him, is included.

BILL PROTECTS SPORTS ON AIR

Montgomery, Ala.

A bill has been introduced in the House at the special session of the legislature to grant to any licensed broadcasting station operating in the State the right to broadcast athletic contests or games staged or sponsored by, or participated in, by any educational institution receiving financial support from the State or from any subdivision.

The bill would make it unlawful for any executive officer, board of trustees, or any person acting on behalf of such institution to refuse the irght to any station.

4 PER CENT. DIVIDEND TO EARL CREDITORS

Newark, N. J.

The receivers of the defunct Earl Radio Corporation are ready to pay a dividend of 4 per cent. on claims against the corporation, according to a report of Vice Chancellor John H. Backes from Arthur T. Vanderbilt, counsel for the receivers. The report said the receivers had a net balance of $275,000 against claims of more than $4,000,000.

NBC Removes Ban on Sponsor's Price Mention

The Columbia Broadcasting System having removed its prohibition against an air advertiser mentioning price, the National Broadcasting System has done likewise, so that now prices are mentioned regularly on both the NBC and CBS, the two big chains

However, the percentage of time permitted to be devoted to sales talks is limited by both CBS and NBC.

A THOUGHT FOR THE WEEK

HE IS A MEMBER of his home State Legislature. He has been a public official for fifteen years. He seems safe, conservative and a clear thinker. In an address over the air recently he referred to the Federal Government at least a dozen times. Each time he called it "the Fed-al Govment." At first we thought our ears had betrayed us. Then we listened more intently; no mistaking the dropping out of whole syllables.

However, maybe its quite all right, for economy seems to be the order of the day with our native orators.

RADIO WORLD

The First and Only National Radio Weekly
Eleventh Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.
Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor; J. Murray Barron, advertising manager.

Mental and Meter Equipment

LABORATORY work combined with book learning makes an attractive combination, and therefore those who are studying radio either for their own amusement or for commercial ends should do a great deal of testing and measuring, as well as some building. The application of the theory not only perfects the knowledge but constitutes a confirmation that adds to the fun.

About the only formula that is constantly used by those in the early stages of acquiring radio knowledge is Ohm's law, and as it is simple to learn, understand and use, no one can profess a serious interest in radio unless he has learned that law well.

The next important theoretical consideration is to have a good knowledge of methods of preventing oscillation in circuits that must be devoid of it to work well. This has become so important because of the very high gain of the tubes used in newest receivers, and the consequent oscillation trouble that may arise in sets even after they have left the factory where they did not oscillate.

With a knowledge of the tubes generally used, and the formal circuit connections, plus Ohm's law and oscillation stoppage, a man begins to have some mental background for service work and receiver construction. But on the physical side he has to possess testing and measuring equipment. Some sort of an analyzer is the first requirement for service work. Many prefer receiver analyzers, others just the meters and accessories for independent voltage, current and resistance measurement, but whatever the preference is, the necessity for testing and measuring equipment must be recognized from the start. One may begin with a flashlight and dry cell for continuity tests, but soon finds it necessary to determine resistance values, also voltages and currents, so sooner or later the meter has to enter the picture. Therefore everyone is advised to make some preparation for obtaining the necessary equipment, and even if present equipment seems adequate, to consider the improvements that must be made upon it to make it thoroughly serviceable, no matter what receiver or circuit is to be measured or tested, or what tubes it contains.

It is a good plan to start saving now for the purchase this coming winter of suitable meter equipment, for the more one learns the more meter he needs.

Ten Years Ago This Week

TEN years ago the famous station MBD, at Poldhu, Cornwall, Wales, from which Guglielmo Marconi had had the S sent across the Atlantic, was dismantled and abandoned. At that, it had served its purpose well, for 21 years had passed since the young Italian who was educated in England performed his feat. The dot-dot-dot was sent to him and received at Cape Cod on this side of the ocean on December 12th, 1901.

An article in the September 30th, 1922, issue of RADIO WORLD paid "due respect to the memory" of the Poldhu station that was passing out of use but not out of history. It was recalled Marconi made his experiment though his apparatus had covered 36 miles at the utmost, and though scientific gentlemen pointed out the "utter impracticability" of trans-ocean radio, because the curvature of the earth would not be followed by the propagated wave, but it would ride on a tangent and thus escape its destination. A wavelength around 600 meters will dart skyward, but not due to the earth's curvature, and also will be reflected back and curvature of the globe is no deterrent. But the facts about the ionized layer were not known to the scientists of those days and it was just as well they goaded young Marconi, for he was strong in appeasing the Missouri spirit of the English scientists.

The September 30th, 1922, issue discussed the subject as follows:

"The story of the first transatlantic signals weaves itself around the Poldhu station. Marconi was in England at the time, conducting experiments before the officials of the postoffice department, and demonstrating, with the rapidly increasing range of his crude instruments, that the span of radio signalling was practically unlimited. But men who called themselves practical—men opposed to Marconi, who was supposed to be visionary—said that the curvature of the earth would prevent transmission to any great distance.

Was Seeking Backing

"They were judging the capabilities of this new force which follows the contour of the earth by the conduct of other systems of signalling, such as the heliograph and other sight devices. Marconi, though not as well acquainted with wireless phenomena then as he is today, thought differently; but up to that time, the distances covered proved neither one thing nor the other. Naturally he was particularly anxious to establish transatlantic records, so that for onc anll this question of limited scope of radio waves should be settled. For him, it meant a matter of gaining the backing of those who withheld their valued support unless this particular controversy was cleared up.

"So eager was Marconi to prove that curvature of the earth would not interfere withe the progress of electromagnetic waves that he started on the station at Poldhu at a time when his instruments had accomplished the record of only thirty-six miles! What greater teribute could there be to Marconi's faith in the possibility of his invent? At the same time, a similar high-powered station was commenced at Cape Cod, which was to be the American side of the great test.

"Marconi knew that to produce electromagnetic waves of a force sufficcient to bridge the Atlantic, he must have instruments far in advance of what he then possessed. He couldn't have instruments that differed to any great extent, for what he had already evolved represented the peak of radio progress; but he could and he would have them larger and more powerful in every respect.

20 Kilowatts Output

"So the layout of the station at Poldhu as it was when the signals were hurled across the Atlantic did not differ in theory from the amateur spark-coil outfit of today, wit ha transformer, condenser, and inductance coil. But there was a generating plant consisting of an alternator capable of an output of about twenty kilowatts, which through suitable transformers, charged a condenser having a glass dielectric of great strength.

"The aerial at Poldhu consisted of fifty almost vertical wires, arranged in the vertical fan style, and supported at the upper end by a wire stretched between two masts. The masts were 150 feet high, and 200 feet apart. As first erected, they were not strong enough to withstand the gales of a Cornwall winter, and on September 18th, 1901, were blown down during a raging storm.

"Work was again started immediately, in an endeavor to haev the Poldhu station and the Cape Cod station ready t about the same time. But a further delay came in the form of a storm on the American coast, which wrecked the masts at Cape Cod. This was in November of the same year, and Marconi's discouragement was extreme. But with a determination that characterized his actions from the very start, he completed the reconstruction work at Poldhu, and then journey across the Atlantic with a few assistants and a makeshift receiving set, which he installed in a rough building on the cold shore of St. John's, Newfoundland.

Used Kite Aerial

"He could build no masts, and so he sent his aerial aloft by the means of kites, which made the stupendous task he was then engaged in doubly hard. The variation of the wind produced constant changes in the angle and the altitude of the aerial, so that capacity and period of electrical resonance were never the same, making it almost impossible for Marconi, tuning with the temporary instrfments below, to remain on any one wavelength for any period of time.

"On the night of December 11th, all was ready. The operators at Poldhu had been instructed to begin sending the test signal —which was the three dots of the letter S —on and after December 11th, keeping a steady transmission of that letter for ten minutes and then resting five minutes.

"When Marconi first listened in at the appointed time, he knew that so far as it was possible to depend on human co-operation, that Poldhu was working and periodically directing her signals towards the anxious inventor in Newfoundland.

"Across the ocean? Could it be done? Some of the greatest scientists in the world had said that the feat was impossible!

"But as in the case of the amateur trials, just twenty years later, the momentary failure was no indication of what was to follow. Marconi listened all the night of the 11th, and heard nothing. The day of the 12th was spent in correcting the receiving instruments so that they responded to Marconi's ideas as to what should obviate the previous night's difficulties, and in the evening of the 12th, to the overjoyment of Marconi, the monotone signals from Poldhu station were heard in Newfoundland."

STATION SPARKS

By Alice Remsen

The Garden Wall

For Ben Alley

WABC, Sunday, 11:15 p. m.; Monday, Wednesday, and Friday, 11:45 a. m.

Come to me where the sweet lilacs grow!
Come to me where the western winds blow!
Down at the foot of the garden wall
Where lilies grow rich and straight and tall.
While the moon liquid gold is spilling,
And the birds sleepy notes are trilling,
Come to me, dearest one of all;
I wait for you here by the garden wall.

Lady moon rides so lazily by;
Her steed fleecy clouds which sail in the sky.
I wait in vain by the garden wall,
Listening, longing to hear your call;
While the night swiftly grows around me,
And the perfumes of flowers surround me.
Come to me, dearest one of all;
I wait for you here by the garden wall.

—A. R.

* * *

And the sweet tenor voice of Ben Alley will make you think of love and moonlight, flowers and garden walls, and all those delightful attributes of romance. Ben is a rather romantic person himself; this is reflected in his voice, in his manner of reading a lyrical ballad. I consider Ben Alley one of the foremost radio delineators of charming ballads. Listen to him. You'll like him.

* * *

The Radio Rialto

Pickings are not so good today; news seems to be scarce. Upon meeting a radio star and asking "What's doing?"—that star invariably answers: "Not much—plenty of things promised, but nothing has really come through." . . . And that's how things are. . . . Advertisers are acting in a cagey manner Shopping around for new talent and ideas, and trying to get something for nothing, which never has worked out properly and never will. . . . A few of the standard hours have returned to the air with new programs, among these, Bourjois' "Evening in Paris," which brings us a series of mystery dramas, rather poor stuff, old ideas rehashed—the players themselves do a good job, particularly Elsie Hitz. . . The Blue Coal Musical Revue returns, with a contract for thirty-one weeks, over WABC, Sundays, 5:30 p.m. George Earle will conduct the orchestra as in a previous series. . . . Campaign speeches will infest the air from now on. . . .

Ran into Singing Sam (Harry Frankel) today, at the N V. A. Club, (in case you don't know what N. V. A. stands for—I mean the National Vaudeville Artists Club). . . . Harry is a grand old trouper. Radio success has not gone to his head. He has no manager, no publicity agent. He still lives in the same little old hotel which used to house him during his lean vaudeville days. He may be seen at the Club every day, mingling with his old fellow troupers, playing billiards or simply chewing the rag. . . . Heard a piece of news today which made me feel very happy. . . . After my Stanco rehearsal at NBC, I stopped off on the third floor and visited the NBC music library Claude MacArthur, who is doing special writing and arranging, was there. Claude told me that the Victor Recording Company has taken eight of his compositions and will bring them out this Fall. . . . Great break for Claude and he deserves it. . . You must surely remember him from WABC a few seasons back. . . . He conducted such programs as the Majestic Hour, Ward's Tip-top Revue, Manhattan Moods and various others. . . . Claude can always be relied upon to do a good job. . . .

Our tour of the Radio Rialto began rather slowly today, but we'll proceed, so trot along with me to a few of the music publishers; we're sure to find somebody around. . . . First stop. . . . Robbins. . . . Our good-looking contact man, Mel White, greets us with a smile and a handful of new numbers, among them a tune which I predict will be heard plenty over the air this Fall, "Rock-a-Bye Moon"; after hearing the numbers demonstrated, we start to leave, only to run into that red-headed young WOR baritone, William Mullen; here's a boy deserving of a break; he'll probably get it soon. . . . Well, as I live and breathe, if that isn't Sam Lanin, late of International Revue, Pillsbury Pageant and other fine hours. . . . He's looking brown as a berry, after a summer in Atlantic City. . . . "What's doing, Sam?" Sam shrugs his shoulders and makes the inevitable reply, but he doesn't look worried. . . . Sam has worked plenty in the past and will do so in the future. . . . There'e George Lottman, one of the best publicity men in the business; we promise faithfully to pay him a visit one of these days and pass on out into the street. . . .

Next stop. . . . Feist's. . . . Going up in the elevator, notice that Lanny Ross's picture adorns the front cover of "Silver Rose"—new song, exploited plenty by Lanny. . . . Johnny White is out, as usual, so we'll ensconce ourselves in a nice, comfortable armchair and wait for him. . . . My, but I'm tired. . . . Goodness, gracious! . . . Must've dozed off. . . . Yes, you're right, I was out late last night. . . . Well, half hour's long enough to wait. . . . Let's go . . . oh, but here's Johnny now. . . . "Hello, my boy. . . . Just dropped in to tell you I'm using that swell song of yours, (Masquerade) on the Stanco program next Wednesday night. . . . Yes; I thought you'd be pleased. . . . Any news for me. . . . No! . . what kind of a professional manager are you? . . . Yes, I know, business is slow. . . ." Who's that over there. . . . Oh, yes. . . . William Hall, of WABC. . . . The tallest baritone in captivity. . . . Six feet, five and a half inches in his stockinged feet. . . . That's what I call a whole lot of man. . . . He's got a swell voice, too. . . . There's Smiling Smolen, little Maxie . . . erstwhile Bourjois maestro; many a good laugh I've had with that lad. . . . A fine conductor and a good fellow. . . . Well, let's pop off. . . .

Next stop. . . . Joe Morris. . . . Here's a little music publisher who always manages to get along. . . . Never brings out more than one song at a time; always makes money with it. . . . Has a good picker in Archie Fletcher. . . . Archie is one of the best-liked men in the music business. . . . Usually full of news, but as I told you before, pickings are bad today. . . . Well, well, here's sweet-voiced Tommy Weir, looking fit as a fiddle. He used to live in Long Island, but moved to Jersey and likes it better. . . .

Into a taxi over to Columbia. . . . Now what! . . . Good gracious. . . . What's the matter today. . . . Place is deserted. . . . Well, supposing we chat with a few people who figure behind the mike. . . . F'rinstance, there's Helen Fox, pretty young hostess, who receives the visitors as they enter the Columbia reception twenty-two floors above Madison Avenue. Until two years ago, Miss Fox was a book-shop owner and interior decorator in Louisville, Ky. . . and then there's Sammy Shiff, night page captain, who at just the right moment beckons the guests into the studio and frets nervously lest someone cough inopportunely. . . . Sammy is eighteen and two years ago was a clerk in a brokerage house. . . . That dreamy looking chap over there is Joe Colledge, control engineer, who flips transcontinental switches, signals "We're on the air," and deftly controls the level and volume of words and music by the radio stars. Colledge is twenty-five, was educated as a pianist and electrical engineer, is a graduate of Columbia University and a product of Paterson, N. J. . . . and . . . why—"Hello, John!" . . . Allow me to present Mr. John Loesch, production man, who directs programs—and how! . . . He arranges the grouping of talent and properties before the "mike" for proper acoustics, and "set up" the orchestra, moving fiddles and horns like so many chess pieces in order to get the desired effect; and—a very important thing—he takes care of split-second timing. . . . Loesch was musical director of a phonograph company at one time, is a concert violinist, and conducted string ensembles in pioneer broadcasts as early as 1920. He lectured and produced chamber music for the New York Board of Education, and left the Edison Company to join Columbia in 1930. Bloomfield, N. J., is his home . . . and by this time I guess you understand that it takes all kinds of people to put on a successful radio production . . . and I understand that it's time for me to pop off home or Octavia will be angry, for her lovely cheese souffle might be ruined.

* * *

Biographical Brevities

ABOUT GERTRUDE BERG

Gertrude Berg was born and raised in Harlem, when Harlem was still a white settlement. Her father was a hotel keeper named Edelstein. Attended Public Schools 103 and 149, Wadleigh High School and Columbia University. Is married to Louis Berg, a sugar merchant, and with the exception of two years spent with her husband on a Louisiana sugar plantation, has lived all her life in New York. . . . Has two children, a boy, Chenay, aged 10; and a girl, Harriet, aged 6.

Mrs. Berg is distinctly a radio product. She came to radio with no stage screen, operatic, concert or literary reputation preceding her. She has always been a student of character and since she was able to handle a pencil has scribbled. Her first radio script had to do with Jewish salespeople but didn't pan out well. Then came the big idea, a story of Jewish family life—The Goldbergs—or The Rise of the Goldbergs, as it was originally called. The preparing of the script was easy enough. Finding an outlet was quite another matter. For months Mrs. Berg patiently and persistently knocked at the portals of the radio stations demanding the right of a hearing. Seven words, "It's a story of Jewish family life," for a long time stood between her and an audition. One fortunate morning she reached the ear of an NBC executive. . . . He liked the idea and arranged an audition. The program board liked the idea but were not certain about the radio audience, and so it was decided to try it out for one night. The

(*Continued on next page*)

PRECISION TEST WAVES TO HAVE 24-HOUR BASIS

Washington.

In order to provide more adequate reception to owners of more than 20,000,000 radio receiving sets tuned in on the country's 600-odd stations, continuous 24-hour service for maintenance of wave-frequencies of broadcasting stations is the goal of the Commerce Department's newly-equipped "standard frequency" stations at Meadows and Beltsville, Md., functioning under scientists of the Bureau of Standards.

Not only will the public be the beneficiary of continuous scientific adjustment of radio frequency bands, but also manufacturers of radio sending apparatus, as well as testing laboratories and governmental departments, it was stated.

While the testing of frequency bands is not a new activity with the Bureau of Standards, such work having been carried on for a number of years in temporary buildings, installation of a new transmitting set in one of the three buildings housing the station on the United States Experimental Farm near Beltsville, Md., will materially enhance its scope, it was pointed out.

In order to overcome the difficulties of mutual interference caused by the radio apparatus and by experimental apparatus in some of the Bureau laboratories in Washington, the Bureau was given funds in 1931 to establish two permanent field stations. Necessary construction has been completed, and now equipment is about to be installed.

United States Blazed Trail

The "standard frequency," in the words of E. C. Crittenden, Chief of the Bureau's Electricity Division, under whose direction the work is carried out, is nothing more than "a frequency of known cycles per second." The "standard frequency" that has been generated at the Bureau in Washington for the last several years is numbered at 5,000,000 cycles per second. This signal is at present sent across the country at a certain hour every Tuesday morning and afternoon.

All interested persons upon receiving the signal are able to adjust their stations in order to keep within the frequency bands assigned them by the Federal Radio Commission. Mr. Crittenden pointed out that the United States was the first Government to provide a service of this kind, and that it was the hope of the Bureau scientists, funds permitting, to improve the service to such an extent that it would be continuous, thus providing, from a broadcast angle, an instantaneous correction upon any program in the country.

That this work is of great practical value is attested from many directions, it was pointed out. Perhaps the beneficiary most directly concerned is the radio listener. The question, how much is it worth to have clear reception? is solved largely because of the work of the Bureau's scientists in sending out standard frequencies. Radio broadcasting stations immediately keep their sending apparatus in tune with the standard measurement, thus avoiding "bumping" into each other on the air, which causes whistling and grating noises in the receiving sets and drowning out of programs.

For the broadcasting stations themselves much money is saved because of the avoidance of endless disputes, legal difficulties and delays which would arise should one station constantly interfere with another.

Where time means money, as it does in the "mike" room, such savings are almost incalculable. The same applies to manufacturers of precision instruments, such as crystal control transmitters used in radio broadcasting, where adequate knowledge beforehand of the proper functioning of an instrument may save thousands of dollars. Upon completion work the manufacturer may have his instrument thoroughly tested by Bureau scientists at their "standard-frequency" station in order that they may operate close to the "standard."

Report on Eclipse

Benefit does not end with the public and private industry, but applies as well to Government departments. At the present time the Signal Corps of the United States Army has several dozen instruments "on the receiving end" of the Bureau's standard frequency testing station, in order to insure proper functioning of the instruments in the field.

The world's largest monitoring station, located at Grand Island, Nebr., operated by the Federal Radio Commission, depends on the standards established by the Bureau upon which to perform its air regulatory functions. At this station signals from all over the world are taken from the air and measured with scientific precision.

One of the transmitter buildings at Beltsville was used by the Bureau during a two weeks' period for transmission during the solar eclipse of August 31st. Transmissions were received and measurements made at a temporary receiving station near Kensington, Md. For such measurements to be of value, it was necessary that observations be made for a period of several days before the eclipse. Field intensity recorders showed no change in radio broadcast transmission during the eclipse. Ionization of the lower (100 kilometer) region of the Kennelly-Heaviside layer decreased considerably as the eclipse progressed, but returned to normal afterwards. Changes were also noted in the region above 225 kilometers, but complete results are not yet available.

Station Sparks

By Alice Remsen

(Continued from preceding page)

reaction of the audience was so favorable that the Goldbergs have been on the air ever since—and that was November 10th, 1929.

Mrs. Berg is 30 years old. She is five feet, five inches in height, and has dark brown hair and eyes. Notwithstanding her radio activities, she finds time to preside over her own home and raise her own family. She likes to dance, sing and paint pictures for diversion. Sam Jaffe is her favorite stage actor, and Helen Hayes her favorite actress. Her favorite color is navy blue.

* * *

ANSWERS TO CORRESPONDENTS

C. PELLEW, Rochester, N. Y.—Yes, John Fogarty is what they call an Irish tenor. He is slender. Dark. Thirty. Unmarried.

H. RHODES, N. Y.—Lanny Ross is still singing for the Maxwell House Coffee concern. Only on once a week now. Friday, 7:30 p. m., WEAF.

* * *

(If you want to know something about your favorite radio artists, drop a card to the conductor of this page. Address her: Miss Alice Remsen, care RADIO WORLD, *145 West 45th Street, New York, N. Y.)*

NEW SCHEDULE SET FOR WWV 5000 KC TEST

Washington.

The Bureau of Standards transmits standard frequencies from its station WWV, Washington, D. C., every Tuesday. The transmissions are on 5,000 kilocycles per second. Beginning October 1st the schedule will be changed. The transmissions will be given continuously from 10 a. m. to 12 m., and from 8 to 10 p. m., E. S. T. (From April to September, 1932, the schedule was from 2 to 4 p m., and from 10 p. m. to midnight.)

The service may be used by transmitting stations in adjusting their transmitters to exact frequency, and by the public in calibrating frequency standards, and transmitting and receiving apparatus. The transmissions can be heard and utilized by stations equipped for continuous-wave reception through the United States, although not with certainty in some places. The accuracy of the frequency is at all times better than one cycle per second (one in five million).

Use of Harmonics

From the 5,000 kilocycles any frequency may be checked by the method of harmonics. Information on how to receive and utilize the signals is given in a pamphlet obtainable on request addressed to Bureau of Standards, Washington, D. C.

The transmissions consist mainly of continuous, unkeyed carrier frequency, giving a continuous whistle in the phones when received with an oscillatory receiving set. For the first five minutes there are transmitted the general call (CQ de WWV) and announcement of the frequency. The frequency and the call letters of the station (WWV) are given every 10 minutes thereafter.

Supplementary experimental transmissions are made at other times. Some of these are made with modulated waves, at various modulation frequencies. Information regarding proposed supplementary transmissions is given by radio during the regular transmissions, and also announced in the newspapers.

Reports Requested

The Bureau desires to receive reports on the transmissions, especially because radio transmission phenomena change with the season of the year. The data desired are approximate field intensity, fading characteristics, and the suitability of the transmissions for frequency measurements. It is suggested that in reporting on intensities, the following designations be used where field intensity measurement apparatus is not used: (1) hardly perceptible, unreadable; (2) weak, readable now and then; (3) fairly good, readable with difficulty; (4) good, readable; (5) very good, perfectly readable.

A statement as to whether fading is present or not is desired, and if so, its characteristics, such as time between peaks of signal intensity. Statements as to type of receiving set and type of antenna used are also desired. The Bureau would also appreciate reports on the use of the transmissions for purposes of frequency measurement or control.

All reports and letters regarding the transmissions should be addressed Bureau of Standards, Washington, D. C.

TWIN SPEAKERS IN SETS SHOWN AT N. Y. HOTEL

At a radio trade show held in the Hotel Edison, N. Y. City, thirty-six manufacturers of receivers and parts exhibited their 1932-33 models. Much stress was given the use of the latest improved tubes and to sound quality.

The midget receivers, which have been popular the last two seasons, are not emphasized this year as much as console models employing superheterodyne circuits and in many instances two loudspeakers. Two speaks are used in the finer receivers, the engineers point out, because it is desired to reproduce all frequencies within the audio band with equal effectiveness, which they say is not practical with a single speaker. Improvements have also been made in the tone chamber with the view of eliminating distortion.

Many of the manufacturers have also put out sets for those areas of the country not served by electric power lines. There are special sets utilizing the new two-volt tubes and the air cell battery, suitable for use where there is no electrical power at all available. Then there are also sets specially designed for farm lighting installations.

Prices have been reduced considerably and are said to be lower than ever before. There are midget receivers, that is, receivers not installed in large cabinets, ranging from five to nine tubes and sell for from $30 to $60. Console machines, employing more tubes, sell for from $70 to $300, many being listed in the neighborhood of $125. Most of the manufacturers advertise their sets complete with quality tubes, and tax-paid.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Leslie Hanyston, 107 North 6th Street, Marshalltown, Iowa

Foster W. Berry, 219 Barrett Street, Syracuse, N. Y.

Sanford Wolf, 3392 De Sota Avenue, Cleveland Hgts., Ohio

James K. Coates (parts suitable for auto and midget radios, also auto "B" eliminators), Tuttle, Okla.

H. Shosh, New Aberdeen Hotel, Aberdeen, So. Dak.

Harold Snyder, Cawker City, Kans.

J. L. Ganson, Wallace, Kans.

R. B. Uhle, 3161 East Derbyshire Road, Cleveland Heights, Ohio

Charles Jasper, Box 1016, Anchorage, Alaska

Neatway Company, 6626 St. Paul Ave., Detroit, Mich.

Marciano Benedicto, 315 Cataluna, Sampaloc, Manila, P. I.

Bonseman Radio Service, 634 South Poplar St., Centralia, Ill.

Leon Sanderson, c/o Fair-Rhodes Oil Co., Hopewell, Va.

H. H. Trowbridge, 1108 2nd St., La Grande, Ore.

SHORT-WAVE CLUB

Thaddeus Gasiorowski, 209 Giffin Ave., Mt. Oliver Sta., Pittsburgh, Penna.

Wm. Kehler, 714 Marshall Ave., South Milwaukee, Wis.

Roy M. Hawkins, General Delivery, Sweetwater, Texas.

Forum

As a reader of the Radio World since December, 1927, I think that the radio constructors of the layman and novice type should give a vote of thanks for the very excellent and understandable way that the information needed to construct a set from a magazine diagram has been given in your construction articles of the 1933 Four-Tube Diamond of the Air. I think that it is the first article to give values in every part.

Most of the writers of such articles in all magazines in the past have overlooked the fact that a large number of their readers depend on catalogs when it comes to selecting parts. In a recent hookup in another magazine a circuit was described as one that could be "built by the layman" and "if he will uif he will use care and patience in following instructions given, he will achieve results that would surprise him."

After a careful examination of the article one finds as follows: One part made from aluminum, very carefully drawn and described, but no reference as to where to use it; also to wind 147 turns of No. 32 wire on a tubing 1 inch in diameter in a space of 1½ inches, and then that it should be properly done. Take a wire table and figure how many turns of No. 32 wire will cover the space as shown in the sketch (wound close) and one finds that nearly 174 turns are needed. Then in the list of parts are given manufacture numbers but four parts that he tells about in his article are not in the list. This writer says to use both the picture and schematic diagrams, but to follow the picture diagram as shown one would need very good eyes.

I think that if you wil follow the exampl as given in the 1933 "Diamond" you would receive the thanks of all fair-minded constructors, who realize that all persons can not figure out the value so as to use other parts that are procurable in their home towns.

The only grief in your articles that I find is this: your coils call for No. 32 wire, also a finer wire to be used optionally as a primary winding.

These kires I find not listed in any catalog nor in many cases can they be bought in local stores.

Keep up the work as shown by the Diamond article.

CHAS. MCBURNEY,
1124 West Berks Street,
Philadelphia, Pa.

DUOVAC SUES A. T. & T.

The Duovac Radio Corporation has sued the American Telephone and Telegraph Company, Western Eelectric Company, Inc., and the Electrical Research Products, Inc., naming violation of the Clayton anti-monopoly act and the Sherman anti-trust laws. Suit was entered in the Federal District Court in Wilmington Delaware.

New Incorporations

Conrad Radio & Television Corp., New York City, electrical apparatus—Atty., E. Light, 27 Cedar St., New York City.

Ontario Electric Corp., Buffalo, N. Y., refrigerators, etc.—Atty., I. Setel, Buffalo, N. Y.

Deane & McLaughlin, New York City, electrical appliances—Attys., Chadbourne, Hunt, Jaeckel & Brown, 70 Pine St., New York City.

BANKRUPTCY PROCEEDINGS

Petition Filed by

Davidson Radio Corp., Chicago, Ill., involuntary: creditors include Crosley Radio Corp.

CORPORATE CHANGES

Capital Increase

Le Winter's Radio Stores, Brooklyn, N. Y., 50 shares no par to $75,000.

NBC ELECTRIC CHIMES GIVEN AUDIENCE TRIAL

The National Broadcasting Company chimes, which for years have kept the networks in synchronous step, have changed their tone.

An automatic electrical device, sending out a modulated, even tone at a constant level, replaced the familiar hand-struck chimes on all programs emanating from the NBC New York studios.

Purpose of Chimes

The contrivance, invented by Captain Richard H. Ranger, designer of the pipeless organ and the bell-less carillon, has been installed in the main control room of the NBC Building in New York. If the trial period proves its operation practical and its precise notes pleasing to the public, it will be adopted as permanent equipment at the New York Studios and also installed in the main control rooms of NBC Studios in all other cities.

The purpose of the chimes, which previously have been rung by the announcer striking one of the small hand sets with which each studio is equipped, is to synchronize local station identification announcements, and to serve as a cue to engineers at relay points all over the country to switch various branches of the networks on or off as the programs change each fifteen minutes.

Automatic Adjustment

For some time technicians have been seeking some automatic instrument which would insure a more constant level than could be obtained when different announcers were required to produce the three notes on different instruments.

The device itself is based on the old-fashioned music box. Actually, the are no chimes, only electrically created tones. A revolving drum with properly spaced pins, striking against a series of metal reeds, tuned to the chime pitch, produces electric vibrations which are picked up and amplified.

7-Prong Tube Offers a Variety of Uses

W. L. Krahl, Chief Engineer of the Arcturus Radio Tube Company, Newark, N. J., said:

"We have developed a new seven-prong tube embodying a filament, cathode, control grid, suppressor grid, screen grid and plate. All of these elements within one bulb results in one of the most versatile tubes ever made. By various connections, this new tube can be used as a Class A amplifier, triode driver-output tube, Class B triode or a pentode output tube.

"Here is a definite example where a multi-element tube, involving difficult manufacturing processes, results in improved performance of a radio receiver."

NEW CALIFORNIA STATION

Washington

The Federal Radio Commission has granted H. H. Hanseth, Eureka, Calif., a permit to construct a new broadcast station to be operated on the 1,2210 kc channel with a power of 100 watts in the day time. It had been found that the people living within a radius of 40 miles of Eureka were inadequately served in the day time because of their isolated location on the Humboldt Bay.

Tradiograms

By J. Murray Barron

Another educational and interesting demonstration is on at John Wanamaker's New York department store. At the wonder house a full-sized French-Norman cottage built in the Wanamaker Auditorium has practically every modern convenience controlled by electricity. Doors leading from the kitchen to the dining room are controlled by a photo cell. If one desires to pass through, one simply does so. As one approaches the door the photo cell in the circuit releases compressed air, which in turn operates the door. One need not stretch any imagination to appreciate the great advantage when carrying dishes or food.

* *

The Airex Co., Inc., announces that it has sold its retail store, 78 Cortlandt Street, to Allen Radio, whc will continue to operate it. This will make the second store on Cortlandt Street for Allen, who conducts one at Number 83.

* * *

National Carbon Company recently appointed the following jobbers to handle its Eveready-Raytheon 4-Pillar Tubes: Asbury Wholesale Radio Service, Asbury Park, N. J.; Globe Motorists Supply Company, New Rochelle, N. Y.; Masbach Hardware Company, New York, N. Y.

* * *

Additional territory was practically added to the radio district in New York City upon the opening of the new Eighth Avenue subway from 207th Street to Hudson Terminal. This is about 12 miles and the time for the full trip is 33 minutes. Transportation facilities always help a district, and when one figures that mid town sections can be reached from Cortlandt Street in a few minutes, shoppers will not hesitate about running out to get that gadget. Even in the early evening they can now catch the radio stores open.

* * *

The Multidapter is being merchandised by the Manufacturers Sales Co., 570 Lexington Avenue, N. Y. City, which announce that not only will this unit test all the new tubes with your present equipment, but provisions have been made to take care of the future seven-prong tube. There is an instructive circular on this device.

* * *

R. R. Williams, of United Radio Service Co., 619 West Fifty-fourth Street, N. Y. City, Brunswick authorized service and replacement parts bureau, announces the change of name to Brunswick Engineers, Inc., same address. In addition to service and replacement parts for Brunswick the company will market a new 8-tube superheterodyne of unusual design and construction. The company also will market the Radiograph, which makes any receiver a combination phonograph and radio. This unit may be used by servicemen as an oscillator in connection with a radio receiver, as the radio receiver may be tuned from low to high on dial and should prove very valuable in testing when no stations are within ready receiving range.

* * *

Edward Cohen, of World-Wide Radio Corp., announces a merger with the Baltimore Radio Corp., 725 Broadway, N. Y. City. N. Lazarus is president, Mr. Cohen vice-president.

* * *

The Airex Co., 78 Cortlandt Street, N. Y. City, while having sold out its interest in the radio retail store at same address, will continue to operate its mail order house. This department has been established for some years and has a good following throughout the country.

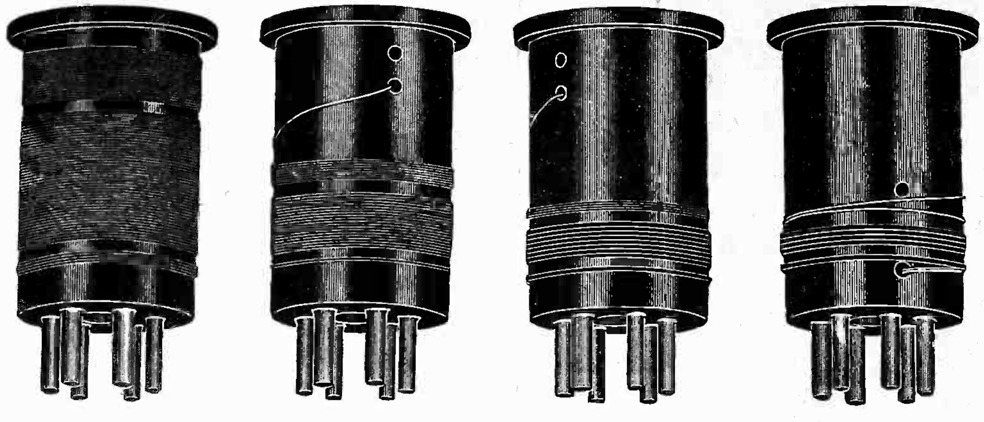
* * *

Try-Mo Radio Co., 85 Cortlandt St., announces, ready for early distribution, a 1933 catalog. Everything for "ham," serviceman and the experimenter is carefully listed.

6-Pin Plug-In Coils

200 to 15 Meters with 0.00014 mfd.

SHORT - WAVE plug - in coils with three separate windings for detector circuit produce best results as they avoid the broadness of plate-circuit tuning or the losses of r-f choke load on plate circuit due to damping. The lower winding is for r-f plate circuit, if t-r-f is used, or for aerial otherwise, the center winding is the tuned secondary, while the top winding is for feedback. The coils are accurately **wound on 1.25** inch diameter Bakelite and have a 3/16-inch flange for gripping. **Thus** the actual **winding need** never **be touched** when you're handling the coils, and they are suitable for calibration.



Cat. SWB—Four plug-in coils, 6-pin base; primary, secondary, fixed tickler..............................$1.70
Cat. SZ—Six-spring wafer socket for use as coil receptacle for six-pin coils..............................11c
Cat. SWA—Four plug-in coils, UX base, primary and secondary; primary may be used for feedback if condenser connects serial to grid..............................$1.35
Cat. SX—Four-spring (UX) wafer socket for use as coil receptacle for four-pin coils..............................10c
Cat. H-14—Hammarlund junior midline 0.00014 mfd. condenser with Isolantite insulation..............................$1.20
Cat. H-20—Hammarlund junior midline 0.0002 mfd. condenser with Isolantite insulation. Used as feedback control..............................$1.35

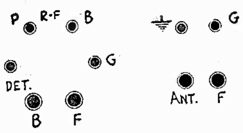
THE secondary is to be tuned with 0.00014 mfd. capacity. Using four coils, there will be sufficient overlapping of bands, also assured coverage to above 200 and below 15 meters. Also, 0.00015 mfd. may be used instead for tuning, with slightly greater overlap. Regeneration may be controlled by a 0.0002 mfd. variable condenser from detector plate to ground, or by a plate voltage rheostat or other means.

The standard six-pin tube socket may be used for coil receptacle.

For antenna stage tuning only two windings are needed, where no stage of t-r-f is included, when use SWA.

HOW TO USE THE COILS FOR HIGHEST EFFICIENCY AND SMOOTHEST OPERATION

In building short-wave receivers using our plug-in coils be careful to locate the coils so that the centers of their cores are at least 6 inches apart, otherwise in sets with t-r-f- the r-f tube may oscillate. Even if a volume control in the r-f stage controls any oscillation present the recommended separation should be maintained, otherwise a critical circuit results.



The connections to make are diagrammed herewith. Bottom views of sockets are shown. For the 6-pin coil P-B RF goes to aerial and ground if there is no r-f. Standard UX and 6-pin sockets serve as coil receptacles.

HIGH-GAIN SHIELDED-COILS FOR T-R-F

DIRECTIONS FOR BEST RESULTS

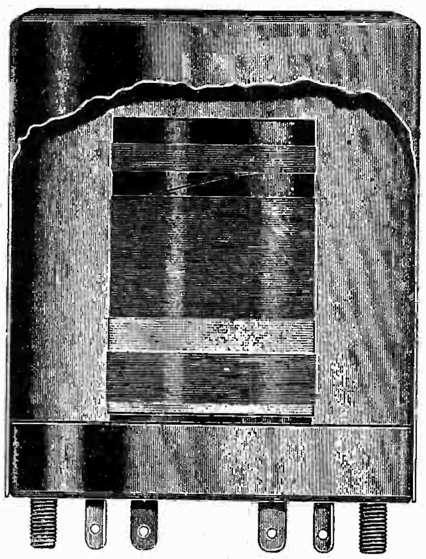
THE shielded coils for tuned radio frequency sets are supplied in matched sets of three or four, with secondary inductance equalized (plus or minus 0.6 microhenry). Thus any lack of sensitivity due to mismatched secondaries is avoided. As inductive discrepancies could not be compensated for by parallel capacity trimming, this high degree of inductive accuracy is important. Complete coverage of the wave band with the specified capacity condensers is absolutely guaranteed.

The coils may be used (set of three) for t-r-f, and with minimum value of negative bias for r-f tubes may oscillate a little at the very highest frequencies, say 1500 to 1580 kc, as they will be tuned below the broadcast band about that much. The negative bias should be increased until oscillation completely stops. Thus also selectivity is improved by heightened permanent or limiting bias.

In using four coils (three stages of t-r-f and tuned detector) each screen and plate lead should be carefully filtered, using 300-turn honeycomb coils and 0.002 mfd. or higher capacity in the filter, and the coil centers placed at least 4 inches apart.

The diameter of the form is 1 inch, the aluminum shield 2⅜ inch diameter, 2½ inches high. The shield has a small protected opening at top so the lead for the grid cap may be brought through. The opening is bevelled. This constitutes the protection against fraying the insulation of leadout wire to grid cap.

In the four-coil system, reversing connections to primary of second coil often stops oscillation in poorly filtered sets.



Cat. No. 1—Three t-r-f coils for 0.00035 mfd., 80-meter tap $1.35
Cat. No. 1-F—Four coils, 0.00035 mfd.....$1.80
Cat. No. 3—Three t-r-f coils for 0.0005 mfd., 80-meter tap $1.35
Cat. No. 3-F—Four coils, 0.00035 mfd......$1.80
Cat. DCH—Diode r-f choke, center-tapped..$ .40
Cat. 3DS—Three-deck long switch for above coils, to utilize 80-meter tap..............$2.50

80-METER TAP PROVIDED

EACH coil for the t-r-f sets has secondary tapped, so that if desired a long switch may be used to shift the tuning condenser stators to extreme of winding (200-555 meters) or to tap (80-200 meters). The tap is represented by a ground symbol stamped on the shield base. Please note ground is not to be connected to ground symbol. Grid return is the side lug inside the shield. P, B represent primary, G and side lug secondary.

The 80-meter tap does not have to be used, but is advantageous to those desiring to tune in television, amateurs, police calls, some relay broadcasting and other interesting transmissions in a band of frequencies replete with novelties for the usual broadcast listener.

High impedance primaries are used, the number of turns chosen so that the same coils may be used for antenna coupler and interstage couplers.

For diode t-r-f circuits, either full-wave or half-wave detector, a diode choke may be inserted inside the detector form. This choke has three terminals, with outleads: two extremes and center. For full-wave use two extremes to anodes of 55 or 85, center to cathode resistor. For half-wave use two extremes and ignore center tap.

Except in rare hookups the diode circuit requires an input free from grounding, and as the tuning condenser rotor and frame are grounded the choke pickup affords any potential output.

T-R-F sets using the 55 or 85 should have three stages of resistance audio, e.g., first stage the triode unit of the 55 or 85, second stage screen grid audio, third stage power tube or tubes (output).

COILS FOR 4-TUBE DIAMOND (CAT. DP) @ 90c—COILS FOR 5-TUBE DIAMOND (CAT. DT) @ $1.35

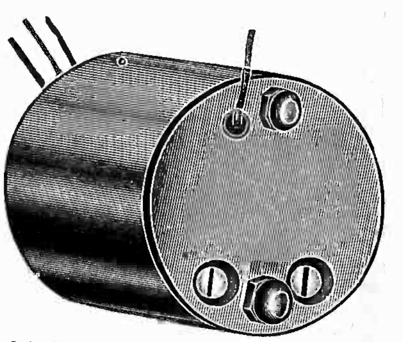
MIXER AND INTERMEDIATE TRANSFORMERS

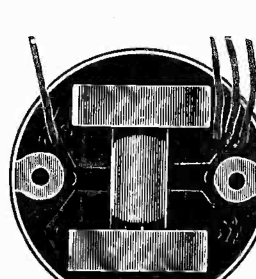
PADDED SETS

For circuits using 175 kc. or 400 kc. intermediate frequency we have two coils for a stage of t-r-f and first detector, and accurately chosen inductance for the padded oscillator for these intermediate frequencies. There is no 80-meter tap provided on these mixer coils.

The coils are of the same type of mechanical construction as the t-r-f coils. Since there is no secondary tap, the code for connecting the t-r-f coils of the superheterodyne combination is different: P and B, primary; G and ground symbol, secondary. P would go to plate or antenna, G to grid cap, while B and ground symbol are the returns.

The oscillator has a smaller inductance secondary, for padding, and moreover is a three-winding coil. The three windings are: pickup, secondary and tickler. The pickup winding consists of 10 turns, and is brought out to two side lugs. The polarity of its connections unusually is of no importance. The secondary is represented by G and ground symbol, G going to grid and ground symbol to grid return, usually ground. The tickler connections for oscillation usually require that the lug at B be conected not to B plus but to plate, hence the P lug goes to B plus. In any case, if no oscillation results, reverse the tickler connections.





Cat. No. 4—Three mixer coils, for 0.00035 mfd. Intermediate frequency intended, 175 kc. Price includes padding condenser, 700-1000 mfd.......$1.80
Cat. No. 5—The mixer coils for 0.0005 mfd., 175 kc., 700-100 padder....$1.80
Cat. No. 7—Three mixer coils, for 400 kc; padding condenser included is 350-450 mfd. $1.80

INTERMEDIATE TRANSFORMERS

The intermediate transformers consist of two honeycomb coils, wound with low resistance wire, coils spaced 1 inch apart, and thus affording loose coupling, stability and high selectivity. Primary and secondary tuned.

Cat. FF-175—Shielded intermediate frequency transformer, 175 kc.......$1.10
Cat. FF-175CT—Same as above, center-tapped secondary, for full-wave diode detector $1.25
Cat. FF-450—Shielded intermediate frequency transformer, affording choice by condenser adjustment of frequencies from 380 to 480 kc..............$1.30
Cat. FF-450CT—Same as above, center-tapped secondary $1.45

Padding Condensers @ 45c Each

Cat. PC-710—For 175 kc intermediate. Put in series with oscillating tuning condenser. Capacity 700-1000 mmfd. Hammarlund, Isolantite base.
Cat. PC-3545—Same as above, except 350-450 mmfd. for 380-480 kc intermediate.

Cat. CH-300—A 300-turn r-f choke, inductance 1.3 millihenries $0.30
Cat. CH-800—An 800-turn r-f choke, inductance 10 millihenries..........$0.35

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Power Transformers, Filter and By-Pass Condensers, Volume Controls, Voltage Dividers and Fixed Resistors.
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11	$3.00	$1.95	'34	$2.80	$1.82
12	3.00	1.95	'35	1.65	1.08
112-A	1.55	1.01	'36	2.80	1.82
'20	3.00	1.95	'37	1.80	1.17
'71-A	.95	.62	'38	2.80	1.82
V—'99	2.75	1.79	'39	2.80	1.82
X—'99	2.55	1.65	'40	3.00	1.95
'100-A	4.00	2.60	'45	1.15	.75
'01-A	.80	.52	46	1.55	1.01
'10	7.25	4.73	47	1.60	1.04
'22	3.15	2.05	'50	6.20	4.03
'24-A	1.65	1.08	55	1.60	1.04
'26	.85	.56	56	1.30	.87
'27	1.05	.69	57	1.55	1.08
'30	1.65	1.08	58	1.55	1.08
'31	1.65	1.08	'80	1.05	.69
'32	2.35	1.53	'81	5.20	3.38
'33	2.80	1.82	82	1.30	.87

We will ship C.O.D. on receipt of 10%. When remitting in full enclose postage.

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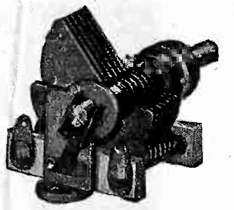
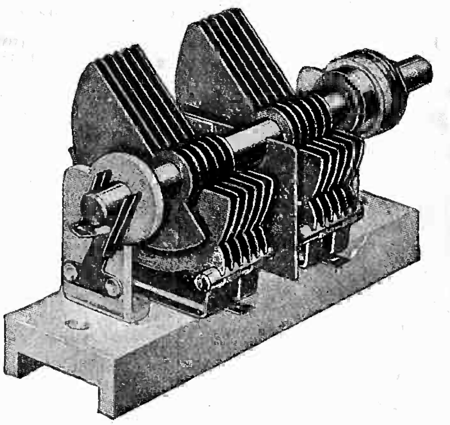
START RIGHT! Use These . . . Superb Condensers for Short Waves!



Single 0.00014 mfd. Hammarlund condenser; non-inductive pigtail; single hole panel mount and two-point base mount; Isolantite insulation; brass plates.

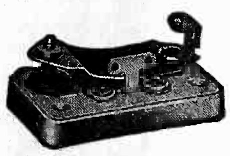
Single 0.00014 mfd. sent free with a 3-months subscription for Radio World (13 issues, $1.50). Double 0.00014 mfd. sent free with a 6-months subscription (26 issues, $3.00).

THE most popular capacity for short-wave use, and the one for which virtually all commercial short-wave coils are wound, is 0.00014 mfd. The Hammarlund condensers of this capacity, both single and double, are compact and efficient. They have Isolantite insulation and Hammarlund precision workmanship. See offer at lower left. Present subscribers may extend their subscriptions under this offer.



RADIO WORLD, 145 West 45th Steet, New York, N. Y.

PADDING CONDENSERS



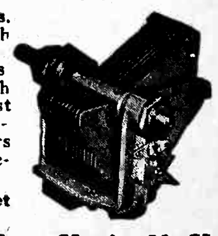
700-1,000 mmfd. (Cat. PC-710) @ 50c net.
350-450 mmfd. (Cat. PC-3545) @ 50c net.

A HIGH-CLASS padding condenser is required for a superheterodyne's oscillator, one that will hold its capacity setting and will not introduce losses in the circuit, for losses create frequency instability. The Hammarlund padding condensers are of single-condenser construction on Isolantite base, with set-screw easily accessible, and non-stripping thread. For 175 kc. intermediate frequency use the 700-1,000 mmfd. model.. For i.-f. from 460 to 365 kc., use the 350-450 mmfd. (General Motors models).

0.0005 HAMMARLUND S. F. L. at 98c.

A sturdy, precision straight frequency line condenser, with end stops. The removable shaft protrudes front and rear and permits ganging with coupling device, also use of clockwise or anti-clockwise dials, or tw either side of drum dial. Front panel and chassis-top mounting facilities True straight line. This rugged condenser has Hammarlund's high quality workmanship and is suitable for precision work. It is a most excellent condenser for calibrated radio frequency test oscillators, any frequency region, 100 to 60,000 kc., short-wave converters and adapters and TRF or Superheterodyne broadcast receivers. Lowest loss construction, rigidity; Hammarlund's perfection throughout.

Order Cat. HOS @............................98c net



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