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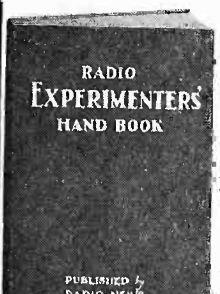

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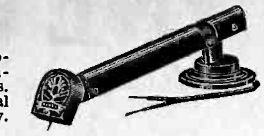

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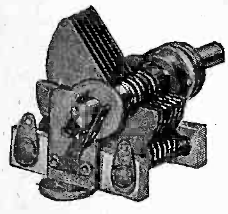

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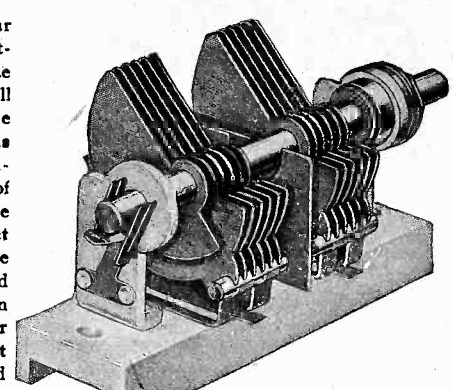

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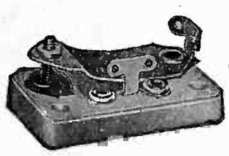

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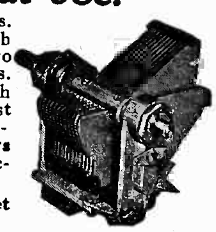

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Five-tube a-c receivers, using variable mu r-f, power detector, pentode output and 280 rectifier, are not all alike by any means. Forty circuits were carefully tested and one selected as far superior to the others. This prized circuit was the 627, and if you built it, you will always be glad you followed our authentic Blueprint, No. 627. This is the best 5-tube a-c t-r-f broadcast circuit we have ever published. Price 25c

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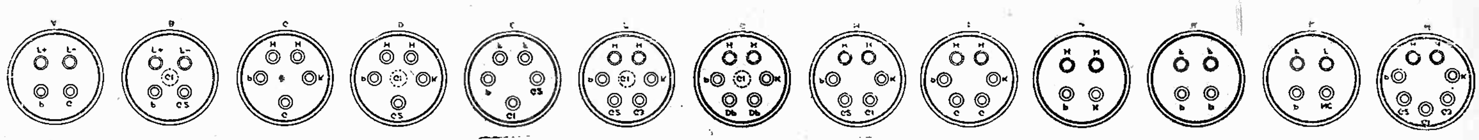
THE 59 WITH 7 PINS

New A-C Power Tube of Heater Type



CONNECTIONS VIEWED FROM BOTTOM OF BASE

The connections at sockets, covering all the popular type tubes. The grids are given the standard numbers by which they are known throughout the industry, where there are two or more grids.

OFFICIAL release of the seven-prong tube, the 59, is to be made by all the licensed tube manufacturers. Some of them have been marketing this tube meanwhile,* but now for the first time the definite addition of the tube to the general line of tubes is to be effectuated.

Uses of the Tube

The 59 is a power tube, to be used either for Class A service as a triode or a pentode, or as Class B in push-pull. When Class B is used there are two output tubes and there must be a driver stage, assumed to be a 59 as Class A triode amplifier.

The bottom view of the tube socket (or tube base) is illustrated at extreme right in the diagram of tube socket connections. See M. The grids are numbered.

The different characteristics arise mainly from the different connections of these grids, also incidentally by virtue of different voltages and loads.

Has Heater, Not Filament

The 59 is a heater type power tube and amplifier tube for a-c operation. Heretofore filament types prevailed excluisevly in the standard classification.

The grid connections are as follows:

Class A triode (roughly approximating the '45), Grids Nos. 2 and 3 tied to plate; Grid No. 1 control grid.

Class A pentode (roughly approximating the '47), Grid No. 3 tied to cathode, Grid No. 2 is screen; Grid No. 1 is control grid.

Class B triode: Grid No. 3 tied to plate, Grids Nos. 1 and 2 tied together for control grid.

* The tube manufacturers, who have the 59 on the market already, include Ken-Rad, Hygrade Sylvania and National Union.

Ratings and Characteristics

The tentative ratings and characteristics follow:

	Class A Triode	*Pentode*	*Class B Triode*
Heater volts	2.5 v.	2.5 v.	2.5 v.
Plate volts	250v max.	250.v.	400 v.
Grid No. 1	—28 v.	—18 v.	0
Grid No. 2	....	250.v.	....
Grid No. 3	....	....	....
Heater current	2 amps.	2 amps.	2 amps.
Plate current	26 ma.	35 ma.	13 ma§
Mutual conductance	2,600 micromhos	2,500	....
Plate resistance	2,400 ohms	40,000	....
Amplification factor	6	100	....
Plate load	5,000 ohms	6,000	6,000§
Power output	125 watts*	3 watts**	10 watts§

* 5% second harmonic.
** 7% total distortion. Screen current is 9 ma (Grid No. 2).
§ Values per tube. Two tubes used, 26 ma Ip, 6000 ohms plate to plate, 20 watts total output.

Load Critical

The blanks in the Class A Triode column are due to grids tied together, and this is true of the blanks in the Pentode column and the two blanks in the Class B column. The Gm, Rp and mu blanks in the Class B column are due to the varying conditions under actual operation, rendering any statement of value meaningless.

The 6,000 ohm load for the pentode is critical. If speakers are used having the 7,000 ohm load called for by the '47 the distortion would be increased by 20 per cent. (to a total of 8.4% distortion).

While 400 volts are given for Class B, average operation would be at 300 volts, whereupon the above distortion increase due to wrong load would apply particularly.

The tube has the new familiar down top bulb (ST-16). Overall height is 5⅝ inches, diameter 2 1/16 inches.

The 59 may be compared with the '45 for Class A triode, '47 for Class A pentode and the 46 for Class B triode as follows:

	59	'45	59	'47	59	46
Mutual Conductance	2600	2000	2500	2500	—	—
Plate resistance	2400	1750	40000	35000	—	—
Amplification factor	6	3.5	100	90	—	—
Plate load	5000	3900	6000	7000	6000	1300
Power output	1.25	1.6	3.0	2.5	20.0	20.0
Grid Bias	—28	—50	—18	—16.5	0	0

(Contnued on next page)

Key to Base Connections

(Diagram from Ken-Rad engineering department.)

A = 201A, 112A, 120, 226, 230, 231, 240, 245, 250, 171A, 199,
B = 222, 232, 234, C = 227, 237, 56,
D = 224, 235, 236, 238, 239, 44
E = 233 46, 47,
F = 57, 58, 89, G = 55, 85,
H = heater pentode, 41, 42,
I = K20 double grid detector; K22 double grid detector,
J = KR1, K = 280, 82, 83,
L = 281, M = 59.

(Continued from preceding page)

Sylvania's Report

Hygrade Sylvania Corporation reports on its 59 as follows:

"Type 59 is a triple grid power amplifier tube of the cathode type, designed especially for household receivers and other applications where the low hum and increased flexibility will be advantageous. The three grids are brought out to separate base pins and the design of each is so that pentode characteristics similar to the Type 47 may be obtained, Class B operation similar to the Type 46 may also be had by connecting the grids in another way, while a third method of connection permits of very acceptable performance as a triode.

"In normal service as a pentode, the arrangement of grids is entirely conventional. The Number 1 grid, nearest to the cathode, being the control grid; Number 2 grid, placed just outside of the control grid, acts as the screen grid; and Number 3 grid, between screen grid and plate, is connected back to the cathode externally to act as a suppressor grid. When operation as a Class A power amplifier is desired, Number 2 and Number 3 grids are connected to the plate and act as a single electrode; the Number 1 grid being used as a control grid in the normal manner. To operate the tube as a Class B output tube, it is only necessary to connect Number 1 and Number 2 grids together, utilizing these grids as the control grid (thus securing the necessary high amplification factor), while Number 3 grid is connected to the plate.

"Type 59 is approximately the same in physical dimensions as Type 83. The bulb size is similar to that of Type 47 but the shape differs somewhat (the ST-16 is used). A seven pin base is used to accommodate the increased number of terminals.

How It Differs from 46

"As may be determined from an inspection of the ratings, the various connections employed on the three grids determine the characteristics of the tube. In designing the tube great care was required in order to secure the desired performance with any type of connection, but once the proper grid structure is determined it is only necessary to arrange the external connections properly to secure the desired performance.

"It will be noted that when operated as a Class B tube, the plate current with no signal is considerably higher than in the case of Type 46. The plate current varies with the signal applied to the grids of the Class B stage, starting at 15 ma. per tube without signal and reaching a maximum of 60 ma. per tube at the highest output obtainable of 20 watts under average signal conditions.

"When operated as a Class A power amplifier triode, the normal plate current under recommended operating conditions is 26 ma, slightly higher than Type 46. It is to be noted, however, that with this connection, the same power output is delivered with a peak signal on the grid of 28 volts instead of 33 as with Type 46. This may be employed as a single driver stage to feed a pair of 59's as Class B amplifiers. The amount of hum introduced in the system by the driver tube will be negligible because Type 59 employs an indirectly heated cathode. A single 59 as a driver will deliver sufficient power to drive the Class B tubes to about 20 watts. It is necessary to use efficient input tranformers in Class B work so that as much power as possible of that developed by the driver tube will be available.

Much Less Hum

"When operated as a pentode, Type 59 delivers the same power output into the same load as Type 47, but requires eighteen peak volts of signal instead of 16.5. This difference, however, is not sufficient to be of much importance. Type 59 tube connected as a pentode will result in much less hum in a receiver due to the fact that an indirectly heated cathode is employed.

"The tube may be operated in either a vertical or horizontal position. In operating the tube horizontally it is preferable to keep the plane of the press vertical, in order to secure maximum strength—this may be done by seeing that the socket is so placed that the large holes for the filament prongs are positioned with one vertical above the other. (This allows two possible positions for the socket; one rotated 180 degrees from the other, and the position which permits best wiring of the socket may be selected.)

"The large plate power dissipated by this tube under some conditions of service causes the bulb to become overheated, and adequate ventilation should be provided around the bulb to prevent overheating. The use of a tight fitting shield should be avoided.

"The heater is designed to operate under the same operating conditions as that imposed on other 2.5 volt tubes. The transformer should be designed so that 2.5 volts is available at the terminals of the socket with maximum line voltage. It is preferable to keep the heater cathode voltage below 45 volts.

"Resistors used in the grid circuit of Type 59, operating as a Class A amplifier (either pentode or triode) should not exceed 0.5 megohm when the tube is self-biased. Without self-bias this resistor should be limited to .25 megohm. Excessive resistances in the grid circuits may cause loss of bias and overheating and damage to the tube."

National Union's Report

National Union Radio Corporation, in its Report No. 8-17, bearing on the 59 tube, sets forth the following as tentative:

"The Type 59 is a general purpose five element power tube. All the elements, a heater-type cathode, three grids and a plate are brought out separately by means of the new seven-prong base. The inner grid will be referred to as No. 1 grid, the middle grid as No. 2 grid and the outer grid as No. 3 grid.

"The tube is designed to be used with either one of three connections: (1) as a Class A operated triode using No. 1 grid as the control grid and with No. 2 and 3 grids connected to the plate; (2) as a suppressor-grid-type pentode with No. 3 grid connected to the cathode and using No. 1 and 2 grids as the control grid and screen grid respectively; and (3) as a Class B operated triode with No. 1 and 2 grids connected together used as the control grid and with No. 3 grid connected to the plate.

"As a Class A triode, the Type 59 has a medium amplification factor, a low plate resistance and a high mutual conductance. As a suppressor-grid-type pentode, the 59 is operated Class A and is capable of giving large undistorted output power with relatively small signal voltage input. As a Class B operated triode, the 59 has such a high amplification factor that negative grid bias is not required for its operation. Two Type 59's in a Class B output stage will supply a large amount of undistorted output power with comparatively low plate voltage and with high plate circuit efficiency.

Advantage Stated

"The NU-59 is to be used in circuits similar to those used with the NU-46 in its Class A triode and Class B triode connections. Its advantage over the 46 is that it can be used also as an output pentode having an undistorted output slightly greater than the Type 247, and that it has an indirectly heated cathode which both reduces hum in the audio amplifier, and allows more flexibility in self-biasing circuits.

"The mechanical design of the NU-59 is characterized by the dome-top bulb and the top mica so shaped as to firmly hold the tube elements rigidly.

"It is necessary that two tubes be used in push-pull in a Class B output stage. It is assumed that the driving tube will be a Type 59 operated as a Class A triode with a transformer of suitable ratio. This ratio will usually be step-down. The transformer should have a good power efficiency. For low distortion in the output, it is necessary that the driver tube be worked somewhat below its Class A undistorted output rating. The load for the driver tube should be chosen a little higher than for its undistorted power output rating to hold overall distortion to a minimum.

'It will be noted that the zero signal plate current of the NU-59 when operated Class B is higher than that of a Type 46 when operated under the same conditions. The tube was so designed to decrease small signal distortion to a low minimum.

Resistance in Grid Circuit

"The Type 59 Class B amplifier requires a plate voltage supply source having good regulation. This can be obtained with a high voltage transformer having good regulation and a Type 83 rectifier tube with a choke input filter.

"The resistance in the grid circuit of the 59 when operating as a Class A amplifier (either with triode or pentode connection) should not be more than one megohm if the tube is self-biased, or more than one-half megohm if not self-biased. If higher resistances are used, the tube may lose bias due to grid current and the result be damage to the tube."

State Commission Asks for 3 Licenses

Washington.

The New York State Conservation Commission has asked the Federal Radio Commission for construction permits for three experimental stations. One of these is to be for the airplane NS74Y to be operated with 4.3 watts on frequencies from 60 to 70 megacycles, the second a portable of 4.3 watts power to operate on 60 to 70 megacycles, and the third a fixed station at Albany to be operated on 60 to 80 megacycles with a power of 30 watts.

Station Pays Its Rent in Form of Advertising

WEVD, Socialist station, has leased the fifteenth floor of Claridge Hotel, 160 West Forty-fourth St., New York City. The rental, deemed to have a value of $500 a month, will be paid in the form of advertising and publicity.

The tenant is to announce every time that an announcement is made that it is WEVD, that it is located in Claridge Hotel, Broadway and Forty-fourth Street. In addition the landlord has the privilege of two minutes a week on the air for advertising the hotel.

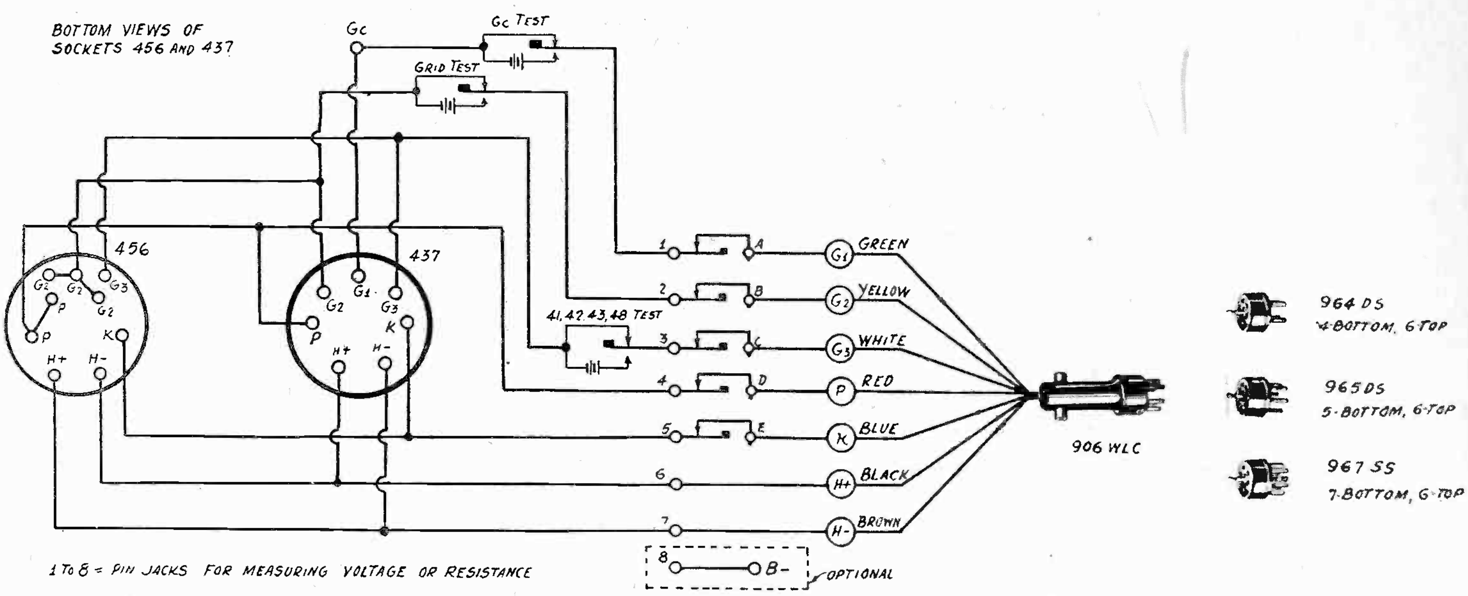
Tube List Prices

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

PIN JACK ACCESSOR COSTING UNDER $10

Enables Readings of Voltages, Currents and Resistances in Set

By Herman Bernard



The wiring diagram of the Pin Jack Accessor shows how two sockets, thirteen pin jacks, eight push-button switches, an analyzer plug and three adapters enable access for voltage, current and resistance measurements. The meter or meters, of course, are independent, being plugged into the right jacks.

MANY a time an experimenter or service man chides himself because he cannot get suitable access to a receiver to make desired measurements, although he has the necessary meter or meters, and for that reason the Accessor principle has been developed by RADIO WORLD, and several Accessors using multiple switches have been described. However, here goes for the simplest and least expensive of the devices so far discussed—the Tip Jack Accessor. Concerning this one no reader need complain that he cannot fathom the mystery of wiring the multiple switch for there is no such switch.

Now, the remarkable thing about the Tip Jack Accessor is that it will make any and all tests you are likely to require, even unto the separate current and voltage conditions of a suppressor grid in a 57 or 58 tube in those unusual instances when suppressor is not tied to cathode, and will also measure the current separately through each plate of a full-wave rectifier.

Grid Tests

Besides, the device is a tube checker, in that the bias may be varied to notice the change in plate current. From tube charts the mutual conductance of an average tube can be obtained and the amount of plate current change to be expected, if the tested tube is in good condition, is therefore the product of the mutual conductance Gm and the grid voltage change Eg. Since the mutual conductance is given in micromhos, the answer to Gm x Eg will be in microamperes. It is assumed that the mutual conductance is the rating at the operating point, which is often correct, although in some instances Gm is given at zero bias. The voltage change is known, since 3 volts of dry cells are used.

The extent of the device's measurements depends on the meters you have and the use to which you put them, as virtually every desirable point of access is provided by the Tip Jack Accessor. Resistance measurements may be taken between any points, but of course this requires that you have a resistance meter.

The Tip Jack Accessor has two sockets on top, one a universal type, which is a composite 4, 5 and 6-hole socket, and the other a 7-hole socket.

The Two Sockets

In the case of the composite socket the grids are given the numbers that apply to them in standard tube data, so far as possible, and it can be seen that three grid connections are tied together at the socket (by the constructor himself) while the two plate springs are also united. The effect is that of connections in terms of three separate sockets, and the Tip Jack Accessor may be wired that way, by using duplicate tip jacks as needed, so that, knowing the tube that has been transferred to the Accessor socket, one has before him virtually a photographic view of the connections.

The universal socket, however, takes three types of tubes, UX, UY and six-pin, and the connections are made properly and infalliably simply by inserting the tube in the socket. No misconnection is possible, as any of these tubes will fit into the socket only by making the right way.

The reason for the seven-hole socket, of course, is to provide for the few seven-pin tubes on the market, and also the contingency that tubes with seven pins may become more numerous in the future, although at present it seems that the limit will stay at six for a long while, and indeed some of the present seven-pin types are likely to appear soon as six-pin types with grid cap.

That B Minus Jack

A tip jack is used for control grid connection when the tube is of the type with grid cap, and also there are thirteen more tip jacks for the other purposes. One of these thirteen is the B minus position, which requires special explanation.

Suppose the bias on a filament type power tube, like the '47 or the '45, is to be measured. This bias is between grid and filament. If the input to the power stage is transformer coupled, picking up the grid would be roughly about the same as picking up grid return, assuming a sensitive meter. But if the stage is resistance coupled then a high resistance is interposed between grid and grid return, and if the meter is connected between grid and filament, then the grid resistor is in series with the meter, and the voltage reading will be so far off as to be

(*Continued on next page*)

(*Continued from preceding page*)
ridiculous. Even the condition of the transformer coupling is not encouraging of accuracy, since the secondary d-c resistance may be 20,000 ohms.

Therefore, since the filament is lifted above B minus to the extent of the bias voltage, between what point and filament shall this voltage be read? Why, there isn't any second point picked up by the analyzer plug that suits the purpose. The plug picks up what the socket in which it is inserted affords, and B minus is not one of the group. However, G1 is not used on power tubes (with the one exception of the 38 grid cap type power tube) so a lead with grip clip at one end and tip plug at the other may have plug connected to chassis, which is usually B minus, and the bias voltage read between G1 of on the Accessor and either side of filament.

Alternatives

However, since there is one power tube with grid cap, and probably more, such power tubes will appear, whereupon the G1 lead would not be available for the B minus purpose, one may decide to ground the G1 lead at the receiver, or provide an extra pin jack for running a separate lead to chassis, from the Accessor, to pick up B minus. It is assumed that the chassis is B minus, or at least the ground post thereon is, and either is in nearly every case.

B minus of the power transformer is not meant, but B minus of the receiver, the only difference arising when the B choke or other impedance is in the negative leg of the rectifier, when some points are "more negative" than ground, although ground serves as B minus for all save the power tubes.

In the case of a negative-leg choke, it is not possible to pick up B minus for the power tube, for that is probably a tap on the choke, or the juncture of two high resistances across the choke, in other words, an inaccessible grid return.

An Unusual Difficulty

In that instance, however, check the plate, screen and other voltages, then the plate current, and if the readings are practically the average, then the voltage conditions are at satisfactory, and the bias voltage may be checked inside the speaker cover by measuring there the voltage drop in the biasing section of the choke. If the bias is obtained from resistors in parallel with the choke the bias can not be read at the speaker, or anywhere else within reach, and when it can be read it requires an electrostatic voltmeter, so pass it up. With plate current and voltages known, of course, the bias can be estimated from the characteristic curve of the tube. For instance, if the '47 passes 30 ma plate current, effective voltage around 250 volts, then the bias is around 20 volts, which is all right.

The use of multiple switching is avoided by using for each current circuit a single pole throw button switch, sprung to a closed position, so that the button has to be depressed to open the circuit and let the current flow through the meter that is put at the two current jack positions. If a too sensitive setting of the meter is used when the meter connections are plugged into the two jacks, no harm is done until and unless the key is depressed, as otherwise the meter is shorted out. So before depressing the key or button be sure that you have the right setting, or start with the least-sensitive setting all the time, and change to greater sensitivity as required, step by step.

Applied Plate Voltage

In three instances single pole double throw switches, sprung to one position, requiring that the key be depressed to provide the other connection, are used for grid tests. Then put a grid battery in series with the line. The three batteries consist each of 3 volts (two dry cells in series) and thus the grid bias may be changed by 3 volts by depressing the key. Three separate batteries are used, dispensing with complicated switching, consistent with the idea of simplicity that pervades this entire device.

Readings Taken

Voltage or resistance is read between any one of the eight positions and the other seven positions numbered 1 to 8. Thus to read the filament voltage on a battery type or a-c filament type tube connect the voltmeter from H— to H+, or for heater type tubes make the same meter connection, although an a-c meter is necessary if there is a-c on the heater. To read plate voltage for battery type tubes put the negative side of the meter to negative filament (H—) and the other side to plate. The effective plate voltage is then read. The applied voltage cannot be read, except in special instances where one of the tube elements picks up the same positive voltage as is applied to the plate, as in the case of th escreen of the '47 tube and the voltage applied to the plate (same lead). Otherwise the applied voltage would have to be taken from the chassis itself.

Reference Points

The negative filament is the reference point for battery-operated tubes. For the a-c filament type amplifying tubes and power tubes the reference point is the center of the filament, but the plate voltage may be read then from either side of the filament to plate. For the indirectly heated tubes the reference point is the cathode, and the effective plate voltage is that voltage between cathode and plate. The bias voltage is that voltage between cathode and grid return, and as the grid return is usually to grounded center of the heater winding, the reading is taken from either side of the heater to cathode.

The special instance of tubes that have their cathodes lifted above B minus of the set, including indirectly heated tubes and filament tubes, particularly filament tubes of the power tube variety, requires that the biasing voltage be read between filament and B minus, as already discussed.

The jacks 1 to 8 are used for voltage or resistance measurements, while the five current readings, A, B, C, D and E, may be taken in the correct direction simply by reversing the meter connections to the two jacks.

How to Obtain Readings

Therefore to read I91, Ig2, Ig3, Ip or Ik, insert phone tip leads from the current meter to IA, 2B, 3C, 4D or 5E, respectively, and push the button (current).

To read voltage from any element to any other point insert the phone tip leads from the voltmeter to the corresponding tip jacks.

To read resistance between any elements insert the phone tip leads from ohmmeter to corresponding pin jacks.

To test screen grid tubes or 55 or 85, push the control grid test button (Gc). To test triodes push the button marked simply "grid test." To test the 41, 42, 43 or 48, push the button that is under those designating figures.

To make tests, where the principal tubes are used, it is necessary to put the analyzer plug into the socket of the receiver from which a tube is taken, and to put the tube in a socket of the Pin Jack Accessor. The analyzer plug has six pins, and besides has a stud that communicates with the two grid caps on the plug and with a latch. The grid clip in the set is put to either cap of the plug, whichever is handier. The cable attached to the analyzer plug has seven leads, and the seventh one is that which is conductively coupled to the two grid caps on the plug and to latch. The control grid of the seven-pin tubes is picked up through the stud and seventh lead already described, as can be seen from the fact that the G post of the seven-pole socket on the Accessor is connected to the lead ordinarily used for Cg.

Use of Adapters

At the receiver end the plug itself will fit into six-pin sockets only. Therefore adapters have to be used: one with seven-pin bottom, one with five-pin bottom and one with four-pin bottom, all tops being six-hole, for the analyzer plug must fit into these tops, and the plug is always the same. But the adapter tops also must have a stud to fit into the latch in the plug, said latch communicating with the grid caps on the plug and the seventh lead. The adapters shown on the diagram fit these purposes excellently.

Moreover, the latch on the plug catches teh stud on the adapters so thatwhen the plug is pulled out of a socket the adapter must come out with it. This is a great help, for it avoids the adapter sticking in sockets under conditions of close quarters and inaccessibility, and yet the plug and adapter may be easily detached by depressing the latch when the combination is held in your hands.

The adapters may be easily remembered by following the code. The number digit denotes the type. Here the number 9 refers to an adapter. The second digit refers to the number of holes on top, the third digit to the number of pins on bottom. Thus, as three adapters are used, the first digit is 9 in all instances, and as the holes on top always are six, to take the six-pin plug, the next digit always is six, whereas the accommodation for UX, UY and seven-pin sockets requires adapters with four, five and seven pins respectively, so the adapters are 964, 965 and 967. The letter D designates the fact that the adapter has a disc bottom, and the letter S that the adapter has a stud. This is the code used by Alden.

Parts Required

Therefore the plug, adapters and sockets required are as follows, with their purposes stated:

906WLC, six-prong analyzer plug seven-lead cable. .The letters WL designate the two control grid caps and C the fact that the cable is included. The purpose is to substitute the plug for the tube removed from the receiver, to pick up all the set socket's leads and bring them to the Accessor.

456, compositite socket, as its digits indicate, to take four, five and six-pin tubes.

437, seven-hole socket to match 456.

964DS, adapter, six-hole top, four-pin bottom, with locking device. To enable use of plug on adapter when adapter is put into UX socket.

965DS, adapter, six-hole top, five-pin bottom, plug on adapter when with locking device. To enable use of adapter is in a UY socket.

967SS, adapter, six-hole top, seven-pin bottom, with locking device. To enable use of plug on adapter when adapter is in seven-pin socket.

Besides these items a panel, box, three 3-volt C batteries (which may consist each of two series-connected 10c dry cells of 1.5 volts each); three single pole double throw push-button spring switches, and five single pole single throw push-button spring switches, thirteen pin jacks and a pair of test leads, plugs at one end, spades at the other end, are required.

The color scheme of the analyzer plug's cable is given on the diagram.

[*Inquiries concerning manufacturers of parts should be addressed to Trade Editor,* RADIO WORLD, 145 *West 45th Street, New York, N. Y.*]

Screen's Effect

IN A SCREEN GRID TUBE does not the screen attract some of the electrons from the cathode or filment, and is this not a reduction of the effective emission? —Y. D. W., Montreal, P. Q., Canada.

Yes, the screen attracts some electrons, but this condition is trivial compared to the advantageous stability contributed to the tube operation by the screen.

BATTERY OSCILLATOR

Simple Device for Broadcast Band

By Jack Tully

ONE of the easiest oscillators to make is a battery-operated device. It requires few parts and gives good service. The circuit, a Hartley, is diagrammed herewith. For uniform dial legibility, regardless of frequency, a straight frequency line Hammarlund tuning condenser, of 0.0005 mfd. capacity, is used.

The coil is wound on 2.5 inch diameter bakelite. There are 52 turns of No. 24 double silk covered wire between grid and grid return (A plus), and 15 turns of the same kind of wire, same direction, between grid return and the plate circuit condenser. This feedback condenser is shown as 0.002 mfd., but may be any capacity from 0.0005 to 0.002 mfd.

The circuit is of the detecting type, as disclosed by the grid return to A plus, and the leak and condenser. The condenser may be 0.00025 mfd., and the leak from 5 to 7 meg., whereupon there will be some grid blocking, which is purposely introduced to afford modulation.

Strengthening Modulation

In some instances this will be a high-pitched squeal, in other instances it will not be so pronounced, but it will be distinctive enough to inform you that the signal is coming through. If the intensity of the modulation is not great enough, put a fixed condenser in parallel with the grid condenser, using whatever capacity you have handy, from 0.00025 mfd. to 0.002 mfd.

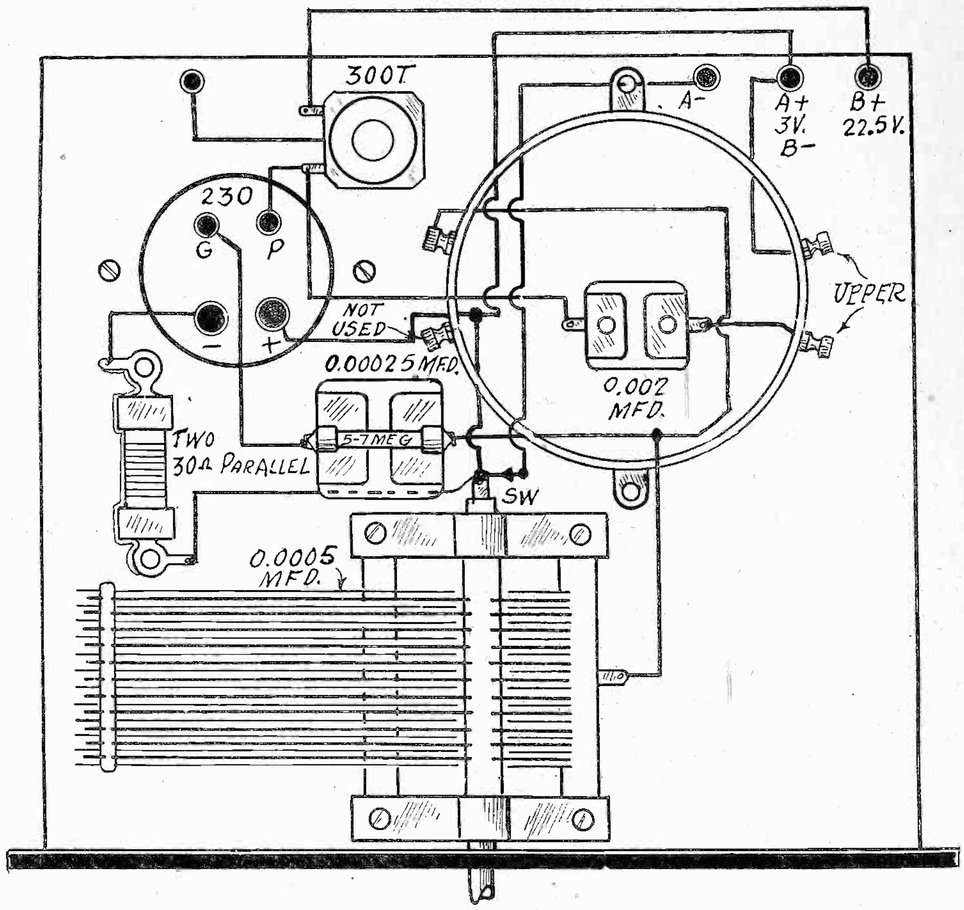
The parts are laid out on a baseboard and the wiring is done as shown in the pictorial illustration of the connections. The switch actually is on the front panel, but is shown symbolically behind the tuning condenser so that the diagrammatic representation can be seen. The tuning condenser hides the view of the switch.

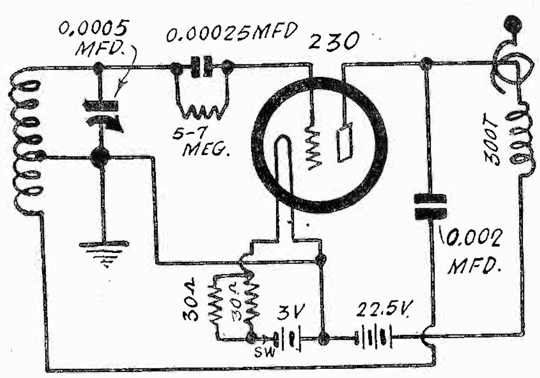
The tube used is a 230, which takes 2 volts on the filament, therefore if a 3-volt dry battery is used, a resistance of around 15 ohms will drop the battery voltage to the desired filament voltage. This resistance value is not in the hands of many, but 30-ohm resistors are plentiful, therefore use two 30-ohm units in parallel for the filament resistor. The B battery need be only 22.5 volts, and oscillation will result, but the modulation and the oscillation both will be stronger if the B voltage is 45 volts.

Output Coupler

Close coupling between test oscillator and tested circuit should not prevail, therefore the coupling is established simply by having an output post to which one end of a piece of insulated wire is connected, while the other end of the wire is wrapped around the plate choke coil dowel for three or four turns, and terminated at the baseboard in such a manner as to be safeguarded from picking up either the A or the B voltage. This gives a combination of inductive and capacitative coupling, both small, but large enough for the purpose.

The circuit will tune from a little above 1500 kc to a little below 550 kc, and the problem of calibrating the oscillator is greatly simplified now that broadcasting stations are compelled to maintain their assigned carrier frequencies plus or minus 50 cycles maximum deviation. Therefore use broadcasting stations, either directly on the test oscillator, as will be explained, or indirectly in connection with an existing receiver.





The pictorial diagram of the wiring is shown above, with the output post at left rear, the coupling with the oscillator being by a few turns of the wire, as explained in the text. At left is the circuit wiring diagram.

To use the oscillator alone, input being broadcast signals, it is necessary to alter the diagram a trifle, so that a pair of earphones with any bypass condenser across them of 0.0001 to 0.002 mfd., is in series with the plate, after the choke coil, preferably. That is, the phones may be cut in between B plus and choke coil return.

An aerial is used for pickup, and the lead therefrom wrapped loosely around the oscillator winding for three or four turns or so. Then the stations can be heard, at least as whistles, and as the frequencies of the stations are known, or can be obtained from newspapers, the dial settings will be noted, and these represent the frequencies. If a dozen or so well-distributed points are registered, then, if desired, a curve may be drawn, and this consulted for obtaining any frequency not actually calibrated on its own account. In other words, the setting for any frequency within the frequency range of the oscillator may be read.

To calibrate in conjunction with a receiver, the aerial and ground are connected to the set as usual, and the oscillator's output post has a wire running from its output to any point along the aerial, not conductively coupled, but just wrapped around the aerial a few times.

Then by the squeals you can determine approximate resonance between oscillator and modulator, while true resonance will result in no squeal or beat, known as zero beat, meaning that there is no difference between the two frequencies. If you can not establish zero beat—which would be true if the receiver were not perfectly aligned for all frequencies used in tests—then use the lowest-pitched growl you can establish, for this will suffice.

The same method of plotting a curve may be followed, and indeed if desired the one method may be checked against the other, as both must give the same result, if accuracy was established.

Of course the oscillator will be used principally for its fundamental frequencies. These are the original frequencies generated. Since the oscillator is of the detecting type, and particularly of the

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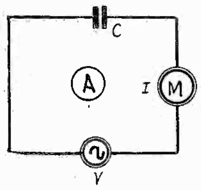
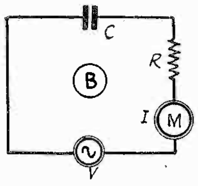
Measuring Capacity With an A-C Voltmeter

By J. E. Anderson



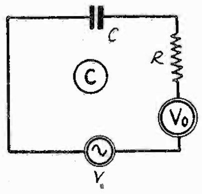
$C = \frac{I}{2\pi f V}$

FIG. 1
A method of measuring the capacity of a condenser with an a-c milliammeter having negligible resistance.



$C = \frac{I}{2\pi f \sqrt{V^2 - R^2 I^2}}$

FIG. 2
A method of measuring capacity with an a-c milliammeter in which the internal resistance is not negligible.



$C = \frac{V_0}{2\pi f R \sqrt{V^2 - V_0^2}}$

FIG. 3
In this circuit an a-c voltmeter is used for measuring capacity. R is the known resistance of the coil in the meter.

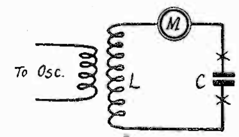


FIG. 4
Resonance method of measuring a small capacity. For resonance indicator an a-c milliammeter of low resistance is used.

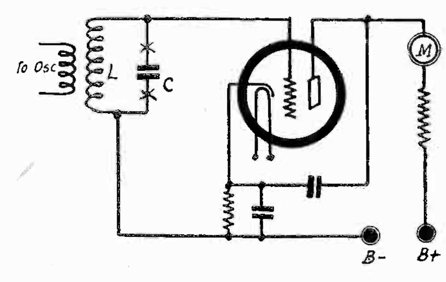


FIG. 5
Resonance method of measuring capacity. For resonance indicator a vacuum tube voltmeter or a grid biased detector is used.

CAPACITY meters are appearing. They are in general based on the generalized Ohm's law. A simple circuit of the type used is shown in Fig. 1. C is the capacity to be measured, M is an a-c milliammeter, and V is a source of alternating voltage. Suppose X is the reactance of the condenser at the frequency of the applied voltage V and also assume that the resulting current in the meter is I amperes. Both the current and the voltage are supposed to be measured in effective values. The generalized Ohm's law then gives X=V/I. That is, the reactance of the condenser is equal to the effective voltage divided by the effective current. After we have found the reactance we can easily compute the capacity of the condenser, for the reactance is 1/Cw, in which w is the frequency of the voltage, and current, in radians. We can simplify the equation by writing Cw=I/V, which states that the admittance of the condenser is equal to the effective current divided by the effective voltage.

If we use the voltage from a power line the frequency may be 60 cycles per second, since that is the most common commercial frequency. Then w=6.2832x60 and C=I/V6.2832.60, or C=0.00265I/V. This gives C in farads if I is in amperes and V is in volts.

Range of Meter

It is clear that by this means we can measure capacities of a considerable range provided that we select the proper ratio for I/V. Calibration of a capacity meter is a relatively simple matter. If we always use the same frequency and the same voltage the capacity is proportional to the current. Therefore if we have a current meter we can write capacity units opposite the scale divisions and we can read capacity just as easily as current.

Let us see what the range may be. Suppose we use an a-c milliammeter having a range of 0-1 milliampere and also let us suppose that the voltage is 110 volts. Then we have C=24.1 I microfarads. If the smallest current we can read is 0.05 milliampere the smallest capacity we can measure is approximately 0.0012 microfarad. The largest current we can read on this meter is 1 milliampere. Hence the largest capacity we can measure is 0.0241 microfarad.

The method assumes that there is no resistance in the circuit. Hence the milliameter used should have a very low re-

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Lining Up a Battery Oscillator

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grid-leak detecting type, with positive grid return, there will be an abundance of harmonics, and the same oscillator may be used for calibrating short-wave sets, converters and oscillators.

Some general idea of the frequency region of the short-wave device must be had first, and then the oscillator may be coupled to the circuit under test, for calibrating the so-called unknown circuit.

Harmonics are multiples of fundamentals, therefore, taking 1500 and 550 as the extreme frequencies, while the oscillator always tunes through this range, it affords response also in second, third, fourth, etc. harmonics.

Harmonics

So the second harmonic range (fundamental frequencies as assumed) would be 1100 to 3000 kc, third harmonic 1650 to 4500 kc, etc. It can be seen that the harmonics overlap considerably, and that is to be expected, for the fundamental frequencies have a ratio a little greater than 2.7 to 1, and there would be no repeats only if the ratio were 2-to-1 or less. Actually the ratio is nearly 3-to-1, for the extreme frequencies assumed are not the true ones. The circuit tunes beyond them. It would not be safe to crop too closely, as there might be missout.

Therefore the higher frequency settings of a superheterodyne oscillator for the broadcast band may be checked with the test oscillator, using the second harmonic of the test oscillator, for no intermediate frequencies higher than 1600 are to be expected, and indeed 465 kc is about the highest used for broadcast reception. The superheterodyne oscillator then tunes 400 kc higher than the modulator or station frequency. This oscillator frequency is the one to be checked, say, from 1400 kc up, for the higher frequencies of the oscillator necessarily are above the highest broadcast frequency.

Lining Up

The oscillator may be used for lining up tuned radio frequency sets, superheterodyne selector and oscillator circuits, band pass filters, etc., but will not be serviceable for determining or lining up intermediate frequencies in broadcast superheterodynes, because the lowest frequency of the test oscillator is a little below 550 kc, and intermediate frequencies are lower than that. The test oscillator's harmonics can not be used, for they are *multiples* of the test oscillator's fundamentals, hence still *higher* frequencies. The attempt would be in the wrong direction and must fail.

The only way to test intermediate frequencies would be to make the intermediate channel oscillate, and couple the present oscillator to the input of the i-f channel. Then a harmonic of the i-f channel would beat with a fundamental of the test oscillator, and the intermediate frequency, which will be somewhere around its rated value, can be determined by dividing the test oscillator's frequency by 2, 3, or 4, and thus discovering the intermediate channel's frequency.

Example of 175 kc

In some instances the intermediate frequency will beat with repeat points on the test oscillator, and these repeats serve as checkup. For instance the following harmonics of 175 kc would beat with test oscillator fundamentals as stated: fourth, 700 kc; fifth, 875 kc; sixth, 1050 kc; seventh, 1225 kc; eighth, 1400 kc. Three of these are station frequencies, and you could tune in one of the stations perhaps (700, 1050 or 1400 kc) with aerial coupled to oscillator as previously outlined, and then a squeal will constitute the modulation and it will be a strong one.

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sistance. There is a rectifying type a-c milliammeter of 0-1 milliampere range that has a resistance of about 5,000 ohms. If we use this meter we have to make allowance for this resistance. In this case the formula becomes $C=1/w(V^2-R^2I^2)^{1/2}$. The term RI in the radical is the voltage drop across the resistance of the meter. If there is another resistance in the circuit this too should be included, but the same formula holds provided R is the total resistance.

Application of Formula

This formula is not very convenient for calibration since C no longer is proportion to the current. But there is no trouble computing the value of the capacity provided that we know the total resistance in the circuit. Suppose that the resistance is 5,000 ohms, that the frequency is 60 cycles per second, that the voltage is 110 volts, and that the deflection is 0.5 milliampere. What is the value of the capacity? RI squared is 6.25 and V squared is 12100. We immediately note that the voltage square is so large that the RI square is negligible in comparison. Hence we make a very slight error by using the simple formula given at first. In fact the error is only about 2.5 per cent. of one per cent. In other cases the drop across the resistance is not negligible. Suppose we had had 100,000 ohms instead of 5,000 ohms. In that case the error would have been about 10 per cent.

Since V must be known accurately in all cases it is necessary to measure it just before the current through the condenser is measured. This may be done with the same meter provided suitable voltage multipliers are available. If the meter dial is calibrated in microfarads it is necessary to have a means for adjusting it to the value it had when the meter was calibrated. The means may take the form of a high variable resistor in the primary of the transformer supplying the voltage.

Measuring Large Capacities

If we are to measure condensers of larger capacities we have to have a milliammeter of larger range or else a lower voltage. Undoubtedly it is simpler to adjust the voltage for it can be done cheaply with a transformer. Suppose, for example, that we have a transformer with a secondary having a voltage of 5 volts. Let us still use the 0-1 milliammeter, one having an internal resistance of 5,000 ohms. Let us see what the largest capacity is that we can measure. The maximum current is 1 milliampere. Let us first put this in the simple formula. We obtain $C=0.00265x001/5$ farads, or 0.53 microfarads. But is the resistance of the meter negligible now? If the current is 1 milliampere and the resistance is 5,000 ohms the square of the RI drop is just equal to the applied voltage. That can only be when the capacity is infinite. In this case our error is infinite. Therefore we must use the accurate formula, and, moreover, we have to make reasonable assumptions. Let us assume that the current is 0.95 milliampere. In this case the drop in the resistance is 4.75 volts, the square of which is 22.56. The square of V is 25. Hence the difference between the squares is 7.44, the square root of which is 2.73. Putting this and the other known values in the accurate formula we obtain $C=0.923$ microfarad. This is a long way from infinity and therefore it is clear that no accurate readings of capacity can be made above 1 microfarad. To get accurate readings in this range we have to increase the current. If we had a meter of much lower resistance, we could also measure capacities of larger values by decreasing the voltage still more.

Using High Current Meter

Suppose we have a calibrated thermocouple type a-c meter having a maximum reading of 100 milliamperes. The resistance of this meter is not more than about 5 ohms. Let us use the 5 volt winding as a source of voltage and let this be of such heavy wire that the resistance is negligible. We have R=5 ohms, I=0.1 ampere, at maximum, and V=5 volts. RI squared is 0.25 and V squared is 25. Hence the difference between the squares is 24.75, the square root of which is 4.93, nearly. If we put this value together with suitable current and frequency in the formula we obtain $C=53.6$ microfarads. Therefore with a voltage of 5 volts and a current of 0.1 ampere we could measure the largest condenser that occurs in radio receivers. But the method is not applicable to electrolytic condensers.

Using Voltmeter

Just as an unknown resistor can be measured with a voltmeter in terms of the resistance of the meter, so the capacity of a condenser can be measured with an a-c voltmeter in terms of the resistance of the meter and the frequency of the voltage. Let us work out the formula. Suppose we connect an a-c voltmeter having an internal resistance of R ohms in series with a condenser of capacity C and a voltage source of V volts. If we short the condenser the reading on the voltmeter will be the voltage of the source, that is V. When the condenser is in the circuit there will be another reading Vo on the meter and this is equal to the resistance of the meter multiplied by the current flowing.

By Ohm's law we have V=IZ. But Z equals $(R^2+1/C^2w^2)^{1/2}$. Therefore $V^2=I^2(R^2+1/C^2w^2)$. But RI equals Vo. Hence $V^2-Vo^2=I^2/C^2w^2$. This may be reduced to $C=Vo/Rw(V^2-Vo^2)^{1/2}$, remembering that RI=Vo. Thus if we know the frequency and the resistance of the meter we can determine the capacity of a condenser if we first measure the supply voltage V and then measure the voltage indication Vo when the condenser is in series.

Applications

Let us apply this to a few cases. Suppose that the meter resistance is 5,000 ohms and that the frequency is 60 cycles per second. What is the capacity of a condenser if the the voltage is 4.5 volts when the condenser is in series and 5 volts when it is shorted? We have $V = 5$, $Vo = 4.5$, $R = 5,000$, and $w = 60 \times 6.2832$. Putting these values in the formula and simplifying wet get $C = 1.09$ microfads. This is hardly the limit because if the voltage scale has 50 divisions we can read at least to 4.9 volts. If that is the value of Vo and the other values remain the same as before we obtain $C = 2.6$ microfarads.

If we have a high voltage source, such as a 110 volt a-c line, we can still measure capacity with the voltmeter, but we have to change the value of R in the formula because it is necessary to use a higher value. Suppose the meter is a 1,000 ohms per volt instrument and that the range is 0-500 ohms. Then R is 500,000 ohms. Let V=110 and $Vo = 55$. What is the capacity of the condenser that will cut the voltage from 110 to 55 volts? Substituting the values in the formula gives us $C = 0.00306$ mfd.

If the instrument used has a sensitivity of 1,000 ohms per volt and if 60-cycle voltage is used all the time we can reduce the formula to $C = 2.65/V_m(D^2/Do^2-1)^{1/2}$ mfd., in which V_m is the highest voltage readable, that is, full scale, and D and Do are the two deflections corresponding to V and Vo, respectively. Thus we do not have to read in volts at all but in the most convenient scale divisions on the meter. However, we do have to know what the voltage is when the meter reads full scale. Of course, this observation is not limited to the case when we use a 1,000 ohms per volt meter, but is general. The factor 2.65 contains the frequency and the meter sensitivity.

Varying the Range

The last formula shows clearly what is necessary to vary the range of the meter. The radical has the same range regardless of the voltage used. Therefore only V_m can be varied to vary the range. The larger this is the smaller the condenser that can be measured. Hence to measure small condensers we must use the highest voltage range and to measure large condensers, the lowest voltage range. If there are 50 divisions on the dial the largest value of D/Do is about 50. If the 500 volt scale is used the smallest condenser that can be measured is about 100 mmfd. The smallest value of the deflection ratio is about 50/49. Then if the 5 volt scale is used the largest condenser that can be measured is 2.61 mfd. Therefore if we have three ranges of voltage, 0-500, 0-50, and 0-5, on a 1,000 ohms per volt a-c meter we can measure capacities with fair accuracy from about 100 mmfd. to 2.5 mfd. In order to get this wide range, however, it is necessary to have voltage sources of 5, 50, and 500 so that V will be equal to V_m. But even if we have different voltage sources within the range of the meter we can still measure a large range of capacities.

We have discussed three methods, all closely related, for measuring the capacity of a condenser. The first utilizes an a-c milliammeter and a known a-c voltage source. The second is the same but the meter contains a resistance that is not negligible, or there is a resistor of appreciable value in the circuit but external to the meter. The third utilizes an a-c voltmeter and a source of a-c voltage. In all cases the frequency must be known. Of these methods the third is perhaps the most convenient because it applies a voltmeter that is ordinarily used for voltage measurement. That is, it is not necessary to rig up a special meter. Just measure a voltage with the voltmeter and then put the condenser in series and measure again, without making any other change.

Using Other Frequencies

While it was assumed above that the frequency of the voltage available was 60 cycles per second, other frequencies may be used just as well provided they are accurately known. However, it is not advisable to use radio frequencies. There are many reasons for this. In the first place the ordinary a-c meters are not accurate at high frequencies. In the second, the impedance of a condenser at high frequencies is very low so that there would be practically no drop in the condenser. In other words, there would be no difference between the two readings. Commercial frequencies and low audio frequencies are the best.

Other Methods

There are other simple methods of measuring small capacities which may be more accurate than any of the methods just described, but some of them require calibrated condensers. Ordinarily, these are not available to the set builder, home experimenter, and the service man. One method, however, which requires a little computation, is available to any one who has a calibrated oscillator. It requires only one small condenser that is known accurately, or one inductance that is known. If no great accuracy is required a coil could be wound to a given inductance and the capacity could then be computed in terms of this inductance and the known frequency. Suppose, for example, that we have an inductance of

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Circuit Mistake Makes 55 and 85 "Insensitive"

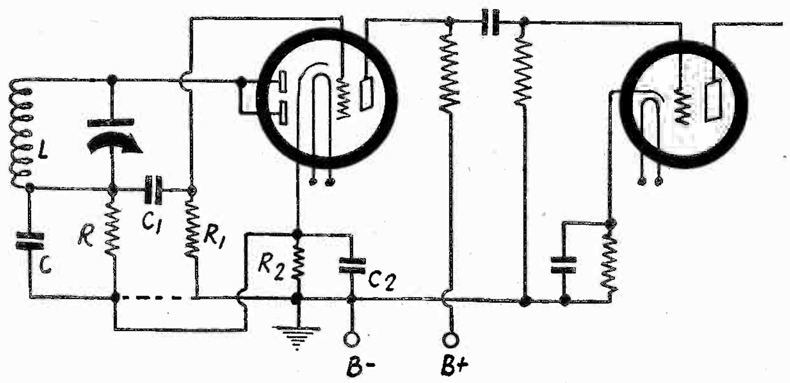


FIG. 1

If the duplex diode triode is connected as indicated by the dotted line, the rectifier is given a severe handicap and the detecting efficiency is low. The load resistance R should be connected to the cathode.

THERE have been many complaints that the diode detector is not sensitive, and, indeed, many circuits incorporating this type of detector have been quite insensitive. But the trouble is not always with the tube.

Suppose we have a grid type of detector, that is, one using a grid condenser and a leak. This is supposed to be the most sensitive. Yet this detector is exactly the same in principle as the diode detector. Not only in principle, it is the same in fact. Where lies the discrepancy? You may answer that the grid leak detector is also an audio frequency amplifier. So it is. But the diode about which complaints have been registered is also an audio amplifier. It is not only an amplifier but it is a better amplifier than the usual grid leak detector because it is operated with a higher plate voltage under optimum conditions. The grid leak detector-amplifier is not ordinarily operated with optimum conditions. We have to look for the difficulty elsewhere.

The 85 or the 55 when used as a diode detector and audio frequency amplifier requires a negative bias on the triode part. The recommended bias is 20 volts for the 55. For the sake of definiteness we are reproducing in Fig. 1 the circuit of a typical detector-amplifier employing one of these recent tubes. Now if we speak in terms of the old grid leak detector, C is the grid condenser and R is the grid leak. The audio signal voltage resulting from detection is developed across C and R in parallel. The fact that the combination in Fig. 1 is below the tuned circuit instead of above it makes no difference. We assume that we can connect in the manner shown, and we always can if the tuning condenser does not have to be grounded. If it must be grounded we can put C and R on the high side of the circuit just as it is in the ordinary grid leak detector.

Diode and Triode Independence

The two diode plates in this circuit, connected together, serve the same purpose exactly as the grid in the grid leak detector. They are the anode in the rectifier just as the grid is the anode in the case of grid leak detector. Up to this point there has not been any difference at all between the two cases. In the grid leak detector, however, the grid, that is, the anode of the rectifier, also serves as control grid of the audio amplifier. As such it operates at a certain bias. We have to adjust the plate voltage to such a value that the tube operates satisfactorily as an amplifier. This voltage, as a rule, is around 45 volts. The low undistorted output of the grid leak detector, which is a well known characteristic, is due to the fact that the plate voltage is so low.

Now if we use the duplex diode triode as detector and amplifier we are enabled to adjust the amplifier independently of the diode. Therein lies the superiority of the new tube over the old. However, if we connected the triode grid to the diode plates there would be no difference between the two circuits. But this connection is seldom used except when a stopping condenser and a grid leak must be saved. Such a saving is hardly worth considering.

Then when we use a diode triode we adjust the diode and the triode circuits independently so that each works best. Now why is that combination less sensitive than a simple grid leak detector? It may be because the amplification factor of the triode is less than that of the tube used as grid leak detector. Nearly always the detector tube has a high amplification constant. But even when a low mu tube is used as a grid leak detector the detecting-amplification efficiency is high, and the mu of the triode in the 55 or the 85 is quite high. Hence we can't look for the trouble there.

The Source of the Trouble

The source of the trouble is an erroneous connection of the diode triode and is not in the tube itself. Once more let us refer to Fig. 1. Note that one connection

(Continued on next page)

Inductive Method of Measuring Capacity

(Continued from preceding page)

L henries. Put the condenser across this coil and measure the resonant frequency of the circuit thus formed by means of the calibrated oscillator. If the unknown capacity be designated by C and the resonant frequency is F we have the relation $C = 0.0253/LF^2$, in which C is given in farads if L is in henries and F is in cycles per second. If C is measured in microfarads, L in microhenries, and F is megacycles, the formula remains the same.

How are we to measure the resonant frequency? If we have a meter that will measure radio frequency current we can put this in series with the circuit, expose the coil to the output of the oscillator and then vary the frequency until the meter deflection is maximum. The calibration of the oscillator then gives the frequency. We could also use a grid dip meter in the usual way. This must be coupled very loosely to the circuit under measurement or there will be a large error. We can also connect the resonant circuit to a vacuum tube voltmeter, or to the grid of a grid bias detector, and find at what frequency the plate current is greatest. The coil in this case would be the secondary of an input transformer and the output coil of the oscillator, coupled loosely to the resonant coil, would be the primary.

Coil Uncertainty

This method is not very accurate because the coil inductance cannot be computed with sufficient accuracy. If, however, we have a small condenser of accurately known capacity we could connect this across the coil and then measure the resonant frequency. By this means we can measure the inductance of the coil. We can use the same formula as that giving the capacity by merely interchanging L and C. When we have found the effective inductance in this way we can later use it for determining other capacities. The method ignores the distributed capacity of the coil. This is small and to make it negligible we can select a fairly large fixed condenser with which to measure the inductance. The coil capacity may not be more than 10 microhenries so that if we select a known capacity of 1,000 mmfd. the error will not be more than one per cent., and that is a greater accuracy than can be expected.

After we have fixed the inductance of the coil accurately we can reduce the formula still more. Suppose, for example, that we find the inductance to be 246 microhenries. Then the formula for capacity would be $C = 0.000103/F^2$, F being in megacycles and C in microfarads. If we care to make adjustments in the coil until its inductance is just 253 microhenries, the formula reduces to the very simple and convenient form $C = (10/F)^2$, where C is in microfarads and F is in megacycles. If many measurements are to be made it is worth while to make the coil adjustment.

A coil of 253 microhenries will result if we wind 94 turns of No. 28 enameled wire on a 1.5 inch form. There should be no separation between turns except the insulation of the wire.

As an illustration of the use of the formula C $(10/F)^2$ let us assume that resonance occurs at a frequency of 600 kc. Then the number of megacycles is 0.6. Hence we have $C = (10/0.6)^2$, or $C = 278$ mmfd. If we had had a coil of 246 microhenries and the resonance frequency had occurred at the same value, the condenser would have been 278x1.03, or 287, for the ratio of the inductances is 253/246, or 1.03.

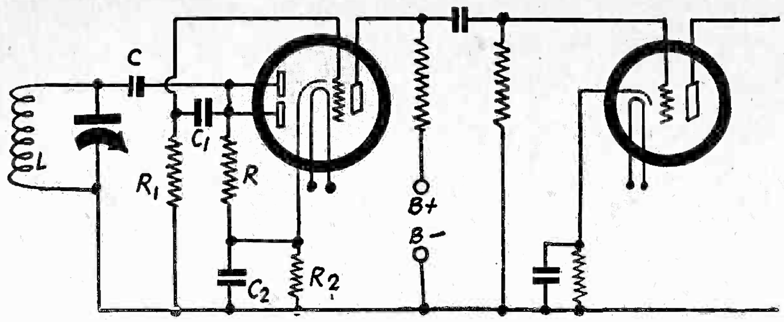


FIG. 2
If the tuning condenser is to be grounded on one side the detector-amplifier may be connected as in this circuit. C, the by-pass condenser is in the anode lead and the load resistance is in shunt.

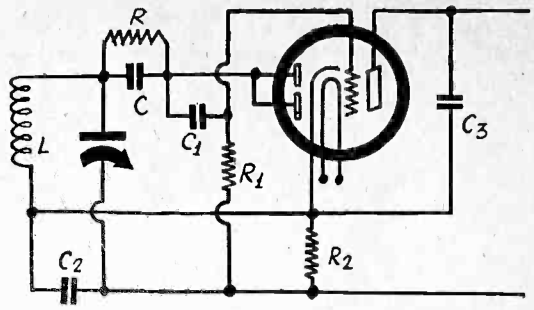


FIG. 3
This is another way of connecting when the tuning condenser is grounded. The coil returns through bypassed R2.

(*Continued from preceding page*)
is shown with a dotted line. Following this let us go around the detector circuit, omitting condensers. The signal voltage is in the coil L. Hence we have the coil L, the anode, the cathode, the grid bias resistor R2, the dotted line, and the load resistance R on the rectifier circuit. In R2 we have a direct voltage which may amount to 20 volts, and it is such direction that the anode is negative with respect to the cathode. That is, we have a direct voltage of 20 volts in the rectifier circuit and this has such polarity that no current can flow, for in order for current to flow in the circuit we just traced the anode would have to be positive with respect to the cathode. The signal voltage in L, therefore, starts with a 20-volt handicap. The signal voltage must overcome this before any current can flow in the rectifier circuit. Therefore, if there is a 20-volt handicap the peak of the signal voltage must exceed 20 volts before any current at all flows around the rectifier circuit. We cannot justly say that a diode rectifier is less sensitive than some other detector when it is handicapped by 20 volts.

Let us, therefore, forget the dotted line and connect RC to the cathode of the tube. No, let us not forget it, let us remember not to make the mistake. Now, if we trace the circuit as it is drawn, we have the signal source L, the anode, the cathode, and the load R. Now there is no polarizing voltage in the rectifier circuit to give the detector a severe handicap. Rectification begins as soon as there is any signal voltage. That is, it starts rectifying as soon as the signal voltage changes from negative to positive in the direction of the anode. It is not difficult to see that this change will make a great difference in the detecting efficiency.

Modifications

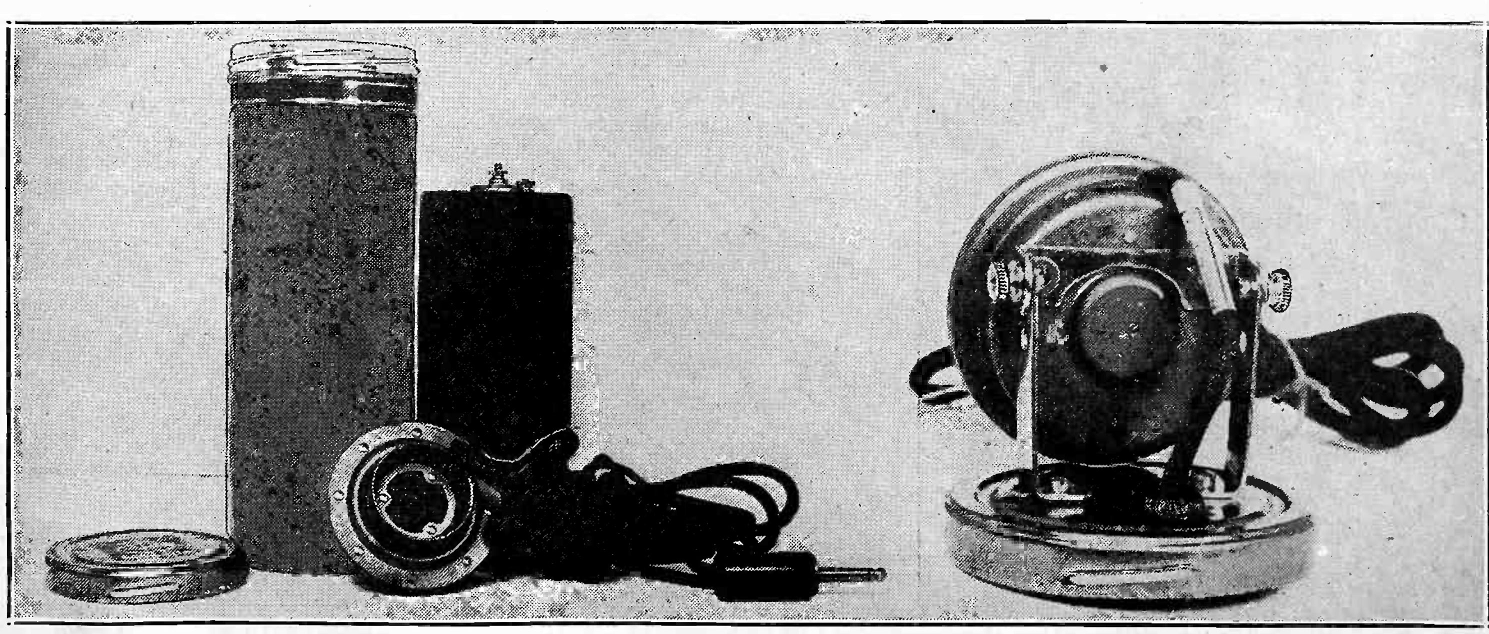
If we want to ground the rotor of the tuning condenser connected across the coil L we can connect as in Fig. 2. C now has the usual position of the grid condenser, in respect to the anode but the grid leak, that is, the load resistance on the diode, is connected between the anode and the cathode. This is a shunt circuit that is often used with grid leak detectors. If we connected R across C we would have the handicap circuit which we just condemned.

The parallel circuit in Fig. 2 is not so good perhaps as the series connection because the damping on the tuned circuit is greater. But we have another possibility of using the series connection and still grounding the rotor of the tuning condenser. This is shown in Fig. 3. Now R and C occupy the usual position in the anode lead of the rectifier and the tuning condenser the usual place. To avoid getting a handicap on the rectifier the coil L is returned to the cathode. In this case we have to depend on C2 to complete the tuned circuit and therefore this condenser should be so large that it does not affect the tuning characteristic of the tuning condenser to any appreciable degree. Since C2 is a condenser for by-passing audio frequencies it is usually quite large and no additional requirement is imposed. In other words, if C2 is large enough to function properly as an audio by-pass it is larger than necessary for the radio circuit. There might be a difference in the placing of the condenser, which is indicated by the position in the diagram.

In the usual grid leak detector a by-pass condenser is employed in the plate circuit of the tube. This could also be done in these circuits. And it is desirable to use one in Figs. 2 and 3. One is shown only in Fig. 3 where C3 is the condenser. It is connected between the plate and the cathode. The value of this condenser depends on what the load resistance or impedance on the triode is. If the resistance is of the order of 20,000 ohms, a 0.0005 mfd. condenser is all right, and this value can also be used if the load is an ordinary audio transformer. If the load is a high resistance, say 250,000 ohms, the condenser should not be larger than about 0.00025 mfd.

—J. E. Anderson.

Components of a Pendant Mike

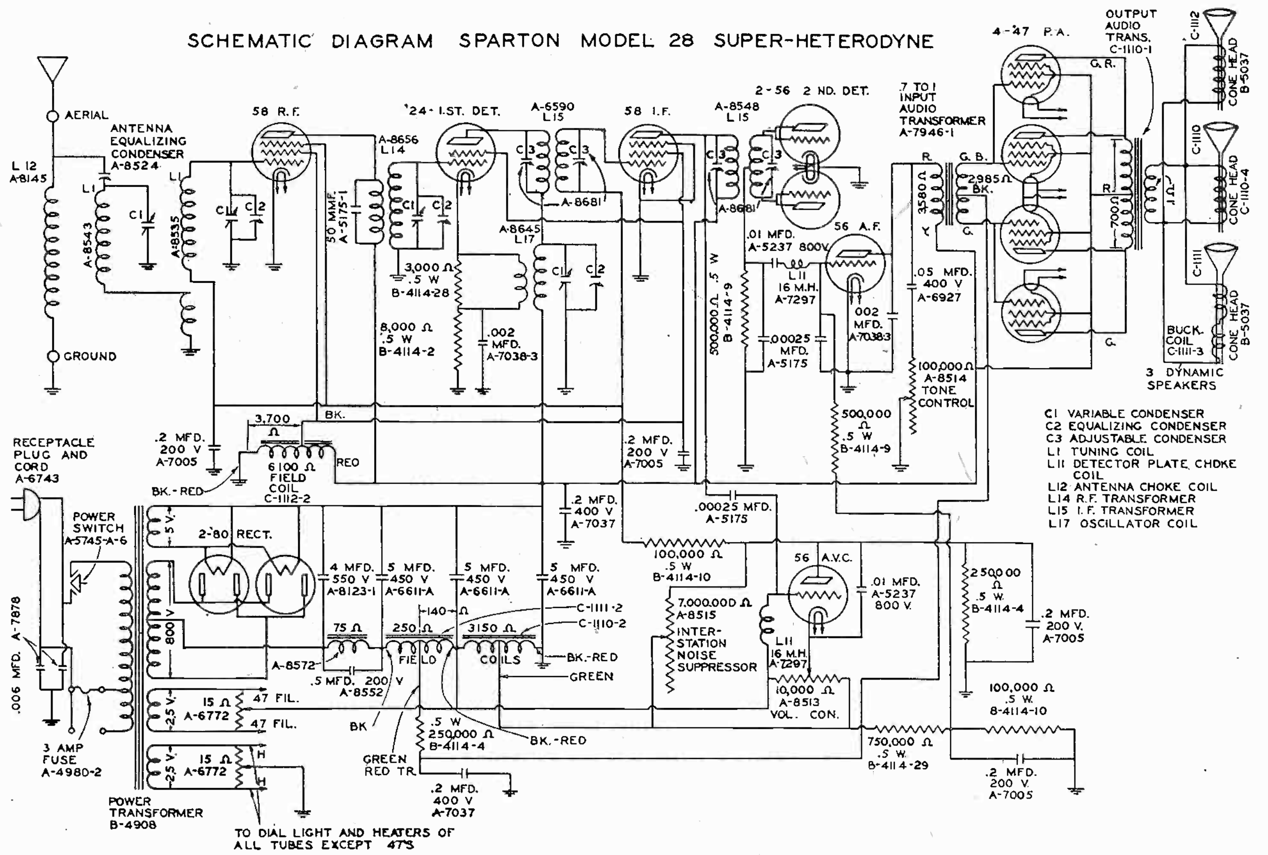


A tin tube with cover, such as a cracker container, into which No. 6 dry cell fits, houses voltage supply. The hand mike (handle removed) is bracketed to cover and screwed on as shown on front cover.

THE MODEL 28, NE

Parallel Push-Pull Output, Three Spe

SCHEMATIC DIAGRAM SPARTON MODEL 28 SUPER-HETERODYNE



Instructions for the Sparton Radio A-C Model 28 Super-Heterodyne:

THE Sparton A-C Model 28 is a thirteen (13) tube Super-Heterodyne Radio Receiving Set.

A transformer coupled radio frequency stage, a combination first detector-oscillator, an intermediate frequency stage, a duolinear second detector, an automatic volume control, a resistance coupled audio frequency stage, a transformer coupled parallel push-pull pentode power output stage, and a dual full-wave rectifier system comprise the circuit. The complete chassis is fully shielded.

At the factory each Sparton radio receiving set is completely installed in the cabinet, and equipped with matched Sparton tubes which reduces to an absolute minimum the work that must be done to place the receiver in operation in the home. The aerial and ground connections, adjustment of the voltage compensator, adjustment of the antenna equalizing condenser, and insertion of the receptacle plug in the light socket completes the installation. This model is designed for operation on 100 to 130 volts, 60 cycle alternating current (a-c). If in doubt about the rating of current which is available, the local power company should be consulted.

An a-c receiving set for operation on 25 cycle alternating current (a-c) is available in this model.

A receiving set designed for operation on a 60 cycle current supply system WILL NOT operate on 25 cycle current. However, a Sparton Model 28 Receiver designed for operation on 25 cycles will operate satisfactorily on 60 cycle current.

WARNING: Do not connect this type SPARTON Radio Receiving Set to a Direct Current (D-C) supply system as it will be damaged.

Triple Speakers

This application of a new principle in acoustical reproduction causes an even distribution of sound energy. Sound waves are propagated on an arc, instead of on a beam as with a single speaker.

Programs are received with a realism that seems to place you in the presence of the artists. The room is flooded with the program which apparently comes from everywhere.

The Lafoy Automatic Volume Control

The Lafoy automatic volume control is Sparton's own development and practically eliminates the fading variations of a broadcast program. A station may fade or increase and yet make but a slight change in the sound output of the speaker, when the Lafoy automatic volume control is set at the desired volume level.

Voltage Compensator

Before inserting the receptacle plug, the voltage at the socket should be measured and the compensator set for the value of voltage present. This compensator is located on the back of the chassis behind the warning plate. The warning plate can be removed by loosening the two holding screws. The compensator is then adjusted by placing the fuse in the clips corresponding to the measured line voltage.

If the line voltage measures 115 volts or less, the fuse should be placed in the clips marked "100-115." If the voltage measures 115 volts or more, the fu should be placed in the clips mark "115-130."

Do not attempt to operate this set the line voltage is less than 100 or mo than 130.

CAUTION: Do not make any adju ment of the voltage compensator wh the receptacle plug is in the light sock

Tubes

Thirteen (13) tested and factor matched Sparton tubes are shipped w each receiving set. They are:

One (1) Sparton type '24-A detect amplifier screen grid tube.

Four (4) Sparton type '47 pento power output tubes.

Four (4) Sparton 56 super-triode amp fier tubes.

Two (2) Sparton type 58 triple-gr super-control amplifier tubes.

Two (2) Sparton type '80 full-wave re tifier tubes.

One type 58 tube is employed in t radio frequency stage, one type 58 tu in the intermediate frequency stage, t type '24-A tube as the first detect oscillator, two type 56 tubes as the du linear second detector, one type 56 tu as the automatic volume control, one ty 56 tube in the audio frequency stage, t four type '47 tubes in the power outp stage, and the two type '80 tubes in t dual full-wave rectifier-filter system.

ANTENNA INSTALLATIO

Each Sparton radio should be install by the authorized Sparton dealer fr whom it is purchased. He is fully co petent to erect the best antenna syste for your particular location.

VEST SPARTON SET

ers, A-V-C N-S-C in Superheterodyne

Aerial

An outdoor aerial 50 to 100 feet in ength (including lead-in wire) and 25 to 0 feet in height consisting of No. 14 randed enamel copper wire gives the est results. Connect the aerial lead-in ire to the binding post on the back edge f the chassis marked "ANT."

The Lightning Arrester

The use of a standard lightning arrester s recommended. This should be the best hat can be purchased and one that has een approved by the Underwriters' aboratories.

Ground

A good ground is of the utmost im-ortance. A galvanized or copper rod bout ¼-inch in diameter, and six feet ng, driven its entire length into the arth at least one (1) foot from all walls akes an ideal ground. In cases where his is impractical, connect to the nearest old water pipe. We suggest that No. 14 nsulated wire be used for the ground lead hich should not be over 15 or 20 feet n length. Connect the ground lead to the inding post on the back edge of the hassis marked "GND."

Antenna Equalizing Condenser

The antenna equalizing condenser hould be adjusted by the dealer at the me the radio receiving set is installed. ts function is to adapt the receiving set o the type of antenna system employed hich practically custom builds the radio nto the location in which it is to operate. he procedure of adjustment is as fol-ows: Tune in a weak distant station be-ween 1400 and 1500 kilocycles, and turn he volume control on full; then, using hex-socket insulated adjusting wrench, urn the hex-head nut on the condenser see chassis view) to the right or left to position of maximum volume. Once ade, this adjustment need not be hanged unless the antenna system is al-ered, or the receiving set is moved from ne location to another.

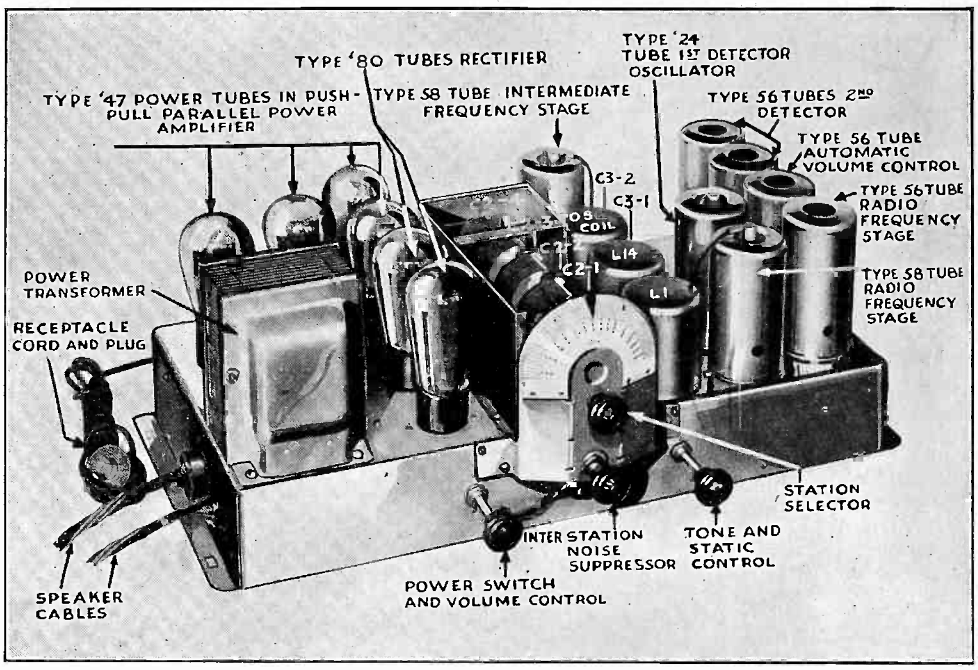
OPERATION

Power Switch and Volume Control Knob

The power switch and volume control nob is located to the left of the dial (see hassis view). The first turn of the con-rol knob to the right turns the power witch on. Wait a few seconds for the ubes to heat up, then use this control to ary the volume of the reception. If it s desired to increase the volume, turn to he right, and if it is desired to decrease he volume, turn to the left. The last ovement of the control knob in decreas-ng the volume turns the power switch off. When the volume of a station is hanged from one level to another by anipulation of the volume control knob, he change does not occur instantly but ags slightly due to the inherent tendency f the Lafoy automatic volume control to revent a change of volume either way.

Tone and Static Control Knob

The "tone and static control" knob is ocated to the right of the dial (see chassis iew). This control enables the operator to vary the tone quality of the reception according to his wishes. When the control knob is turned all the way to the right the high notes are emphasized and when turned all the way to the left the low notes are emphasized. When static is excessive a noticeable improvement in reception can often be obtained by turning this control towards the low note position.



The chassis, viewed from top, with identities of components imprinted. C2-1, antenna equalizing condenser; C2-2, r-f stage equalizing condenser; C2-3, first detector equalizing condenser; C2-4, oscillator equalizing condenser.

Station Selector

The station selector control knob is located directly below the dial (see chassis view). Its function is to provide a means whereby stations are "selected" or "tuned in." Tune the desired station to the point of loudest reception and use the volume control to reduce or increase the volume. Never reduce the volume by "tuning" off the point of loudest reception as this will impair the tone quality and introduce noise. Between stations noise will be noticeable. This is not heard when the receiver is "tuned in" on the station frequency channel and thus the operator is able to determine when the station has been properly "tuned in."

Inter-Station Noise Suppressor

The inter-station noise suppressor control knob is the second control knob located directly below the dial. The purpose of the inter-station noise suppressor is to permit the sensitivity of the receiver to be decreased, in order to eliminate the objectionable atmospheric or other noises received when tuning between stations.

To operate the inter-station noise suppressor proceed as follows:

1. Turn volume control on full.
2. Tune between station wanted and adjacent station, and bring in undesired noise.
3. Rotate inter-station noise suppressor control knob counter-clockwise until noise is reduced to desired level or disappears entirely.
4. Tune in desired station and use volume control to raise or lower volume as required.
5. When tuning for distant stations, or if use of the inter-station noise suppressor is not desired, rotate the control knob clock-wise as far as it will go.
6. For reception of local or nearby stations this control may be used as a manual volume control if desired. When used in this manner the regular volume control knob should be turned to the full position. This method of operation eliminates the automatic volume control feature and will allow the received signals to fade out and in if atmospheric conditions are such that they tend to do so.

The Full Vision Dial

The full vision dial is indirectly illuminated. It is calibrated in kilocycles as this is the manner in which broadcasting station channels are allotted. This permits the selection of favorite stations by merely consulting a log book or the radio column in your local newspaper, and the full vision range of the dial allows you to locate the station instantly.

In some locations, due to conditions beyond the control of the manufacturer, these calibrations cannot be made more than a close approximation.

Dial Light

To replace the dial light in the event it burns out, remove the four control knobs and the four screws that bolt the chassis to the bottom of the cabinet, then pull the chassis all the way out the back of the cabinet. Remove screw which will re-

(*Continued on next page*)

(*Continued from preceding page*)
lease the dial light socket from its support and permit insertion of the new bulb.

The dial light is rated at 2.5 volts, and a replacement bulb can be obtained from an authorized Sparton dealer. Do not attempt to use a flash-light bulb.

SUGGESTIONS IN CASE OF TROUBLE

Antenna System

Inspect the aerial and ground lead-in wires to see that they are properly connected to the receiving set and that they are not shorted to each other. Also note whether or not the aerial is touching some other grounded object. The lightning arrester should be investigated to see whether or not it is shorted. This can be determined by disconnecting the lightning arrester from the aerial wire. Then, if the receiver operates, it is an indication that the arrester is shorted and it should be replaced with a new one.

Tubes

See that all tubes are lighted and firmly seated in their sockets. Check this by pressing down gently but firmly on top of each tube.

The simplest method of testing tubes where test equipment is not available is to replace each tube in the receiving set alternately with a new tube of the same type. Any trouble caused by a defective tube can readily be located in this manner. It is well to remember that there are four different types of tubes (see chassis view), each for a special purpose. None of these tubes are replaceable with other than those of identical characteristics.

If it is found necessary to replace the type '24-A Sparton tube in the first detector-oscillator socket (see chassis view), it may be necessary to readjust the oscillator equalizing condenser. Whether or not this should be done can be determined by noting whether the new tube has altered the kilocycle reading of stations above 1200 on the dial. If it does, the condenser should be readjusted. This should be done by an authorized Sparton dealer as he has been instructed how to do it properly. No adjustment is necessary if any of the other tubes in the set are replaced.

Power Supply

Ascertain that current is being supplied to the light socket to which the receiver is connected. To check this, remove the receptacle plug from the socket and connect some other electrical appliance to it. If the appliance does not operate it indicates that current is not being supplied.

The Fuse

The fuse is located at the back of the chassis behind the warning plate. The warning plate can be removed by loosening the two holding screws.

The function of the fuse is to protect the radio from injury when subjected to abnormal electrical conditions.

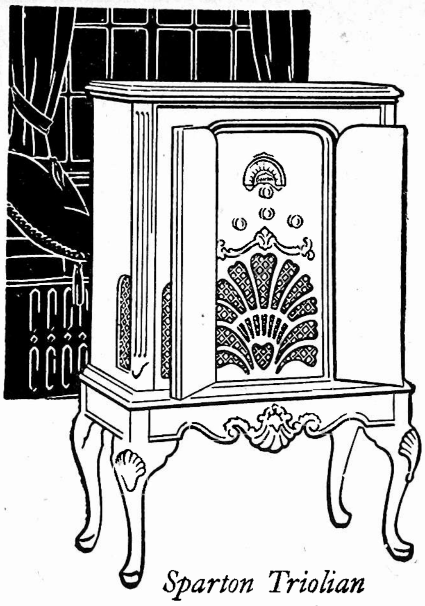
When any abnormal condition occurs, the fuse opens, thus stopping the flow of current to the radio.

Should the tubes fail to light when the power switch is turned on after ascertaining that current is available, it is a usual indication that the fuse has opened, denoting the existence of trouble. If this occurs, notify your Sparton dealer to correct the trouble and replace the fuse.

WARNING: Due to special construction of the fuse, it must be replaced with one of identical characteristics in the same clips from which removed. Failure to do this and to have the trouble corrected may result in severe harm to the receiving set for which the manufacturer is not responsible.

Noises

To determine the origin of noises, disconnect the aerial and ground wires from



Sparton Triolian Model 28

their respective binding posts. If the noise continues at the same intensity, the cause lies within the receiving set. If it stops altogether, or is only slightly audible, it is caused by outside sources.

G. Montjoy, Sparton' engineer, prepared the following:

Selectivity

It is not sufficient to have bandpass tuning circuits. It is imperative to have properly proportioned constants in order to get real benefits from bandpass tuning. Sparton sets assure generous selectivity without a sacrifice of brilliant musical notes and without complicating the manual tuning in of stations. Stations are trapped on the broad crest of the bandpass filter where there is room for both carrier wave and the full rounded tones of all orchestral instruments. An easy motion of the dial drops the station down from the steep sides of the tuning curve and ushers in the next channel, 10 kc away.

Sensitivity

The sensitivity of Model 28 is made uniform throughout the entire broadcast spectrum. This is accomplished by the use of a special type of radio frequency transformer. Many sets in order to have pasable gain at the low frequencies accent the gain at the high frequencies. This complicates tuning in the latter region and makes static between stations more objectionable.

Antenna Compensating Condenser

Through this device, a Sparton is adjusted to work to the best advantage on each individual aerial, in the same fashion as would custom-built radios designed for special antenna lengths. Increased selectivity result from its use.

Ailments peculiar to super-heterodyne circuits, such as intermediate frequency harmonic whistles and the reception of local stations on two different parts of the dial (a malady which makes impossible the reception of distant stations on these two channels) are eliminated on Spartons. Careful and costly shielding plus the addition of balanced bypassing devices have taken care of these normal super-heterodyne drawbacks. A special circuit which eliminates the repeat of a local station is built into the selector stages.

Inter-carrier Noise Suppressor

This device used on all Sparton a-c house sets eliminates static and hiss encountered when tuning from station to station. Of several types of noise suppressors, it appears unique in that it has positive action. Some other devices now in use in the field were contemplated for use on Sparton sets, but were rejected because of anticipated service troubles. If the user of a Sparton set contents himself with the stations which are satisfactorily receivable with this device, he may have as quiet a tuning set in summer as in winter.

Tone Control

The Sparton type of tone control eliminates the outer region of high frequency audio notes without affecting the bass register. This device is useful in suppressing static and hiss as well as ueful in adjuting the character of tone to the individual tastes of the consumer.

Automatic Volume Control

From published engineering data sheets, the last year's Sparton automatic volume control is shown to hold stations to a more level of ouput than does any other set on the market. This year's sets have sacrificed no feature over last, and have as additional value a quicker recovery from static impulses.

Tone

The tone is the result of many balanced factors, the first of which is duo-linear detection. This new system of detection is the only one to rectify and separate sound from the inaudible station wave without distoring the quality of the extracted music. The conventional type of detector adds to every program a background of the same program pitched an octave higher. This is called second harmonic distortion. The duo-linear detector is incapable of distortion.

The audio transformer of these three sets is designed to reproduce without appreciable loss the lowest note of the world's largest pipe organ. This is done without accenting any one bass frequency. All frequencies are amplified with even fidelity. A special design of secondary winding eliminates the usual noticeable peaks in the treble register. All recognizable musical notes are amplified in the same degree, preserving the perfect quality of tone just as delivered from the ideal duo-linear detector.

Factory matched pentode output tubes, worked with high plate voltage, take the audio voltages from the transformer and deliver it to the speaker. The automatic volume control is so tied in with the audio circuits that overload of the power pentodes is prevented. They handle just as much power as they are capable of delivering faithfully. No attempt is made to over work them on a "something for nothing" basis.

The Model 28 employs four pentodes in parallel push-pull Class A amplification. These deliver 18 watts of undistorted tone.

The reproduction of the entire musical register is not affected by any cabinet peculiarities.

Super-sensitive dynamic speakers are used.

The Model 28 makes use of three speakers, of slightly different pitch. These three speakers through the nature of their placement in the cabinet radiate sound in all directions, evenly.

WHY TWO SPEAKERS?

How Complementary Operation Improves Quality

By J. E. Anderson

THE latest of the better types of radio receivers are equipped with two or more loudspeakers. Why this extravagance? There are two objects to be achieved by the use of two or more loudspeakers. Some manufacturers stress one and some the other.

It is well-known that any loudspeaker has a definite frequency characteristic. Some are said to be low-pitched, others high-pitched, and still others to have tone balance. In any case the characterization is an admission or a recognition that the speaker is not perfect. If a speaker is low-pitched it emphasizes the low tones or some range of low tones. If it is high-pitched it emphasizes the high-pitch tones. And if it has tone balance it brings out the tones in a certain range of low frequencies about the same as it does the tones in a certain high frequency region, but may not bring out well at all the very high, the very low, or the intermediate frequencies. As far as the effect is concerned, the speaker having tone balance is the best provided the balance is right. But it is far from perfect.

Using Two Speakers

When two speakers are used one of them can be made strong on the low tones and the other on the high. By proper design of these two speakers, and by proper coupling of them to the output of the radio receiver, tone balance can be achieved, and this tone balance is much better than that which could be achieved with a single speaker. If the frequency characteristic of each speaker be made as good as possible and if the unavoidable deficiencies are made complementary, the combined effect is that of a nearly perfect speaker. To achieve this near perfection is the object of using two speakers. In the few cases where more than two speakers are used, the object is the same.

The other object of using more than one speaker is to throw the sound in different directions. For example, the sound of one might be thrown forward and that of the other downward. This is said to achieve various results. One claim is that it gives the stereoscopic, or should we say stereosonic, effect, that is, a sense of depth as well as direction. There appear to be grave doubts about that, for regardless of how many speakers are used and how they are placed, the sound comes from only one direction. The source of the sound in so far as the listener is concerned is the loudspeaker. Any stereo effect would begin at the speaker and would certainly not extend back to the broadcast studio. But the illusion of depth even if it only extends to the loudspeaker may be an improvement.

There is a grave question, however, whether the stereo effect is desirable. In a concert hall where a large orchestra is playing it is generally admitted that the best effect is obtained if the listener sits away back so that the sound from the different instruments will have a chance to blend. A person sitting close up may get too much from the bass viol, or from the drums, and there may be a noticeable time difference between the arrivals of the different sounds that should arrive at the same time. At the back of the hall the sounds from all the instruments will arrive at sensibly the same time, and they will appear to come from nearly the same point.

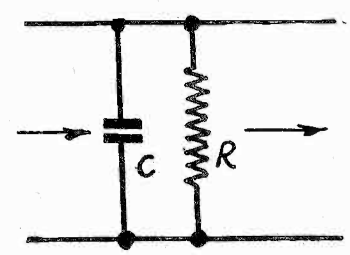


FIG. 1
Condenser C is in shunt with the line. R may or may not be in shunt. If R is a grid leak it is in series

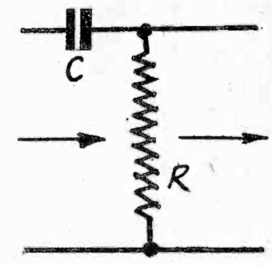


FIG. 2
Here the condenser C is in series with the line. If R is a grid leak it also is in series and is the termination of the line.

Studio Technique

In broadcasting the microphone can always be placed in the optimum position with respect to the instruments, so that each radio listener will have the most favored seat in the orchestra hall. A great deal of the technique of broadcasting has been built up around this. The various instruments are rearranged with respect to the location of the microphone to give the very best effect and many microphones are used to give the right blending of the sounds. All these sounds are put on a single radio wave and all come out of the same reproducer in the home. There is no chance of arranging the speakers so that the sound of a violin will seem to come from one direction, the sound of a bass viol from another, and the sound from the drum from still another. It is possible, however, to make the high pitch sounds seem to come from one part of the room and the low pitch sounds from another. There may be something in that, but that would hardly be natural, and the listener would not get the same effect as the most favored listener in the orchestra hall.

If the placement of the speakers has to do with leveling out the frequency response of the receiver as a whole, then there is something in the idea. The low-pitch speaker may be placed on a large baffle board in order to put a heavy air load on the diaphragm. That brings out the lowest tones. If there is no baffle the air will not go forward as sound waves but it will merely flow around to the back or the front, depending on which direction the diaphragm is moving. If there is a baffle the air cannot so easily flow around the edges. The best obtainable baffle, perhaps, in a home is a wall. Many particular radio fans who have the right to cut a hole in the wall do so with good results.

An Odd Fact

Obtaining the low notes by resonance, as is done in cheap sets, is not conducive to good quality. In the better sets great pains have been taken to eliminate all resonance in the audio system. This not only includes mechanical resonance in the structure but also acoustical resonance in air cavities.

It is odd that tone controls should be put into high quality sets. A great deal of design work and many expensive parts are put into the receiver to make the reproduction as natural as possible, and then a cheap device is added whereby the listener may spoil the whole thing when it suits his fancy. Of course, this is a recognition of the commercial principle that the customer is always right. There is no tone control, however, that allows the customer to select the high pitch tones to the exclusion of the booms. Maybe the low tones are not strong enough to be weakened. There are moments when "soft" music is preferable to high pitch music. But suppose we have a really good set that will bring out the bass viol, the tuba, and the bass drum very strongly. If the customary tone control is applied to the limit of "softness" the resulting booms are not very soothing to the nerves.

A volume control whereby we can select our own level of sound is no doubt more than a necessity. When exuberance is lacking we can turn the set down to bare audibility to derive pleasure from listening. But jazz is jazz no matter at what intensity it is heard. That is why the most logical position of the power switch is on the volume control.

Retention of Quality

What must be done besides using the speaker or speakers to retain the quality of the radio signal reproduction? First of all, the set must not be too selective, or if it is very selective there must be band pass filtering so that the sidebands will come through without appreciable distortion. To meet this requirement is very difficult if the set is to separate stations on adjacent channels, especially if the one not desired is local and very strong and the desired station is weak and far away. It is almost certain that if the selectivity is adequate the upper sidebands will be greatly suppressed. Let us consider an illustration. Let the strength of the local station be 500 millivolts per meter and that of the distant station 5 microvolts per meter. The ratio is 100,000 to one. This condition may be met. To start with we have to have a receiver so selective that the station that is 100,000 times stronger will be reduced to equality with the weak station. But we have to go further. The

(*Continued on next page*)

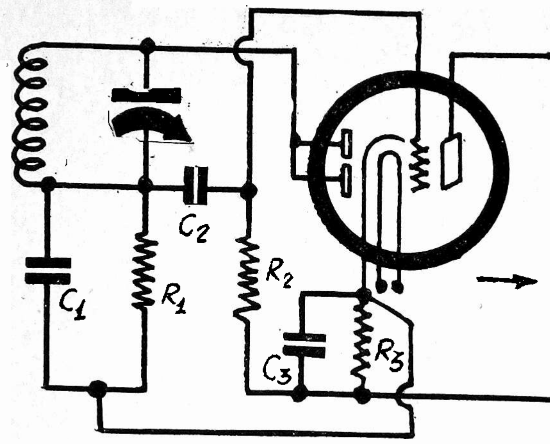


FIG. 3
In this detector and amplifier we have three different combinations of condensers and resistors. C1R1 corresponds to Fig. 1 and C2R2 to Fig. 2. C3R3 must be considered in series with the line.

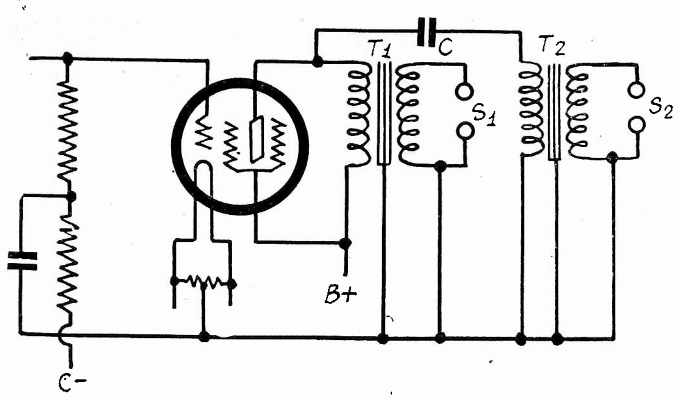


Fig. 4
Here is one method of connecting two loudspeakers to the same output tube. T1 is the output transformer for the low frequency speaker and T2 that for the high. C is a relatively small condenser

(*Continued from preceding page*)
desired station must be so strong that the other cannot be heard. Let us suppose that this will occur when the signal from the desired station is 100 times stronger. That makes the discrimination ratio up to 10,000,000 to one. If we have a straight line detector this should be the suppression ratio between two adjacent channels, say 550 and 560 kc. The required selectivity is enormous and we may put without appreciable error $Q = 10^7 f^2/(f^2 - f_r^2)$. The difference between the squares of the two frequencies, expressed in kilocycles, is 11,100 and f^2 is 313,600. Hence $Q = 2.82 \times 10^8$. Expressed in words this is 2.82 times one hundred million. There is no receiver with a selectivity remotely approaching this, but let us carry on. Suppose such selectivity were possible. What would be the suppression of a side frequency 5,000 kc off resonance? It would be 2.5 million. What would be the suppression ratio of 100 cycles off resonance? It would be nearly 100,000. In other words, only the sub-audible frequencies would get through at all.

Using Reasonable Selectivity

The figures are entirely fantastic. But let us consider a case closer to actuality. Suppose that the strength of the local station is 100 millivolts per meter and that that of the desired distant station is 10 microvolts per meter. The ratio of strengths is now 10,000. If the desired signal is to be 100 times stronger than the local the ratio becomes 1,000,000. The selectivity then is smaller than before in the ratio of 10 to one, but this is a negligible improvement in so far as the transmission of the side frequencies is concerned.

Now let us take a case which must be very common. Let us assume that the strength of the desired station is 0.1 of that of the interfering station and that the frequencies are 560 and 550 kc. As before, let it be required that the undesired station should be 100 times stronger. Then the suppression ratio is 1,000 and the required selectivity is 28,200. What will be the relative suppression of a side frequency 5,000 kc off resonance? The answer is 501. That means that the side frequency will only be 1/501 as strong as it ought to be for perfect reproduction.

No doubt the assumption that the desired station should be 100 times stronger than the undesired in order that the interference be tuned out completely, as far as the ear can tell, is excessive. But even if we assume that it should only be 10 times as strong we reach the conclusion that the high audio frequencies will be suppressed greatly in comparison with the low if we are to have sufficient selectivity to meet requirements that may arise.

Suppression in Detector

The tuner is not the only place where the high audio frequencies are discriminated against. There is also discrimination in the audio system. First we have the detector. No matter what type of detection we use we must have a condenser across the load of the detector. In the diode it is connected across the load resistance directly. In the grid leak detector we have the grid condenser across the grid lead, and this detector differs not at all from the diode detector in this respect. In addition we have a by-pass condenser in the plate circuit which adds to the suppression of the high frequencies. Any by-pass condenser or stray capacity across an audio coupling impedance will reduce the high frequencies.

Let us see what the degree of suppression is in a typical case. Suppose we have a load resistance of **0.5 megohm in a diode** and a condenser of 250 mmfd. across it. The relative suppression is equal to the relative values of the impedance of the condenser and resistor in parallel. At very low audio frequencies the impedance is equal to the resistance. But at any higher frequency the impedance is $R/(1+C^2w^2R^2)^{1/2}$. Therefore we may say that the relative suppression is $(1+C^2w^2R^2)^{1/2}$. If we substitute our assumed values in this formula and determine the suppression at 5,000 cycles we obtain 4.05. It may be said that the detecting efficiency at 5,000 cycles per second is only about one-fourth as great as it is at the low frequencies. While this suppression is not comparable with that in a highly selective tuner, it adds to the overall reduction of the high frequencies. Incidentally, if the condenser across the load resistance is made variable, this offers a very good tone control.

Suppression of Lows

The degree of suppression by a condenser across a resistance depends on the product of R, C, and w. At any one frequency it depends on the product of R and C. Therefore at a given frequency we can get the same suppression with a large condenser and a small resistance as with a small condenser and a large resistance, provided that the product of the two remains the same. In design we should first fix the frequency at which we want a given suppression, and then we should choose the product of R and C accordingly. For example, suppose we do not want the suppression to be greater than at 5,000 cycles per second. The product of R and C should not be larger than the square root of 3 divided by w. Or R C should not be larger than 55.1 microseconds. This value we can get by making C 100 mmfd. and R 551,000 ohms. Therefore the combination C = 100 mmfd, and R = 500,000 ohms would meet the requirements. Or we could make C 50 mmfd. and R one megohm.

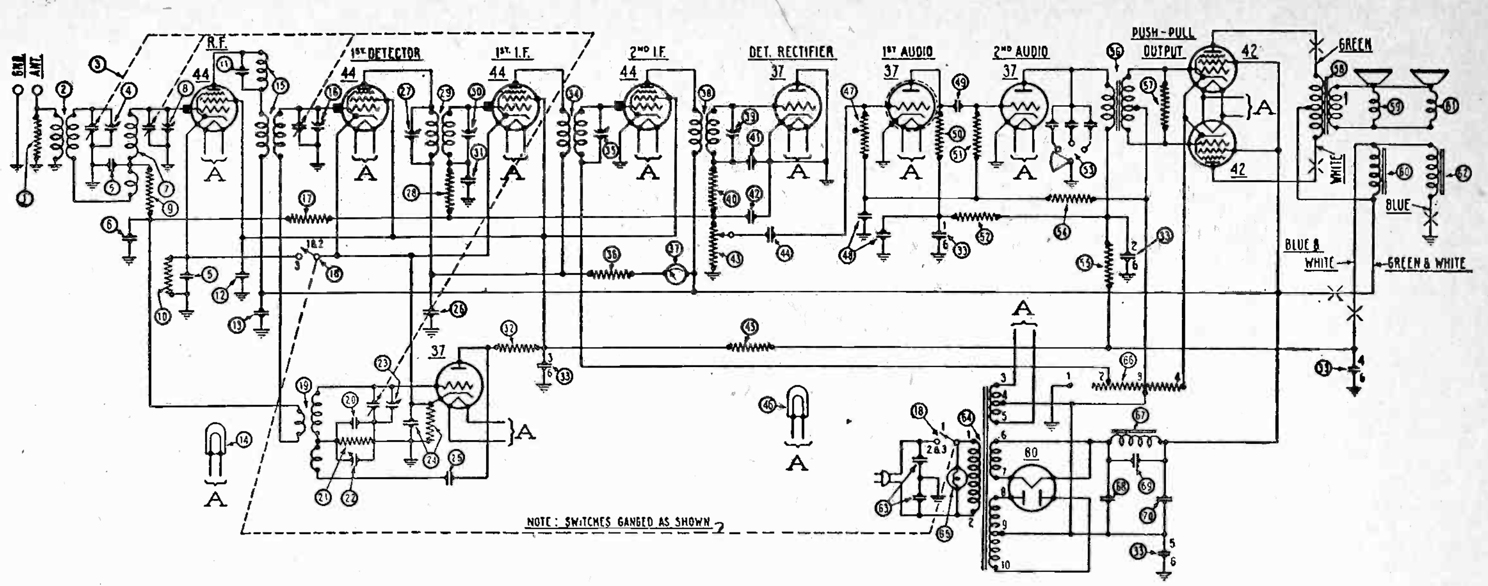
The suppression of the low frequencies is effected by condensers in series. One of the main suppressors of the lows in a resistance coupled circuit is the stopping condenser. But this must be taken in conjunction with the grid leak following it if we are to get a quantitative value of the suppression. The idea is that there should be no voltage drop across the condenser and all the drop should be across the resistor. Of course, this cannot be attained, but we can approach it as closely as we wish.

Suppose a signal voltage E exists across the stopping condenser and the grid leak. The useful voltage is the drop across the grid leak and the voltage drop across the condenser is wasted. If Z is the impedance of the condenser and the leak in series $E = IZ$, I being the current. The drop across the leak is RI. The ratio of the useful voltage to the total is RI/ZI, or R/Z. But $Z = (R^2 + 1/C^2w^2)^{1/2}$. Therefore the ratio of the useful voltage to the total voltage is $1/(1 + 1/C^2w^2R^2)^{1/2}$.

Let us apply this to an amplifier. Suppose we want the useful voltage at 25 cycles per second to be one-half of the total. Then the above expression is ½ or the denominator is equal to 2. Or $2 = (1 + 1/C^2R^2w^2)^{1/2}$. Therefore $CRw = 0.578$. Since $w = 2\pi\ 25 = 157.08$, $CR = 0.00368$ second. It is customary to use a resistance of 0.5 megohm for R. Therefore the capacity if the condenser for this resistance should be 0.00736 mfd. Values ranging from 0.006 to 0.01 mfd. are often used. It should be remembered that 0.00736 mfd. was obtained by treating a single circuit. If there are other circuits of the same characteristics, the capacity of each condenser should be multiplied by the number of such circuits. For example, if there are three couplers each of which has a grid leak resistance of 0.5 megohm, the capacity of each condenser should be 0.022 mfd. If they are made larger no harm is done unless they are leaky.

Degeneration

Suppression of lows also occurs as a result of degeneration in cases where self bias is used on audio amplifier tubes. There is usually a by-pass condenser across the resistor to prevent this, but in most cases it is so small that it does more harm than good in so far as frequency discrimination is concerned. It may serve some other useful purpose. The resistor alone causes a reduction in the amplification in the tube it serves. When a condenser is connected across the resistor this reduction becomes less. Due to the fact that bias resistors are usually small the condenser must be very large if it is to prevent reverse feedback at the low audio frequencies. The impedance of the bias resistor and the condenser across it is $R/(1 + C^2R^2w^2)^{1/2}$. The reverse feedback is roughly proportional to it. Hence it is clear that to prevent degeneration on the very low frequencies the capacity of condenser should be very large. Or, the product of CRw should be large. As



In this commercial receiver two loudspeakers are used to improve the tone quality.

$R^2C^2w^2$ becomes very large compared with unity the impedance becomes that of the condenser alone, which is 1/Cw. Suppose we have a bias resistor of 1,500 ohms and a condenser across it of 2 mfd. What is the value of the impedance at 25 cycles per second? It turns out to be 1,090 ohms. This is a very small reduction.

There is one advantage in some instances in using a small condenser. Suppose there is a motorboating, or an oscillation, at a very low audio or sub-audible frequency. One remedy against this trouble is to reduce the amplification on the lowest notes. This might just as well be done by reverse feedback as by any other means. Thus if the condenser across the bias resistor is a little too small, the circuit may be quite stable, while with a larger condenser it might be oscillatory. Omitting the condenser entirely often stops the trouble, but it also reduces the desired amplification. Therefore a condenser should be used but it should not be made smaller than absolutely necessary.

Samples of Connections

It is not always easy to recognize whether a condenser is in series or in shunt with the line, especially in a complex circuit like a receiver. However, ground is always one side of the line and the plate or the screen the other. If the signal current must flow through the condenser it is in series, but if the signal current can flow either through the condenser or through some other device then the condenser is in shunt. If the signal voltage divides between the condenser and the other device, the condenser is in series. If the current divides the condenser is in shunt. But there is another combination possible. The condenser may be in shunt with the resistance, or with some other impedance, but this parallel combination may be in series with the line. In Fig. 1 we have a simple case of a shunt connection. C is in shunt with the line, but we cannot say whether the resistance is in shunt or in series. If the upper end of R is connected to a grid and the lower to ground R is in series with the line, but if the two output terminals are connected to the primary of a transformer R is in shunt. In Fig. 2 C is in series with the line, but as before we cannot say whether R is in series or in parallel. However, if R is a grid leak connected between ground, or the cathode, and the grid, it is in series. R then is the termination of the line because the tube acts as a relay and it is the beginning of another line.

In Fig. 3 we have three diffrent combinations of resistors and condensers. No, only two, for the first and the third are of the same type but due to the different functions they may be regarded as different. C1 is surely in shunt with R1 and it must be small if the high audio frequencies are not to be suppressed. C2 is in series with the line for it is in series with R2, the termination of the line. For good low tone reproduction C2 times R2 should be large, as has been explained in preceding paragraphs.

Reverse Feedback

C3 and R3 are primarily in the plate circuit of the amplifier and in series with it, for the signal current must flow through the combination. But the condenser is in shunt with the resistor. The combination is also with the grid circuit for the grid return is made to the negative end and the grid circuit begins at the cathode. There is therefore a reverse feedback which will reduce the amplification by an amount depending on the value of the impedance of the combination. Since the impedance is less the larger the condenser, the reverse feedback will be less the larger the condenser. The size required depends on the lowest frequency that must be amplified at full strength and it also depends on the value of the resistor across which it is connected.

Time Constant Controlling

The interdependance of the condenser and the resistor holds for all combinations. In every case it is the time constant of the combinations that counts; that is, the product of the condenser capacity in farads and the resistance of the resistor in ohms. But in some cases we must select a time constant so small that the high audio frequencies have a chance to get through and in other cases we must select one that allows the low frequencies to get through. If the condenser is in shunt it should be small, if it is in series, it should be large.

Two Things in Mind

When we are dealing with a by-pass condenser which is to carry r-f current around some resistor or other impedance we must keep two things in mind. First, it must be large enough to by-pass adequately the radio frequency currents. Second, it must be small enough not to by-pass appreciably the high audio frequencies. Hence the choice of the condenser must be a compromise.

If the radio frequency is very high there no difficulty in satisfying the conditions, but for the lower broadcast frequencies and for the intermediate frequencies it is necessary to sacrifice the higher audio frequencies in order to get by-pass efficiency at the carrier frequency.

POWER AMPLIFIERS IN NUMERICAL ORDER

Type Number	Purpose	Base	Type Cathode	Rating Filament (or heater) Volts	Amperes	Supply	Plate Max. Volts	Screen Max. Volts	Plate Supply Volts	Negative Grid Bias Volts D C on Fil.	A C on Fil.	Screen Volts ( ) = Current	Plate Current Milliamp.	A C Plate Resistance Ohms	Mutual Conductance Micromhos	Voltage Amplification Factor	Ohms Load for Stated Power Output	Power Output Milliwatts
46	Power Amplifier †Class A	UY	Filament	2.5	1.75	A C or D C	250	...	250	31.5	33	...	20	2380	2350	5.6	6400	1250
46	Power Output ††Class B	UX	Filament	2.5	1.75	A C or D C	400	...	400	0	...	...	200 peak				1300 per tube	20000 max. (2 tubes)
59	Power Amplifier (x) Class A	7 pin	Heater	2.5	2.0	A C or D C	250	...	250	28	28	...	26	2400	2600	6	5000	1250
59	Power Amplifier (y) Class A	7 pin	Heater	2.5	2.0	A C or D C	250	250	250	18	18	250 (9)	35	40000	2500	100	6000	3000
59	Power Output (z) Class B	7 pin	Heater	2.5	2.0	A C or D C	400	...	400	0	0	...	26 2 tubes Min.				6000 plate to plate	20000
89	Power Amplifier (1) Class A	6 pin	Heater	6.3	0.4	A C or D C	160	...	160	20	20	...	17	3000	1570	4.7	7000	300
89	Power Output (2) Class A	6 pin	Heater	6.3	0.4	A C or D C	180	163 180	163 180	17 18	17 18	163(2.0) 180(3.0)	17 20	79500 82500	1575 1635	125 135	9000 8000	 1500
89	Power Output (3) Class B	6 pin	Heater	6.3	0.4	A C or D C	180	...	180	0	0	...	3 to 75					6000 max. (2 tubes)
112-A	Power Amplifier	UX	Filament	5.0	0.25	A C or D C	180	...	135 180	9.0 13.5	11.5 16.0	... ...	6.2 7.6	5300 5000	1600 1700	8.5 8.5	8700 10800	115 260
120	Power Amplifier	UX	Filament	3.3	0.132	D C	135	...	90 135	16.5 22.5	... ...	... ...	3.0 6.5	8000 6300	415 525	3.3 3.3	9600 6500	45 110
171-A	Power Amplifier	UX	Filament	5.0	0.25	A C or D C	180	...	90 135 180	16.5 27.0 40.5	19.0 29.2 43.0	... ...	12.0 17.5 20.0	2250 1960 1850	1330 1520 1620	3.0 3,0 3.0	3200 3500 5350	125 370 700
210	Power Amplifier	UX	Filament	7.5	1.25	A C or D C	425		250 350 425	19.8 27.0 35.0	22.0 31.0 39.0	... ...	10.0 16.0 18.0	6000 5150 5000	1330 1550 1600	8.0 8.0 8.0	13000 11000 10200	400 900 1600
231	Power Amplifier	UX	Filament	2.0	0.130	D C	135	...	135	22.5	...	...	6.8	4950	760	3.8	9000	150
233	Power Amplifier	UY	Filament	2.0	0.26	D C	135	...	135	13.5	...	135(3.5)	14.5	50000	1350	70	7000	650
238	Power Amplifier	UY	Filament	6.3	0.3	D C	135	135	135	13.5	...	135(2.5)	9.0	102000	975	100	13500	525
245	Power Amplifier	UX	Filament	2.5	1.5	A C or D C	275	...	180 250 275	33.0 48.5 54.5	34.5 50.0 56.0	... ...	27.0 34.0 36.0	1900 1750 1670	1850 2000 2100	3.5 3.5 3.5	3500 3900 4600	780 1600 2000
247	Power Amplifier	UY	Filament	2.5	1.75	A C or D C	250	250	250	15.0	16.5	250(7.5)	32.0	35000	2500	90	7000	2500
250	Power Amplifier	UX	Filament	7.5	1.25	A C or D C	450	...	250 350 400 450	41.0 59.0 66.0 80.0	45.0 63.0 70.0 84.0	... ...	28.0 45.0 55.0 55.0	2100 1900 1800 1800	1800 2000 2100 2100	3.8 3.8 3.8 3.8	4300 4100 3670 4350	1000 2400 3400 4600
841	Power Amplifier Class A	UX	Filament	7.5	1.25	A C or D C	* 425	... ...	425 1000	5.8 9.2	... ...	... ...	0.7 2.2	63000 40000	450 750	24 26	250000 250000	... ...

†UY socket, K spring tied to P spring.
††Both grids tied together (socket G and K). Class B is a form of push-pull. Maximum continuous power output, two tubes, 16 to 20 watts.
*Supply voltage may exceed 425 by the voltage drop in the plate load.
**1,000 volts applied; 575 volts dropped in plate load, so effective plate voltage will be 425.
(1), triode, Class A. Two grids in line with heaters tied to plate. Control grid is cap of tube.
(2), pentode, Class A. Grid next to socket cathode tied to cathode. Grid adjoining socket plate is screen. Cap is control grid.
(3). Class B output triode. Grid next to cathode on socket tied to plate. Grid next to plate tied to control grid, i.e., cap. Two tubes used. Currents given for one.
(x), Class A triode, grids Nos. 2 and 3 tied to plate; No. 1 is control grid. See page 3.
(y), Class A pentode, grid No. 3 tied to cathode; grid No. 2 is screen; grid No. 1 is control grid. See page 3.
(z), Class B triode. Grid No. 3 tied to plate; grids Nos. 1 and 2 tied together for control grid. See page 3.

RECTIFIERS IN NUMERICAL ORDER

280	Full-Wave Rectifier	UX	Filament	5.0	22.0	A C	1 { A C Voltage per Plate (Volts RMS)............350 { D C Output Current Maximum MA)............125 2 { A C Voltage per Plate (Maximum Volts RMS....400 { D C Current (Maximum MA)....................110 3 { A C Voltage per Plate (Maximum Volts RMS)....550 { D C Output Current (Maximum MA)............135 This rating is permissible only with filter having an input choke of at least 20 henries.
281	Half-Wave Rectifier	UX	Filament	7.5	1.25	A C	A C Plate Voltage (Maximum RMS)............700 D C Output Current (Maximum MA)............ 85
82	Full-Wave Mercury Vapor Rectifier	UX	Filament	2.5	3.0	A C	A C Plate Voltage (Maximum Volts RMS)........500 D C Output Current (Maximum MA)............125 Approx. tube voltage drop, 15 volts.
83	Full-Wave Mercury Vapor Rectifier	UX	Filament	5.0	3.0	A C	A C Plate Voltage (Maximum Volts RMS)......500 D C Output Current (Maximum MA)............250 Approximate tube voltage drop...................... 15

Radio University

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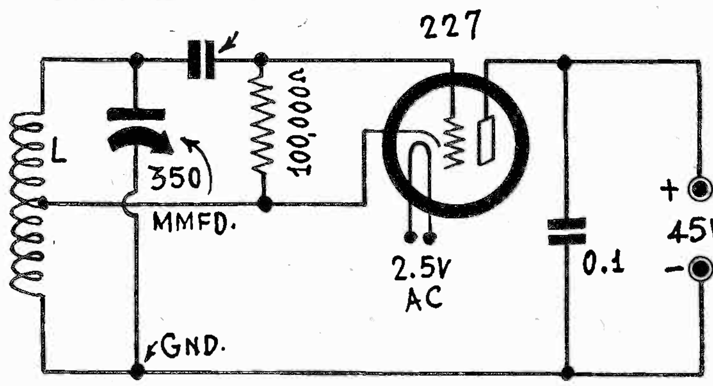


FIG. 1036

Oscillator hookup. This may be followed either for a single 3-to-1 frequency ratio band, or by switching may be used for all-wave coverage. The grid leak may be 100,000 ohms, or, if blocking occurs, may be reduced to 50,000 ohms. The grid condenser (arrow) is 0.00025 mfd.

The Stretched Wire

CONSIDERING a straight (stretched) wire in a magnetic field, what is its characteristic? A says he doesn't know, but assumes that it is a resistance. B says that it is an inductance pure and simple. C insists that it is a condenser. Will you please state what the wire is and why?—O. P. W., Brocton, Mass.

A is right, in the sense that he doesn't know, but neither do B and C know, so here goes. Assume a bronze wire stretched tight in a magnetic field, so that the wire runs straight. It is obvious that this wire has a mechanical frequency of vibration or natural mechanical frequency or period. Assume that there is induced an alternating current, for otherwise the question has no significance. If the frequency of the alterating current is greater than the natural vibrational frequency of the stretched wire, then the e.m.f. along the wire leads the mechanical motive force, and the wire is a condenser. If the frequency of the alternating current is less than that of the wire's mechanical frequency, then the mechanical motive force in the wire leads the induced e.m.f., or the current in the wire lags, hence the wire is an inductance. If the two frequencies are the same, then the wire is as a pure resistance, but of higher resistance than that of the mere d-c resistance of the wire. These considerations lead to a broader but firmer grasp of the nature of inductance, capacity and resistance. Whereas inductance is commonly thought of in connection with a coil of wire and the electromagnetism when a-c is applied, the larger view depicts the reality better, in that the inductance is considered by its effect. So too with capacity, its effect denoting its existence, i.e., it causes the voltage to lead the current. Pure resistance produces no phase angle difference.

* * *

Inexpensive Tester-Analyzer

WILL YOU KINDLY give me some directions for the construction of a set tester that will be as inexpensive as possible, and yet will make practically all tests?—H. W. Q., Geneva, O.

The most economical method, although one that introduces some slight inconveniences, is to use pin jacks at each of seven leads of a cable to the tester or analyzer, for voltage, and five pairs two pin jacks in series with each lead where current is to be read. Then end-tipped wires complete the connection for current continuity. Remove them when the current meter is to be inserted. Then, too, the voltages would be read between other pin jacks points, in the manner outlined in the article in the present issue, beginning on page 3. The cable would have seven leads and would terminate in a simple seven-pin base, the set requirements for accepting bases of fewer pins being met by using pin-reducing adapters, i.e., seven top six bottom, seven top five bottom, seven top four bottom. On the tester there may be a six-hole socket with a six-bottom seven-top adapter, or two sockets, i.e., a six-hole and a seven-hole, as in the article just mentioned. By this method you can make virtually every test, and the total cost will be well under $10.

* * *

Oddity of Tuning

A MOST PECULIAR condition exists in tuning my superheterodyne, and I wonder if you have ever run across it, and can explain it? If I want to get a distant station that is very weak, I can do so by tuning from a lower to the somewhat higher one of the desired station, but if I tune in the opposite direction I usually do not get the desired station, at least not without interference.—U. E. C., Washington, D. C.

Yes, we have encountered this phenomenon in some oscillators, and therefore assume that it has something to do with the oscillator in your superheterodyne. The particular condition we met in a tricky circuit also was that the low frequency oscillations would have to be established first and then the tuning done in the direction of higher frequencies, so that oscillation would obtain properly at these higher frequencies. We believe that the phenomenon has something to do with the d-c resistance feature of the oscillator, and that part stoppage of oscillation is caused by intermittent grid blocking, but that is a surmise. We really do not know the answer.

* * *

Oscillator Coils

USING 2.5 inch diameter tubing, to make a simple switch type oscillator, 0.00035 mfd. condenser, please give circuit and number of turns, etc.—K. O. S., Plainfield, N. J.

The simplest type oscillator to make is one using a '27 or 56 tube. See Fig. 1036. Single windings on coils are center-tapped, condenser across total coil, one end of coil toward grid, other end to grid return (B minus), with cathode to tap. The switch should move the cathode and grid connections (double pole, five throw). The largest coil consists of two commercial type honeycomb coils of 800 turns each, joint to cathode switch, the diameter being about 1 inch, so this coil outfit may be placed inside the bakelite form. On the form (2.5 inch O. D.) wind 76 turns of No. 28 enamel wire, leave ½ inch and wind 20.5 turns of No. 24 enamel wire, leave 1.2 inch and wind 7.5 turns of No. 18 enamel wire, leave ½ inch and wind 2.5 turns of No. 18 enamel wire. Remember all these home-made windings (four) are center-tapped. The frequency ranges will be about as follows: 75 to 220 kc (use second harmonics, 150 to 440 kc, for intermediate frequencies); 530 to 1,550 kc; 1,470 to 4,400 kc; 4,000 to 11,000 kc; 11,000 to 30,000 kc. You may use a grid condenser and leak (0.00025 mfd. and 100,000 or 50,000 ohms), and for output coupling two turns of thick wire under the tube socket, led to the output binding post. The socket end of the under-socket coil should be insulated with friction tape.

* * *

Audio Transformer Ratio

PLEASE LET ME KNOW what type (ratio) of audio transformer to use in a circuit.—H. W. E., Columbus, Nebraska.

The type audio transformer to use depends on various factors, particularly the plate impedance. Assuming a tube with 10,000 ohms plate impedance, or thereabouts, the transformer may have a ratio of 1-to-3, primary to secondary. Since ratios are built up by increasing the number of secondary turns, it is always desirable to have the ratio low enough so that a low distributed capacity of the secondary will exist, thereby preventing serious attenuation of the high audio frequencies. Also the primary inductance should be high enough to safeguard the low frequencies, and the core should not be so large as to introduce serious eddy current and hysteresis losses. Transformer manufacturers of the better calibre will tell you what type of transformer they make for use with particular tubes, and will cite the plate voltage and negative bias, as these affect the plate resistance. There is a formula for obtaining the correct turns ratio, and if it will help you we shall be glad to send it on receipt of a stamped, addressed envelope.

* * *

Seven-Pin Tube

WHAT ARE the seven-pin tubes that so much is printed about? I have never seen or run across such a tube.—H. R., Boise, Idaho.

The principal seven-pin tube is the 59, which some of the smaller tube manufacturers have been making, and which is about to be marketed by all the tube makers. It is a multiple purpose tube, the different purposes achieved principally by the method of connecting the various grids. Thus the tube may be a low-mu Class A tube, a Class A pentode or a Class B power tube.

* * *

End in Sight?

HAS the end been reached in the announcement of new tubes, for the present, or may we expect some more announcements?—U. S. A., Ardmore, Pa.

It is safer to expect some more new types, as there are a few gaps still to be filled. Much of the recent advance in radio technique has been made possible by new tubes.

A THOUGHT FOR THE WEEK

"BROTHER, Can You Spare a Dime," from "Americana," is the latest song hit over the air and in the sheet music trade. The publishers have decided not to give a general release on this song, the idea being to preclude the probability of seeing radio help to make a hit and then, by too frequent repetition, as speedily to kill the sales by surfeiting the public taste for a corking good number.

Everybody interested in radio and the music publishing business is watching the outcome of this experiment with a great deal of interest. It might lead to another million copy sale. Let's see!

RADIO WORLD

Title Reg. U. S. Pat. Off.

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.

Forum

An Astrologer Speaks Up

I READ your publication. Sometimes I buy it retail. I always read the advertising. There are always certain things I need.

I take exception to your recent editorial, "Farewell Necromancers!" How you rejoice to say "Out go the astrologers." I expect to republish a publication "Information Weekly," which has no advertisements and that gives radio information. As for astrology—having an investment of about $200 in its literature, in books useful and rare—I ought to know its principles. Being personally acquainted with the astrologers, I ought to know them also. I also practice astrology, however, for my own benefit. I do remember one of the large radio editors and publishers in New York who claimed he was above all planet influence. I told him, in a friendly letter, he would go down and out in spite of his disbelief, and he said "Let's see it happen." It happened.

Astrologers on the air were a nuisance and using the air for profit. It is a good thing to be rid of their tongue. But there is far more in their science than you realize. They were not the chief offenders. All this cussed advertising is rot. I have to turn the dials all over the lot to escape it. The worst offenders have the full support of the government. Political howlers, especially women. Financial houses promising safety and robbing the public. Insull is gone. His companies were very active. Some investment trusts have gathered up and gone but enough remain. Everybody says radio is rotten, meaning it.

FRED E. GREEN,
Newburyport, Mass.

MODEL 28 PHILCO

The complete data on the new Philco 28 superheterodyne were published last week, issue of October 29th.

Radios Classified by Owners' Nativity, Color and Location

The native and foreign-born white residents of the United States run neck and neck as to the percentage of families having radio sets. The percentages are: native, 44.4 per cent., foreign-born, 43.6 per cent. Of the total Negro families, 7.5 per cent. have radio sets.

The final total, considering the 29,904,663 families in the United States, shows radio set ownership in 40.3 per cent.

The Director of the Census Department of Commerce, announced the number of families in the United States having a radio set, by color and nativity of head and for urban and rural areas, as returned in the Fifteenth Census (1930).

The tabulations relating to radio sets show the number of families (not including institutions, etc.) having a radio set at the time the census was taken in April, 1930. (Institutions and other quasi-family groups were included in the preliminary count of families which formed the basis of the series of mimeographed press statements giving the number of families and the number having radio sets, by States and counties. These quasi-family groups, if included, would increase the total number of families by less than three-tenths of 1 per cent.) The figures therefore do not represent the whole number of radio sets in existence or in use, since one family may have two or more sets, and since there are considerable numbers of sets in use in stores and in other commercial and industrial buildings, and in hotels, boarding-houses and institutions.

50% in Urban Families

There were 29,904,663 families in the United States in 1930, of which number, 12,048,762, or 40.3 per cent., had a radio set. Distributed by color and nativity of head of family, 44.4 per cent of the native white families had a radio set; 43.6 per cent. of the foreign-born white families; and 7.5 per cent. of the Negro families.

Of the 17,372,524 urban families in the United States, 8,682,176, or 50 per cent., had a radio set; of the 6,604,637 rural-farm families, 1,371,073, or 20.8 per cent.; of the 5,927,502 rural-nonfarm families, 1,995,513, or 33.7 per cent.; and of the total number of farm families (6,668,681), including the small number living in urban territory, 1,339,495, or 21 per cent., had a radio set.

In the urban population, 56.3 per cent. of the native white families had a radio set, 46.2 per cent. of the foreign-born white families, and 14.4 per cent. of the Negro families; in the farm population, 24.2 per cent of the native white families had a radio set, 32.2 per cent. of the foreign-born white families, and only three-tenths of 1 per cent. of Negro families. These differences are to some extent the result of the geographic distribution of the different classes involved.

Figures Tabulated

The following table gives the number of families in the United States having a radio set, classified by color and nativity of head, with separate figures for urban and rural areas:

	Total	Urban	Rural-farm	Rural-nonfarm	Total farm
All families	29,904,663	17,372,524	6,604,637	5,927,502	*6,668,681
Having radio set:					
Number	12,048,762	8,682,176	1,371,073	1,995,513	1,399,495
Per cent	40.3	50.0	20.8	33.7	21.0
Native white	20,968,803	11,322,555	5,006,748	4,639,500	5,050,808
Having radio set:					
Number	9,315,223	6,377,973	1,202,455	1,734,795	1,224,239
Per cent	44.4	56.3	24.0	37.4	24.2
Foreign-born white	5,736,491	4,535,603	510,889	689,999	526,868
Having radio set:					
Number	2,500,540	2,094,742	163,316	242,482	169,743
Per cent	43.6	46.2	32.0	35.1	32.2
Negro	2,803,756	1,328,170	978,653	496,933	981,038
Having radio set:					
Number	209,779	191,790	3,327	14,662	3,407
Per cent	7.5	14.4	0.3	3.0	0.3

*Includes 64,044 urban-farm families.

The three States having the highest percentage of families reporting a radio set were New Jersey, with 63.4; New York, with 57.9; and Massachusetts, with 57.6. The three States reporting the lowest percentages were Mississippi, with 5.4; South Carolina, with 7.6; and Arkansas, with 9.1.

STATION SPARKS

By Alice Remsen

My Desire

For "A Wayside Cottage"
WOR: Monday, Wednesday and Friday. 7:30 p. m.

When I have my will,
A house on a hill
I'll cover with ivy and such;
And each window sill
With flowers I'll fill,
My door will respond to the touch.
And under my thatch,
When you lift the latch,
A right royal welcome you'll find;
A pipeful—a match—
Some coffee—a batch
Of pancakes—the old-fashioned kind.

And there I will light
A log fire bright;
I shan't worry over the storm.
I'll close the door tight,
And shut out the night,
And keep the house cosy and warm.
My dog will be there—
A comfy armchair—
A bookshelf with all my old friends;
For naught will I care,
With these for my share—
I'll welcome whatever Fate sends.
—A. R.

* * *

And if you listen in to William Adams as Pa, and Vivian Ogden as Ma, in their lovely little program, "A Wayside Cottage," a desire will be created in your heart for just such a little home of contentment. Listen; you'll like them!

* * *

The Radio Rialto

A gloomy day—smells like snow . . . feels like it, too . . . well, we'll take a brisk walk along the old rialto. What say! . . . Right off the reel we run into George Olson and tell him how much we admired his friendly gesture to the Old Maestro, Ben Bernie, the other evening. Ben's mother was very ill. He came in to New York from Chicago, leaving his band in the Windy City; George Olson loaned Ben his band and singers, including Ethel Shutta, in order that Ben might play his radio date for Blue Ribbon Malt . . . and they do say George refused compensation . . . that's what you call a pal. . . . Ben waved a stick over Olson's musickers that night, but his heart was not in his work; his mother had died that morning . . . George Olson, by the way, is packing 'em in at the Hotel New Yorker Grill. . . . Another piece of news we hear is that George Hall is out of the hospital, and back at his old job, conducting the dance orchestra which you hear over WABC coming from the Hotel Taft. . . . Jack Coombs has left the Joe Morris music organization, after being there for five years; he is now with Bibo-Lang, two good friends of mine. . . .

Sponsors are still on the fence, waiting to see which way the cat will jump. Wish the election were over and done with. . . . Mysteries are still holding sway, and, for the life of me, I can't understand why. . . . There's Bill Card, bless his heart, arms full of orchestrations. "Where you going, Bill?" . . . He whistles for a taxi and then tells us . . . "NBC" . . . so we go along, too. . . . First thing we learn is that Hart Giddings has gone South and nobody seems to know when he'll be back. . . . There's Maria Cardinale, looking just as pretty as ever . . . Maria went on Friendship Town for a couple of weeks, made good, and now she's on steady; she's playing a part as well as singing. . . . Speaking of sopranos: heard one recently on a personal appearance date which I played, and I think she's a wonder . . . on a par with Lily Pons . . . her name has slipped my memory, but she is a protege of Eddie Wolfe's, and is bound to be heard on the air very shortly. . . . Georgie Price vacates the Chase and Sanborn program in favor of Eddie Cantor, but he keeps his mid-week tea program on WABC, and may get another big commercial soon. . . . There are not so many musicians around the NBC now; last year you couldn't move without falling over a drummer, or a saxophone player; now there are more actors than musicians. . . . Radio City is coming on apace; won't be long now before 711 will be a memory. . . .

Well, let's vamoose over to WABC. . . . The shops along Fifth Avenue are full of Christmassy looking things—fur coats—woollen dresses—sweaters—and at the corner of 58th Street there is a toy shop which always intrigues me; I could stand and gaze for hours . . . but gracious me, that isn't getting radio news, so in spite of a longing to turn up toward 56th, we resolutely go the other way, down to 52nd and over to Madison. . . . Here we are . . . there's a stand in the lobby, something new. . . . Sells cigars, cigarettes, and yes, by golly, it sells the Radio World and other trade papers . . . the man behind the counter informs me they sell out quickly. . . . First thing we hear at WABC is the fact that the Eno Crime Club series will revise its schedule after this month. Instead of being heard twice a week, with one sketch taking up two broadcasts, the program will be heard only on Wednesday evenings at 9:30 p. m., when a complete mystery story will be offered. . . . There's Evan Evans, the Welsh baritone, who has a good break this season; he is co-featured with Jack Denny on the new Sampler program, sponsored by my favorite candy maker, Whitman. . . . This broadcast is transmitted direct from the Empire Room of the Waldorf-Astoria Hotel, in New York, where Denny is featured with his band. . . . Don Ball, veteran Columbia announcer, and Virginia Arnold, CBS staff pianist, were married the other day, at 8:30 a. m. Although it was known that they were interested in each other, the marriage came as a surprise to their fellow broadcasters. . . . We may be a bit late, but here's congratulations, anyhow.

There are those nice girls, the Three X Sisters, who inform me that the Tidewater program is their first radio experience in this country; although they were born and brought up here in the United States, they learned their remarkable radio technique in Europe. . . . Harry Barris, one of Paul Whiteman's original Rhythm Boys, is now broadcasting regularly over WABC three times weekly from the Coconut Grove, in the Park Central, where he and his band are appearing. This is an exact reproduction of the famous Coconut Grove at the Hotel Ambassador in Los Angeles, where Barris played before coming East. . . . We also learn that, by courtesy of the Board of Directors of the Philadelphia Orchestra Association, a total of eleven Friday afternoon concerts will be heard over WABC. Dr. Stokowski has helped to plan these broadcasts with the purpose of extending to music lovers throughout the country the benefit of good music. . . . Would it interest you to know that baritone William O'Neal is six feet, two inches tall? Well, he is, and he looks like a young giant. . . . He is now heard regularly over Columbia as the result of participating in the Columbia guest revue. . . . The latest fad is collecting those tiny stamp pictures of your favorites and using them on letters, cards, etc. You can get them for one dollar per hundred; they're very cute. . . . Do you remember Don Ameche? . . . I thought you did! You may hear him again, five times a week, from 5:15 to 5:30 p. m. . . . He will play the role of "Captain Jack" in an adventure program for juveniles, sponsored by the John F. Jelke Company. The program will originate from the Chicago CBS studios. . . .

I promised to tell you something about that picture, "The Big Broadcast," didn't I. . . . Well, it's not so hot. . . . Bing Crosby is the shining light, and does very well in the role of a radio crooner—though I thought him much too nonchalant . . . the story itself is very thin, a mere thread on which to hang the radio stars . . . please don't take me literally. . . . Burns and Allen supply some of the comedy . . . Stuart Erwin the rest. Cab Calloway gives the best performance of the radio stars; Donald Novis sings the much-murdered "Trees" in a beautiful voice, but with utter lack of expression; he doesn't even raise an eyebrow. . . . Kate Smith was her usual self . . . the Boswell Sisters photographed well, but I think they used poor judgment in song selection, which probably wasn't their fault. Everybody in radioland was at the preview; we made a good audience, and applauded everything. . . . There are a couple of good songs in the show and they'll be heard plenty over the air. . . . I'm writing this in my sun-parlor . . . there isn't any sun, but I enjoy it just the same, for I'm surrounded by my window-garden, and only this morning a box came from a thoughtful fan of mine, who lives in Pennsylvania, and in the box I found some baby plants, so I'm going to say "toodle-oo!" to you, and get busy re-potting my little green friends.

* * *

Biographical Brevities

ABOUT PAT BARNES

I remember Pat Barnes when he was connected with the National Radio Advertising Company of New York, and I did some work for them. That was three years ago. At that time Pat was writing and directing. At a party one night I saw him do some marvelous imitations and first realized that he was a clever actor. Now I listen to him whenever I get a chance. . . . He was born in Sharon, Pa. Always loved nature, particularly trees. . . . This resulted in Pat becoming a tree surgeon, in which occupation he remained and gained his livelihood for some time. . . . Then, in his early twenties, he became a thespian, and landed on the stage. . . . During his stage career he played most of the characters in the Old Testament of the Bible; the "ghost" in Dickens' "Christmas Carol"; the leads in stock and repertoire, from "Ten Nights in a Barroom" to "Dr. Jekyll and Mr. Hyde," and countless lesser roles.

Then along came the World War and put a stop to Pat's dramatic career. . . . He served with the motor transport division and was mustered out in August, 1919. . . . The first Detroit convention of the American Legion nominated him for president of the transport group and unanimously elected him in a ballot conducted by mail. . . . It was while in the service that he conceived and wrote his famous "Buck on Leave," which he produced in France, appearing himself in one of the leading roles. . . . For this story of life in Uncle Sam's army he won a citation from General Pershing. . . . Upon his return from France he entered motion pictures.

He made his first acquaintance with

(*Continued on next page*)

STATION SPARKS

By Alice Remsen

(Continued from preceding page)

the microphone while playing an engagement at the Duquesne Theatre in Pittsburgh, but it was not until 1924 that he took up broadcasting as the source of his bread and butter. He started in radio as an announcer, at the old station WHT in Chicago, and introduced such novelties as a dramatized weather forecast, set to music. . . . In 1926 and 1927 he won gold and silver cups awarded by Radio Digest as the most popular announcer in the country. . . . In all of his subsequent radio history he has been author, producer and actor in his presentations, among which have been "Old Timer," philosopher of the ether; "Mr. Kelly," whimsical, imaginative, lovable Irishman, who led the listeners on pilgrimages in the "Valley of the Unknown"; "Jim Brown and Joe Be-Dor," the men of the north woods; the "Romances of a Dream Pipe"; and his present "Jimmy and Grandad" skits, which have been running for more than a year and a half over an NBC network; and then there was "The Rookies," which has been called the most vivid and outstanding serial performed on the radio. All his characters are taken from life. The broadcasts emanate from the NBC Chicago studios.

Replies Awaited from DX Hounds

Those who read the special announcement about DX hounds in RADIO WORLD, issue of October 29th, probably have their answers on the way. At least we hope so, for the idea was to conduct a column for the DXers if enough asked for it.

There has been a considerable interest in the idea, but we must have a hearty response to know we are serving the radio fans well.

Well to those who may not have read the announcement it might be well to see a copy.

Anyway the idea of conducting a column for the DXer was brought about by a request.

Since that issue there has been further interest and no doubt a great response will be forthcoming.

Send your letter to me, care RADIO WORLD, 145 West 45th Street, New York,

J. MURRAY BARRON.

FAVORS BOOST FOR KFSD

Washington.

A favorable report on the application of Airfan Radio Corporation, Ltd., operating KFSD, San Diego, Calif., to increase its power from 500 watts at night to 1,000 watts has been made to the Federal Radio Commission by Ellis A. Yost, chief examiner of the Commission.

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.*

Charles S. Sutton, 409 12th St., Toledo, Ohio.
Cecil Boar, 127 Pacific, Ventura, Calif.
Buckels Radio Service, C. C. Buckels, Crichton, Ala.
Leonard McAchren, 2030 Monongahela Ave., Swissvale, Pa.
Stanley Matus, 1023 Toll St., Eddystone, Pa.
C. E. Buchanan, Rt. 2, Box 60, Oklahoma City, Okla.
Mitchell Scinicki, 3324 Edwin St., Hamtramck, Mich.
Patrick Mandarano, 78 Chatsworth Place, New Rochelle, N. Y.
E. H. Wiget, 2432 Collis Ave., Huntington, W. Va.
B. A. Laurie, Box 631, Corpus Christi, Texas.
R. A. Willis, Radio Service, Elmdale, Mich.
J. W. Waite, Grand Hotel, Chattanooga, Tenn.
H. T. Morton, 322 South 28th St., Billings, Mont.
Edward A. Colson, 611 S. Fifth St., Ironton, Ohio.
Sun Elle Co., 105 E. 23rd St., Houston, Texas.
Gilbert Green, Buckley Street, Williamstown, Mass.
Kenneth Kobayashi, No. 31-445 Buckle Lane, Honolulu, Oahu, T. H.
Jos. P. Burns, 533 Riverside Drive, North Tarrytown, N. Y.
R. L. Smith, Box 18, Glenwood, N. C.
George Rasmussen, 1065 Lexington Ave., New York.
G. H. Harper, 3065 Clinton St., N. E., Washington, D. C.
Harold Sheerer, 8 Leon St., Somerville, Mass.
Glen Lorett, care Spec. Delivery Dept., Post Office, Portland, Ore.
C. S. Graves, Graves Radio Service, 77-79 Summer St., Pittsfield, Mass.
Ft. Worth Radio Supply Co., 104 S. 10th St., Ft. Worth, Texas.
Moore Engineering Co., 203 E Main St., El Dorado, Ark.
William E. Boileau, Soldiers Home, Erie, Penna.
Lee G. Bonelli, 1209 Washington St., Vicksburg, Miss.
A. C. Glewwr, 2 Greenough, Jamaica Plain, Mass.
Walter S. Swift, Sea Breeze, N. Y.

New Incorporations

Gould Television, Inc., Wilmington, Del., patents—Attys., Cononial Charter Co., Dover, Del.
Charles Bellitte, Queens, N. Y., radios—Atty., E. A. von Sothen, Jamaica, N. Y.
Kay Electric Supply, Inc., Atlantic City, N. J.—Atty., Joseph B. Perskie, Atlantic City, N. J.
Mayer Pictures, New York City, theatrical enterprises—Atty., A. S. Friend, 521 Fifth Ave., New York City.
New Era Specialties Corp., New York City, sound reproducing devices—Attys., Lee, Donnelly & Curren, 160 Broadway, New York City.
W. B. Buchanan & Son, Inc., Haddonfield, N. J., electrical supplies—Filed by company.
A. Mamlet, Inc., Newark, N. J., electricians—Attys., Minturn & Weinberger, Newark, N. J.

CORPORATE CHANGES

Delaware

Serelco Products Corporation to Pelcode Electric Corporation, New York, N. Y.

CORPORATION REPORTS

Howe Sound Company—Nine months ended Sept. 30: Net loss after taxes, depreciation and other charges, but before depletion, $66,034, contrasted with net profit of $547,025, equal to $1.10 a share on $496,038 no par capital shares, last year. Quarter ended Sept. 30: Net loss after same allowances, $83,241, against $6,114 loss in preceding quarter and net profit of $99,860, or 20 cents a share on $496,038 no par capital shares, in third quarter of 1931.

Zenith Radio Corporation—Quarter ended July 31: Net loss after expenses, depreciation and other charges, $75,842, against $58,511 loss last year.

TRADIOGRAMS

By J. Murray Barron

There are some complaints regarding the tactics of certain types of radio retail stores as to their methods of window display offerings. What often appears to be an attractive price turns out to be a deception by use of "trick" price cards. It is very difficult to handle a situation of this kind, unless one first reads very carefully before entering the establishment. In any case it is well to have a complete understanding as to price and what is included before passing over any money, and where guarantees are talked about to have them in writing, e. g., printed on the sales slip.

* * *

Universal Microphone Company, Inglewood, California, announces a new supermicrophone with a diaphram protected by grille work. A factory survey showing most of the repair work came about through fooling and meddling with the open face caused the addition of the grille. There is also a new type floor stand especially designed for portable work.

* * *

Beginning with the December issue "Television News" will be published as "Radio Review and Television News."

* * *

Servicemen and experimenters who have been following photoelectric cell progress should not wait too long before realizing the great field and opportunity this new science offers. Daily new uses and method are related. Recently in photo-engraving the electric eye commanded a tool to dig into a plate of metal and produce a photo-engraving in a very short time.

* * *

What is considered the most complete demonstration board for dynamic and magnetic speakers has recently been installed at the Try-Mo Radio Company, 85 Cortlandt Street, N. Y. City. A comparative test of more than fifty speakers can be carried on in a few seconds by merely throwing a switch.

* * *

Federated Purchaser, Inc., downtown store at 169 Washington Street, just around the corner from Cortlandt Street, N. Y. City, has made a decided change in the arrangement of the parts counters. It affords more room and a greater outlet for serving customers. Manufacturers of radio receivers or those who handle good kits should be interested in knowing that there is a big demand for such, if efficient and capable of pulling in long distance. The DX fans are much larger in numbers than most persons realize and are always fine prospects as buyers of good receivers, but the sets must be good.

A-C Patent Invalid, Highest Court Rules

Washington.

The United States Supreme Court, without opinion, affirmed the order of the Federal Circuit Court at Philadelphia dismissing the complaint of the Dubilier Condenser Corporation against the Radio Corporation of America concerning infringement of a patent covering alternating current receivers. The lower court had held the patent invalid. The patent involved was Lowell and Dunmore's No. 1455141.

The Dubilier Corporation had sought a review of the case, but this was denied. Except for the possibility of a rehearing before the United States Supreme Court, an exceptional remedy, the case is closed.

Quick-Action Classified Advertisements

7c a Word — $1.00 Minmium Cash With Order

SCHEMATIC BLUEPRINT of any commercial receiver, 25c (coin). 5 Short Wave Blueprints, 25c. Super Engineering, 1313-40th St., Brooklyn, N. Y.

BARGAINS IN FINEST PARTS! — Highest grade, new parts, few of each on hand. National dial, flat type, modernistic escutcheon, type G, clockwise, $2.19; Pilot drum dial No. 1285 @ $1.89; a-c toggle switch, 19c; Aerovox dry electrolytics, bracket, 4 mfd., 500 volts, 39c; three-point, four-throw Best switch, insulated shaft, $1.62; double pole, four throw, $1.08. Direct Radio Co., 145 West 45th St., N. Y. City.

THE FORD MODEL—"A" Car and Model "AA" Truck—Construction, Operation and Repair—Revised New Edition. Ford Car authority. Victor W. Page. 708 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

25 CYCLE filament transformers, 110 v. pri., 2.5 volt c.t. secondary, 8 amperes, 96c. ea. Direct Radio Co., 145 W. 45th St., N. Y. City.

"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Pagé, author of "Modern Gasoline Automobile," "Ford Model A Car and AA Truck," etc., etc. 450 pages, price $2.00. Radio World, 145 W. 45th St., N. Y. City.

"SWOOPE'S LESSONS IN PRACTICAL ELECTRICITY," 17th Edition, Revised by Erich Hausmann, E.E., Sc.D. Requires no previous technical knowledge; fully explains every question about the entire subject of electricity. New chapters on vacuum tubes, telegraphy, telephony and radio signalling. 709 pages, 542 illustrations, 5½ x 8, Cloth, $2.50. Radio World, 145 W. 45th St., New York, N. Y.

BOOKS AT A PRICE

"The Superheterodyne," by J. E. Anderson and Herman Bernard. A treatise on the theory and practice of the outstanding circuit of the day. Special problems of superheterodynes treated authoritatively. Per copy. (Cat. AB-SH), postpaid..50c

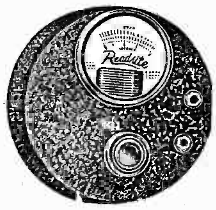
"Foothold on Radio," by Anderson and Bernard. A simple and elementary exposition of how broadcasting is conducted, with some receiver circuits and an explanation of their functioning. (Cat. AB-FH), postpaid 25c

Guaranty Radio Goods Co., 145 W. 45th St., N. Y. City

THREE-IN-ONE TESTER *FREE!*

EVERYBODY who does any radio work whatsoever, whether for fun or for pay or for both, needs a continuity tester, so he can discover opens or shorts when testing.

A mere continuity tester is all right, but—



Often it is desired to determine the resistance value of a unit, to determine if it is correct, or to measure a low voltage, and then a continuity tester that is also a direct-reading ohmmeter and a DC voltmeter comes in triply handy.

So here is the combination of all three:

A 0-4½-volt DC voltmeter, a 0-10,000-ohm ohmmeter and a continuity tester. A rheostat is built in for correct zero resistance adjustment or maximum voltage adjustment. The unit contains a three-cell flashlight battery. Supplied with two 5-foot-long wire leads with tip plugs. Case is 4-inch diameter baked enamel. Weight, 1 lb. Sent you with an order for one year's subscription for RADIO WORLD (52 weeks) at the regular rate of $6. Order Cat. PR-500. Use Coupon below.

Radio World, 145 W. 45th Street, New York, N. Y

Enclosed please find $6 for one year's subscription for Radio World (one copy a week, 52 issues). Send Cat. PR-500 as premium.

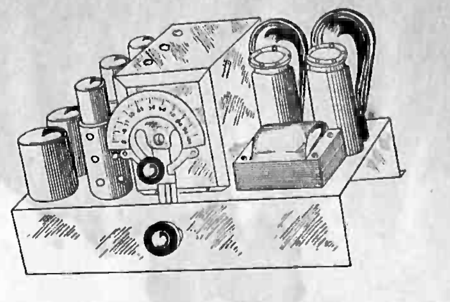
Name ....

Address ....

City .... **State**..............

5-TUBE DIAMOND

A TUNED radio frequency set, two stages of t-r-f (58 tubes) and tuned detector input (57 tube). One stage of audio ('47) and rectifier ('80). For 105-120 v. a-c, 50-60 cycles. Extremely high sensitivity for a t-r-f set —10 microvolts per meter at 1,000 kc. Brings in the high wavelength stations with tremendous volume, as well as the low wavelength stations. One knob for dial, one for volume control-switch. Selectivity to meet modern needs. Tone of the first quality.



Coils, tubes and tuning condenser in the Five-Tube Diamond are fully shielded.

COMPLETE KIT (Less Tubes and Cabinet)........$15.69

The 5-Tube Diamond uses a three-gang tuning condenser with a midline tuning characteristic and affords a coverage of from 1520 to 500 kc (below 200 meters, to 600 meters). This affords excellent quiet spots past either extreme of the broadcast band for operation with short-wave converters.

Precision shielded coils are used in the circuit, matched to plus or minus 0.6 microhenry. The vernier dial, travelling light type, has 1-to-5 ratio, for close tuning.

The complete parts—chassis, Rola 8" speaker, power transformer—everything except tubes and cabinet, is Cat. D5CK @...........$15.69

FOUNDATION UNIT..............................$6.19

Drilled metal subpanel, 13¾ x 8⅝ x 2¼", cadmium plated, with mounting flap at rear......$0.92

Three-gang Scovill 0.00035 mfd. condenser, midline tuning, brass plates, trimmers built in, ⅜-inch diameter shaft at both ends; full shield.............................. 1.95

Three special tube shields for the 58 and 57 tubes.............................. .33

Six sockets (one for speaker plug).............................. .66

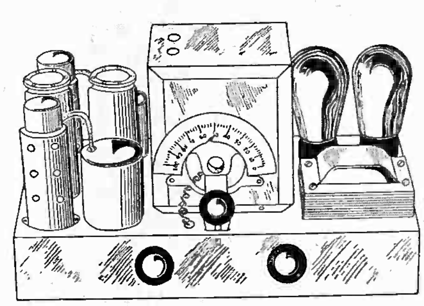
Two Polymet 8 mfd. wet electrolytic condensers, inverted type; insulators; lugs............ .98

One set of three shielded coils (antenna coupler and two interstage transformers).......... 1.35

Foundation Unit (Cat. D5FU)..............................$6.19

Kit of five Eveready-Raytheon tubes for this circuit, Cat. D5T..............................$4.97

4-TUBE DIAMOND



Excellent parts and an original circuit make the 4-Tube Diamond remarkable.

HOW much can be accomplished in an a-c set on only four tubes was revealed when the 4-Tube Diamond was announced and demonstrated recently. This remarkable circuit has the utmost in tone, and all that can be obtained in selectivity and sensitivity from a 4-tube design. It is heartily recommended and will give enduring satisfaction. The chief praise heard of the circuit concerns its tone. The other qualties are not deficient, however.

Complete Kit (Less Tubes, Less Cabinet) $13.58

All the parts, except cabinet and tubes, are supplied in the official kit, including Rola 8" dynamic, chassis, shielded condenser, dial, etc.

Kit of four Eveready-Raytheon tubes for this circuit, Cat. D4TK........$3.89

FOUNDATION UNIT $5.48

Drilled metal plated subpanel 13¾ x 2½ x 7"; cadmium plated, with mounting flap at rear..$ .85

Two-gang 0.00035 mfd. SFL condenser, brass plates, 2½" long shaft; full shield........... 1.39

Two special tube shields for 58-57.............................. .22

Center-tapped 200-turn honeycomb coil.............................. .40

Five sockets (one for speaker plug).............................. .55

Two Polymet 8 mfd. electrolytics; insulators; lugs.............................. .98

One pair of r-f coils, consisting of impedance antenna coil and interstage transformer...... .90

20-100 mmfd. Hammarlund equalizer for use as antenna series condenser.................. .19

Cat. D4FU @ $5.48

8 MFD.

The Rola Series F speakers with 1800-ohm field coil tapped at 300 ohms are now standard in the 4-Tube and the 5-Tube Diamonds. The list of parts specifies the 8" diameter speaker, but larger diameters may be used, to fit any particular console. The small model is intended for mantel set installations.

The Rola speakers are supplied with 5-lead cable and plug. The output transformer built in is matched to the **impedance of a** single '47.

8" diameter (Cat. RO-8)....$3.83

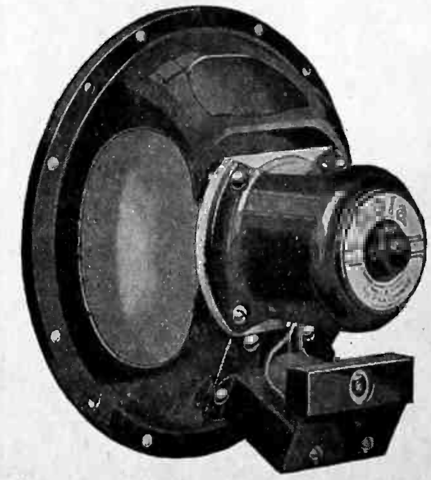
10.5" diameter (Cat. RO.-105) 4.27

12" diameter (Cat. RO-12).. 5.35

* * *

8 mfd. Polymet wet electrolytic condenser, inverted mounting, insulating washers (Cat. POLY-8) $0.49

ROLA SPEAKERS



POWER TRANSFORMERS { **4-Tube Diamond (Cat. D4PT) . $1.49** / **5-Tube Diamond (Cat. D5PT) . 2.16** }

Travelling light vernier dial, 5-to-1 (0-100 for 5-tube, 100-0 for 4-tube); lamp; escutcheon; knob. Same dial takes either ¼ or ⅜" shafts..............................$0.91

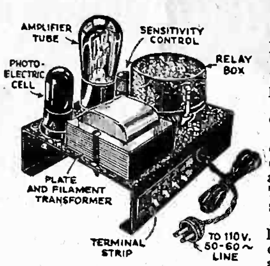
DIRECT RADIO CO., 143 West 45th Street, New York City

NOVEMBER SPECIALS!!

EVERY month we list on this page certain *STAR* ★ items, which are NOT LISTED IN OUR CATALOG. These are all specials of which the quantities on hand are not sufficient to catalog them. *Once sold out, no more can be had.* First come, first served. ORDER NOW, TODAY.

STOP SHOPPING. The lowest prices are right on this page. *No one undersells us.* We meet any price on ANY NEW Merchandise. Order direct from this page and save money. 100% satisfaction on every transaction. Take advantage of these special offers. ORDER NOW, TODAY.

G-M PHOTO-RELAY SWITCH For 110-20 Volts 60 Cycle A.C.

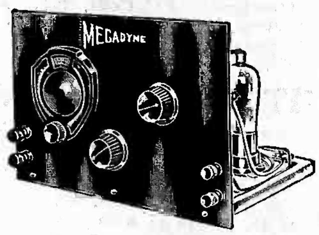


This new unit is an actual Photoelectric Relay containing all the principal parts used in the more costly industrial units. It comes fully equipped with a VISITRON Type B Caesium Cell, Magnetic Relay with special winding and silver contacts, Transformer of large capacity, Amplifier Tube, Wire-Wound Potentiometer, Condensers, Terminal Strip, Sockets, Chassis, etc. This unit can be made the foundation of such photoelectric applications as burglar alarms, door-opening equipment, illumination control, race timing, counting, control of window displays and illumination, and myriad other installations. **The Foto-Switch**

No. 1222A—Photo-Switch. Your Price **$15.00**

"MEGADYNE" ONE-TUBE PENTODE LOUDSPEAKER RECEIVER KIT

In the front part of our catalog—get your FREE copy now—there is presented a thoroughly illustrated discussion on the construction and operation of the MEGADYNE Receiver by Hugo Gernsback, editor. This ingenious circuit was originally described in the July issue of the RADIO CRAFT Magazine. FREE copy of which will be given with each purchase. This receiver is indeed one of the most outstanding developments in the radio industry. It is the first real one-tube receiver which will actually operate a loudspeaker. Thousands of experimenters and radio fans will want to build this remarkable receiver. For their convenience, we have compiled a complete list of parts required for its construction. These parts are of the highest quality and are exactly as specified by the author. The following parts comprise the complete kit.



1 B.M.S. Fixed Crystal Detector; 1 6-ohm Filament Rheostat; 1 3-circuit tuner for use with a .0005 mf. tuning condenser; 1 Na-ald type 481 UY 5-prong socket; 1 Hammarlund type ML-23 Variable Condenser; 2 sets of Cinch double binding posts; 1 Polymet .00025 mf. fixed condenser; 1 X-L Variodenser; 1 Polymet .00025 mf. fixed condenser, or 1 Polymet .0005 mf. fixed condenser. (NOTE: Only one of the latter two condensers is actually employed in the circuit); 5 Fahnestock binding posts" 1 25-ft. roll of hookup wire; 2 black Bakelite 1½" knobs; 1 Kurz-Kasch vernier dial with 0 to 100 scale reading clockwise; 1 type 38 pentode tube, "Triad" or "Speed"; 1 Bakelite Panel **already drilled with all holes,** size 7 x 10 x 3/16 inch; 1 hardware assortment. The wooden base is not included.

No. 2545—Megadyne Receiver Kit. Your Price.... **$10.25**

ELIMINATES NOISE AND CROSS-TALK

Service men throughout the world are beginning to realize the importance as well as the advantages obtained through the use of a shielded lead-in wire from antenna to radio receiver. More than 75 per cent of the complaints of "noisy" and "inselective" receivers may be eliminated by merely replacing the old, unshielded wire which leads from the aerial on the roof to the radio set with this new type of wire. Not only does it help to clear radio noises but to a certain extent, it makes the receiver more selective due to the capacity effect between the wire core and the metal shield. Easily installed. The wire core is connected between aerial on the roof and antenna post on receiver. The outer shield is connected to ground. Every service man should carry at least one spare roll of shielded wire in his service kit.

No. 1665. 50 Ft. Roll Shielded Lead-in Wire.. $ .85
No. 1668. 100 Ft. Roll Shielded Lead-in Wire.. 1.60

★ "PEERLESS" DIRECT COUPLED AMPLIFIERS

All the latest features in amplifier design have been incorporated in this direct coupled amplifier. Input terminals for permitting phonograph attachment, and in addition, by attaching the proper microphone transformer, also dry cell batteries, a microphone may be used for public address work. Any type of receiver can be connected to the input terminals without fear of loss of energy. These amplifiers are for use with dynamic speakers.

Amplifiers supply field current of 2500 ohms to dynamic speakers. Resistors are furnished when A.C. speakers are used. Amplifiers operate on 110 volts, A. C., 60 cycles.

Model SP-5003 uses 1—224, 1—245 and 1—280. Output is rated at 3 watts.

No. SP-5003—Your Price........**$10.95** (less tubes)
Exactly the same amplifier, but employs a power pentode in place of the 245 tube. Output 3.5 watts.

No. SP-5004—Your Price........**$12.95** (less tubes)
Model SP-5005 uses 1—224, 1—250 and 1—281. Consumption is 85 watts; maximum undistorted output, 6 watts. Gain rated at 1000 cycles, 55db; gain at 10,000 cycles, 51.5. Input direct to 224 control grid; output direct from 250 plate.

No. SP-5005—Your Price........**$15.25** (less tubes)

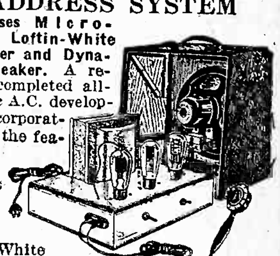
FREE RADIO AND SHORT WAVE TREATISE

The new and enlarged Summer edition of our Radio and Short Wave Treatise, No. 25, has just come off the press—**100 solid pages of useful information, radio items, diagrams and illustrations.** Positively the greatest book in print—**NOT JUST ANOTHER CATALOG.** Contains a large editorial section with valuable information not found anywhere else. Considerable space is devoted to a **TREATISE ON SHORT WAVES** for both beginners and regular "hams." Among the new technical information listed are the following: **Modernizing old radio sets—repairing speakers and headsets—making superhets out of old sets—data on constructing two-volt battery and automobile receivers—circuit of the famous Gernsback Megadyne One-Tube Loudspeaker Set—short wave coil winding data—discussion on S.W. adapters, converters and receivers, etc., etc.**

100 New Hook-Ups, Etc. 1000 Illustrations.

WRITE TODAY. Enclose 4 cents for postage. Treatise sent by return mail.

★ PORTABLE PUBLIC ADDRESS SYSTEM



Comprises Microphone, Loftin-White Amplifier and Dynamic Speaker. A recently completed all-electric A.C. development incorporating all the features and advantages of the direct-coupled Loftin-White Amplifier principle. The amplifier is a high quality two stage job, having some **RADICALLY NEW IDEAS IN AUDIO FREQUENCY AMPLIFICATION** and employing 1-'27, 1-'45 power tube and 1-'80 full-wave rectifier. It is remarkably free from A.C. hum.

The design is adaptable to all purposes, i.e., microphone, radio and phonograph. Has an undistorted power output of approximately 3.5 watts; **SUFFICIENT TO OPERATE FROM 2 TO 3 ADDITIONAL DYNAMIC SPEAKERS.**

The portable address system is sold **COMPLETE WITH THE NEW R.C.A.-VICTOR HAND MICROPHONE.**

Put up in a single compact and perfectly balanced carrying case, the front of which is utilized as a baffle for the self-contained dynamic speaker. Complete with microphone and accessories the weight is only 30 pounds. For 50-60 cycles, 110-120 volts A.C. operation. Shipping weight, 38 pounds.

List Price, $75.00

No. SP-5011—Versatile Portable Address System Your Price, complete with microphone... **$24.95**

★ SILVER-MARSHALL AUDITORIUM AMPLIFIER

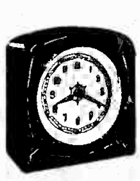
CONTAINS 2 STAGES SUPER POWER A. F. AMPLIFICATION

Ideal for theatres seating approximately 3,000 people, dance halls, schools, lectures, hospitals, auditoriums, outdoor gatherings, etc., etc. The gigantic power is at all times within control—for that matter it can be used in any home, as the volume can be regulated down to a whisper!

Supplies all necessary A, B and C. power to its own tubes. Operation requires one type X250 power tube, one X226 A.C. tube and two type X281 rectifier tubes. Attractive crystalline finish metal cabinet. 21x5¾x5½ in. Shipping weight, 38 lbs.

No. SP-5006—Your Price.............................. **$12.75**

★ SYNCHROMATIC ELECTRIC CLOCK



Never was such a first class electric clock sold at such a ridiculously low price. An electric clock using **the famous synchromatic movement.** Naval observatory time right from your light socket! No spring to wind, no batteries. Never out of order. Lubricated for a life-time at the factory. Enclosed in a dust-proof and shockproof genuine molded Bakelite case. The case is of walnut-brown finish with simple but catching design. For 110 volts, 60 cycle A.C. operation only. Complete with cord and attachment plug. Size 3⅞"x4⅛"x1⅞". Weight 1 lb. Service men now sell these fine clocks by the hundreds. Be the first in your locality to handle them.

List Price $3.00

No. 1689—Synchromatic Electric Clock. Your Price **$1.00**

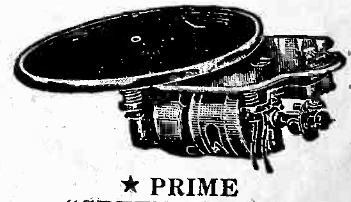
★ METALLIZED PIGTAIL RESISTORS AT ROCK BOTTOM PRICES

A very fortunate purchase enables us to offer these fine resistors at prices which surprise even ourselves—prices more than three times lower than in our own catalog. Resistors are guaranteed to maintain their ohmage under even adverse operating conditions. **The resistance element is based on the famous metallized principle** which has proven its superiority wherever accuracy and uniformity are paramount requisites. The special ceramic casing of these resistors is of sturdy construction and **affords maximum heat dissipation.** A feature of these resistors is their molded end-caps, tapered so they can be mounted in all standard resistor mounts. By means of their pigtails, they may also be soldered in any convenient position. Available in the following sizes—all rated at one watt: 300, 450, 600, 8,000, 10,000, 12,000, 350,000. Act fast to take advantage of this offer, as the supply is limited. Sold only in lots of six or more.

Values Clearly Marked on Each Unit

No. SP2226. Metallized Resistors. YOUR PRICE...... **NOW 6c EACH** 12 for 60c.

★ PRIME "GREEN GIANT" Electric Phonograph Motor



Induction type model with newly improved, humless motor. Equipped with speed regulator, also "on and off" switch. Completely equipped with large turn-table—takes records up to 12" in diameter. An ideal motor for electrifying the old phonograph. When used in conjunction with any amplifier on this page superb electrical reproduction is obtained.

No. 100—Your Price........ **$7.50**

WE ARE A WHOLESALE HOUSE AND CANNOT ACCEPT ORDERS FOR LESS THAN $3.00.
If C. O. D. shipment is desired, please remit 20% remittance, which must accompany all orders.
If full cash accompanies order, deduct 2% discount. Send money order—certified check—U. S. stamps.

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