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RADIO WORLD

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The First and Only National Radio Weekly

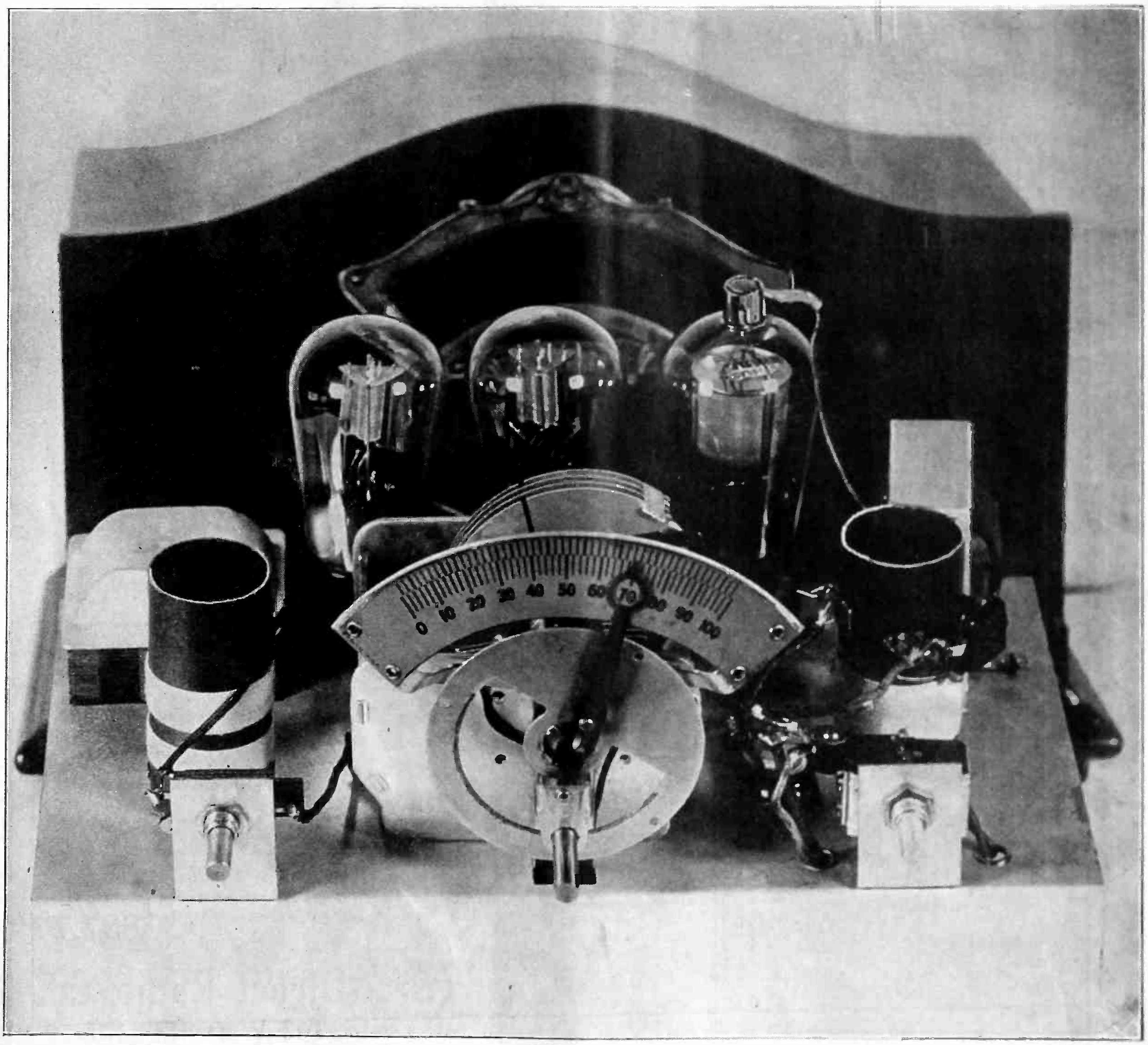
Twelfth Year *584th Consecutive Issue*

CONSTRUCTION OF 12-TUBE DIAMOND

RECTIFIER METERS

1-TUBE S-W SET

WIDE-BAND FILTER FOR TELEVISION



An up-to-date, self-powered short-wave converter. See pages 12 and 13.

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RADIO WORLD

The First and Only National Radio Weekly
TWELFTH YEAR

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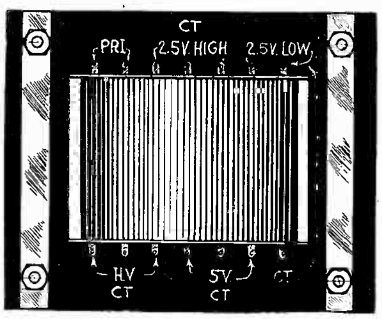
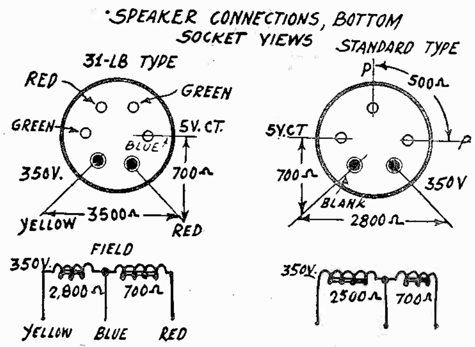
Detailed Construction Data on the 12-TUBE DIAMOND

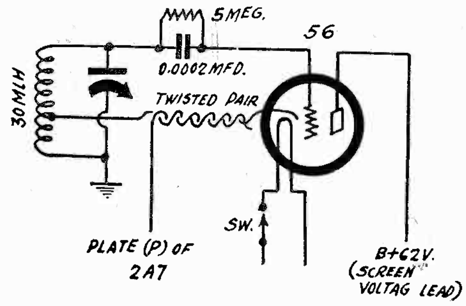
By Herman Bernard



The 10.5-lb. power transformer used in the 12-Tube Diamond follows the code shown above. On the transformer the primary lugs are marked P and P, and the code gives the other lug identifications on a basis relative to primary.



There are two types of speakers available, one the standard type, the other a 31-lb., 25-watt type. The diagrams show the connections for both. The set can put out 15 watts of power.



Circuit for the built-in test oscillator. For r-f line-up remove the two r-f 58 tubes and the 2A7. For r-f line-up leave them in. The oscillation field is strong enough for self-coupling at r-f, i. e., mere radiation.

THE diagram and the list of parts of the 12-tube Double Push-Pull Super Diamond are printed herewith, and details not heretofore given concerning this circuit will be set forth in the order in which the parts are listed.

Coils

The three radio-frequency transformers have secondary inductances of 230 microhenries, to be tuned with 0.00041 mfd. condensers. There is a tap on the secondary to permit coverage of from 1,500-4,500 kc. This frequency range takes in all the police signals, three amateur bands, some aircraft communication channels and some relayed program broadcasting. However, the receiver is primarily intended for broadcast reception. Many broadcast listeners do not know about the vagaries of short waves, so might think there was something wrong with the set if on some night the short-wave signals were weak, or smothered in static, or interference on those bands was unusually high, which is frequently the trouble when listening to amateurs, and has nothing to do with the receiver itself.

Coils for the Set

So that the tuning system will work as a whole, the oscillator coil has a smaller secondary inductance (126 microhenries), and the tap is lower down. For broadcasts it is necessary to use a padding condenser. This is shown and specified as 350-450 mmfd. For short waves it is not necessary to use any padding condenser, and the one in service for the broadcast band would not do at all, being then too small a capacity. So inductive padding is resorted to, which is taken care of by the tap location.

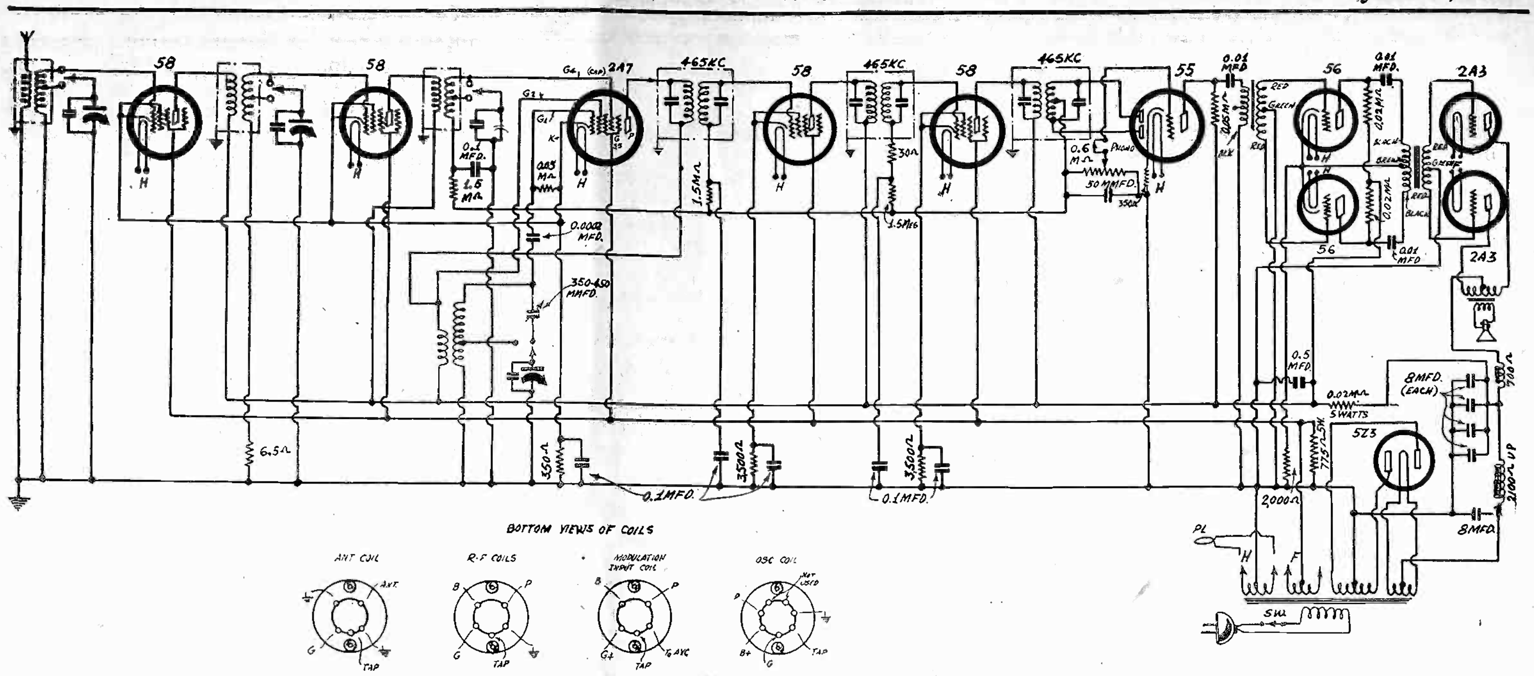
The coils are enclosed in aluminum shields 2½ inches high, 2⅛ inches outside diameter, and are wound on 1-inch diameter forms.

There are three intermediate transformers, with both primaries and secondaries tuned, the condensers tuning them having air dielectric. These condensers have a capacity range from 56 to 90 mmfd., as there is a built-in minimum of 56 mmfd., the variation being confined to 34 mmfd. Two transformers are alike, consisting of usual primary and secondary, but the third intermediate coil, the one feeding the 55, has its secondary center-tapped. All three coils have the plate condenser accessible from beneath the chassis and the grid condenser accessible from the top. When the adjustment is made, if any, the grid should be tuned properly all through, the plate tackled next, and after the plate condensers are adusted the grid condensers are not molested.

Built-in Oscillator

These intermediate coils are peaked at the factory at 465 kc, so one gets at least a good adherence to the desired intermediate frequency. However, circuit

(*Continued on next page*)



The circuit diagram of the 11-Tube Push-Pull Diamond, to which a test oscillator, diagramed elsewhere, is added. The oscillator coil connections are always in the order shown, though lug positions may be slightly different. Look inside the coil. The long enamel lead to top of form is for grid (G), the relative positions of other lugs as drawn. The resistor marked 0.02 meg. 5 watts may be 0.015 meg. (15,000 ohms) 5 watts.

(*Continued from preceding page*)
conditions change the resonance, for instance bias and other d-c voltage values, as well as coupling media, and while any two transformers may be lined up to match one at the resonant frequency of that one, whether the frequency is exactly 465 kc will then be not quite certain. In other words, the circuit could be lined up on the basis of any one intermediate coil, but since we are striving for just 465 kc, we shall adopt an auxiliary method.

That method consists of using a built-in oscillator for lining up the intermediate channel. This oscillator is a Hartley, uses a 56 tube, and has a high value of grid leak, so that the blocking grid will produce a high-pitched note, which constitutes the modulation. The tube oscillates both at the intermediate and at an audio frequency.

A switch is provided so that the oscillator's heater supply source is cut off when oscillation is not desired. It is well to use this oscillator first for lining up the intermediate, then for adjusting the padding condenser and the trimming condensers, a method sketched last week, but which will be detailed now.

Establishing 116.25 kc

The tuning coil is a radio frequency choke coil if of 30 millihenries inductance, the maximum of the variable condenser across it is 63 mmfd., and the resonant frequency is then 115.6 kc, but since the condenser is variable, the capacity is reduced slightly, to 62.5 mmfd., for exactly 116.25 kc. If another receiver or oscillator is at hand, the setting may be checked against any of the following in the broadcast range of frequencies, whereupon a beat will result: 581.25, 697.5, 813.75, 930, 1,046.25, 1,162.5, 1,278.75, 1,395 kc, or with an accurate intermediate frequency oscillator at 116.25, 232.5, 348.75 or 465 kc. The frequencies above 116.25 kc are harmonics and it can be seen that 465 kc is the fourth harmonic.

The reason for using the 116.25 kc frequency is that the same oscillator is serviceable for lining up the front end of the set. This advantage obtains without confusion by harmonics when peaking the intermediates, for the i-f transformers will not tune to any harmonic of the fundamental other than the fourth, due to purposeful restriction of their frequency range.

It is usual to line up the front end by padding the oscillator at 600 kc and then by trimming the r-f and oscillator, although in the second instance parallel trimmers are used alone. When we inspect the list of harmonics we discover that 581.25 kc is only 18.75 kc lower than 600 kc, or about a 3 per cent. difference, therefore it is obvious that the fifth harmonic is entirely satisfactory for the low frequency line-up.

The 581.25 kc Setting

A word about this adjustment. No aerial need be used. The oscillator isn't connected to the antenna post. All trimmers are turned down about half way. The padding condenser is adjusted for maximum response. The trimmers on all the r-f condensers are tentatively adjusted for strongest response and the set dial is turned to near the high frequency end, where 1,395 kc is heard, and the r-f trimmers next are adjusted for maximum response. The local oscillator trimmer is changed from maximum to minimum to determine the position for greatest volume of sound (or maximum needle deflection if an output meter is used), and then at 581.25 kc the series padding condenser is given a slight readjustment, if it is found that response is increased that way, which would be true only if the ultimate setting of the oscillator trimmer were somewhat different from the one that originally obtained.

So, first line up the intermediates, then make the preliminary low frequency r-f adjustment, which requires no shifting of oscillator connection from intermediate to antenna post, and then make the high frequency adjustment, finally checking up on the series padding condenser only. The high frequency broadcast adjustment does not require that the set be operated in t-r-f fashion.

When the receiver is properly lined up there should be no squeals whatever arising from any cause in the receiver, but of course some squeals may be heard due to the great sensitivity, since some foreign stations are 5 kc removed from United States stations, and 5 kc is an audible frequency.

No Oscillation or Regeneration

Of course neither the r-f level nor the i-f level should be oscillating. There is no expectation that there will be r-f oscillation, except such as results from gross mispadding, when at some high frequency broadcast points the oscillator and r-f frequencies are almost the same, but it is supposed the builder knows enough to use less parallel capacity in the oscillator to avoid that. A metal chassis bottom will cure any r-f oscillation, since it would be conductively connected to grounded chassis.

The intermediate amplifier may oscillate, for the receiver is to be operated just under the point of oscillation, for maximum sensitivity, and no ready directions can be given for stability attainment at once, without sacrificing sensitivity.

The intermediate amplifier may regenerate a bit, when there is a squeal at a few points, whereas with oscillation there would be squeals all over the dial. At all hazards, the remedies are the same. The middle intermediate transformer may be detuned by adjusting the set-screw at top until the regeneration or oscillation disappears, to locate trouble. An 0.06 meg. may be interposed between plate of either first or second i-f tube and grounded chassis, whichever is more effective. Another method would be to reduce the screen voltage on the two i-f tubes by putting a 50,000-ohm resistor between each of these screens and the general screen voltage lead, bypassing the two screens to ground with any condenser from 0.01 mfd. up.

Any changes as suggested should be followed by relining the intermediate, as the changes slightly alter the frequency previously established.

These directions are complete and will stop i-f oscillation or regeneration.

Audio Transformers

The audio transformers are alike and have both primaries and secondaries center-tapped. In the first instance the primary center tap is not used, as this is effectively across the 55 plate circuit. The ratio of transformation, primary to secondary, when the transformer is used this way, is 1 to 1½. In the next stage, when both center taps are used, the ratio of transformer is 1 to 3, for the husky output tubes, which stand a 61-volt grid swing and deliver 15 watts maximum output power at full load signal, will stand the now doubled increase in voltage due to transformation.

The power transformer is extra-husky. Generally not more than 120 ma will be drawn for B supply, but the transformer secondary is gaited to 150 ma, and the

LIST OF PARTS

Coils

Three shielded radio frequency transformers, secondary tapped for 1,400-4,500 kc.
One shielded oscillator coil, secondary tapped for 1,565-4,965 kc.
Two shielded Hammarlund intermediate transformers, air-dielectric-condenser tuned, both as to primary and secondary; 465 kc.
One shielded Hammarlund intermediate transformer, air-dielectric-condenser tuned, both as to primary and secondary; secondary center-tapped; 465 kc.
One tapped 30-millihenry honeycomb choke.
Two audio-frequency transformers, primary and secondary both center-tapped. Center on primary of one not used.
One 150-watt power transformer; primary, 115 volts, 50-60 cycles; secondaries: (a), 2.5 volts, 10 amperes, center-tapped, for heaters; (b), 2.5 volts, 6 amperes, center-tapped, for power tubes; (c), 5 volts, 3 amperes, center-tapped, for rectifier; (d), 800-volt center-tapped for high voltage of full-wave rectifier; stands 150 ma @ 400 volts d.c.
One dynamic speaker, 12 inch diameter: 2,800-ohm or higher resistance field, tapped at 700 ohms or more, windings reversed in respect to common point; output transformer for 2A3 tubes in push-pull built in. Cable and UY plug attached.

Condensers

One four-gang 0.00041 mfd. tuning condenser with trimmers built in; shaft ¼-inch diameter, 1⅛-inches long.
One padding condenser, 350-450 mmfd.
One 50 mmfd. mica condenser.
Two 0.0002 mfd. mica grid condensers.
Three 0.01 mfd. mica stopping condensers.
Six 0.1 mfd. bypass condensers.
One 0.5 mfd. bypass condenser.
Five 8 mfd. electrolytic condensers.

Resistors

One 6.5-ohm resistor.
One 30-ohm resistor.
Two 350-ohm pigtail resistors.
One 775-ohm 5-watt pigtail resistor, wire-wound.
One 2,000-ohm pigtail resistor.
Two 3,500-ohm pigtail resistors.
One 20,000-ohm or 15,000-ohm 5-watt pigtail resistor, wire-wound.
Two 20,000-ohm pigtail resistors.
Two 50,000-ohm pigtail resistors.
Three 1.5-meg. pigtail resistors.
One 0.6-meg. potentiometer with switch attached.
One 5-meg. pigtail resistor.

Other Requirements

One five-pole, double-throw switch, insulated shaft type.
One toggle switch for 116.25 kc. oscillator.
One toggle switch for phonograph pickup (optional).
Six grid clips.
Twelve sockets: five six-hole, four five-hole (UY), three four-hole (UX). The extra UY socket is for speaker plug.
Nine tube shields and bases.
One a-c cable and plug.
One antenna-ground binding post assembly.
One phonograph twin jack.
One vernier dial, traveling light type, with pilot lamp and escutcheon.
Length of flexible wire for pilot lamp connections.
One roll of hookup wire.
Four 12/24 nuts for power transformer.
Three dozen 6/32 nuts and bolts.
One a-c cable bracket with lug affixed.
Three knobs.
One chassis 18½x10x3 inches.
One metal bottom piece to fit chassis.
Six insulated bushings tapped at both ends for 6/32 screws.
Six lugs.
One 6/32 bolt, 1½ inches long, for wave switch.
One a-c cable bracket with lugs affixed.
Three knobs.
Tubes: four 58's, one 2A7, one 55, three 56's, two 2A3's and one 5Z3.

same general margin of safety obtains in the other windings. The transformer, unpacked, weighs 10.5 lbs. It has worked satisfactorily even on a 20-tube set.

Speaker Data

The dynamic speaker specified is the 12-inch diameter type of usual construction, with a good output transformer built in, and a field coil that will stand the 120 ma, but will get hot after a few hours use. This heat is not detrimental and need not be feared. However, a speaker that costs more than three times as much as the other, weighing 31-lbs, may be obtained commercially, which will stand 25 watts, or more than the set can deliver undistortedly. The lighter speaker will not well carry the 15 watts for sustained periods, but of course for home use nothing like 15 watts would be used, but nearer to a few watts generally. Extra power is for safeguarding against distortion otherwise present when there is a sudden demand on set and speaker, as during heavy low-note passages in an orchestra or band, or even when a talker gets loudly energetic.

Condensers

The four-gang condenser has high walls between sections comprising sectional shields, but there is no necessity to shield the condenser as a whole.

The padding condenser may be of the adjustable type, 350-450 mmfd., and is set near maximum. However, there is also obtainable a highly accurate fixed condenser combination in molded bakelite case, and thus moisture-proof and vibration-proof, which may be used instead. Most experimenters prefer the adjustable type.

The 50 mmfd. condenser across the potentiometer is large enough for the bypass purposes. The larger the capacity, the lower the sensitivity of the set, except that if the i-f is oscillating, then anything that stops the trouble increases the sensitivity, and considerably greater than 50 mmfd. will help stop oscillation, though not recommended, because of attenuation of high audio frequencies.

The 0.0002 mfd. grid condensers are not critical, and the more conventional 0.00025 mfd. may be used instead.

The Higher Capacities

The 0.01 mfd. stopping condensers are large enough, due to a sensible amount of low-frequency feedback in the audio amplifier.

The 0.1 mfd. bypass condensers may be individual or in pairs, or one block affording numerous different capacities, none less than 0.1 mfd., may be used. For instance, one such block has two 0.25 mfd., useful in parallel for the 0.5 mfd. purpose, and nine 0.1 mfd., the three extra 0.1 mfd. being all right to be put in parallel with the two 0.5 mfd. to constitute 0.7 mfd., if desired.

The Electrolytic Condensers

The electrolytic condensers may be wet or dry, as inverted mounting is used, but certain types of dry condensers stand better the high voltage next to the rectifier, so if you have any choice make it on this basis.

Resistors

The 350-ohm resistor in the common cathode leg of the two r-f and the mixer tubes biases those tubes negatively, around 3 volts. While relatively small increases in resistance value here will decrease sensitivity considerably, the method should not be used for correction of any r-f oscillation, because one tube usually will be oscillating, and it is too crippling to increase the bias on all three tubes. The other similar resistor, in the 55 cathode, is discussed later.

The 6.5-ohm resistor in series with the second r-f tuned circuit and the 30-ohm resistor in series with the second i-f tuned circuit are stabilizing devices, and their inclusion should render it unnecessary to resort to any further methods of stopping oscillation, the previous directions having been given on the basis of the unusual instance of oscillation at either level after the stabilizers are inserted. It is assumed the oscillation would be confined to the two circuits specified—the second stage in each instance—because conditions purposely introduced experimentally caused oscillation to appear only in those two stages. However, at the intermediate level, sometimes it will be the first r-f tube, and if so put the 30 ohms in that circuit.

Other Biasing Resistors

The 775-ohm biasing resistor for the power tubes will get hot, but this will not impair it. No condenser is across this resistor, as with a balanced circuit there is no signal voltage in this leg.

The bias for the 56 push-pull pair is obtained from the voltage drop in the 2,000-ohm resistor, which unit for the same reason has no condenser across it.

While lower values of resistance than 3,500 ohms may be used for the intermediate tube biasing, results were found to be generally satisfactory with this value, especially since the B current is low, due to low screen voltage principally.

So that direct current is kept out of the primary of the first audio transformer, resistors of 20,000 ohms each are in the plate circuits, while stopping condensers keep the positive d.c. voltage on the plates from getting to the primary winding. The signal is returned to the neutral point, cathode.

The 20,000-ohm 5-watt resistor drops the maximum filtered B voltage to the

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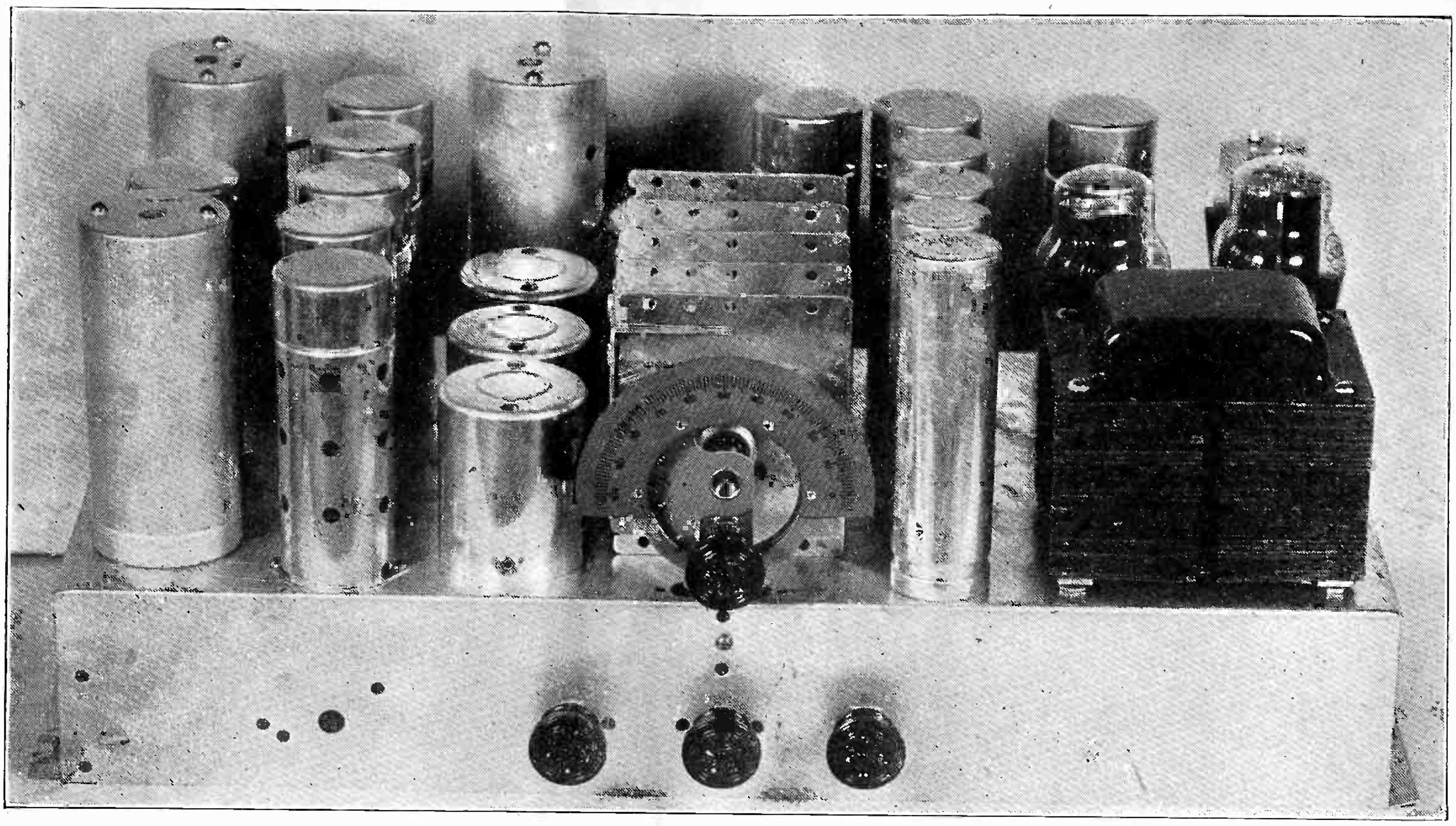


The chassis of the 12-tube Double Push-Pull Diamond. The antenna coil is hidden behind the tuning condenser. The three coils to left of the condenser, back to front, are second r-f, modulator input and oscillator. The tall coil shields are for i-f, front to back, first and second; third one at rear to right. Tubes at left, back to front, second i-f, first r-f, second r-f, first i-f, mixer (2A7). The 56 test oscillator is at left center. The five electrolytics are in a row at right, behind them one of the two 56 a-f tubes. To its left is the 55, to its right other 56. The large tubes are two 2A3 output and one 5Z3 rectifier.

(*Continued from preceding page*)

value that gives best results in this circuit on the tubes ahead of the transformer audio stages. Instead 15,000 ohms may be used.

Of the two 50,000-ohm resistors, one is the grid leak for the oscillator and the other is the plate load resistor for the 55. When "oscillator" is mentioned, the one for generating frequencies 465 kc higher than the desired signal is meant. The 116.25 kc oscillator may be referred to as the test oscillator.

A-V-C Filter System

Three 1.5-meg. resistors are used as part of the filter system in the a.v.c. branches. Being high in value, they prevent any serious reduction of the effective value of the load circuit on the second detector, that is, do not vitiate the effectiveness of the total resistance of the 0.6-meg. potentiometer.

The 5-meg. resistor, the grid leak in the test oscillator circuit, is intended to produce a modulation note, because of grid blocking. If this value does not produce the desired note the plate voltage on this tube may be altered or the grid leak resistance or the grid condenser value increased.

Other Requirements

The switch for broadcast- short-wave selection has five sections, each double throw, but one section is not used. Therefore it is, in this circuit, effectively a four-pole, double-throw switch, made such by soldering a wire between adjacent lugs on one side, toward the leads from tuning condenser stator, and attaching thereto the stator leads, thus creating the index, while the two companion lugs on the other side pick up one circuit or the other.

When one looks into the bottom of the chassis, the lugs nearer to him are for the broadcast band and those nearer the inside bottom of the chassis are for the short-wave tap. The switch should be affixed to the back of the chassis, for strong anchorage, by using a bushing, a nut and a screw. The distance is about 1⅛ inches, and the bushing, if not long enough, may be effectively extended by nuts or by washers of any kind. Insulation is not necessary at all, but it so happens the type of bushings used are usually insulated.

The switch for the test oscillator is for shutting off the heater supply when this oscillator is not to be used. Once the set is lined up there might not be any necessity for using the oscillator in connection with this particular receiver for a long time, and then only on suspicion that somehow the circuit may have been put out of adjustment due to experimental tinkering.

Phonograph Connection

The phonograph switch is at front panel for those who desire such service, whereas if one does not use a phonograph pickup he may ignore the switch, or, in building the set, leave it out, together with the wiring of the phonograph jack. To provide a little bias, sufficient for phonograph operation, the 350-ohm resistor is in the cathode leg of the 55, and a concomitant effect is to prevent grid current at no signal during radio use.

The radio reception will not come through when the phonograph switch is "on," if the volume control is turned to zero. Any control of phonograph volume would have to be done on the device with which pickups are equipped.

The grid clips are of the type that will not short to the tube shields.

The tube shields, sockets, a-c cable and plug, antenna-ground posts, phonograph twin jack, dial, flexible pilot wire, hookup wire, power transformer nuts, 6/32 nuts and bolts, knobs and chassis with bottom piece certainly need no explanation.

The a-c cable bracket is a special device, which fits on the under side of the chassis, beneath the front section of the tuning condenser. It has two lugs riveted to it, and a large hole through its upright portion. The a-c cable is inserted in the large hole. Insulation is removed from a few inches of hookup wire and twisted tightly around the a-c cable, the two terminals then cut to allow no play, and the connections of this bare wire ends made to the lugs.

Use for Extra Lugs

The distance from a-c switch to this bracket is measured, and the a-c cable made a bit longer, so that any pull on the cable from the outside will be exerted on the bracket and not on the soldered con-

Alternative Coil for Short Waves

For short waves one may use the tap on the local oscillator as the diagram shows, or if a change is made in feedback windings, so that the "unused" one is in the plate (Grid. No. 2) circuit of the 2A7 oscillator, then the other winding may be connected as the tuned winding. Thus one side of this coil would go to ground, it being the side diagrammed now as B plus.

The wave switch would connect the stator of the oscillator tuning condenser to the free side of this winding. The method is cited because sometimes the broadcast lining up is such that the sensitivity is not so high on short waves as it would be with the small extra coil used, even though the high potential (r-f) of this coil does not go directly to grid, but to the stator of the tuning condenser.

There is no padding capacity for the short-wave circuit, but if desired a small equalizer may be connected across the third winding, if that winding is used as described, and the sensitivity increased somewhat.

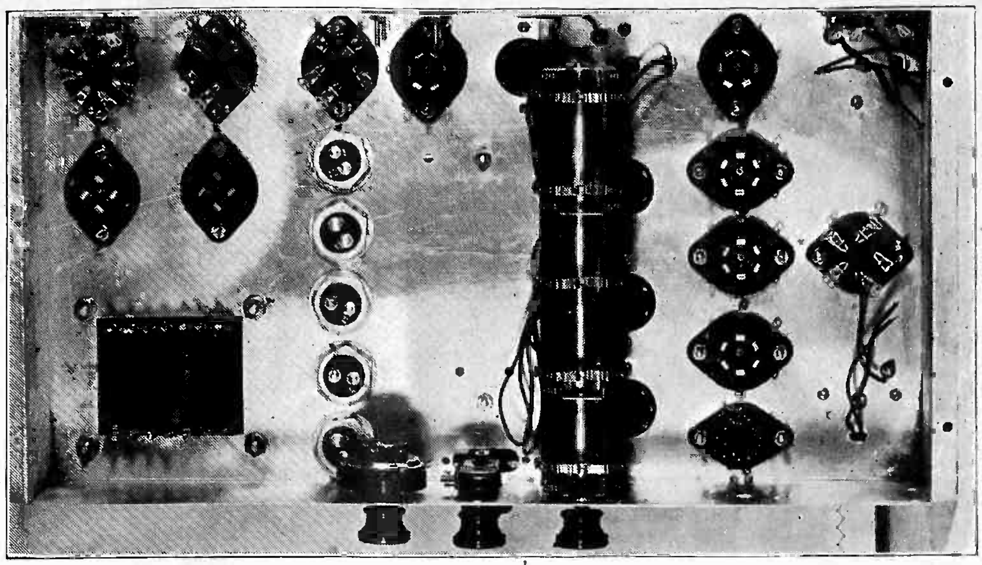
nections to the a-c switch on the volume control. This prevents yanking off the wire of the a-c line voltage that carries the a-c line voltage.

Extra lugs, individual ones, may be used on threaded insulators, whenever it is desired to find an anchorage for some potential above grounded chassis, e.g., a.v.c. filter resistors, B plus, etc. An existing socket mounting screw may be used at one end of the insulator, while a lug is put on a short 6/32 bolt and the bolt then screwed into the remaining or free end of the threaded bushing.

Dial Readings

The dial readings should conform numerically as follows, numbers increasing as frequency decreases:

Dial	*kc*	*Dial*	*kc*	*Dial*	*kc*
96	540	70.8	700	38	1,120
94	550	64.75	750	33.5	1,190
92	560	58	840	28.75	1,260
90	570	57	850	23	1,350
85.75	590	56	860	20	1,400
84	600	52.25	910	16	1,470
82.5	610	51.5	920	14	1,500
79	630	47.5	980	12	1,550
75	660	42.5	1,010	6	1,600



Bottom view of chassis after principal parts other than resistors are mounted. The controls are, left to right, combination a-c switch and volume control, phonograph switch and wave-band switch.

Test Oscillator's Calibration Described

A test oscillator may be built into the Double Push-Pull Super Diamond, and thus renders convenient the line-up of the intermediate amplifier, as well as the padding of the r-f and local oscillator at or near the usual frequencies.

If the fundamental frequency of the test oscillator is 116.25 kc, then there will be sufficient response automatically from the r-f level to enable lining up at the broadcast low and high frequency points, as the medium pitched note will come right through, due to pickup of the modulated r-f harmonics by the tuner.

At the intermediate level, although the modulation would come through, it might prove confusing, since one would have to be an excellent judge of intensity to determine whether the note is due to i-f lineup with the fourth harmonic of 116.25 kc (i.e., 465 kc), or whether it is due to simply resonating the i-f at any frequency that permits the 2A6 output to come through. It is clear that at any intermediate frequency within the range of the coil-condenser combination in the i-f coils, the i-f circuit could be lined up, and one might assume it was being done at 465 kc but might be mistaken.

Error Avoided

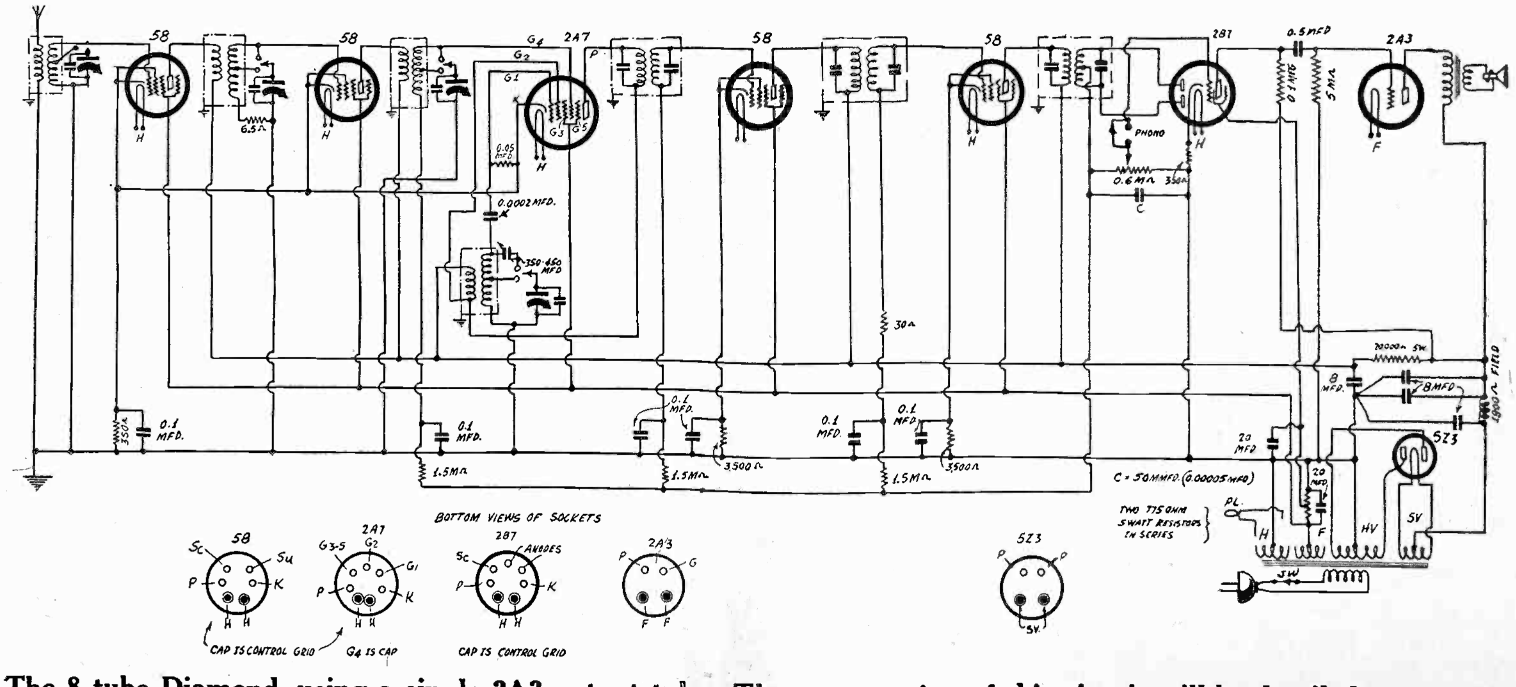
To remove the possibility of mistake, take out the two r-f tubes and the 2A7, and then the output of the test oscillator is feeding the intermediate amplifier only. Line up on that basis. Then when the removed tubes are restored, while it is true that the intermediate frequency of harmonic oscillation goes right through, the augmentation by the r-f amplification makes it easy to distinguish the addition, that is, judge even by ear when the r-f is properly aligned.

The 56 tube used as test oscillator has a switch in its heater leg, so that the tube is out of service when the switch is open, and when a test is to be run the switch, of course, is closed. The 56 might take quite a while to heat up sufficiently to insure oscillation.

The test oscillator frequency setting depends somewhat on getting the receiver working before the test oscillator frequency is completely confirmed, if no other source of testing is to be used. Therefore, take the intermediate transformers as you find them, as the Hammarlunds are peaked at the factory, and line up the second and third ones to match the unmolested first one, using whatever frequency from the test oscillator makes for loudest or strongest response through the first coil.

Final Check-up

Then when the set is working, line up the r-f at a modulated point that is the high frequency end of the dial, turn to near where 600 kc would come in (comparing with stations of known frequency, or about 86 on the dial) and line up by the hum point here, then find 930 kc either relative to other frequencies of known stations or by actually tuning in a 930 kc station, and set the test oscillator condenser at somewhere near maximum so that the squeal is heard. Then you have 116.25 kc, you may reline the i-f on the previously-stated basis, and repad at the oscillator at the low frequency and high frequency points, although it should not be necessary to molest the r-f trimmers, assumed already set.



The 8-tube Diamond, using a single 2A3 output tube. The construction of this circuit will be detailed next week.

WIDE-BAND FILTER

High and Low Pass Combined for Television

By J. E. Anderson

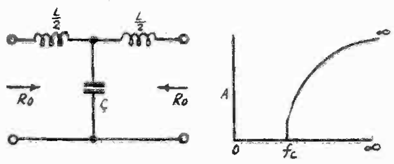


FIG. 1
A simple section of low pass filter with attenuation characteristic. Characteristic resistance 1,000 ohms.

WHEN very wide bands of frequencies must be passed by a radio frequency receiver, for example, a receiver intended for the reception of television signals, a band pass filter is necessary. Such a filter may be constructed in several ways. One is to construct a network which by itself is a band pass filter. Another is to make two networks, one a low pass and one a high pass filter, and to put these in tandem. If the cut-off frequencies of these two filters be properly placed, the two will have the same effect as a single band pass filter with the same cut-off frequencies. We shall outline the method of designing a band pass filter of the latter type for those who may wish to experiment with television reception.

A certain television transmitter utilizes a frequency of 1,650 kc and the problem arose to construct a filter that would pass all frequencies between 1,600 and 1,700 kc. Suppose a low pass filter is constructed that has a cut-off at 1,700 kc. All frequencies below that frequency will pass through. If a high pass filter with a cut-off at 1,600 kc is constructed, that will pass all frequencies above that frequency. If these two filters are connected in tandem, only those frequencies that lie between the two-cut-off frequencies will be passed. All frequencies below and above the two cut-off frequencies will be stopped to a degree depending on the number of sections in each filter.

Low Pass Section

In Fig. 1 is a section of low pass filter with so-called mid-series termination, or it is a T-section. At the right of the circuit is the attenuation characteristic of this section. Between zero frequency and the cut-off frequency, f_c there is no attenuation but beyond f_c the attenuation is high. This is an ideal characteristic, that is, one that would be obtained if there were no resistance in the coil. The actual characteristic does not differ greatly from this ideal if the resistance in the coils is kept reasonably low.

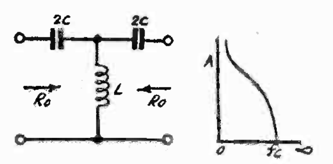


FIG. 3
A simple section of high pass filter with attenuation characteristic. Characteristic resistance 1,000 ohms.

In this circuit, that is, Fig. 1, left, Ro stands for the characteristic or image impedance. The filter section must be connected between these impedances if it is to have the indicated characteristic. We are at liberty to choose almost any value for Ro. It would be desirable to choose a value equal to the plate resistance of the tube, but if the tube is of the screen grid type, this choice would lead to excessively large coils and unpractically small condensers. Hence we shall choose the value 1,000 ohms for Ro.

The cut-off frequency of the low pass filter is $f_c = 1/\pi(LC)^{1/2}$ and the characteristic impedance is $R_o = (L/C)^{1/2}$. From these two equations we can obtain $L = R_o/\pi f_c$ and $C = 1/\pi R_o f_c$ as two design formulas. Since in the problem set forth Ro is 1,000 ohms and f_c is 1,700 kc, we obtain L = 187 μH and C = 187 μμF. It will be noticed that L is split into two equal coils between which there is no mutual inductance. Thus each of the two coils has an inductance of 93.5 μH.

Derived Section

The simple section in Fig. 1 does not have a high attenuation immediately above the cut-off frequency. It is desirable that the filter have a high attenuation at all frequencies above the pass band. This can be accomplished by adding another section of the so-called derived type. This is shown in Fig. 2. It will be noticed that in this circuit there is a coil L2 in the shunt arm of the filter. At a certain frequency this will resonate with condenser C2, and at that frequency the attenuation is infinite. If the constants are chosen so that the frequency of infinite attenuation is just above the cut-off frequency the attenuation will be high immediately above the cut-off. The resulting attenuation of the derived T-section alone is shown at the right of Fig. 2. The attenuation rises rapidly beyond the cut-off and reaches an infinite value. Then it decreases as the frequency increases. Of course, the attenuation is never really infinite because of resistance in the coil L2.

The impedances of the sections in Figs. 1 and 2 are the same in the pass band region and for that reason they can be connected in series, provided that the elements in Fig. 2 are chosen so that the two have the same cut-off frequencies and the same characteristic resistance at zero frequency.

Values of Elements

A suitable value for the frequency of infinite attenuation is 1,800 kc when the cut-off frequency is at 1,700 kc, and this will be chosen for the low pass filter.

The three elements of the derived section in Fig. 2 can be obtained from the elements of section in Fig. 1 by the following relations: $L1 = mL$, $L2 = (1-m^2)L/4m$, and $C2 = mC$, in which $m = (1 - f_c^2/f_1^2)^{1/2}$, f_1 being the frequency of infinite attenuation.

In the present example $f_c = 1{,}700$ kc and $f_1 = 1{,}800$ kc. Hence $m = 0.329$. It follows that L1 = 61.5 μH, L2 = 126.8 μH, and C2 = 61.5 μμF.

Composite Filter

The second section has the same impedance as the first and the same cut-off frequency. Hence they may be connected in series. How this is done is shown in Fig. 5. At the right in this figure are shown the attenuation characteristics of the two sections, superposed. The actual attenuation is the sum of the two characteristics.

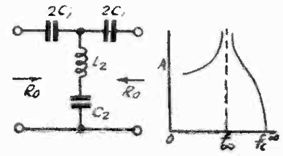


FIG. 2
A derived section of low pass filter with attenuation characteristic. Characteristic resistance 1,000 ohms.

It will be noted that there is first a coil of L/2, or 93.5 μH. Then there is another coil of the same value in series with one of $L_1/2$, or 30.75 μH. These two may be combined, making a single coil of 124.25 μH. Then follows another coil of 30.75 μH. L_2 has a value of 126.8 μH. The first shunt condenser has a value of 187 μμF and the second, C2, a capacity of 61.5 μμF. This completes the two section filter.

This filter should work between two resistances of 1,000 ohms each. To make the output impedances 1,000 ohms it is only necessary to use a grid leak of 1,000 ohms and to connect the last coil to the grid. To get 1,000 ohms for the plate side it is necessary to employ a transformer. If the tube is a 58, which has an internal resistance of 800,000 ohms, the transformer should have such a ratio that the secondary impedance, looking toward the tube, has an impedance of 1,000 ohms. The ratio should be the square root of 800,000/1,000, or 28.28/1. The coupling between the primary and the secondary should be as close as possible. Practically this means that the secondary winding, which might consist of 25 turns, should be in the center of the primary turns and that the primary should be bunched. A rather large diameter should be used so that the winding will be short.

A High Pass T-Section

In Fig. 3 is a simple T-section of a high pass filter corresponding to the low pass filter in Fig. 1. The characteristic resistance is Ro, which will be chosen the same as in the low pass filter, and at right of the circuit is the attenuation characteristic. All frequencies between zero and f_c are attenuated but all frequencies above f_c are passed.

The characteristic resistance is $R_o = (L/C)^{1/2}$ as before and the cut-off fre-

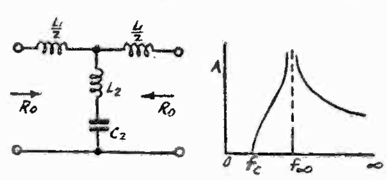


FIG. 4
A derived section of high pass filter with attenuation characteristic. Characteristic resistance 1,000 ohms.

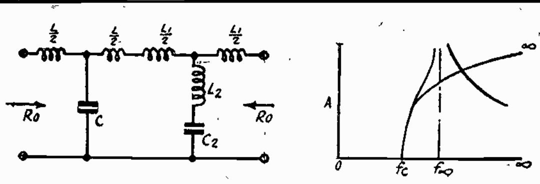


FIG. 5
A composite low pass filter made by connecting filters in Figs. 1 and 2 in series. Cut-off at 1,700 kc and infinite attenuation at 1,800 kc.

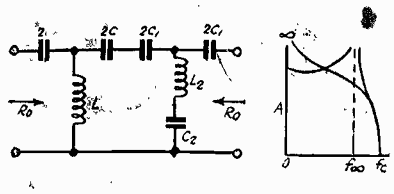


FIG. 6
A composite high pass filter made by connecting filters in Figs. 3 and 4 in series. Cut-off at 1,600 kc and infinite attenuation at 1,500 kc.

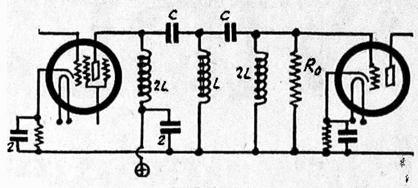


FIG. 7
A filter of two pi-sections designed to cut off at 1,000 cycles and to work between resistances of 7,500 ohms.

quency is $f_c = 1/4\pi(LC)^{1/2}$. By combining these two equations we obtain the two design formulas $L = R_o/4\pi\ f_c$ and $C = 1/4\pi\ R_of_c$. The cut-off frequency is to be 1,600 kc and the resistance 1,000 ohms. Putting these two values into the formulas we obtain $L = 49.7\ \mu H$ and $C = 49.7\ \mu\mu F$. It will be noticed that there are two equal condensers in the section and that each is twice as large as the value obtained above. When two condensers, each equal to 2C, are connected in series, the resulting capacity is just C.

Derived T-Section

As in the case of the low pass filter, the attenuation of this section will not be good just inside the stop band, which in this case is just below the cut-off frequency. Hence it is necessary to add a derived section that has infinite attenuation just outside the pass band. It is convenient to make this frequency 1,500 kc.

The elements of this derived section can be obtained from those of the original section, that is, Fig. 3. The formulas are: $C1 = C/m$, $C2 = 4mC/(1-m^2)$, and $L2 = L/m$, in which $m = (1 - f_1^2/f_c^2)^{1/2}$, f_1 being the frequency of infinite attenuation.

In this case $f_c = 1{,}600$ kc and $f_1 = 1{,}500$ kc. Hence $m = 0.348$. Putting this value of m in the formulas we obtain: $C1 = 143\ \mu\mu F$, $C2 = 78.75\ \mu\mu F$, and $L2 = 143\ \mu H$.

Series Connection

The two high pass sections in Figs. 3 and 4 can be connected in series as shown in Fig. 6. When they are so connected the attenuation of the composite structure will be the sum of the attenuations of the two, the two separate characteristics being superposed, but not added, in the right portion of Fig. 6.

It will be noticed that in the center of Fig. 6 are two condensers, one 2C and the other $2C_1$. These condensers can be combined into a single condenser having a value $2CC_1/(C + C_1)$. Since $C_1 = 143\ \mu\mu F$ and $C = 49.7\ \mu\mu F$, the middle condenser should have a value of 73.75 $\mu\mu F$. The composite high pass filter will then have one condenser of 99.4 $\mu\mu F$, one of 73.75 $\mu\mu F$, and one of 286 $\mu\mu F$ in series with the line and one, C2, of 157.5 $\mu\mu F$ in shunt with the line. L will have a value of 49.7 μH and L2 a value of 143 μH.

Termination

As in the case of the low pass filter the high pass filter should be terminated by 1,000 ohm resistances. On the output side a grid leak of 1,000 ohms can be used, the condenser $2C_1$ being connected to the grid of the second tube. On the input side it becomes necessary to use a step-down transformer. If the tube ahead of this filter is a 58, the step-down ratio should be exactly the same as the matching transformer for the low pass filter, that is, 28.28/1. The two transformers may be identical. Close coupling is essential.

The Composite

When the low pass filter is put between two tubes and the high pass filter between one of these and a third tube, the composite will be a band pass filter having cut-off frequencies at 1,600 kc and 1,700 kc. Inside this band there will be practically no attenuation; outside the band there will be very high attenuation. The better the coils used in these filters the less will the loss be in the transmission band and the sharper will be the cut-offs. To some extent this is also true the better the condensers are. If mica condensers are used, losses in the condensers may be assumed to be zero. Of course, if air condensers are used this assumption is still more justified.

Audio High Pass Filter

Another problem was to design a high pass filter that would admit all frequencies above 1,000 cycles and that would stop all frequencies below. This was in order to test what the effect on the clarity of the signals the low frequencies had. The characteristic frequency of the television signal is 1,200 cycles and it was desired to pass this with as little attenuation as practical and for that reason the cut-off was put at 1,000 cycles. Two sections were deemed to give sufficient attenuation.

For this filter two pi-sections of the simplest type were selected. The filter was to work between resistances of 7,500 ohms, the input impedance being the internal resistance of a 55 vacuum tube. The filter is shown in Fig. 7.

Impedance Ratio

The mid-shunt impedance of the filter at frequencies reasonably far above the cut-off is the ratio of the square root of L/C. This is to be 7,500 ohms. The cut-off frequency is determined by $1/4\pi\ (LC)^{1/2}$. The design formulas for this filter are the same as for the high pass radio frequency filter, namely, $C = 1/4\pi\ f_cR_o$ and $L = R_o/4\pi\ f_c$. In this case $f_c = 1{,}000$ cycles and $R_o = 7{,}500$ ohms. Putting these values into the design formulas we obtain: $C = 0.0106\ \mu F$ and $L = 0.596$ henry.

Shunt Coils

The first shunt coil for mid-shunt termination is 2L and the last has the same value. The middle shunt coil is simply L. Therefore the shunt elements are two 1.192-henry coils and one 0.596-henry coil. The two series condensers are 0.0106 mfd. each.

The first coil can be used as coupling coil in the plate circuit of the first tube provided a condenser of negligible reactance is used to by-pass frequencies above 1,000 cycles. A 2 mfd. condenser is all right for this purpose. Across the last coil there should be a 7,500-ohm resistance to terminate the filter properly. The coils should have as low resistance as practicable for the sharpness of the cut-off and the loss in the pass band will depend on how low the losses in the coils are. It is a comparatively simple matter to get coils of such low inductance that have the required low loss. This filter should follow a tube that has an internal resistance of 7,500 ohms.

Self-Powering Aids Converter Performance

Some radio experimenters, because of their personal experience with short-wave converters which may have been unsatisfactory, condemn all converters. This is not only unfair to this type of unit, but to themselves. When one has a fairly good receiver, either a-c or battery, and can get a well-designed self-powered converter, the results in a great many cases have proven a revelation. Reception from all parts of the globe is not unusual.

One of the great drawbacks of the non-powered converters that depend on the radio set for filament and B supply is that the set is really robbed of the voltage attainment at which it was designed to work, hence often insufficient B is furnished to the r.f. of the set. Since the receiver acts as intermediate amplifier, poor and more often practically no reception results. This can generally be avoided by using a self-powered converter.

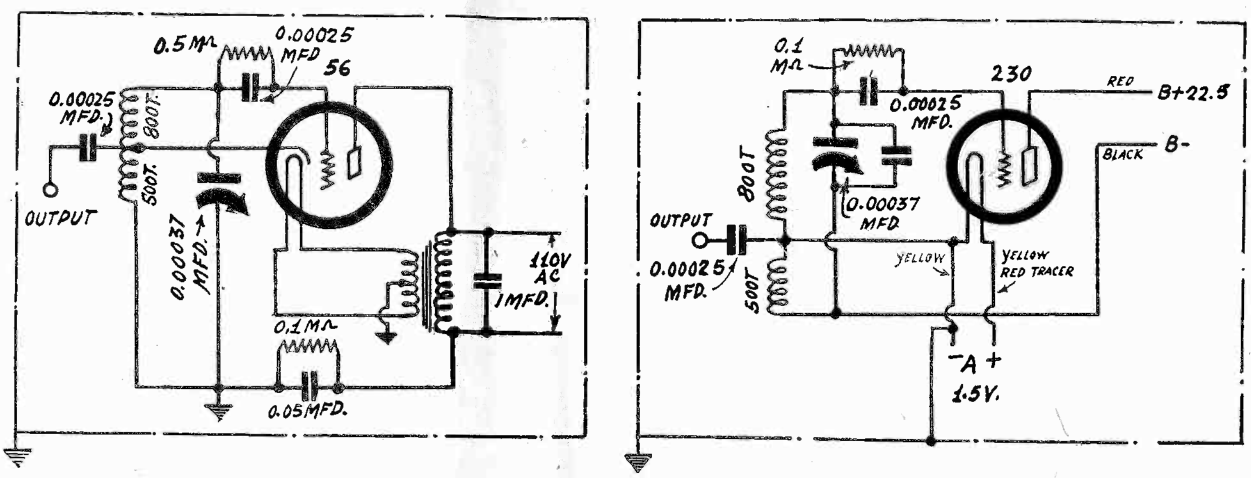
Universal Receiver Handy as "Extra Set"

With further regard to the numerous universal a-c and d-c receivers it might be of real interest to the buyer to know that all receivers of this classification are not necessarily equal in operation, not even if equipped with five or six tubes. A nationally-known name very often carries a guarantee with any comparable new article or unit. Manufacturers are less likely to put out inferior merchandise. This does not mean one has to buy from the manufacturer, as that is not always possible in the mail order business. If one can get a guaranteed tried and proven receiver in this type the enjoyment and satisfaction will more than compensate, even if the set is used only as an extra receiver or to take away to the camp or seashore.

SHIELD OSCILLATORS

For Lining up Supers and T-R-F Sets

By William C. Worth



The shielded test oscillator, in a-c (left) and battery forms. The fundamental frequencies generated are 50 to 150 kc, and the dial is frequency-calibrated. Both types are constantly modulated. The Hartley circuit is used.

THE a-c and battery-operated test oscillator, 50 to 150 kc, featured in these columns as to its various aspects since last December, has been developed in a shielded form.

The shielding of the battery model consisted simply of putting the device in a metal cabinet, which cabinet may be grounded. However, the mere enclosure of the a-c model in a metal cabinet was not sufficient, because of radio frequencies carried by the a-c line from the test oscillator to the tested receiver. Therefor a line-blocking condenser was used, shown as 1 mfd. in the diagram.

Since the a-c line usually has one side grounded, a connection of external ground to the metal cabinet in one of two possible circumstances would result in shorting the a-c line. To avoid that difficulty a resistor of 0.1 meg. was put between the metal cabinet, which is at ground potential, and one side of the line. Under such circumstances the voltage difference between the metal cabinet and the otherwise unlucky external ground connection would be less than 20 volts, and to this low voltage the hand is barely sensitive.

Capacity to Ground

Besides, the metal cabinet is automatically grounded capacitatively, due to the capacity between filament transformer and ground, and therefore no external ground connection is made to the test oscillator, and the precaution taken was on the basis of any accidental grounding, as when the test oscillator is placed on the grounded metal chassis of a receiver. There would be no harm done if the test oscillator were left that way continuously.

Both models provide modulation. The a-c model uses the line frequency, for a-c is applied to the plate. The battery model uses the grid blocking method, resulting in a high-pitched note. This blocking is accomplished by using a medium capacity grid condenser (0.00025 mfd.) and a large value of grid leak (0.5 meg.).

The battery model is constantly modulated, but that does not afford zero beats, or, rather, the modulation is so strong that it hides the zero beats that are inevitably present. That is, if a station is tuned in, and the oscillator set going at a frequency of which the station carrier in an harmonic, no squeal or zero beat is heard in any detecting device. The squeal would represent a difference in frequency between the carrier fundamental and the oscillator harmonic, while zero beat, between the varying pitches of the squeals closely on either side, would represent zero difference in frequency.

Zero Beats on A-C Model

The a-c model does provide squeals and zero beats, though constantly modulated, for the tube is not oscillating at the audio frequency, which is derived from the a-c on the plate. But in the battery model the tube is oscillating at two frequencies: first, the radio frequency (or call it an intermediate frequency), and, second, at the audio frequency, or modulation frequency. The intensity of the modulating oscillation is about as great as that of the radio frequency oscillation.

In a former model a switch was included, so that modulated or unmodulated service could be obtained on the battery model, but the radio frequencies were slightly different when the modulation was included, compared to its omission, and therefore the accuracy was not of a constant value, although still good. With unmodulated service omitted from the battery model there is no danger of confusion about any readings, or wonder why slightly different settings result in the same frequency, modulated compared to unmodulated use. It is preferable therefore to omit the unmodulated service from the battery oscillator.

Coil Connections

Both the a-c and the battery models use the same type tuning coil, which is a honeycomb of 1,300 turns, tapped at 500 turns. It does not make any substantial difference in which direction the two extremes of the winding are connected, but the conventional method is to use the outside terminal for the grid, tap (central lug) to cathode and inside terminal to grid return. The outside terminal can be selected by inspection, as the end of the winding is kept in place by a piece of transparent adhesive.

The filament transformer has its low potential side connected to the heater, center of that winding to the metal cabinet, primary to the line. Since the line a-c voltage is used on the plate, one side of the line has to go to plate and the other to the cathode, which it does through part of the tuning coil in the second instance.

The tube used is the 56, which is a better oscillator than the 27, and works infallibly in the circuit, although in a pinch a 27 could be used.

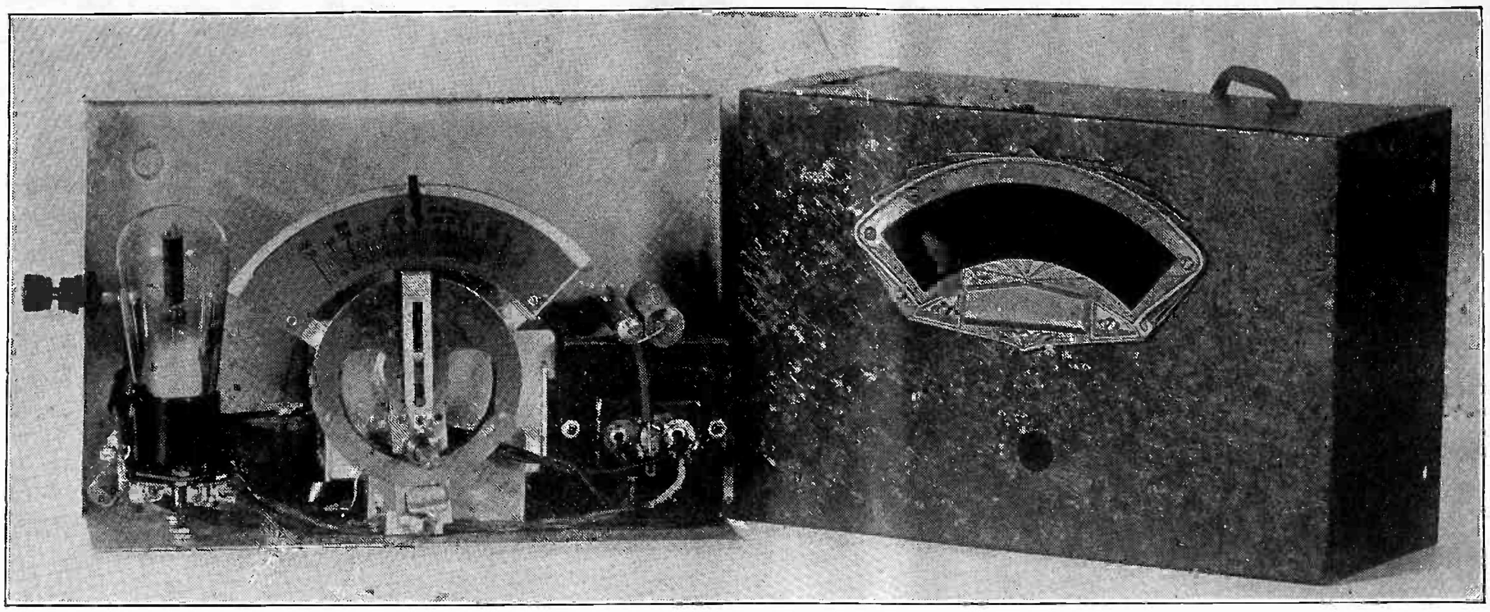
To work the oscillator, connect the a-c plug into the line outlet, have the tube inserted in its socket, and couple the output of the oscillator to the circuit to be tested. The sole post on the oscillator is for the output. As stated, the cabinet is automatically grounded through the capacity of the filament transformer.

Dial in Frequencies

The dial is calibrated in frequencies, 50 to 150 kc, which may be read directly, for any measurements within that range, which includes some low intermediate frequencies. For other intermediate frequencies, and higher frequencies, harmonics are used.

In regard to the most important intermediate frequencies, these are imprinted also on the dial, saving the necessity of figuring the harmonic. But in any other instance, multiply the fundamental by the nearest whole number, or divide the test frequency by the lowest whole number, and then turn the oscillator dial to that fundamental, to get a harmonic that is useful for adjusting a tested set to the desired frequency. For instance, suppose 465 kc is the intermediate frequency to which a channel is to be tuned. The intermediate frequency, 465 kc, may be divided by the lowest whole number, to attain a fundamental within the scope of the dial. Thus, 4 is the lowest whole number, and the dial is set at 116.25 kc.

The two models oscillate sufficiently to



Rear view of the wired a-c test oscillator. The battery model has the same general appearance, except that the filament transformer and a few other parts, not needed, are omitted. Cabinet at right.

give a husky input, and it is customary to turn down the volume control of the receiver in such instances where such action will reduce the receiver gain at the working frequency level, so that the resonance point will be more readily determined. This reduction always applies to r-f when such controls present in the r-f level, but if the control is at the r-f level and the lining up is being done at the intermediate level, then there would be no ready method of such attenuation.

Line-up Points

The oscillator is most useful for intermediate frequencies. At the lower broadcast frequencies the actual frequencies may be determined readily but at the higher radio frequencies in the broadcast band it is virtually impossible. That does not reduce the value of the oscillator, since the lining up may be done with full effectiveness at the low frequency level of r-f (usually 600 kc) while the high frequency end (1,450 kc usually) may be lined up with the oscillator at 145, using the tenth harmonic, although there would be resonance points close by, on the oscillator dial, which may be disregarded. For the 1,450 kc or equivalent line-up it would be more practical perhaps to use a broadcasting station, especially as stations on or near that frequency abound, holding local assignments.

In both models the Hartley oscillator circuit is used, but in the battery model the tap is grounded to the A supply, and the B battery is put between the terminal of the coil and plate. This sends plate current through part of the winding and effectuates feedback.

The A supply is a single dry cell, heating a 230 tube. Although the voltage is only 1.5 volts, and usually 2 volts are used on the filament of this tube, the lower voltage is high enough to insure oscillation, and besides there is somewhat better frequency stability.

Special Tubes for Short Waves

The high frequency and electronic art is being applied more and more to engineering, medicine and industry. This places demands on the research scientists for new materials, processes, new types of tubes and more knowledge regarding what goes on in the vacuum and gaseous discharge devices.

When radio broadcasting started, the output of receiving tubes was in the order of milliwatts the transmitting tubes had their output expressed in watts, and now we have high vacuum tubes giving outputs in hundreds of kilowatts.

Standing Wave Tubes

Enormous advances also have been made in the field of ultra-short wave or high frequency devices. In the range of 3 to 7 meters we have tubes which we call "standing wave tubes." They have outputs many times that of any other types at these high frequencies. Below 4 meters these waves have unusual properties and are being applied in industry where the longer waves cannot be practically applied.

In the field of very short waves, below one meter, two other types of oscillator have been developed which give much higher power and will extend the use of these waves having optical properties the same as light.

It is interesting to see the men in the laboratory project 4 cm. waves in a beam 18 in. in diameter from an antenna about 2 inches long and located at the focus of a parabolic mirror. These waves are from what we call the magneto-static oscillator.

They can be reflected from metal and other mirrors, refracted with large wax prisms, focused with wax lenses made to interfere and changed to circular and elliptically polarized waves with birefringent screens.

Used for Secret Communication

The uses of these special beams are at present limited to secret communication between points in direct view but will, we think, have other uses later.

The higher power ultra short waves are finding application in the treatments of wheat and other foods to kill infestations. These and still longer waves are useful in the production of artificial fevers for the cure of certain diseases. The shorter waves can be projected upon the patient and bring him to 105 or 106 degrees F in less than one hour. This cooperative work done with the clinics and hospitals appears now to be quite important.

Other Special Tubes

High vacuum tubes required in many applications have been limited in output by electron emission from the filament or hot cathode. This problem has been intensively worked on. New cathode coatings and cathode alloys have been developed which give longer life and several times the space current at lower temperatures. In tubes, rectifiers, grid controlled discharge tubes and mercury vapor devices much improvement has been made. The newest thing is what we call the "Ignitron." By its use in vapor devices more efficient and reliable operation can be obtained than with the usual grid.

As the name implies it is a means of "starting the discharge." This is done every cycle at the desired phase position. By its use the arc drop is lowered and all ionization is absent during the reverse potential period. The arc is reliably started within a few microseconds each cycle. It is especially suited to rectifiers, inverters, frequency converters and control tubes.

Trouble Due to Error in Connecting Up Electrolytics

The voltages in a d-c set a man just finished are abnormally low and the electrolytic condenser gets very warm. What do you suppose is wrong? Could it be that the condenser is connected incorrectly as to polarity?

A wrong connection of the electrolytic is quite likely. Suppose one has mounted the electrolytic on the chassis without insulation. The negative side of the condenser is then to the chassis. When the plug is inserted in the line the chassis becomes positive in nearly all cases. This would practically cause a short circuit in the condenser and the voltage would be very low and the condenser would heat hum. Use paper condensers or insulated electrolytics. Do not leave the power on for any length of time because there is danger of explosion of the electrolytic condenser.

THE DETROLA SHOR

A Self-powered Frequency C

By Jack
North Radio Co.

INTEREST in short-wave reception is gaining rapidly because results can now be obtained with relatively simple equipment. To bring in the shortwave signals, a complete short-wave receiver can be built, but this is rather expensive. They can also be brought in with a simple regenerative receiver, usually on a pair of headphones. Such reception now is not very popular because of the inconvenience of the headphones. Another way of bringing them in is to use a short-wave converter in conjunction with a broadcast set. This is the most attractive method because it utilizes the broadcast receiver to the full, and the short-wave feature is merely an addition. The short-wave converter converts the t-r-f broadcast receiver to a short-wave superheterodyne, and it converts a superheterodyne broadcast receiver to a double superheterodyne.

As a rule, the converter should be as simple as practical to give the best results. It should have a modulator or mixer tube and a separate oscillator tube. These are essential features. But to make the converter convenient for use and dependable in all instances, it should have its own power supply. That demands another tube, used as rectifier. Thus a simple practical converter can be constructed with three tubes.

Circuit of Converter

In Fig. 1 is a short-wave converter incorporating these features. The mixer tube is a 224 screen grid tube, the oscillator is a 227, and the rectifier is also a 227 but is used as a diode rectifier, the plate and the grid being tied together.

For power transformer the filament transformer is used. That is, the anode of the rectifier tube is connected to one side of the line and the other side of the line is connected to the chassis, directly across the primary of the transformer. Therefore an a-c voltage of 110 volts is applied to the rectifier. This is sufficient to operate the tubes because the rectifier output voltage is slightly higher than the effective a-c voltage.

The secondary of the transformer is used for all the filaments as well as for the pilot light. The center of this winding is connected to the chassis as a means of eliminating hum. This is a most important feature in a short-wave converter, even when the tubes are of the heater type, because unless the filaments are balanced with respect to ground, hum enters by modulating the carrier.

Thorough filtering is also essential, and for the same reason, because modulation of the carrier can easily be effected by a slight ripple in the B supply. In this converter there is a high inductance choke in the positive lead, and, in addition, there are two 2 mfd. electrolytic condensers across the line. This combination does not seem to be an adequate filter, but it should be remembered that the rectified current is extremely small. The smaller the current the more effective is a given capacity, and, also, the smaller the current the more effective is a given choke coil, because there is no saturation of the core.

Voltages on the Tubes

The highest voltage available is applied to the plate of the oscillator, thus assuring oscillation at all settings of the tuning condenser. A bias resistor, R3, is used to bias the grid of the oscsillator, and its value is 2,000 ohms. Condenser C9, which has a value of 0.0001 mfd., is also used to facilitate oscillation. It is necessary because at very high frequencies an electrolytic condenser is not effective.

The voltage on the plate of the modulator tube is also the highest available, but it is impressed on the tube through a 0.5 megohm resistor. Hence the effective voltage is very low. However, the effective voltage is of little significance since the tube is operated as a triode. The high value of the resistance insures a high input to the broadcast receiver.

The small condenser, C4, which has a value of 0.002 mfd., is used to couple the output of the converter to the antenna post on the broadcast set. This is the only essential connection between the two components.

Universal Applicability

Due to the fact that the converter is self powered, it can be used with any type of broadcast set. The only requirement is that the receiver be provided with an antenna binding post or lead, and that, of course, encompasses all receivers.

The detector is of the grid leak, grid condenser type, which is recognized as the most sensitive. In order to make the sensitivity as high as possible a high value grid resistance, 5 megohms, is used and a small grid condenser, 0.0001 mfd.

Coupling between the modulator and oscillator tubes is effected through capacitive coupling. Between the grid of the oscillator and the tap on the r-f inductance is a very small condenser made by twisting two insulated wires together, the twisted portion being about 1.5 inches. This constitutes fairly close coupling between the two circuits. It must be remembered that it operates at frequencies above 1,500 kc. If the coupling should be so close that the oscillator would overload the modulator, it can be loosened by untwisting the wires a little.

Range of Converter

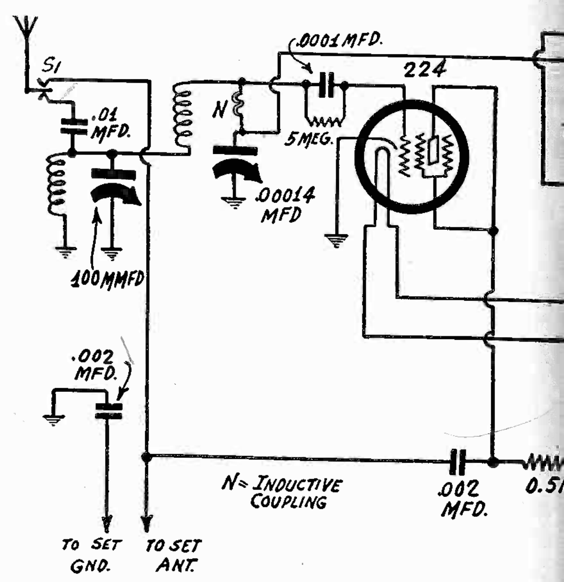
The tuning range of the converter is from 15 to 200 meters. This range is covered in two steps, one from 15 to 70 meters and the other from 70 to 200 meters. The change-over is effected by means of a switch in the tuned grid winding of the oscillator, which when turned to the left brings in the 15 to 70 meter range and when turned to the right brings in the 70 to 200 meter range. The switch is located at the left on the front panel.

The change-over switch operates by shorting a portion of the oscillator coil. Ordinarily it would not be good practice to short any part of a coil, but in this instance the larger portion is shorted and therefore there can be no appreciable loss in the coil due to current in the shorted portion because there is a high inductive impedance in the shorted circuit. Moreover, the coil is in the oscillator where small losses have no significance. The simplicity that this method of wave-changing permits is a real advantage.

There is also a switch in the antenna lead. Its purpose is to change antenna connection to the converter or to the broadcast set. Built into the same switch assembly is also the line switch, which is so connected that when the antenna switch S1 is set on the set antenna, the line switch S3 is open. Thus the power is off the converter when the converter is not in use. This dual switch is a most convenient arrangement as it makes it unnecessary to disconnect the converter when broadcast signals are to be received. Just one turn of the antenna switch and then the usual tuning of the broadcast set are all that is necessary.

Trimmer Condenser

Condenser C2 which is across a portion of the r-f inductance is not a variable of the regular type, but is merely adjustable. It is accessible from the top of the subpanel by means of a screwdriver, or by means of a small socket wrench. This is adjusted once only. After the converter has been otherwise completed and hooked up to the broadcast set, tune in a station around 75 meters and adjust the condenser



A Self-powered Frequency C

LIST O

Coils

One tapped oscillator coil.
One tapped radio frequency coil.
One high inductance choke coil.
One 110/2.5 volt filament transformer.

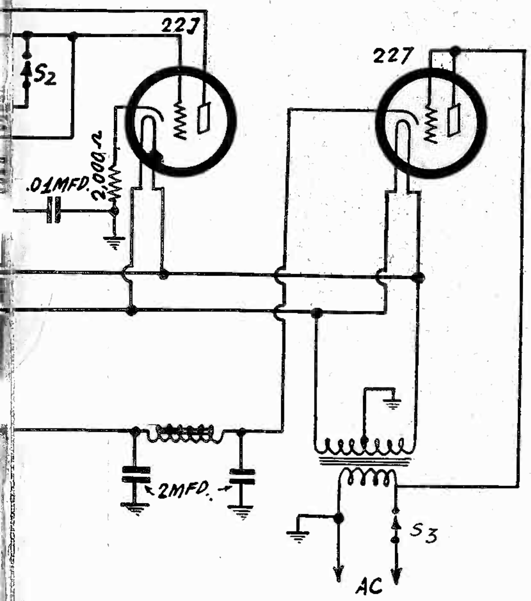
Condensers

C1, C9—Two 0.01 mfd. condensers.
C2—One 100 mmfd. adjustable condenser.
C3, C4—Two 0.002 mfd. condensers.
C5—One 140 mmfd. variable condenser.
C6—One 0.0001 mfd. grid condenser.

-WAVE CONVERTER

anger Utilizing Three Tubes

echter
Star Radio Co.



r Utilizing Three Tubes.

for loudest signals. That will be the correct adjustment for all other waves.

Assembling Short-Wave Converter

If the converter is obtained in kit form, the following directions will help in the assembly:

The only tools needed are a soldering iron, a screw driver, a pair of long nose pliers, and a 5/16 socket wrench for tightening nuts.

Commence by bolting power transformer in place so that the side with two lugs is next to back of chassis. Now wire filaments starting from these two lugs. Solder the small flexible wires on the filament prongs of the 224 socket for the pilot light.

Next fasten on the switches—the single pole, double throw with auxiliary switch should be placed on the right hand bracket and the small inductance switch on the left. Now bolt the small balancing condenser as shown in the diagram, using 3/8 6-32 screws, placing lugs under nut nearest the front of the chassis.

Mount the coils, being careful to put the oscillator coil (the one with the two separate windings) on the left side. Fasten them by slipping the two blank lugs through the small holes and bending over. Put the dial on the variable condenser shaft before screwing variable condenser on the chassis. Use one of the condenser mounting screws also for mounting the filter choke. In connecting the filter condensers make sure that the positive terminals are connected to the positive side of the line. In other words, make sure that the negative sides of the condensers are connected to the chassis. The polarity of electrolytic condensers is always marked. If the condenser is of the dry type, the positive and negative terminals will be unmistakably marked. If the electrolytic is of the can type, the can is always negative. Hence in either case there is no need of making any error in the connections.

It is not unusual on short wave sets to have the volume fade, but unlike the regular broadcast receiver, it is very rapid and is sometimes so rapid that it gives to the music a very peculiar fluttering effect. Slow fading is remedied by an A.V.C. if broadcast set is equipped with it.

Interference

On short wave sets, there is hardly any true static, but operation of electric machinery nearby will cause "electrical interference" to which short-wave sets are very sensitive. In fact, they are so susceptible to this type of interference that you can often pick up disturbances caused by the ignition system of a passing automobile.

Because of the points only slightly mentioned herein, it will require some time and considerable practice before an operator can familiarize himself with the possibilities of short-wave reception and can tell by the time of day, or season of year just which short-wave band will produce the best results.

However, it will greatly aid in mastering the short-wave tuning if careful consideration is given to the information herein and operating instructions are very carefully followed.

Your broadcast receiver may be insensitive due to poor tubes or improper adjustment.

You may be in a poor location or shielded by steel buildings.

You may not have a good aerial. It takes a good outside aerial for distance.

Try another tube in oscillator socket of converter (the one nearest the transformer).

See if rectifier is functioning by reading voltage with voltmeter connected between chassis and connection on choke. Voltage should be approximately 125 volts.

Connecting and Operating

1. Place converter as near as possible to broadcast receiver so the wires from converter will reach to the set.
2. Disconnect antenna from broadcast receiver and connect to antenna wire on converter.
3. Connect wires from converter marked "Ant" and "Grd" to set to "Ant" and "Grd" posts of broadcast receiver, leaving ground wire connected as it was.
4. Plug 110 volt cord of converter into wall socket.
5. Turn on converter (right hand knob) and broadcast set.
6. Turn volume control all the way on.
7. Set dial of broadcast set at a point where no station is heard, preferably above 1500 kilocycles (between 1,500 and end of dial). A few experiments will show you the best spot on the dial by trying different positions and returning the converter.
8. Tune converter very slowly until a station is heard.
9. The left hand knob is the band selector switch. Turn to left for stations between 15 and 70 meters and to right for stations between 70 and 200 meters.
10. To turn off converter simply turn right hand knob all the way to the left and your set to which the converter is attached can be used for ordinary reception the same as though the short wave converter was not connected—leave all connections as they were.

Careful Tuning Essential

You must be very careful in tuning a short wave set as the usual careless turn of the tuning dial to bring in broadcast stations will not suffice for short-wave reception. Unless tuning instructions are carefully followed, distant stations will be passed by, as a station can be tuned in and out again in but a fraction of a dial division. You can realize the precaution which must be taken when you consider that there are more than twelve full width transmitting channels in the one meter band between 49 and 50 meters.

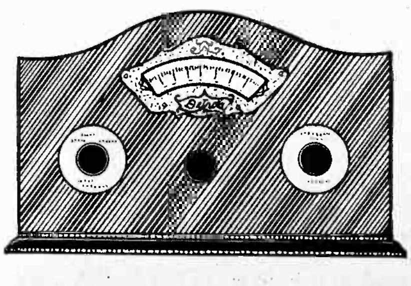
This set is built on a superheterodyne principle and takes full advantage of all the amplification of the broadcast receiver and has been designed for use with any standard a-c broadcast receiver. To get the best results from your converter, it is essential that you use a highly sensitive broadcast set.

Differences in Time

The best time to tune for foreign stations is in the afternoon, as by 7:00 p.m., Eastern Standard Time, it is 1:00 a.m. in England and 2:00 a.m. in most of Europe, at which time their broadcast stations are off the air.

On short-wave sets, it is often possible to tune in extremely distant stations, while the nearer stations cannot be tuned in at all. This frequently occurs on very short waves and is known as "skip distance effect."

[Other Illustrations on Front Cover]



RTS

C8—Two 2 mfd. by-pass condensers, ry electrolytic.

sistors

—One 5-megohm grid leak.
—One 0.5-megohm resistor.
—One 2,000-ohm resistor.

her Requirements

e 224 and two 227 tubes.
ree five-contact sockets.
S3—One tandem switch.
—Wave band switch.
e grid clip.

SHORT WAVES On a Set Using Only 1 TUBE

By Emanuel Mittleman
Try-Mo Radio Co., Inc.

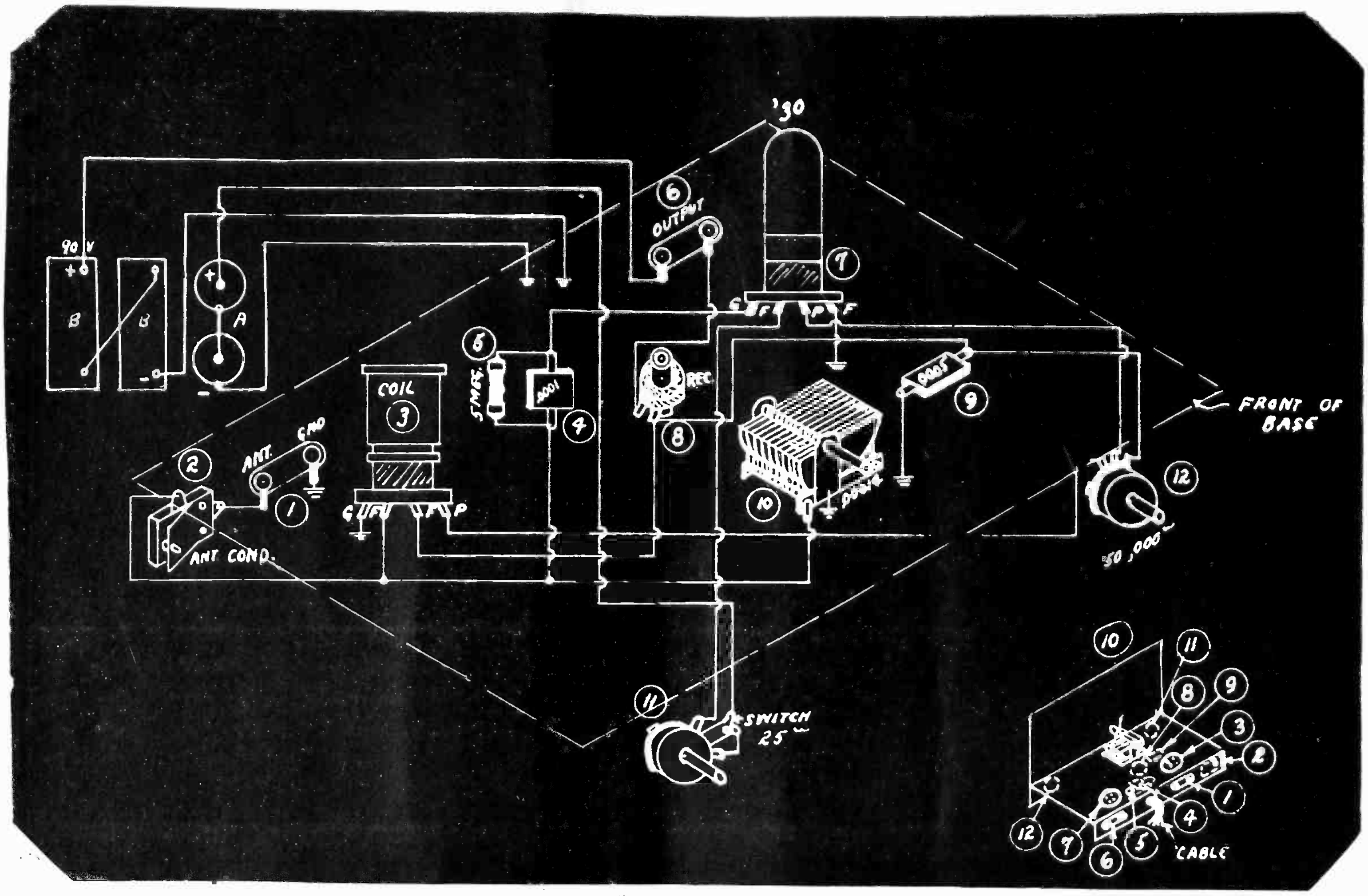


FIG. 1

The wiring and circuit diagram of the Reliable One, a one-tube, battery operated short-wave receiver of high sensitivity.

THE one-tube set has come back in modernized form, but for short-wave reception mainly. Surprisingly fine results may be obtained with a 30-type tube in a regenerative circuit, provided that the control of the regeneration is smooth and efficient coils are used, and also provided that a suitable size of condenser is used for tuning the circuit.

A combined circuit and wiring diagram of such a set is shown in Fig. 1. A single 230 type tube is employed. This small tube draws only 0.06 ampere at a voltage of 2 volts. For that reason the circuit can be operated with two small dry cells for long periods. The circuit will also operate satisfactorily on 22.5 volts on the plate although it is usually operated on 45 volts. A more economical set could hardly be devised. Nor a more sensitive one-tube set.

Sensitivity is obtained primarily by means of regeneration but also by the use of low loss tuning coils. An essential feature of a short-wave set of this type is that the regeneration control be smooth so that it is possible to approach the point of oscillation very closely without danger of "spilling over." In this circuit the control is a 50,000-ohm potentiometer connected across the tickler coil with the plate of the tube connected to the slider. This method of control has about the same effect as varying the tickler turns in a continuous manner. Moreover, the potentiometer chosen is smooth in its action so there are no sudden changes in the amount of regeneration.

In addition to the potentiometer control there is also a rheostat in the filament circuit with which the regeneration and the sensitivity can be controlled. The rheostat, which is put in the positive leg of the filament circuit, has a value of 25 ohms. When a three volt battery is used and when this is fresh, the resistance required in the circuit is 17 ohms. The extra eight ohms can be added as a means of control. As the battery runs down the resistance may be made less than 17 ohms so that every bit of power stored in the battery can be utilized. The circuit should always be operated with the lowest filament current that will give satisfactory control and sensitivity. This is a matter of economy because not only will this lengthen the life of the filament and B batteries but it will also lengthen the life of the tube.

In order to make this tuning circuit of this set relatively independent of the antenna used, a small adjustable condenser of about 50 mmfd. is connected in series with the antenna lead. The longer and higher the antenna the less capacity should be used in this condenser. The circuit will be more selective the smaller the capacity is and the more effective will the regeneration be.

The tuner consists of a 140 mmfd. Hammarlund condenser of the midget type and a low loss coil. Space winding is employed so as to make the losses in the tuner as low as possible.

The coil is of the plug-in type and has four prongs. Therefore the set can be made to cover any desired wave band or bands by merely plugging in coils of different inductances. For the condenser used and the type of circuit, coils are available that will cover the entire short-wave band from about 15 to 200 meters.

LIST OF PARTS

Coils
One set of short-wave plug-in coils
One 10-millihenry choke coil

Condensers
One 140 mmfd. Hammarlund variable condenser
One adjustable condenser
One 0.0001 mfd. grid condenser
One 0.0005 mfd. by-pass condenser

Resistors
One 5-megohm grid leak
One 50,000-ohm potentiometer
One 25-ohm rheostat, with filament switch

Other Requirements
Two two-post binding post strips
One 3.5-inch dial
One metal subpanel with two four contact sockets
One metal front panel
One four-lead battery cable
One 230 tube, new type

RECTIFIER METERS

A. C. Measured Accurately up to 35,000 Cycles

By B. R. Hill

Instrument Division, Westinghouse Electric & Mfg. Co.

THE practical measurement of alternating currents has heretofore been made by three types of instruments: electrodynamometer, repulsion or attraction iron vane, and thermo-couple-d'Arsonval.

The electro-dynamometer type has a system of stationary and moving coils without iron in the magnetic circuits. The repulsion iron vane types have a stationary coil, movable vane and stationary vane. Some types of this movement consist of a stationary coil and a single movable attraction iron vane. In the thermocouple-d'Arsonval type, a thermocouple is heated by the alternating current and the resulting thermo-emf is measured by a d'Arsonval instrument.

Now we have a fourth practical a-c instrument known as the Rectox type. It consists of a copper oxide rectifier and a d'Arsonval type of instrument. The alternating current is rectified and then measured by the ordinary direct current d'Arsonval instrument.

More Power for A-C

The energy consumption or the power required to operate the pointer, in the previous types of alternating current instruments, is much more than for direct current instruments. This is because in a direct current instrument the magnetic field is supplied from a strong permanent magnet, permitting a comparatively small current in the moving coil. The higher energy consumption of alternating current instruments has been an application handicap for a long time, especially where the energy consumed by the instrument would seriously change the circuit conditions, particularly true in radio measurements.

The rectifier units are plates of copper, oxidized on one side. Copper, when oxidized on its surface, has the peculiar property of rectification, allowing current to flow much more readily from the oxide to the copper, than from the copper to the oxide. The copper plates are assembled and held firmly in place under constant pressure by a sturdy clamp and the entire unit is impregnated to seal it from moisture and corrosion.

The size of these rectifier units is considerably smaller than the usual battery charging unit. The relative area of the copper oxide plates greatly affects the performance of rectifier instruments. The proper area of plate has been determined after exhaustive research.

Full-Wave Rectification

The assembly of copper plates is made to give full-wave rectification for all instrument applications. This is accomplished by assembly of the plates into four sections in reverse order in connecting to the instrument.

The instrument has certain characteristics which make its application to measurement of alternating currents somewhat critical. For this reason its operating characteristics should be carefully considered in any application for measurement purposes.

This class of instruments differs from the usual alternating current types in that the torque and deflection are proportional to the first power of the current. Therefore, it measures the average value and not the effective value of the alternating current wave. The scale is, however, calibrated to read effective or root mean square values of a pure sine wave. Consequently, such instruments read correctly only on sine wave and have serious errors on other than sine wave forms. These errors can be compensated for in readings, provided the wave form is known from which a correction factor can be applied, or the instrument may be calibrated on the wave form with which it is used.

The resistance of the Rectox is a function of the current flowing.

Current Affects Operation

When a rectifier type milliammeter is connected in a circuit it affects the circuit conditions not only on account of its added resistance like any other instrument, but also the effect depends upon the actual current value passing. This disturbance of the normal circuit must be recognized if the milliammeter resistance is a large percentage of the total circuit resistance. If the circuit resistance is relatively high then this change will result in negligible effects. The instrument always correctly indicates the actual current passing through it, but the magnitude of the current may depend upon the non-linear value of the instrument resistance.

The readings of Rectox instruments are quite free from frequency errors. The reading may be expected to decrease about ½ per cent per kilocycle up to 35,000 cycles where different conditions occur. Due to capacity effects this type of instrument is not recommended for radio frequency measurements. It is, however, reasonably accurate throughout the audio frequency bands.

Resistance Changes

The effect of current upon the resistance of a rectifier unit has been previously discussed, but the copper-oxide unit also has the property of changing its resistance with temperature, and furthermore, the amount of change due to temperature depends on the amount of current passing. We have, therefore, a very complex relation between current, temperature and resistance. As a result of these conditions, a great deal of skill is required in designing a Rectox instrument to prevent errors arising from temperature changes.

Tests show that the effective resistance of a copper-oxide rectifier decreases as the temperature increases. Therefore, if a rectifier instrument should be used as a low-range voltmeter without designing for suitable temperature compensation, the voltmeter might read as much as 20 or 25 per cent high at a temperature of 40 degrees C. It is for reasons of this kind that little success has been met in trying to adapt Rectox units to standard direct current instruments. Much better results have been obtained by use of specifically designed combinations of instrument and rectifier in which proper temperature compensation has been developed.

Like all devices of its kind, the efficiency of the copper-oxide rectifier is less than 100%; in other words, if 1 milliampere a. c. is passed through it the resulting rectified current available for operating the indicating instrument is usually 1/10 of a milliampere or less.

A Complex Situation

Furthermore, the current efficiency ratio (d. c. current output divided by d. c. current input) is affected to some extent by temperature and also by the absolute value of current flowing. This again results in a complex situation involving temperature, current and efficiency, and a simultaneous study of all of these variables is the only means by which errors from temperature variations can be minimized. For example, with certain values of current flowing, the efficiency of an uncompensated rectifier instrument may drop from 80% to 75% during a 40° C. temperature rise. This would result in lowering the calibration of the instrument 6% at the higher temperature if no steps were taken to secure temperature compensation.

The majority of the above discussed errors, characteristic of rectifier instruments, can be minimized by careful design and by taking advantage of the opposite effects of certain errors. However, it is important that the instrument be properly designed to operate with the copper oxide rectifier. It is therefore not advisable to try to apply a copper oxide rectifier to an existing d'Arsonval instrument which has not been designed for this application, unless changes are made to provide proper moving coil resistance temperature compensation and swamping resistance. If the errors are properly cared for in the design of a complete rectifier instrument, reasonable accuracy can be obtained.

Sensitivity Is High

The chief advantage of a rectifier instrument is in its high sensitivity. By use of the rectifier principle, alternating current voltmeters may be made with a very high resistance per volt. Standard voltmeters are available in ratings as low as 4 volts with 1,000 ohms per volt, 1.5 volts with 2,000 ohms per volt and even .5 volt with 5,000 ohms per volt resistance. Below four volts rectifier voltmeters should have a resistance of 2,000 and, better still, 5,000 ohms per volt, in order properly to compensate for the errors discussed above. Milliammeters and microammeters of low ratings are also available.

Rectifier instruments are rapidly finding their place in the radio field for the measurement of such quantities as output of amplifiers and oscillators and power level indicators. The user of these instruments should bear in mind their characteristics, particularly their accuracy when used under various conditions. Rectifier instruments are a valuable contribution to the science of radio and they are continually finding new uses in this rapidly advancing art. Possibly the further developments in Research and Engineering on these instruments will tend to minimize their present errors and make them still more useful.

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53 @ $1.80, 6A4 @ $1.60

The list price of the 53 Class B twin amplifier tube is announced at $1.80, while that of the 6A4 power amplifier pentode is $1.60. Both are new tubes.

Radio University

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

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

Cutting Out the Lows

IN AN experiment I wish to cut out all frequencies below 1,000 cycles and to receive those above. Is there some kind of filter by means of which this can be accomplished? If so, will you kindly outline the circuit?—F. G. W., Detroit, Mich.

Yes, the suppression of the frequencies below 1,000 cycles can be effected by a high pass filter having the cut-off frequency at 1,000 cycles. Connect two condensers of 0.01 mfd. in series between the plate of one tube and the grid of the next. Connect a choke coil of low resistance and 1.2 henries between the plate and B plus. Connect another choke of 0.6 henry between the junction of the two condensers and ground. Next connect a choke of 1.2 henries between the grid of the second tube and the grid bias. This filter is supposed to work between a tube having a plate resistance of 7,500 ohms and a load of 7,500 ohms. The load may consist of a 7,500 ohm grid leak in parallel with the last coil.

* * *

58 As Oscillator

WILL you kindly publish a circuit diagram of superheterodyne using the 58 as oscillator and the 2B7 as detector? A circuit of six or seven tubes will be all right. I prefer a pentode in the output stage, but if you have a circuit that otherwise fits my request a triode will do because I can make the necessary changes.—W. H. P., New York, N. Y.

You will find a diagram of the type you asked for on this page. It is designed for utilization of the speaker field as choke in the B supply filter.

* * *

Mistaken Identity

IN THE May 6, 1933, issue you have a 7-tube d-c superheterodyne. I have built this and cannot get a thing through it. The screen voltage is practically zero. Is there any mistake in the circuit or do you suppose I have made an error in the wiring?—E. S., Brooklyn, N. Y.

There is one error. The screen of the 6A7 should be connected to the screen voltage line and not to ground. The low voltage may be due to your misreading "350 MMF" for "350 ohms." In the reproduced diagram "MMF" looks like a resistance symbol.

* * *

Excellence of Coils

HOW does the selectivity of a circuit depend on the size of the coil and on the size of the wire used in it? Is it better to use large coils and heavy wire than small coils and fine wire?—F. R. T., Erie, Pa.

As a rule, it increases with the size of coil and of wire. It is better to use large coils, in general, and heavy wire. There are exceptions, which have to do with placement of shields.

* * *

Loss of Signal in Resistance Coupling

ABOUT how much gain from a 58 tube at 3,000 kilocycles can be obtained when the plate coupling resistance is 50,000 ohms, the grid leak half megohm, the stopping condenser 0.001 mfd., and when the voltages on the various tube elements are the normal? Is the gain sufficient to make it worth while to use a resistance coupled radio frequency amplifier?—W. G. J., Springfield, Ohio.

The gain may be of the order of 10 whereas with tuning the gain might be 150 or more. It is not at all certain that the gain will be 10, for in many cases there has been a loss. The trouble is due to the grid-cathode and the plate-cathode capacities of the tubes in question. The greater the distributed capacities the less the high frequencies will be amplified. Since screen grid tubes have higher inter-element capacities than triodes, the voltage gain from a screen grid tube is not much greater than that from a triode, although the amplification factor of the screen grid tube may be 100 times greater.

* * *

Grid Emission

HOW can grid current flow when electrons are emitted only when a conductor is hot? Does it mean that the grid heats up to a sufficient temperature to emit electrons? If so, why does the grid get hot before it carries any current?—W. R. K., Newark, N. J.

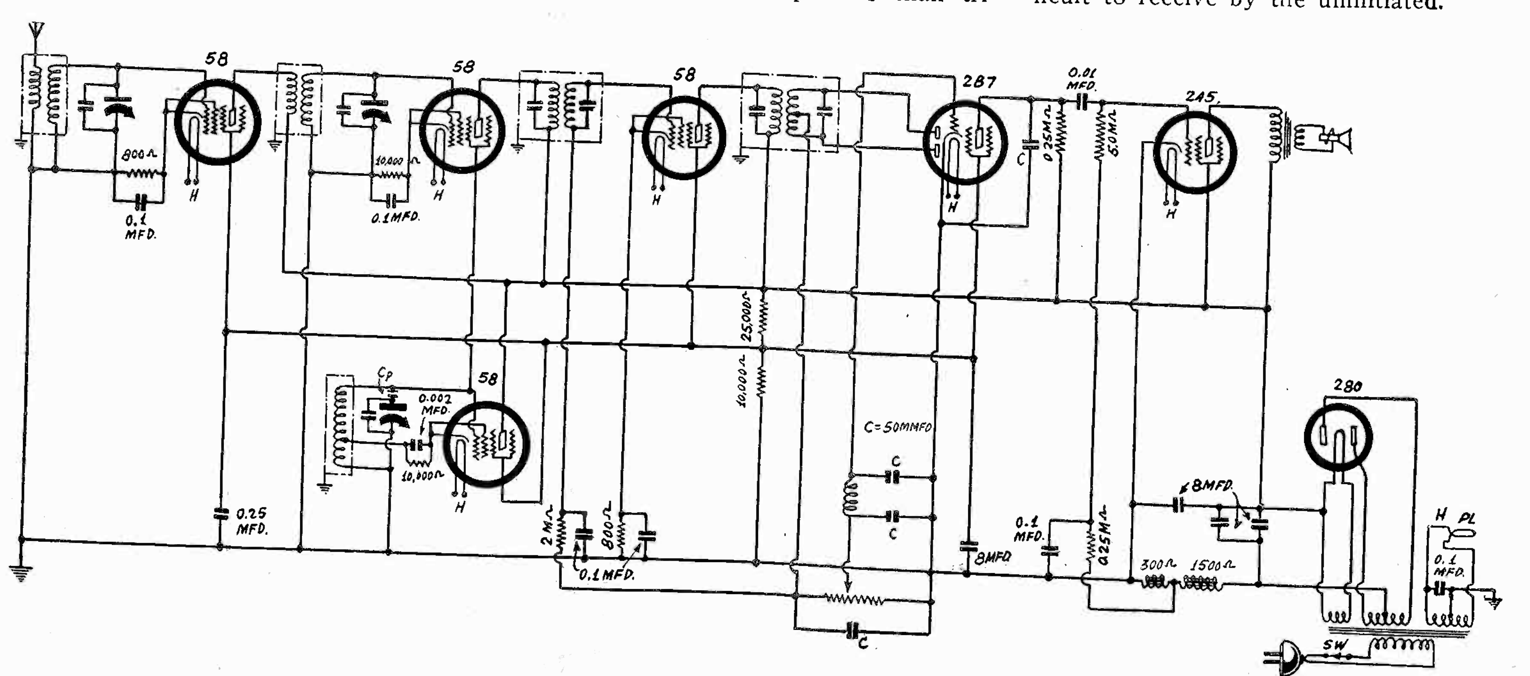
The grid is close to the cathode, which is heated, and it will get hot enough to emit.

* * *

Secret Telephony

IT IS my understanding that radio telephony can be made secret so that only the station for which it is intended can pick up the signals as intelligible sounds. If this is the case, how is it done?—G. H. L., Jamaica, L. I.

There are several methods by which it can be done. Some of them are quite complex. Perhaps the simplest is the one employing inversion of speech. Suppose, for example, that speech frequencies range from 250 to 2,500 cycles per second. These frequencies are impressed on a carrier of, say 3,000 cycles. The modulation results in two side frequency bands, one ranging from 500 to 2,750 cycles and the other from 3,250 to 5,500 cycles. The lower of these is selected by means of a band pass filter and then impressed on a radio frequency carrier. The side band can be received with any receiver tuned to the radio frequency carrier, but all the sounds of speech are inverted, and no one can understand them. In order to make the speech intelligible it is necessary to supply the missing carrier of 3,000 cycles and detect once more. Then a filter is used to select the original frequency band, in which all audio frequencies are in their true relative position. Of course, this is not entirely secret because any one could receive the signals by supplying the missing carrier. However, he must know what the carrier is and must hold it constant. The sending station may without warning to eavesdroppers change the carrier. The legitimate receiver operator would have been apprised previously of this change and he would be ready. Another method depends on moving certain frequencies to another part of the spectrum. For example, a narrow band around 600 cycles may be lifted and placed at the edge of the transmission band. This type is more difficult to receive by the uninitiated.



A seven-tube superheterodyne utilizing the 58 as oscillator, and the 2B7 as detector. The oscillator grid voltage is the screen voltage on the modulator.

Determination of Ballast

IN THE issue of May 13th you have a short wave universal in which there is a ballast resistance of 200 ohms rated at 20 watts. Please explain how the resistance is arrived at and how the wattage rating is determined.—T. Y., White Plains, N. Y.

The heaters of the three tubes are connected in series. One requires 6.3 volts and the other two 25 volts each. Thus the total is 56.3 volts. The line voltage, on the average, is 115 volts. Hence the ballast must drop 58.7 volts. All the tubes are of the 0.3-ampere type. Hence the current through the ballast will be 0.3 ampere. Therefore the required ballast resistor is 58.7/0.3, or 196 ohms. The nearest commercial value is nominally 200 ohms, and accordingly that is specified. A variation of 5 per cent either way does not matter, that is, 5 per cent above or below 196 ohms. The wattage is determined by computing the wattage dissipation in the ballast resistor. Since the voltage drop in it is 58.7 and the current is 0.3, the wattage is 17.6 watts. The nearest higher resistor is 20 watts. There is no objection whatsoever in using a much heavier ballast, say one of 100 watts, provided that the resistance has the proper value.

* * *

Use of 2B7

YOU have shown two ways of using the 2B7 tube. In one you use the pentode element for radio frequency amplification and in another for audio frequency amplification. Which is the preferable arrangement? That is, which method will give the better quality and the louder signals?—W. E. W., Pittsburgh, Pa.

We prefer using the pentode for radio frequency amplification because then it is not necessary to adjust the bias on the control grid or the screen voltage so carefully. When the tube is used as an audio amplifier, it is difficult to get best results because the grid bias and the screen voltage are critical and also because the pentode is easily overloaded when used as an audio amplifier. There is no practical difference in the sensitivity if the same number of tubes is used and if the audio amplifier that takes the place of the pentode has a comparable amplification. The quality is likely to be better because of the decreased distortion in the audio amplifier.

* * *

Resistance Capacity Filter

CAN a high pass filter be constructed out of resistance and capacities? Recently you showed that resistors and capacities could be combined so that a broadly tuned circuit resulted. Perhaps it is possible to make a high pass filter along the same line.—S. H., New York, N. Y.

A high pass filter of a kind can be constructed provided that the shunt capacities can be made negligibly small. The article to which you referred indicated that it was not possible to pass very high frequencies because there would necessarily be some shunt capacities. It is easy enough to stop the low frequencies, because all that is necessary is to make the series condensers very small, and the shunt resistances not very large.

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IS THERE any advantage in using a radio frequency control of the volume in a set that is equipped with automatic volume control? If so, please explain.—E. S., Richmond Hill, N. Y.

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Installing Tone Control

HOW would you connect a tone control in a receiver in which the output stage consists of a push-pull 48 amplifier? What should it consist of?—W. E. M., Covington, Ky.

Connect it across the primary of the push-pull transformer. First connect a condenser of about 0.05 mfd. to the plate of the tube, then a variable resistor of about 250,000 ohms between the condenser and ground. This connection makes it unnecessary to insulate the variable resistor from the chassis because one side of it will be connected to the chassis. The condenser will prevent the plate voltage from shorting through, so it is safe all around.

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MY receiver uses a 55 diode bias detector and this is followed by a 56 audio amplifier working into a push-pull transformer and two 2A3 tubes. I wish to connect a phonograph pick-up unit to this amplifier. Where is the best place to connect it?—E. T. B., Portland, Me.

The best place is in the grid circuit of the 56. You may connect it across the grid leak or you may connect it in place of the grid leak. You will get much more amplification if you connect the pick-up in the grid circuit of the triode of the 55, that is, between the cap of the tube and ground. But since your triode is diode biased there will be no bias on the tube when the pick-up is connected, assuming that you kill the radio frequency amplifier while you are playing phonograph records, or that you detune it. Naturally, you will have to do one or the other. Lack of bias, however, will not prevent the circuit from operating, and there will be no excessive plate current if you use resistance coupling between the 55 and the 56.

* * *

Capacity of Three Condensers

IF THERE is a formula giving the capacity of three condensers connected in series please give it. I know the formula for two condensers in series and I assume there is an equally simple formula for three.—A. B., Brooklyn, N. Y.

It is not so simple for three condensers as for two. However, the formula is based on an equally simple formula. The reciprocal of the capacity of the three in series is equal to the sum of the reciprocals of the three capacities. The reciprocal of a number is one divided by that number. If you "simplify" this formula it becomes $C = C_1 C_2 C_3/(C_1 C_2 + C_1 C_3 + C_2 C_3)$. Stating this in words it is: the capacity of three condensers in series is the product of the three capacities divided by the sum of the three possible products taken two at a time. As an example, suppose the three capacities are, $C_1 = 0.01$, $C_2 = 0.02$, and $C_3 = 0.025$. The product of the three is 0.000005. $C_1 C_2 = 0.0002$, $C_1 C_3 = 0.00025$, and $C_2 C_3 = 0.0005$. The sum of these three products is 0.00095. Hence the value of C is 0.00526 mfd. The capacity of any number of condensers in series can always be found by the rule for obtaining that of two in series, because as soon as two have been combined the result can be combined with another, and so on until all have been used.

Radio University

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

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

Cutting Out the Lows

IN AN experiment I wish to cut out all frequencies below 1,000 cycles and to receive those above. Is there some kind of filter by means of which this can be accomplished? If so, will you kindly outline the circuit?—F. G. W., Detroit, Mich.

Yes, the suppression of the frequencies below 1,000 cycles can be effected by a high pass filter having the cut-off frequency at 1,000 cycles. Connect two condensers of 0.01 mfd. in series between the plate of one tube and the grid of the next. Connect a choke coil of low resistance and 1.2 henries between the plate and B plus. Connect another choke of 0.6 henry between the junction of the two condensers and ground. Next connect a choke of 1.2 henries between the grid of the second tube and the grid bias. This filter is supposed to work between a tube having a plate resistance of 7,500 ohms and a load of 7,500 ohms. The load may consist of a 7,500 ohm grid leak in parallel with the last coil.

* * *

58 As Oscillator

WILL you kindly publish a circuit diagram of superheterodyne using the 58 as oscillator and the 2B7 as detector? A circuit of six or seven tubes will be all right. I prefer a pentode in the output stage, but if you have a circuit that otherwise fits my request a triode will do because I can make the necessary changes.—W. H. P., New York, N. Y.

You will find a diagram of the type you asked for on this page. It is designed for utilization of the speaker field as choke in the B supply filter.

* * *

Mistaken Identity

IN THE May 6, 1933, issue you have a 7-tube d-c superheterodyne. I have built this and cannot get a thing through it. The screen voltage is practically zero. Is there any mistake in the circuit or do you suppose I have made an error in the wiring?—E. S., Brooklyn, N. Y.

There is one error. The screen of the 6A7 should be connected to the screen voltage line and not to ground. The low voltage may be due to your misreading "350 MMF" for "350 ohms." In the reproduced diagram "MMF" looks like a resistance symbol.

* * *

Excellence of Coils

HOW does the selectivity of a circuit depend on the size of the coil and on the size of the wire used in it? Is it better to use large coils and heavy wire than small coils and fine wire?—F. R. T., Erie, Pa.

As a rule, it increases with the size of coil and of wire. It is better to use large coils, in general, and heavy wire. There are exceptions, which have to do with placement of shields.

* * *

Loss of Signal in Resistance Coupling

ABOUT how much gain from a 58 tube at 3,000 kilocycles can be obtained when the plate coupling resistance is 50,000 ohms, the grid leak half megohm, the stopping condenser 0.001 mfd., and when the voltages on the various tube elements are the normal? Is the gain sufficient to make it worth while to use a resistance coupled radio frequency amplifier?—W. G. J., Springfield, Ohio.

The gain may be of the order of 10 whereas with tuning the gain might be 150 or more. It is not at all certain that the gain will be 10, for in many cases there has been a loss. The trouble is due to the grid-cathode and the plate-cathode capacities of the tubes in question. The greater the distributed capacities the less the high frequencies will be amplified. Since screen grid tubes have higher inter-element capacities than triodes, the voltage gain from a screen grid tube is not much greater than that from a triode, although the amplification factor of the screen grid tube may be 100 times greater.

* * *

Grid Emission

HOW can grid current flow when electrons are emitted only when a conductor is hot? Does it mean that the grid heats up to a sufficient temperature to emit electrons? If so, why does the grid get hot before it carries any current?—W. R. K., Newark, N. J.

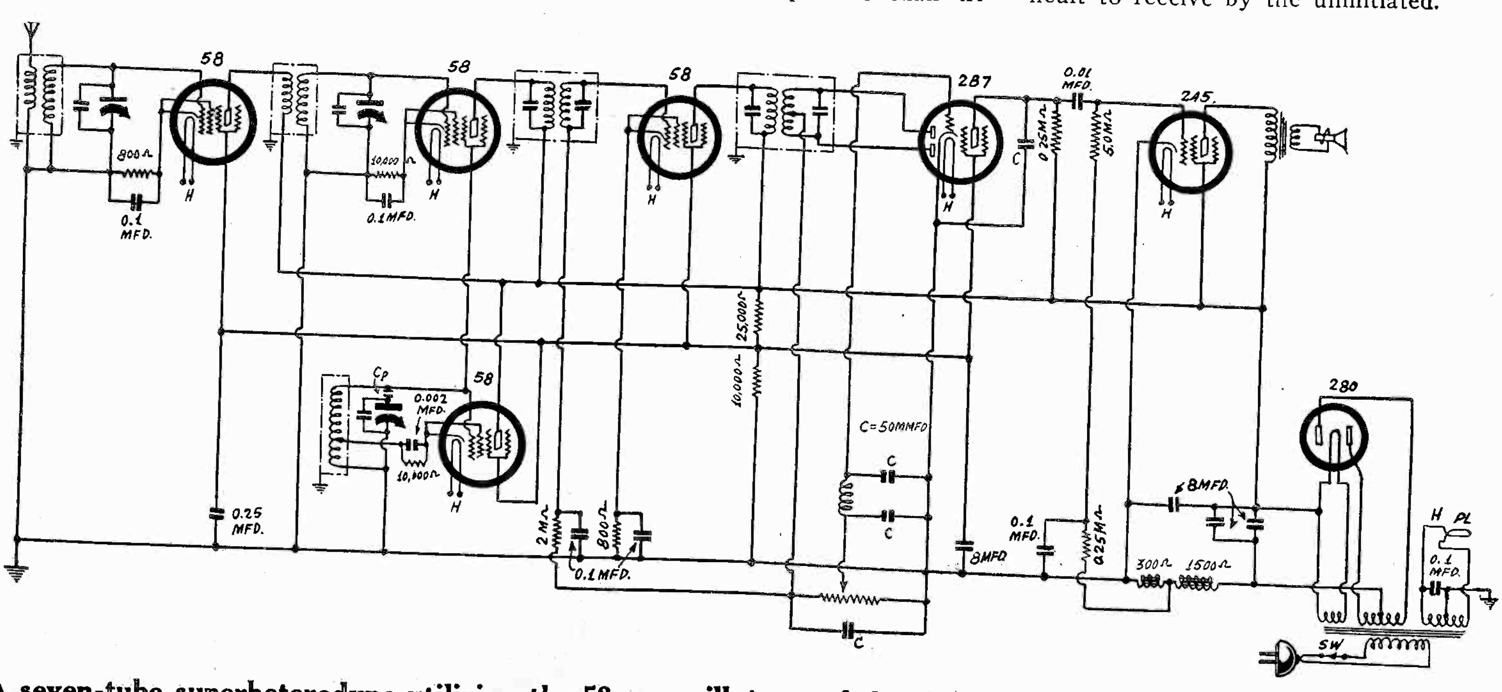
The grid is close to the cathode, which is heated, and it will get hot enough to emit.

* * *

Secret Telephony

IT IS my understanding that radio telephony can be made secret so that only the station for which it is intended can pick up the signals as intelligible sounds. If this is the case, how is it done?—G. H. L., Jamaica, L. I.

There are several methods by which it can be done. Some of them are quite complex. Perhaps the simplest is the one employing inversion of speech. Suppose, for example, that speech frequencies range from 250 to 2,500 cycles per second. These frequencies are impressed on a carrier of, say 3,000 cycles. The modulation results in two side frequency bands, one ranging from 500 to 2,750 cycles and the other from 3,250 to 5,500 cycles. The lower of these is selected by means of a band pass filter and then impressed on a radio frequency carrier. The side band can be received with any receiver tuned to the radio frequency carrier, but all the sounds of speech are inverted, and no one can understand them. In order to make the speech intelligible it is necessary to supply the missing carrier of 3,000 cycles and detect once more. Then a filter is used to select the original frequency band, in which all audio frequencies are in their true relative position. Of course, this is not entirely secret because any one could receive the signals by supplying the missing carrier. However, he must know what the carrier is and must hold it constant. The sending station may without warning to eavesdroppers change the carrier. The legitimate receiver operator would have been apprised previously of this change and he would be ready. Another method depends on moving certain frequencies to another part of the spectrum. For example, a narrow band around 600 cycles may be lifted and placed at the edge of the transmission band. This type is more difficult to receive by the uninitiated.



A seven-tube superheterodyne utilizing the 58 as oscillator, and the 2B7 as detector. The oscillator grid voltage is the screen voltage on the modulator.

Determination of Ballast

IN THE issue of May 13th you have a short wave universal in which there is a ballast resistance of 200 ohms rated at 20 watts. Please explain how the resistance is arrived at and how the wattage rating is determined.—T. Y., White Plains, N. Y.

The heaters of the three tubes are connected in series. One requires 6.3 volts and the other two 25 volts each. Thus the total is 56.3 volts. The line voltage, on the average, is 115 volts. Hence the ballast must drop 58.7 volts. All the tubes are of the 0.3-ampere type. Hence the current through the ballast will be 0.3 ampere. Therefore the required ballast resistor is 58.7/0.3, or 196 ohms. The nearest commercial value is nominally 200 ohms, and accordingly that is specified. A variation of 5 per cent either way does not matter, that is, 5 per cent above or below 196 ohms. The wattage is determined by computing the wattage dissipation in the ballast resistor. Since the voltage drop in it is 58.7 and the current is 0.3, the wattage is 17.6 watts. The nearest higher resistor is 20 watts. There is no objection whatsoever in using a much heavier ballast, say one of 100 watts, provided that the resistance has the proper value.

* * *

Use of 2B7

YOU have shown two ways of using the 2B7 tube. In one you use the pentode element for radio frequency amplification and in another for audio frequency amplification. Which is the preferable arrangement? That is, which method will give the better quality and the louder signals?—W. E. W., Pittsburgh, Pa.

We prefer using the pentode for radio frequency amplification because then it is not necessary to adjust the bias on the control grid or the screen voltage so carefully. When the tube is used as an audio amplifier, it is difficult to get best results because the grid bias and the screen voltage are critical and also because the pentode is easily overloaded when used as an audio amplifier. There is no practical difference in the sensitivity if the same number of tubes is used and if the audio amplifier that takes the place of the pentode has a comparable amplification. The quality is likely to be better because of the decreased distortion in the audio amplifier.

* * *

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Station Sparks

By Alice Remsen

Tranquility

For Ann Leaf and the Madison Singers.

In "Quiet Harmonies"—WABC Sundays

10:45 p.m. EDST.

The sun is setting in the west,
A soft breeze stirs the willow tree;
It bends its head to touch the breast
Of that cool lake, which we can see
Below us, nestling in the green.

A sleepy bird calls to its mate,
Across the land there comes the hush
Of twilight time, to compensate
For all the frenzied daytime rush.
The first pale trembling star is seen.

Then softly to our list'ning ear,
Like fairy flutes that sweetly play,
There comes the sound of music, clear,
To finish out a perfect day
And leave our heart and soul serene.

—A. R.

* * *

And tranquility will descend upon you if you listen in to the beautiful organ music of Ann Leaf and the sweet voices of the Madison Singers. If you have never heard them, listen; you'll like them. They may be heard over the following stations: WABC, WOKO, WCAO, WAAB, WKBW, WGR, WDRC, WFBM, KMBC, WCAU, W3XAU, WJAS, WFBL, WSPD, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WICC, WDOD, KVOR, WCAH, KRLD, KLZ, WTAQ, WLBW, WBIG, WHP, KTRH, KLRA, WFEA, WISN, WCCO, WODX, WLAC, WDSU, WMBD, WDBJ, WHEC, KSL, WSBT, WIBW, CFRB, WMT, WSJS and WORC.

* * *

The Radio Rialto

MOSTLY PUPS!

At last the weather seems to have made up its mind to be consistent. The sun is shining and even though there is a bit of a chill in the air, by mid-afternoon it will be warm. And I have a new dog—well, he's not really a dog yet, being only five months old; and, besides, he's not really mine yet, as we have just taken each other on trial for a couple of weeks to see if we get along together. He's a wire-haired fox, his name is Muggsy, and he's the cutest trick you ever saw; just at the slipper-hewing stage; thank goodness, I've got a few old slippers around the house; Muggsy really belongs to Frank White, the aviator, who must be a pretty shrewd judge of character. He's a keen dog-fancier, running particularly to wire-hairs, and I'm so glad he let me take this affectionate little pup on trial. . . . Suppose you're wondering what on earth I'm talking about dogs for when this is supposed to be a radio column; well, let's go. . . .

Rumors and More Rumors

There are quite a few rumors around radio row; f'rinstance, that Rubinoff presentation will undergo a complete overhauling within a few weeks; that Ann Butler, who was summarily let out of NBC sustaining programs, will open on a commercial series June 15th; yes—on NBC; that Myrtle Vail's motor smashup will very likely prevent her from appearing on the air next season, not because of injuries, but because sponsor is mad at her; the official displeasure was incurred because the smash-up was on a safety-island; that, as I predicted, those 7:00 p.m. spots on WABC were too manly, therefore Mildred Bailey takes two of them; that Phil Baker has rated eight additional weeks on his commercial; that "yours truly" will sing on the Standard Oil's Five Star Theatre program over WABC this Tuesday, too late, alas, for you to tune in, as it will be all over by the time this reaches print; thought you'd like to know I rated it, anyhow; that my old pal Uncle Don just couldn't help but be kindhearted enough to present the little prodigy, Grisha Gubuloff, with a real Stradivarius, after the kiddie had to return the violin, a Gaurnerius, loaned to him by the German Government, and simply because the Nazi leader, Hitler, objects to the child being a Jew; he must be a hard intolerant man to deprive a child of a musical instrument for such a reason; that Everett Marshall is more than making good on his three-time weekly Westinghouse program over WJZ; and that Welcome Lewis, taken off her sustaining job, is back again on NBC just the same. . . .

Here, There and Other Places

Just found out that Lou Raderman is the Phantom Gypsy; and why not, Lou is what I call an ace-violinist and rates as a star. . . . I understand that Grace Cluave Raine is at present in New York but will leave for Cincinnati almost at once; sorry you didn't give me a ring, Gracie! I don't forget your hospitality accorded to me in Cincinnati, and if I had known you were coming to town you would never have escaped me, don't let it happen again. . . . Expect to go to Cincinnati for one night on June 5th. Will make a personal appearance at the State Stationers Convention to be held at the Netherland-Plaza Hotel. What a grand reunion that will be. . . . Amelia Earheart will go radio; with Ted Husing she will cover the New York amusement center by plane with two-way conversations from theatres back-stage, night clubs and a voice stationed atop the Empire State Building; this will be a novelty in itself and kept up as an intermittent series. . . . Milton Berle goes on the Fred Waring program as comedian after several other flops. . . . Let's hope he makes good. . . . Radio is like a bogey-man to comedians. . . .

I feel very optimistic about the future of vaudeville. A new spirit seems to have entered the hearts of stage entertainers recently. It does my heart good to see the old-time buoyancy appearing at the National Vaudeville Artists Club House, 229 West 46th St., New York City. Saturday night is play night. A show, jolly good, too. . . . Dancing to a fine orchestra composed of our own people. Lots of good-natured chaffing, sandwiches galore and beer—well, rather—Lion Brew! and do we have good times—just like the old days, only better, for there are no restrictions. A membership drive is now on, get aboard children; anybody in the entertainment world may join, this includes radio folk; the dues are only ten dollars a year, and during the period of the drive there will be no initiation fee; save yourself twenty-five dollars and join now; you'll not regret it, for you'll do yourself a good turn, and also help the many poor folk of the vaudeville world who need friends. . . .

Mostly About Songs

It might interest you to know that Bob Miller, who was formerly with Witmark's, is now with the Superior Music Company, located at 1619 Broadway, New York. Pop in to see him; he has some good songs. . . . Arthur Behim is back in the music business again. He has gone into partnership with Irving Caesar; they also are located at 1619 Broadway. Irving has just written a gorgeous ballad, "If I Forget You," a song that will never grow old. . . . Beatrice Berenson is young, dark-haired and dark-eyed. Slender, graceful and pretty. Heard her over WEAF just recently and discovered that she also possesses a very charming lyric soprano voice, which showed to good advantage over the air. She should be good material for commercial purposes this Fall. . . . The Pickens girls are still warbling effectively over NBC. I can always pick out Jane's warm voice among the trio. . . . Just about time for tea now. So here goes for hot rolls—rather indigestible—but oh, so nice! Crosse and Blackwell's strawberry jam—put up in the States now, therefore only a quarter a jar—and delectable strong black tea. A friend of mine wrote me from the Coast right after the earthquake and said: "After it happened, all I could think of was a nice strong cup of Alice Remsen's tea." . . . Well, that's just how I feel about it, so here's how!

* * *

Biographical Brevities

About Emily Post

If ever you want to know just what to do at a wedding, funeral, birthday party or what-not, consult Emily Post; she has all kinds of etiquette at her finger-tips—or should I say her typewriter keys? Known as the Lady Chesterfield of the air, this charming personality is the arbiter of good manners for countless thousands of American women. . . . A native of Bar Harbor, Maine, she made her first money there when, as a child of five, she composed and stage-managed a performance of Mother Goose, advised the choice of costumes, rehearsed a group of children, and played or sang most of the parts herself.

Later on in life she wrote a book and took it to Dodd, Mead & Co., because their establishment was near where she lived. She told Mr. Dodd she had a book, and was very disappointed because he did not read it then and there. . . . However, she left it with him and a week later received a letter asking her to come in and sign a contract. The book was "The Flight of a Moth" compiled from actual letters she had written to her father from house parties in England, France and Germany.

Since that time Mrs. Post has written nine novels and one travel book, "By Motor to the Golden Gate," then came that remarkable book "Etiquette," the book for which Mrs. Post is universally known, somewhat to her chagrin, because its amazing success has been paid for by the frustration of her career as a writer of fiction. Her last and favorite book is "The Personality of a House," by means of which every home-owner may make her own home more livable, inviting and beautiful.

Mrs. Post runs her own life as a captain runs a ship. She is up at six in the morning and retires promptly between nine and ten o'clock P.M. She eats three moderate meals and always gets eight hours of sound sleep. She insists upon a four months' vacation, but she works, according to her friends, almost every minute she is resting. To those interested in a radio career she suggests: "Be sincere. Think about the music or the message you have to give, and not about yourself. You are only the medium. Try to perfect yourself to the utmost, but don't do anything that is not unself-conscious. The radio is the X-ray medium which reveals everything you not only are, but were, and it spotlights sham; but it is beautifully kind to simplicity and sincerity."

And I think that is jolly good advice

(Continued on next page)

PERSONALITIES

The father of Eddie Duchin, orchestra leader at the Central Park Casino, N. Y. City, whence his WABC-Columbia broadcasts are heard, narrowly missed prescribing remedies for headaches instead of rhythms for blues. . . . His father owns a chain of Boston drug stores and Eddie planned to follow in his father's footsteps, graduating from Pharmacy College. A Leo Reisman piano audition, which he won, changed all his plans. He had never planned a musical career. He had to take piano lessons from the age of 9 and thereafter. As a youth he served as waiter in a boys' camp and became pianist of the three-piece orchestra the waiters organized. During other summer vacations he worked in a drug store by day and played at local dances in the evenings, after a professional musician, who was more intrigued than Eddie's teacher at the young man's original patterns of syncopation, had advised him to join the musicians' union. In the summer of his junior year at Pharmacy College he won the Reisman audition and joined that orchestra, returning to school in the fall to be graduated as president of his class. After that, however, he was given the opportunity to organize his own orchestra to play at the Central Park Casino. He is a confirmed bachelor.

* * *

The guitar effect of the Pickens Sisters, NBC harmony trio, is effected by pinching the nose with forefinger and thumb as the girls hum their theme song. It was Jane's idea that started the trio on their own special technique.

* * *

Because Emmett Gowen, young author of the "Mis' Lilla" dramas heard each week over NBC networks, couldn't get a newspaper job in New York six years ago he turned his hand to fiction writing. He is the author of a number of short stories and his first novel, "Mountain Born," was recently published. Gowen had previously worked on Memphis, New Orleans and Nashville papers.

* * *

Harry Reser started broadcasting over an NBC network nearly eight years ago with a specialty banjo orchestra. He has broadcast each week without interruption since, but now there is only one banjo in the band. That one is Reser's and he plays only solos.

* * *

May Singhi Breen and her husband, Peter de Rose, have moved from their New York City apartment to a home in New Rochelle, N. Y.

* * *

The Neil Sisters, who are heard with Phil Baker, the Armour Jester, over NBC, remember of their early days in the show business especially the night they spent in a small town. They stayed at a hotel that advertised "Rooms $1 and Up." They took one of the one dollar rooms and were up all night.

* * *

When Edna Odell, the Hoosier Songbird heard regularly over NBC networks from the Chicago studios, made her first public appearance at an amateur theatrical night, she won the grand prize, singing "Bring Back My Soldier Boy For Me." The purse was two and one-half dollars.

* * *

A medallion, or sculptured plaque, of Howard Claney's head, executed by Bradley Warren, is being exhibited at the Grand Central Galleries in New York City. Claney is himself an artist and has had a number of his paintings—oil and water color—on display in Manhattan at various times. He is an NBC announcer.

* * *

Allyn Joslyn and Rosaline Greene, celebrated their fifth year on the air during the Maxwell House Show Boat program last week, as "radio sweethearts." They started playing opposite each other on the Eveready Hour in 1928.

* * *

Jimmy Wallington's knowledge of dogs probably saved the life of his full-blooded bull terrier, poisoned in the Wallington yard at Bayside, N. Y.

Recognizing poison symptoms a few minutes after the dog had eaten something, Wallington rushed his 65-pound thoroughbred "Pat," to a Long Island animal hospital. There the doctor told the NBC announcer he had saved the dog's life by his quick action.

* * *

Although Carveth Wells, the explorer, actually speaks for twelve minutes during his travel programs, listeners think he talks from three to five minutes. In letters to the National Broadcasting Company, the lecturer's listeners repeatedly ask why Wells doesn't talk longer on the air!

* * *

Mary Steele, contralto, heard regularly from Chicago, earned her first money by singing at a funeral when she was 14 years old. She began giving concerts in small towns about Kentucky when she was 16.

* * *

The Rollickers Quartet, NBC singers, had a difficult time getting into the studio recently for their usual broadcast with Sigmund Spaeth. They all had a two day's growth of beard and were not recognized by the man who guards the entrance on the ground floor. "Scram," said the attendant, "No panhandlers allowed in the studios."

It took Victor Hall, the manager of the Rollickers, some time to explain that they were letting their beards grow for a motion picture short they are making.

* * *

John Seagle, NBC baritone, born in Paris, has a slight Southern accent. He has crossed the ocean nineteen times, but his first public appearance was at a Billy Sunday revival meeting in Chattanooga, Tennessee. John was only three years old at the time. He has sung for the Duke of Connaught and Prince George of England but his greatest pride is the log cabin he built himself in the Adirondacks. He has been singing publicly for twenty-four years and he's only twenty-seven now.

* * *

In three years of broadcasting over networks, Ralph Kirbery has never sung that favorite of all baritones, "The Road to Mandalay." However, because of insistent demands from listeners, Ralph has finally decided to include the number in a program.

* * *

Fannie Brice tries to forget the studio audience when she broadcasts over NBC. After one or two experiments, she has resolved not to wear costume, and when she sings, she has the glass curtain down and stands directly in back of the mike. She has found that any tendency to play to the studio visitors causes her broadcasting to suffer.

* * *

Oliver Smith has a unique record on the air. Like professional fliers, Smith has kept a complete "log" of his singing time on the radio since his first performance for NBC in 1928. Up to the time he left for his vacation last September he had totalled a record of 429 singing hours.

WYNN'S CHAIN SOON TO OPEN

In preparation for the impending opening of its radio chain, the Amalgamated Broadcasting System's building at 501 Madison Avenue, N. Y. City, work on the seven studios on the fourteenth and fifteenth floors has so far advanced that decorators have succeeded technicians in equipping them. The general technical construction has been directed by Frank Orth, engineer in charge, formerly in charge of similar work for the Columbia Broadcasting System. With him are associated a former chief engineer of WEAF here and other experts.

The parent network is being tested nightly. On this network, which will be first to open, are WMET, New York; WTNJ, Trenton, N. J.; WPEN, Philadelphia; WDEL, Wilmington, Del.; WBCM, Baltimore, and WOL, Washington, D. C.

50 Daily Features

"More than a score of sponsors will be on the air when we start," said Wynn. "Our time schedule is a full 16 hours. The hourly rate for the whole Atlantic Seaboard network is about the same as for one leading 'spot' station in New York City."

More than 50 features daily are to go on the air with Amalgamated.

Hundreds of artists are rehearsing daily in special studios in the Amalgamated building. Their initial offerings, supervised by George M. King, director of the Amalgamated Artists' Bureau; Irvin Z. Grayson, his assistant, and a large staff of production experts, will range from individual presentations to full-length musical shows. In the shows, one of which it is announced will be two and one-half hours in length, the Ed Wynn innovation of his "Theatre of the Air" will reach fulfillment. This will be a light opera production, one of the historical hits of the contemporary stage, and it is to be presented with a cast of 45, with symphony orchestra, under the counsel of the original Broadway producer, with the co-operation of Amalgamated's technical staff. Between its many scenes the radio audience will be taken backstage, into the dressing-rooms of the stars and again into the theatre lobby, the intermissions thus being invested with the atmosphere of a Broadway first night.

Link Planned

The next step in Amalgamated's engineering plans is the completion of its privately-operated circuit between Baltimore and Pittsburgh, when WWSW, Pittsburgh, is to serve as the link between the so-called Atlantic Seaboard network of Amalgamated and its Michigan network. This comprises WXYZ, Detroit, the twin unit WOOD-WASH, Grand Rapids; WELL, Battle Creek; WKZO, Kalamazoo; WIBM, Jackson, and WFDF in Flint. These stations now are operating as a subsidiary unit of Amalgamated.

Station Sparks

(Continued from preceding page)

for anyone to follow. You may hear this charming exponent of graceful living and good manners twice weekly, each Monday and Thursday over an NBC-WJZ network, on the Dupont Cellophane program at 10:45 a.m.

METROPOLITAN OPERA SIGNS UP AN AIR TENOR

A new record for radio has been made, with the announcement that Nino Martini, young Italian operatic tenor, presented in nationwide WABC-Columbia broadcasts, has been signed up by the Metropolitan Opera Company to be starred in leading tenor roles throughout the 14-week period of the 1933-1934 season. Although numerous opera stars have been heard on the air both in operatic performances and in concert programs, their broadcasting came as a result of their established fame in operatic and concert fields, but Martini is the first artist to be selected by the Metropolitan from the ranks of regular broadcasting talent.

Reverses the Trip

Thus, with Martini, the trend is reversed and he steps from the microphone to the Metropolitan stage after his fame has been built primarily by radio.

Martini's rise to the most coveted position in his profession comes as the result of less than five months of bi-weekly recitals over Columbia, but he is not entirely new to opera. His repertory includes some 15 Italian and French operas, and he has sung leading roles with the Philadelphia Grand Opera and two of the smaller Italian opera companies.

When he made his debut with the Philadelphi company two years ago as the Duke in "Rigoletto," he received so thunderous an ovation that he was forced to break a long precedent and interrupt the performance with several encores.

Vocal Range a Feat

His phenomenal vocal range, covering more than two and a half octaves, extends to "F" above high "C." Several weeks ago he sang the exacting aria, "Credea si Misera" from Bellini's opera, "I Puritani," for the first time on the air and for its first American performance, hitting the high "F's" in full voice. He is the first tenor since the time of Rubini, more than 50 years ago, who has been capable of its performance as written.

Martini is 28 years old, slender, romantic in appearance, dark-haired, and brown-eyed. He has had more than a year's experience in films and is an accomplished actor.

Ten Years Ago!

(Some of the things that made Radio World of June, 1923, of interest to its readers)

Our own J. E. Anderson signed an article headed "Wigwagging with Sharps and Flats." The story had to do with a system of signaling, especially in the Army service. Mr. Anderson explained that he had been working on the idea for some time and that in certain respects it resembled the system announced by General Squier of the Signal Corps of the Army.

Arthur S. Gordon was author of an article entitled "Some Good Radio Kinks for Yachtsmen," illustrated with several drawings of boats showing which radio devices were especially suitable for various types of craft.

C. White explained the advantages of a portable loop aerial receiver which fitted into a small-sized case or portable cabinet.

Kenneth Malcolm, A.I.R.E., told "How to Buck the Bugaboo of Summer Static" and static surely was a man-size bugaboo in 1923.

Arthur G. Shirt gave directions for building a portable loop for summer portage and clear-cut illustrations added interest to the article.

W. S. Thompson devoted considerable space (and the technical art departments furnished diagrams) to "A Fine One-tube Reflex Set."

The R. C. A. had just appointed F. P. Guthrie, former head of the Radio Division of the Shipping Board, as district manager, with headquarters in Washington, D. C.

Cardinal Dubois, Archbishop of Paris, announced: "Radio cannot save sinners," —referring to the fact that, while he was a radio enthusiast, he did not consider that listening in on a sermon on Sunday was a suitable substitute for churchgoing.

9 Out of 10 Aerials Poor, Says Caldwell

"At least nine radio listeners out of ten have antennas so poor and inefficient as to interfere with rather than aid good reception," Orestes H. Caldwell said in a recent broadcast. He added that in summer properly-arranged aerials are even more important than during the cold weather.

During the broadcast Caldwell explained why even the best radio receiver is handicapped by a poor aerial, and gave practical suggestions on how to eliminate man-made static, how to safeguard sets through the use of lightning arrestors, the use of shielded conductors and the importance of proper insulation.

CHURCH OF AIR TEN YEARS OLD, FOLLOWS CODE

Recently there was celebrated the tenth anniversary of the inauguration of the vast religious radio enterprise under Protestant leadership broadcast over the combined networks of the National Broadcasting Company, which furnishes its facilities without charge.

Church leaders who have spoken on the air thanked the officials of the National Broadcasting Company for making possible this service, at a dinner in the Waldorf Astoria Hotel. Among the officials of the broadcasting company present were M. H. Aylesworth, president; Richard C. Patterson, Jr., executive vice-president, and vice presidents George F. McClelland, John W. Elwood, John F. Royal, Roy C. Witmer, and Mark J. Woods, Treasurer.

The radio speakers who attended included Drs. S. Parkes Cadman, J. Stanley Durkee, Harry Emerson Fosdick, Charles L. Goodell, Stanley High, Frederick H. Knubel, Daniel A. Poling, Paul E. Scherer, Ralph W. Sockman and Frederick K. Stamm.

Throughout the decade, the National Broadcasting Company has maintained the following principles in carrying out these religious programs:

"Religious messages should be non-denominational and non-sectarian in appeal; the National Broadcasting Company will serve only the central and national agencies of great religious faiths; the messages should present the broad claims of religion which not only aid in building up the personal and social life of the individual but also aid in popularizing religion and the Church; only the recognized outstanding leaders of the several faiths as determined by the best counsel and advice available shall be given the privilege of broadcasting."

Chapters on Television in Arnold's New Book

Television is the subject of three chapters in the new television edition of "Broadcast Advertising," by Frank A. Arnold, which has just been published. The author formerly was director of development for the National Broadcasting Company.

In addition to the material on broadcast advertising which formed the body of the original edition, now revised and brought up to date, Arnold has included the most important phases of the newest radio art in the current printing. There is an introduction to the added chapters by Dr. Alfred N. Goldsmith.

Not only has Arnold compiled existing material in chronological order, but he has included original matter and prophecies of his own.

NAVY BAND BACK ON AIR

The United States Navy band has returned to the Columbia network for its nationwide broadcasts, after an absence of several months. With Lieut. Charles Benter directing, the band offers programs of patriotic music every Tuesday from 4:00 to 4:30 p.m., EDST. The U. S. Army Band, directed by Capt. William J. Stannard, continues on its present schedule: Thursdays from 4:00 to 4:45 p.m., and Fridays from 4:30 to 5:00 p.m., EDST.

"Odds on Radio" Just Issued by the C. B. S.

The advertising and publicity departments of the Columbia Broadcasting System have been busy for some time on a treatise between covers and have just issued it. The facts assembled are intended for the use of advertisers who are wondering whether radio advertising really pays when compared with newspaper display space.

The C.B.S. calls this collection of carefully-prepared facts "Odds on Radio," and believes it has proved that radio has all the better of the controversy. There are carefully tabulated returns from many trades, including drugs, cosmetics, electrical equipment, gasoline, wearing apparel, automobiles, confectionery, food products, shaving cream, silverware, jewelry, and radio sets. Some of the reports are based on statements made by noted heads of important concerns whose names are used and who state unequivocally that carefully prepared figures indicate that advertising over the air has brought returns far ahead of those obtained through the medium of the printed word.

"Odds on Radio" is a mighty interesting production which, while obviously intended as radio advertising propaganda, nevertheless is worth reading if only to discover how some radio advertisers make comparisons of costs and results of various types of public announcements regarding the goods they offer the public.

Three Changes Proposed in Amateur Regulations

Hartford, Conn.

The board of the directors of the American Radio Relay League recommended three changes in the Federal Radio Commission's regulations governing amateur radio.

A widening of the existing amateur radio-telephone assignment, to 1,875 to 2,000 kc, now 1,800-2,000 kc, a new 'phone assignment in the region of 10 meters (28,000 to 28,500 kc) and restriction to only pure direct current power supplies in amateur stations were the recommendations. Up to the present time substantially d.c. effects have been required, but it has been permitted that these be obtained through the use of unfiltered supply on certain stages. This privilege has been abused, thus bringing about the new recommendation.

Central Amateurs to Meet at Fair In August

Chicago.

The annual Central Division convention of the American Radio Relay League is to be held here in connection with A Century of Progress Exposition, under the auspices of the World's Fair Radio Amateur Council. The dates have been set at August 3d, 4th and 5th.

The convention headquarters will be the Medinah Athletic Club, 505 North Michigan Avenue.

Newton D. Baker Succeeds Young on RCA Board

David Sarnoff, president of the Radio Corporation of America, announced that at a meeting of the Board of Directors, Newton D. Baker was elected a director of the corporation to fill the vacancy on the Board created by the resignation of Owen D. Young.

NEW FULL HOUR ON CBS

A new series of hour programs, sponsored by Silver Dust, will be heard intermittently during the summer over eastern stations of the WABC-Columbia network. Entitled "Around the Town," the elaborate and novel presentations will depict cross-sections of entertainment in New York City, with actual visits to leading amusement centers and the appearance of many outstanding performers of the metropolis. The first broadcast was on May 26th.

WARNOW MADE MUSIC CHIEF

Mark Warnow, who has conducted and played for a variety of musical programs during his four years in radio, has been appointed staff musical director for the Columbia Broadcasting System.

WESTINGHOUSE GAINS

Westinghouse Electric and Manufacturing Company announced that bookings for March were the largest of any month since July, 1932.

A THOUGHT FOR THE WEEK

LOOK for something important, perhaps sensational, in radio in the near future. Reference is made to the present impasse in the relations between the broadcasters and the American Society of Composers, Authors and Publishers. Things are brewing in a manner that indicates both sides will get together and arrange the matter of royalty payments on a mutually satisfactory basis—or else there'll be a blowup that will make everybody in or out of radio stop, look and listen.

TRADIOGRAMS

By J. Murray Barron

Try-Mo Radio Co., Inc., 85 Cortland Street, New York City, announces the new Spring 108-page radio catalogue is now off the press and will be available within a few days for distribution. Judging from the advance copy there is nothing quite like it and its general make-up. Completeness marks this very valuable addition to the mail order field.

* * *

Emanuel Mittleman, now associated in the organization of the Try-Mo Radio Co., Inc., is making rapid progress in his kit assembly department and the design department. In these days to cut corners and not sacrifice quality becomes a part of the engineering and designing department of all radio organizations. In this respect Emanuel is showing up in fine style.

* * *

W. W. Jablon, of the Hammarlund Mfg. Co., New York City, announced a special display of the Hammarlund products at the Short-Wave Show recently held at the St. George Hotel, Brooklyn, N. Y. Walt was there to welcome his many friends.

* * *

Robert G. Herzog, E.E., a graduate of C. C. N. Y. School of Technology, has been appointed by Thor Radio Co., 167 Greenwich Street, New York City, as radio consultant and engineer. Mr. Herzog brings to this organization more than technical knowledge, for his radio experience covers a number of years with such organizations as Freed-Eiseman, C. A. Earl and A. H. Grebe Co. He is former branch Chairman of American Institute of Electrical Engineers.

* * *

The Fanning Radio Labs., 377 Eighty-seventh Street, Brooklyn, N. Y., are now specializing in special buys in small radio receivers. These are picked because they have met the test and standards and are complete in cabinets with speakers and R. C. A. tubes, ready to operate. It is their intention to offer these specially from time to time.

* * *

Radio Manufacturers Association, Inc., will hold an informal stag dinner following its ninth annual convention at the Stevens Hotel, Chicago. The dinner will be on Tuesday evening, June 6th.

CORPORATE ACTIVITIES

CORPORATION REPORTS

Cables & Wireless, Ltd.—For year ending December 31, 1932, after deduction of charges, directors' fees, expenses, and £357 preference dividends for previous years, report a profit of £649,220. This compares with £642,033 profit for the year 1931, before deducting £5.865 preference dividends.

Crosley Radio Corp.—For year ending March 31, 1933, after deduction of taxes and charges, report a net loss of $291,061. This compares with net loss of $139,091 for the preceding fiscal year.

B. F. Keith Corporation (subsidiary of Radio-Keith-Orpheum).—For year ending Dec. 31, 1932, report a net profit of $209,782, after charges and taxes. In 1931 the net profit was $545,777. Stock outstanding, 400,000 shares. Cash $48,561 against $421,479, accounts receivable, $40,687 against $89,954, total current liabilities, $409,544 against $495,286.

Marconi Wireless Telegraph, Ltd.—For year ending December 31, 1932, after deduction of taxes and charges, report a net income of £74,735. In 1931 the net income was £60,007.

ASSIGNMENT

Helen Catron (Catron's Radio), 156 Nagle Ave., New York, N. Y., retail radios and accessories; to Milton Annis 3415 31st Ave., Queens, L. I., N. Y.

RECEIVER APPOINTED

Sol Lazarus, Inc., 218 East 59th St., New York, N. Y., radios and sporting goods. Justice Coxe appointed The Irving Trust Co. as receiver.

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.*

Weldon Stripling, Box 230, Mineral Wells, Texas.
W. F. Diehl, Box 245, Urbana, Ohio.
Radio Clinic, 216 S. Morton, Okmulgee, Okla.
Alfred E. Leslie, 79 Bostwick Ave., Jersey City, N. J.
W. Guy & Son, 28 Maude Street, Kimberley, South Africa.
R. W. Droory, National Radio Service Co., Ltd., 160 Main Street, Toronto, Ont., Canada.
H. C. Young, Supervisor Purchases & Supplies, International Railway Co., 540 Masten Ave., Buffalo, N. Y.
Chester Sherman, 403 First St., San Francisco, Calif.

SHORT-WAVE CLUB

F. W. Grassly, Capitol Heights, Frankfort, Kentucky.

STUTTERING INTERFERENCE

In certain superheterodynes a stuttering noise appears at some spots of the tuning dial which renders reception impossible at those points. This trouble always occurs when the intermediate frequency bears a certain relation to the signal frequency. For example, in a superheterodyne in which the intermediate frequency had been adjusted to 175 kc the trouble appeared at 700 kc. There were other points where it also occurred but not nearly to the same extent as at 700 kc. WLW, Cincinnati, is operating on this frequency, and when this trouble does not appear that station is easily received with a superheteroyne in New York. But when the sputtering appears it is impossible to receive WLW. Moreover, it is difficult to receive WOR clearly, which is operating on a frequency only 10 kc away.

It will be noted that 700 is the fourth harmonic of the intermediate frequency. The trouble evidently is the result of the production of harmonics of the intermediate frequency. Ordinarily the trouble manifests itself in the form of a heterodyne squeal.

It appears that the interference is so strong that the circuit overloads and that the sputtering is the resulting blocking of the grids in the tubes connected to the automatic volume control. Sometimes the trouble stops when the a.v.c. is shorted out, but usually not unless the input to the receiver is adjusted to a lower level.

This type of trouble has appeared especially since the pentagrid tubes were introduced into sets.

RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR **$7.00** Canadian and Foreign $1.50 extra

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first and only national radio weekly and the leading monthly for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks, is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total 64 issues for $7.00.

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

CIRCUITS AND SERVICE DETAILS OF COMMERCIAL RECEIVERS in issues of Radio World as follows: The Philco Model 15 Superheterodyne, Oct. 29, 1932; Philco's 4-tube Superheterodyne, Dec. 10, 1932; The Philco 37, Dec. 31, 1932; Philco Service Bulletin—No. 146, Models 89 and 19, Jan. 21, 1933; The Model 28, Newest Sparton Set, Nov. 5, 1932; Sparton 14, 14A, and 18, Jan. 7, 1933; The Majestic 324, Nov. 12, 1932; Stromberg-Carlson's Latest Circuits, Nos. 37, 38, 39, 40, and 41 Receivers, Nov. 19, 1932; The Pilot Dragon, Nov. 19, 1932; National Co. Short-Wave Receivers, Dec. 3, 1932; The New Fada Chassis, Dec. 24, 1932; Howard Model M, Jan. 7, 1933; The Comet "Pro," Jan. 14, 1933; Gulbransen Series 322, Jan. 14, 1933; United American Bosch Service Corp. Instructions, Jan. 21, 1933; Crosley Models 132-1 and 141, Jan. 28, 1933; The Colonial C-995, Feb. 11, 1933; Kennedy Model 563, Feb. 11, 1933, U. S. Radio No. 700, Feb. 18, 1933; Bosch 250 and 251, also Clarion Model 300, and Zenith 430 and 440, Feb. 25, 1933. 15c a copy, any 8 issues, $1.00. Radio World, 145 W. 45th St., New York City.

SHORT-WAVE COILS and FORMS

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

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

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

UX sockets for use as coil receptacle, Cat. 5X, @ 10c each. Forms, four for 60c, either UX or 6-pin. Six-spring sockets. Cat. SZ. @.......... 11c each.

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

Quick-Action Classified Advertisements

7c a Word—$1.00 Minimum Cash With Order

CAPACITY MULTIPLIER, over eighty different values obtainable using standard, inexpensive parts. Schematic, $1.00. MICRO-INSTRUMENTS, 514—5th St., N.W., Washington, D. C.

ENVELOPES, $1.39 per thousand; we pay postage; samples for stamp. Young Printing Company, Fairfield, Penna.

URUGUAY STAMPS—100 different stamps, $1.00. 200 different stamps, $3.50. Stamps will be shipped direct from Uruguay. Heriberto Meyer, care Radio World, 145 West 45th St., New York City.

"AMATEUR MOVIE CRAFT," by James R. Cameron. A book dealing with the making and showing of 16 m/m pictures and equipment necessary for same. Paper cover, $1.00; Cloth, $1.50. Radio World, 145 W. 45th St., New York, N. Y.

PUSH-PULL SUPER DIAMOND: Construction and trouble-shooting article and double-page picture diagram. In Radio World of March 18, 1933. 15c a copy. Radio World, 145 W. 45th St., New York City.

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. 1283 @ $1.89; a-c toggle switch, 19c; triple pole, four-throw Best switch, insulated shaft, $1.62; double pole, four throw, $1.08. Direct Radio Co., 145 West 45th St., N. Y. City.

NEW RADIO AMATEUR'S HANDBOOK, 180,000 words, 207 illustrations, 218 pages (10th edition, issued 1933). Price, $1.00 per copy. Radio World, 145 West 45th Street, New York, N. Y.

"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Page, 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

Special Summer Trial Subscription Offer

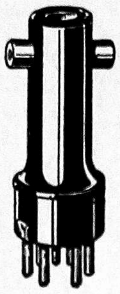
FOR

NEW SUBSCRIBERS

Send $1.00 in cash, check, P. O. money order or stamps, and receive Radio World postpaid from now until Sept. 2.

Sub. Dept., Radio World, 145 West 45th St., N. Y. City

NEW SERVICE EQUIPMENT



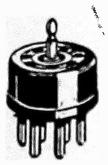
Cat. 907 WLC De Luxe Analyzer Plug, with 5-ft. 8-lead cable attached. Price $3.23

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

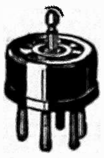
The eighth lead connects to the two grid caps and stud socket which is a latch lock. Standard adapters for the De Luxe Analyzer Plug are 7 top to 6 bottom, 7 top to 5 bottom and 7 top to 4 bottom, thus reducing to required number of pins and enabling testing of circuits using all popular tubes. Special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

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

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



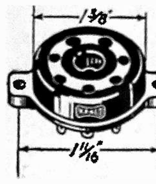
Cat. 976-DS New plug-in adapter, 7-hole top, 6-pin base, with locking stud that fits into 907-WLC latch. Price .... .73



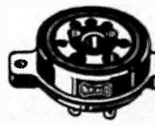
Cat. 975-DS New plug-in adapter, 7-hole top, 5-pin base, with locking stud that fits into 907-WLC latch. Price .... .73

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

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



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



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

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

MULTIPLE SWITCH

For switching to nine different positions, enabling current, voltage and other readings. Any one position opens a circuit and closes another. Thus the opener, by interruption, gives access to plate, cathode, etc., leads, for current readings, while the closer puts the current meter in the otherwise open circuit. Opener is disregarded for positions used for voltage measurements. Switch has detent for "snappy" action. Cat. 2NS9-KP-9-B9 ....$ 2.00

Double pole, nine throw switch. Cat. 2NS9-KP-9 @ $2.18

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

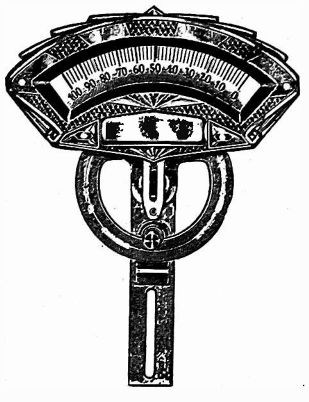
BLUEPRINT

627. Five-tube tuned radio frequency, A-C operated; covers 200 to 550 meters (broadcast band), with optional additional coverage from 80 to 204 meters, for police calls, television, airplane, amateurs, etc. Variable mu and pentode tubes. Order BP-627 @ 25c

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

THE FORD MODEL—"A" Car and Model "AA" Truck — Construction, Operation and Repair — Revised New Edition. Ford Car authority, Victor W. Page. 703 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

Matched Combination of Dial, Condenser, Coil



Dial obtainable with either of two numerically divided scales or with frequency scale.

Travelling light dial, bulb, escutcheon, 6-to-1 vernier, smooth action. Hub is for ⅜-inch shaft but ¼-inch reducing bushing is supplied. This dial is obtainable with either type numerical scale (100-0 is illustrated) or with frequency-calibrated scale, marked 500 to 150. The frequency scale requires 0.00037 mfd. condenser and 250 microhenries inductance for the broadcast band, or 0.00037 mfd. condenser and 20 millihenries inductance for actual 500 to 150 kc. fundamentals.

Cat. DJAD—0-100 for condensers that increase in capacity when turned to the right. Scale, 0-100.......... **75c**

Cat. DJAD—100-0 for condensers that increase in capacity when turned to the left. Scale 100-0 .... **75c**

Cat. DJADF — Frequency calibrated **94c**

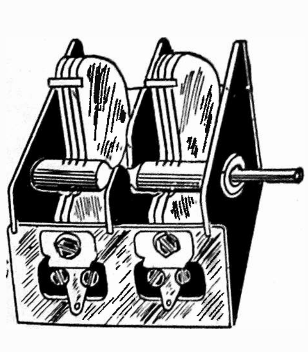
Cat. RFCH — (TH) — Honeycomb coil of 30 millihenries inductance. Two extreme lugs for total winding. Center lug is tap.......................... **45c**

Cat. TRF-250—Radio frequency transformer 2½-inch diameter shield; primary and tapped secondary. Tap may be used for oscillation in cathode leg of heater tube **45c**

Cat. DJA-14-D—Two gang 0.00014 mfd. short-wave condenser with compensators **$1.96**

Cat. DJA-37—Single tuning condenser, compensator built in; 0,00037 mfd. **98c**

Short-Wave Condenser



Two-gang condenser for short-waves. Low minimum. Sturdy construction. Ball race at front and back of Shaft. Compensators built in at side. Shaft is ¼-inch Aluminum plates. Useful with all standard make short-wave coils. ⅜-inch bushing supplied.

DIRECT RADIO CO., 143 West 45th Street, NEW YORK, N. Y.

ANDERSON'S AUTO SET

Designed by J. E. ANDERSON

FOREIGN RECEPTION ON 6-INCH AERIAL

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

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

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

DIRECT RADIO CO.

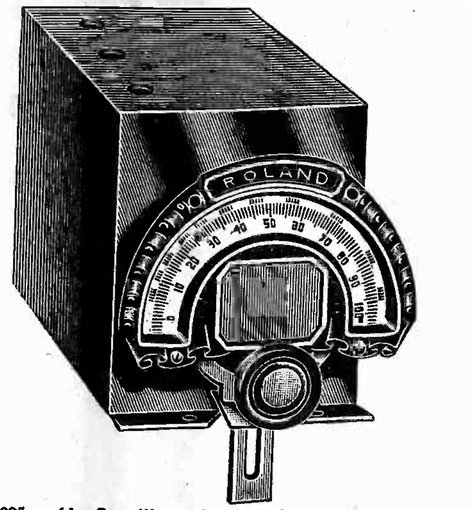
143 West 45th St. N. Y. City

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



0.0005 mfd. Scovill tuning condenser, brass plates, shaft at both ends so condenser takes 0-100 or 100-0 dials and two can be used with drum dial; sectional shields built in, trimmers affixed; total enclosed in additional shield as illustrated. Access to trimmers with screwdriver. Side holes for bringing out leads to caps of screen grid tubes. Cat. SCSHC @....$1.95

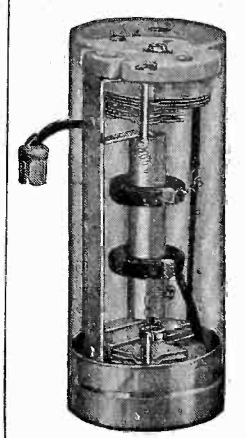
Same as above, with ghost type dial (travelling light). Cat. SCSHC-DL @......................$2.85

DIRECT RADIO CO., 143 W. 45 St., New York City

STATIONS BY FREQUENCIES

Frequency list, broadcasting stations, call, owner, location, power, wavelength, United States, Canada, Cuba, Mexico and Newfoundland. In Mar. 18th, 1933, issue of Radio World. Send 15c per copy to Radio World, 145 West 45th Street.

NEW $2.65 INTERMEDIATES



465 kc. model is used in 12-Tube Push-Pull Diamond

Highest grade intermediate transformers, 465 kc or 175 kc, with or without secondary center tap, just released by Hammarlund, use air-core condensers for tuning.

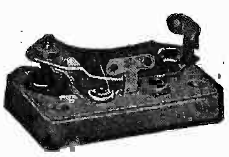
The transformer is of the tuned primary-tuned secondary type, with both plate and grid coils being tuned by air-dielectric variable condensers of special design. These condensers are mounted on an Isolantite panel 1 15-16 inches in diameter. The rotor is carried in a single bearing in the Isolantite panel and consists of two circular and three semi-circular brass plates of ¾ inch radius riveted to the rotor shaft. The stator, also of brass, consists of two circular and two semi-circular plates soldered to stator support rods which in turn are soldered in the bushings in the Isolantite panel. Contact is made to the rotor plates by phosphor bronze spring under considerable tension. No locking device is necessary, as the tension of the contact spring is sufficient to maintain the setting of the rotor even where extreme vibration is present. A screwdriver slot is provided in the end of the rotor shaft to facilitate tuning.

The use of these air variables practically eliminates the variations in gain and selectivity inherent in intermediate transformers in which the coils are tuned by means of adjustable condensers of the compression type using mica as dielectric. The transformers are pre-tuned to the desired frequency. List price, $4.50; net, $2.65 each.

Guaranty Radio Goods Co.

143 West 45th Street

PADDING CONDENSERS



Either capacity, 50c

A HIGH-CLASS padding condenser is required for a superheterodyne's oscillator, one that will hold its capacity setting and will not introduce losses in the circuit, for losses create frequency instability. The Hammarlund padding condensers are of single-condenser construction on Isolantite base, with set-screw easily accessible, and non-stripping thread. For 175 kc. intermediate frequency use the 850-1350 mmfd. model. For i.-f. from 460 to 365 kc., use the 350-450 mmfd.

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

A sturdy, precision straight frequency line condenser, no end stops. The removable shaft protrudes front and rear and permits ganging with coupling device, also use of clockwise or anti-clockwise dials, or two either side of drum dial. Front panel and chassis-top mounting facilities. True straight line. This rugged condenser has Hammarlund's high quality workmanship and is suitable for precision work. It is a most excellent condenser for calibrated radio frequency test oscillators, any frequency region, 100 to 60,000 kc., short-wave converters and adapters and TRF or Superheterodyne broadcast receivers. Lowest loss construction, rigidity; Hammarlund's perfection throughout.

Order Cat. HOS @..98c net

Guaranty Radio Goods Co., 143 West 45th Street, New York, N. Y.

SOLDERING IRON FREE!

Works on 110-120 volts AC or DC, power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

RADIO WORLD

145 West 45th St. N. Y. City

"SERVICING SUPERHETERODYNES,'' by John F. Rider. A reliable aid to the service man or to organizations in tackling superhet service problems. 161 pages, canvas cover. Price $1.00. Radio World, 145 W. 45th St., New York, N. Y.

NEW MODEL SHIELDED TEST OSCILLATOR!

Either model FREE with two-year subscription for Radio World (104 issues) $12.00

AN improved modulated test oscillator, fundamental frequencies, 50 to 150 kc, enabling lining up of intermediate frequency amplifiers, t-r-f and oscillator circuits, is now ready. It is shielded in a metal box 9½" wide x 6¼" deep x 4½" high, with beautiful Japanese finish. The test oscillator is obtainable in two models, one for a-c operation, the other for battery operation. The same cabinet is used for both.

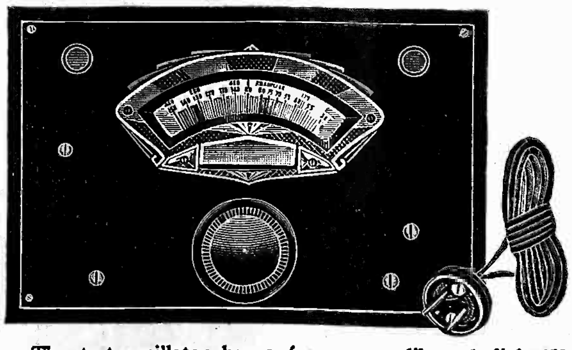
The a-c model not only is shielded but has the line blocked, that is, radio frequencies generated by the oscillator cannot be communicated to the tested set by way of the a-c line. This is a necessary counterpart to shielding, and a special circuit had to be devised to solve the problem.

The modulation in the a-c model is the a-c line frequency, 60 cycles, effected by using the line voltage on the plate of the tube. In the cabinet there is a very high resistance between the shield cabinet and the a-c, a double preventive of line-shorting and application of a-c line voltage to the user.

The oscillator is equipped with an output post. No ground connection need be used, as the circuit is sufficiently grounded through the power transformer capacity to prevent body capacity effects in tuning.

The frequencies are more accurately read than normal use requires, being never more than 2% off, and usually not more than 1% off, many readings being right on the dot (no discernible difference). The frequency stability is of a high order from 100 to 50 kc, and somewhat less from 100 to 150 kc. Zero beats are guaranteed at all frequencies.

The oscillator was designed by Herman Bernard and is manufactured under the supervision of graduates of the Massachusetts Institute of Technology.



The test oscillator has a frequency-calibrated dial, 150 to 50 kc, with 1 kc separation between 50 and 80 kc and 2 kc separation between 80 and 150 kc. Intermediate frequencies are imprinted on the upper tier. Broadcast frequencies are obtainable on tenth harmonics (500 to 1,500 kc).

RADIO WORLD

145 West 45th St., New York, N. Y.

THE a-c model is completely self-operated and requires a 56 tube. The battery model requires external 22.5-volt small B battery and 1.5-volt dry cell, besides a 230 tube. The use of 1.5 volts instead of 2 volts on the filament increases the plate impedance and the operating stability.

The battery model is modulated by a high-pitched note. Zero beats are not obtainable with the battery model.

Directions for Use

Remove the four screws and the slip cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service.

For testing some particular set, follow the directions given by the designer or manufacturer. In the absence of such directions, use the following method.

Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired broadcast frequency. Connect a wire from output post of test oscillator to antenna post of set. Leave aerial on for zero beats, off otherwise. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the wire to plate of the first detector socket. The first detector tube may be left in place and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way.