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.

Experience the Thrill of Police Reports, Ship-to-Ship and Commercial Communication and Amateur Conversations.

Do not confuse this Self-Powered Short Wave Converter with the average Converter that takes power away from your set, thereby causing the set to lose its sensitivity and resulting in disappointment.

The Detrola Is Self-Powered, Simple To Attach To Any Radio Receiver.

NORTH RADIO CO.
172 Washington St., N. Y. City
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.

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 microhens, to be tuned with 0.00041 mfd. condensers. There is a tap on the secondary to permit coverage of from 1,500 to 6,500 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 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 microhens), 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, 2¼ 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 S5, 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 adjusted 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 fundamental other than the fourth, frequency range.

due to purposeful restriction of their fre-

formers will not tune to any harmonic of

ing the intermediates, for the i-f trans-

of the set.

serviceable for lining up the front end

be seen that 465 kc is the fourth harmonic.

above 116.25 kc are harmonics and it can

232.5, 348.75 or 465 kc.

278.75, 1,395 kc, or with an accurate in-

whereupon

2

The tuning coil

is

63 mmfd., and the resonant

circuit could

1

If another receiver or oscil-

range

will

result:

1,046.25,

1,162.5,

1,395 kc, or with an accurate in-

oscillator for lining up the intermediate

method.

That method consists of using a built-

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 con-

stitutes the modulation. The tube osci-

llates both at the intermediate and at

an audio frequency.

A switch is provided so that the oscil-

lator'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 para-

des of the set.

trimmers, for the i-f trans-

formers will not tune to any harmonic of

the fundamental other than the fourth, due to purposeful restriction of their fre-

quency range.

It is usual to line up the front end by

paddling the oscillator at 600 kc and then

by trimming the r-f and oscillator, al-

though in the second instance parallel

trimmers are used alone. When we in-

spect 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 trim-

mers are turned down about half way. The padding condenser is adjusted for

maximum response. The trimmers on all

the r-f condensers are tentatively ad-

justed for strongest response and the set
dial is turned to near the high frequency

end, where 1,395 kc is heard. Then 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 de-

flection if an output meter is used), and
then at 581.25 kc the series padding con-

denser is given a slight readjustment, if it

is found that response is increased that

way, which is likely to be the case if the ul-

timate 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 set to see if the condenser only.

The high frequency broadcast adjust-

ment 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 aris-

ing from any cause in the receiver, but of course some squeals may be heard due
to the great sensitivity, since some for-

eign 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 oscil-

lation, except such as results from gross mispaddling, 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 oscil-

late, and the receiver is to be operated just

under the point of oscillation, for ma-

ximum sensitivity, and no ready di-

rections can be given for stability attain-

ment at once, without sacrificing sensi-
tivity.

The intermediate amplifier may re-

generate a harmonic. In this case 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 0.05 meg.

may be interposed between plate of

either first or second i-f tube and ground

chassis, which 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

general screen voltage load, bypassing

the two screens to ground with any con-

denser from supply, but the turnings

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 cen-
ter-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 1 1/2. 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 limited to 150 ma, and the
LIST OF PARTS

**Coils**
Three shielded radio frequency transformers, secondary tapped for 1,400-4,500 kc.
One 30,000-ohm, well-tapped for 1,600-4,950 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; center-tapped; 465 kc.
One tapped 30-millihenry honeycomb choke.
Two audio-frequency transformers, primary and secondary both center-tapped. Center coil 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 rectifier; (c), 5 volts, 3 amperes, center-tapped, for rectifier; (d) 465 volts 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 DY plug attached.

**Condensers**
One four-gang 0.00014 mf. tuning condenser with trimmers built in; shaft 1/4-inch diameter, 1 1/4-inches long.
One padding condenser, 330-450 mmfd.
One 50 mmfd. mica condenser.
Two 0.0002 mf. mica grid condensers.
Three 0.01 mf. mica stopping condensers.
Six 0.1 mf. bypass condensers.
One 0.5 mf. bypass condenser.
Five 8 mf. electrolytic condensers.

**Resistors**
One 0.5-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 1,000-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 115-25 kc. oscillator.
One toggle switch for phonograph pickup (optional).
One 115-25 kc. oscillator.
Six grid clips.
Twelve sockets: five six-hole, four four-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 turn Jackson.
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 187/16x12x 3 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, 1/4 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 2AJ's and one 5Z3.

**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. The 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 priced 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.

**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 potential meter 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 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 bias on all the stages. The other similar resistor, in the 55 cathode, is discussed later.

The 350-ohm resistor in the common cathode leg of the two r-f and the mixer tubes, unless those tubes remain 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 bias on all the stages. The other similar resistor, in the 55 cathode, is discussed later.

The 55-ohm resistor in series with the second i-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 that these capacitors, none less than 0.1 mf., may be used. For instance, one such block has two 0.25 mf., useful in parallel with the 0.5 mf. purpose, and nine 0.1 mf., the three extra 0.1 mf. being all right to be put in parallel with the two 0.5 mf. to constitute 0.7 mf., 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, unless those tubes remain 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 bias on all the stages. The other similar resistor, in the 55 cathode, is discussed later.

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

The 55-ohm resistor for the 55 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. With lower values of resistance than 3,500 ohms may be used for the intermediate tube biasing, results were found to be very satisfactory with this value, especially since the low, due to low screen voltage principally.

So that direct current is kept out of the primary of the first r-f 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 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 1He.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. 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 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 1/4 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 side of the chassis and is connected to 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-
connections 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:

<table>
<thead>
<tr>
<th>Dial</th>
<th>kc</th>
<th>Dial</th>
<th>kc</th>
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<tbody>
<tr>
<td>96</td>
<td>540</td>
<td>90</td>
<td>700</td>
</tr>
<tr>
<td>94</td>
<td>530</td>
<td>87</td>
<td>750</td>
</tr>
<tr>
<td>92</td>
<td>520</td>
<td>84</td>
<td>800</td>
</tr>
<tr>
<td>90</td>
<td>510</td>
<td>80</td>
<td>850</td>
</tr>
<tr>
<td>85.75</td>
<td>500</td>
<td>76</td>
<td>900</td>
</tr>
<tr>
<td>84</td>
<td>522.5</td>
<td>750</td>
<td>910</td>
</tr>
<tr>
<td>82.5</td>
<td>600</td>
<td>71.5</td>
<td>920</td>
</tr>
<tr>
<td>79</td>
<td>630</td>
<td>67.5</td>
<td>980</td>
</tr>
<tr>
<td>75</td>
<td>660</td>
<td>62.5</td>
<td>1,010</td>
</tr>
</tbody>
</table>

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 line-up with the fourth harmonic of 116.25 kc (i.e., 465 kc). In such a case, the augmentation of 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 dial readings should conform numerically as follows, numbers increasing as frequency decreases:

- **Dial Readings**
  - **Dial** | **kc** | **Dial** | **kc**
  - 96 | 540 | 90 | 700
  - 94 | 530 | 87 | 750
  - 92 | 520 | 84 | 800
  - 90 | 510 | 80 | 850
  - 85.75 | 500 | 76 | 900
  - 84 | 522.5 | 750 | 910
  - 82.5 | 600 | 71.5 | 920
  - 79 | 630 | 67.5 | 980
  - 75 | 660 | 62.5 | 1,010

**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 80 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 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.

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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

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 impractically small condensers. Hence we shall choose the value 1,000 ohms for Ro.

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

The characteristic impedance of the two sections, superposed. The actual attenuation is the sum of the two characteristic impedances. It will be noted that there is first a coil of L/2, or 93.5 \( \mu H \). Then there is another coil of the same value in series with one of L/2, or 30.75 \( \mu H \). These two may be combined, making a single coil of 124.25 \( \mu H \). Then follows another coil of 30.75 \( \mu H \). L has a value of 126.8 \( \mu H \). The first shunt condenser has a value of 187 \( \mu F \) and the second, \( C_2 \), a capacity of 61.3 \( \mu F \). This completes the two-section filtering.

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 bias 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 S8, 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 the secondary winding, which might consist of 25 turns, should be in the center of the primary turns and 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 the 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.
quency is \( f_c = 1/4\pi (LC)^\frac{1}{2} \). By combining these two equations we obtain the two design formulas \( L = R_o/4\pi f_c \) and \( C = 1/4\pi R_o f_c \). 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 \( L = 49.7 \mu F \) and \( C = 49.7 \mu F \). 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:

\[
C_1 = C/m, \quad C_2 = 4mC/(1 - m^2), \quad L_2 = L/m, \quad \text{in which } m = (1 - f^2)/f^2, \quad f_c \text{ being the frequency of infinite attenuation.}
\]

In this case \( f_c = 1,000 \) kc and \( f = 1,500 \) kc. Hence \( m = 0.348 \). Putting this value of \( m \) in the formulas we obtain: \( C_1 = 143 \mu F, \quad C_2 = 78.75 \mu F, \) and \( L_2 = 143 \mu H \).

**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 attentuations 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 \( C \). These condensers can be combined into a single condenser having a value \( 2CC/(C + 2C) \). Since \( C_r = 143 \mu F \) and \( C = 49.7 \mu F \), the middle condenser should have a value of 73.75 \mu F. The composite high pass filter will then have one condenser of 99.4 \mu F, one of 73.75 \mu F, and one of 286 \mu F in series with the line and one, \( C_2 \), of 157.5 \mu F in shunt with the line. \( L \) will have a value of 49.7 \mu H and \( L_2 \) a value of 143 \mu H.

**Self-Powering Aids**

**Converter Performance**

Some radio experimenters, because of their personal experiences 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 are very satisfactory. 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 voltage is that the set is really robbed of the voltage attainment at which it was designed to work hence often insuffficiently 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. 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 about 1,000 ohms.

**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 2,980/8,700. If the cut-off frequency \( f_c \) is determined by \( 1/4\pi (LC)^{1/2} \), the design formulas for this filter are the same as for the high pass filter, that is, \( L = R_o/4\pi f_c \) and \( C = 1/4\pi f_c \). In this case \( f_c = 1,000 \) cycles and \( R_o = 8,700 \) ohms. Putting these values into the design formulas we obtain: \( C = 0.0106 \mu F \) and \( L = 0.596 \mu H \).

**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.
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 metal cabinet.

The shielding of the battery model consisted simply of putting the device in a metal cabinet which 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. Therefore, 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 band is barely sensitive.

Capacity to Ground

Besides, the metal cabinet is automatically grounded capacitively, 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 of 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 confusing 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, since 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 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 broadcasting 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 antenna. 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 without leaving the power on for any length of time because there is danger of explosion of the electrolytic condenser.

**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 up. 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.
INTEREST in short-wave reception is growing rapidly because results can now be obtained with relatively simple equipment. To bring in the short-wave 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, but the short-wave feature is merely an addition. The short-wave converter converts the 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 possible 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, and the rectifier is also a 224 but is used as a diode rectifier. The plate and the grid being tied together. The only requirement is for power transformer and filament transformer. That demands another tube, used as rectifier. Thus a simple practical converter can be constructed with three tubes.

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 a 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 good grid resistance, 5 megohms, is used and a small grid condenser, 0.0001 mfd.

Coupling between the modulator and oscillator tube 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 condenser couples between the two circuits. It must be remembered that it operates at frequencies above 1,500 kc. If the coupling should be so high that the r-f signal would override 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 S1. This switch, which is a two-position switch, is made by twisting two insulated wires together, the twisted portion being about 1.5 inches. This condenser couples between the two circuits. It must be remembered that it operates at frequencies above 1,500 kc. If the coupling should be so high that the r-f signal would override the modulator, it can be loosened by untwisting the wires a little.

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 sub-panel 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 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 connect or disconnect the antenna switch and then the usual tuning of the broadcast set is all that is necessary.

LIST 0

Coils
One tapped oscillator coil.
One tapped radio frequency coil.
One high inductance choke coil.
One 110/25 volt filament transformer.

Condensers
C1, C9—Two 0.01 mfd. condensers.
C2—One 100 mfd. adjustable condenser.
C3—One 200 mfd. condenser.
C5—One 140 mfd. variable condenser.
C6—One 0.001 mfd. grid condenser.
A-WAVE CONVERTER

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 inch 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 to 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 3/8-5-32 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) to 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 goes 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 just where no station is heard, preferably above 1500 kilocycles (between 1500 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 just which short-wave band will produce the best results.

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.

11. Tune converter very slowly until a station is heard.

12. 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.

13. 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.
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 the point of oscillation is well defined. 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 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 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 0.001 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 33-inch dial
- One metal subpanel with two four contact sockets
- One metal front panel
- One four-lead battery cable
- One 230 tube, new type
THE practical measurement of alternating currents has heretofore been accomplished by means of instruments such as the electrodynamometer, rectification, or alternating current instrument, and the d'Arsonval instrument.

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 station ary coil, movable vane and stationary vane. Some types of this movement consist of stationary coil and a single moving coil, a copper oxide rectifier and a 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 an ordinary direct current d'Arsonval instrument.

More Power for A-C

The energy consumption or the power required to operate the pointer, in the present instance, in the direct current instruments, is much more than for direct current instruments. This is because in a direct current instrument the magnetic field is supplied by a strong permanent magnet, permitting a comparatively small current in the moving coil. The higher equilibrium current 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 one side, has the property of changing its resistance if the milliammeter resistance is a little resistance like any other instrument, but also the effect depends upon the actual current value passing. This disturbance of the normal current 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 a change in the current 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 effect of current upon the resistance of the copper-oxide rectifier is less than that of the milliammeter resistance. Like all devices of its kind, the efficiency of rectifier instruments 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 90% to 75% at a temperature of 40° C. This would result in lowering the calibration of the instrument 6% at the higher temperature if certain 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 for temperature compensation. Milliammeters and d'Arsonval instruments of high temperature compensation can be obtained.

Sensitivity Is High

The chief advantage of a rectifier instrument is its high sensitivity. By use of the rectifier principle, 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 worst 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 in the future Research and Engineering on these instruments will tend to minimize their present errors and make them still more useful.

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.
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 question in which there is a specified 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. Therefore the required ballast resistor is 58.7/0.3, or 196 ohms. The nearest commercial value is nominally 200 ohms. Fortunately 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 200 watts. There is no objection whatsoever in using a much higher ballast, say one of 500 watts, provided that the resistance has the proper value.

Use of 2B7

YOU have shown two ways of using the 2B7 tubes, one of which 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., Pittsfield, Pa.

We prefer using the pentode for radio frequency amplification because then it is not necessary to control the bias control grid or the screen voltage so carefully. The tube is used as an audio amplifier, it is not difficult to get just right, because the grid bias and screen voltage are critical and also because the pentode is easily overloaded which would overload the amplifier. There is no practical difference in the sensitivity if the same number of tubes is used in both amplifier. 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 con- denser and ground. This connection makes it unnecessary to insulate the variable resistor from the chassis because one side will be connected to the chassis. The condenser will prevent the plate voltage from shorting through, so it is safe all around.

Connection of Phonograph Pick-up

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 2AB3 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, as you will have to put the battery amount to the same thing. Perhaps the easiest way out of the difficulty is to have a local distance switch in the antenna circuit so that when signals are very strong the input can be reduced by the switch. Another way, which really amounts to the same thing, is to have one antenna for weak signals and another for strong signals. The outdoor antenna could be used for the weak signals and an indoor antenna of a few feet of wire for the strong locals. It is only on the strong local stations that the trouble will appear.

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 transformers. 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 will be connected to the chassis. The condenser will prevent the plate voltage from shorting through, so it is safe all around.

Resistance Capacity Filter

CAN a high pass filter be constructed out of resistance and capacities? Recently you showed that resistors and capacities cannot 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 are very small. The article to which you referred indicated that it was not possible to pass very high frequencies because that would amount to having some shunt capacities. It is easy enough to stop the low frequencies, because all that is necessary is to make the shunt capacities very small, and the shunt resistances not very large.

R-F Volume Control

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

Sometimes the signal is so strong that the bias developed across the load resistance of the detector is high enough to cut off the amplification in the tubes over certain sections of the signal voltage. Distortion results even though the difficulty lies in the radio or intermediate frequency amplifiers. If there is a manual control for the input to the set, this can be prevented. It will not help if the manual control merely varies the bias on the grid control valve because that would amount to the same thing. Perhaps the easiest way out of the difficulty is to have a local distance switch in the antenna circuit so that when signals are very strong the input can be reduced by the switch. Another way, which really amounts to the same thing, is to have one antenna for weak signals and another for strong signals. The outdoor antenna could be used for the weak signals and an indoor antenna of a few feet of wire for the strong locals. It is only on the strong local stations that the trouble will appear.

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 rule. The reciprocal of the capacities 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 \[ C = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \] (\( C_1, C_2, C_3 \)). Stating this in words it is: the capacity of the three condensers in series is the product of the three capacities divided by the sum of the products of the capacities 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 0.00005. \( \frac{1}{C_1} = 0.01 \). \( \frac{1}{C_2} = 0.05 \). \( \frac{1}{C_3} = 0.04 \). The sum of these products is 0.095. Hence \( C = \frac{0.00005}{0.095} \). 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.
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 the 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 the 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 worthwhile 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 by 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 1,250 to 2,500 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. This 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 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 15th you have a paper in which there is a list of tube specifications and a load resistance of 200 ohms rated at 20 watts. Please explain how the resistance is obtained at and how the wattage rating is determined.—T. Y., White Plains, N. Y.

The heaters of the three tubes are connected to a 6.3 volts and the other two 25 volts each. Thus the total is 56.3 volts. The line voltage, on the average, will be 120 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, strongly that is, 5 per cent. 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 0.3, the wattage is 17.6 watts. The nearest higher resistor is 20 ohms. There is no objection whatever in using a much heavier resistor, say one of 100 ohms, provided that the resistance has the proper value.

Use of 2B7

YOU have shown two ways of using the 2B7 tube. How 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., Pittsburg, Pa.

We prefer using the pentode for radio frequency amplification because then it is not necessary to have a bias on the control grid or the screen voltage so carefully. When the tube is used as an audio amplifier the bias is difficult to get right and 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. The amplifier that uses 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 are not so small as to ignore their effect. The article to which you referred indicated that it was not possible to pass very high frequencies because the value of the capacities would necessarily be some shunt capacitances. It is easy enough to stop the low frequencies, because all that is necessary is to use such a resistor that the value of the capacities will be small, and the shunt resistances not very large.

R-F Volume Control

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

Sometimes the signal is so strong that the bias developed across the load resistance of the detector is high enough to cut off the amplification in the tubes over certain sections of the signal voltage. Distortion results even though the difficulty lies in the radio or intermediate frequency amplifiers. If there is a manual control valve it is possible to use the input to the set, this can be prevented. It will not help if the manual control varies the bias on the control grid to the same amount to the same thing. Perhaps the easiest way out of the difficulty is to have a local-distance switch in the antenna circuit so that when signals are very strong the input can be reduced by the switch. Another way, which really amounts to the same thing, is to have one antenna for weak signals and another for strong signals. The outdoor antenna could be used for the weak signals and an indoor antenna of a few feet of wire for the strong locals. It is only on the strong local stations that the trouble will appear.

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 transformers. 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.

Connection of Phonograph Pick-up

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, as long as you keep the radio frequency amplifier while you are playing phonographic 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 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 one. 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 \( C = \frac{C_1 C_2 C_3}{C_1 C_2 + C_1 C_3 + C_2 C_3} \). 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 products of the 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 \( C_2 C_3 = 0.00005 \). The sum of these three products is 0.0003. Hence the value of \( C \) is 0.00026 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.

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Name ____________________________
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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 is so sweet, so cool, so free.
Of that cool lake, which we can see
Below us, nesting in the green.

A sleepy bird calls to its mate,
Across the land there comes the hush
Of twilight, time to assume.

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,
A soft breeze stirs the willow tree;
And leave our heart and soul serene.

Then softly to our list'ning ear,
Like fairy flutes that sweetly play,
A soft breeze stirs the willow tree;
And leave our heart and soul serene.

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 Don, and I'm so glad he let me take this affinity for fancy, running particularly to wire-hairs, judge of character.

It does my heart good to think of the Madison Singers. If you have never heard them, listen; you'll like them. They may be heard over the following stations: WABC, WCAO, WAAB, WKBW, WGR, WNBC, WFAE, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WOAF, WGBB, WLCN, WNYW, WO
WYNN’S CHAIN SOON TO OPEN

In preparation for the impending opening of its radio chain, the Amalgamated Broadcasting Systems, building at 501 Madison Avenue, N. Y. City, work on the seven studios on the fourteenth and fifteenth floors has so far advanced that the station has started production crews in equipping them. The general technical construction has been directed by Frank Orth, NBC’s assistant technical director, in charge of similar work for the Columbia Broadcasting System. With him are associated a former chief engineer of WEAF and other engineers.

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 a supporting ‘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 buildings. Their initial offerings, supervised by George M. King, director of the Amalgamated Artists’ Bureau; Irvin Z. Grayson, his assistant, and a large staff of technicians, 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 fulfilment. 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 cooperation of Amalgamated’s technical staff. Between its many scenes the radio audience, be taken to 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 Burbank, Calif., circuit. Baltimore and Pittsburgh, when WWSW, Pittsburgh, is to serve as the link between the so-called Atlantic Seaboard net-work of Amalgamated and its Midwest network. This comprises WXYZ, Detroit, the twin unit WOOD-WASH, Grand Rapids, Mich.; WELL, 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 three weeks, every Monday and Thursday over an NBC-WJZ network, on the Dupont Cellophane program at 10:45 a.m.
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 "Niggawithing with Sharps and Flats." The C.B.S. was doing so 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 "Good Radio Kinks for Yachtmen," 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 main-size bugaboo in 1923.

Arthur G. Shirt gave directions for building a portable loop for summer portable 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 Washing- ton, D. C.

Cardinal Delbehre, Archbishop of Paris, announced: "Radio cannot save sinners,"—referring to the fact that, while he was a radio enthusiast, he did not consider -referring to the fact that, while he was a radio enthusiast, he did not consider

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

Vocal Range a Feast

His phenomenal vocal range, covering more than two and a half octaves, extends to "P" above high "C." Several weeks ago he sang the exacting aria, "Credea st Miniera" from Bellin's opera, "I Purit- tani," for the first time on the air and for its first American performance, hitting the high notes with his full voice. He is the first tenor since the time of Rubini, more than 50 years ago, who has been capable of a performance as written.

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

"Odds on Radio" Just

The advertising and publicity depart-ments of the Columbia Broadcasting Sys-tem have been busy for some time on a treatise between covers and have just is-sued it. The facts assembled are intended for the use of advertisers who are won-dering whether radio advertising really pays when compared with newspaper dis-play space.

The C.B.S. calls this collection of carefully prepared facts "Odds on Radio," and believes it has proved that 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. The 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 in-tended to be used as agents in radio propaganda, nevertheless is worth reading if only to discover how some radio advertisers make comparisons of costs and results of vari-ous types of public announcements re-garding the goods they offer the public.

Recently there was celebrated the tenth anniversary of the inauguration of the vast religious radio enterprise under Pro-tection from the National Broadcasting Company, which furnishes its facili-ties without charge.

Many 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 Wal-dorf Astoria Hotel. Among the officials of the broadcasting company present were Mr. W. A. Ayerst, president; Richard C. Pat-terson, Jr., executive vice-president, and vice presidents George F. McClelland, John W. Elwood, John F. Royal, Roy C. White, and Mark J. Woodruff.


Throughout the decade, the National Broadcasting Company has maintained the following principles in carrying out these religious programs: "Religious messages should be non-de-nominational and non-sectarian; only 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. White, which has just been published. The author formerly was director of development for the National Broadcasting Company.

In addition to the material on broad-cast 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 introductory talk on 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 prophe-cies of his own.

NAVY BAND BACK ON AIR

The United States Navy band has re-turned to the Columbia network for its nationwide broadcasts, after an absence of several months. With Captain Benter directing, the band offers programs of patriotic music every Tuesday from 4:30 to 4:45 p.m., and Fridays, from 4:30 to 5:00 p.m., EDST.
Three Changes Proposed in Amateur Regulations

The board of the directors of the American Radio Relay League recommended three changes in the Federal Radio Commission’s regulations governing amateur radio: (1) A widening of the existing amateur radiotelephone 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 filtered supplies. This privilege has been abused, thus bringing about the new recommendation.

Central Amateurs to Meet at Fair In August

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 Medical 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 intermitently during the summer over eastern stations of the 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.

TRADIOGRAMES

By J. Murray Barron

TRY-MO Radio Co., Inc., 85 Cortland Street, New York City, announces the new Spring 108-page radio catalog 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 in the industry and its completeness marks this 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 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. Jablons, of the Hammarsland Mfg. Co., New York City, announced a special display of the Hammarsland 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., 157 Greenwich Street, New York, as radio consultant and engineer. Mr. Herzog brings to this organization more than technical knowledge, for his experience in radio research 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 completed in case of good 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.

TWO for the price of One

Get, EXTRA, one-year subscription for any One of these magazines:

- POPULAR SCIENCE MONTHLY
- RADIO-CRAFT (monthly, 12 issues)
- RADIO INDEX (monthly, 12 issues), stations, programs, etc.
- RADIO WORLD (monthly, 12 issues)
- EVERYDAY SCIENCE AND MECHANICS (monthly)
- RADIO NEWS (24 issues) FULL LIST
- AMERICAN BOY’S COMPANION (monthly, 12 issues; popular magazine)
- DON’T STOP LISTENING (monthly, 12 issues; popular magazine)
- OPEN ROAD (monthly, 12 issues)

Select any one of these magazines and get it free for an entire year by sending in a year’s subscription for RADIO WORLD at the regular price, $6.00. Cash in now on this opportunity to get RADIO WORLD for the entire twelve weeks at the standard rate. This offer is good for new subscribers only, plus a full year’s subscription for any ONE of the other enumerated magazines FREE. Put a cross in the square next to the magazine of your choice in the above list, and mail the coupon below, and make 50 cents cash, money order or stamps to RADIO WORLD, 145 West 45th Street, New York, N. Y. (Add $1.50, making $7.50 in all, for extra foreign or Canadian postage for both publications.)

A THOUGHT FOR THE WEEK

LOOK for something important, perhaps the answer to the problem in the world—Reference is made to the present impasse in the relations between the broadcasters and the laboratories of Corresponding Authors and Publishers. Things are being going 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 blow-up that will make everybody in or out of radio stop, look and listen.

RADIO WORLD, 145 West 45th Street, New York. (Just East of Broadway)

WALNOR 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 the answer to the problem in the world—Reference is made to the present impasse in the relations between the broadcasters and the laboratories of Corresponding Authors and Publishers. Things are being going 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 blow-up that will make everybody in or out of radio stop, look and listen.

RADIO WORLD, 145 West 45th Street, New York. (Just East of Broadway)
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 77 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 superheterodyne in New York. But when the stuttering 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 an heterodyne squeal.

It appears that the interference is so strong that the circuit overloads and that the stuttering is the resulting blocking of the grids in the tubes connected to the automatic volume control. Sometimes the trouble stops when the tube 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.

DIAMOND PARTS

Tuned Radio Frequency Sets

FIVE-TUBE MODEL

A-C operated circuit, 50- to 90-cycles, 150- to 300 volts, using two 56 t-r-f stages, 57 power detector and 47 output, with or without receiver. Three gang shielded condenser and shielded coils in a sensitive, selective and high efficiency arrangement. Dynamic speaker and all sockets used as B supply choke. Complete kit of parts, including two 97 and 874 tubes, all 300 volt sockets (one for speaker plug), two 8 mfd. electrolytic condensers; set of three coils.

FOUR-TUBE MODEL

The four-tube model is similar, except that there is one stage of t-r-f and a two-gang condenser is used. Tubes required, one 56, one 57, one 47 and one 97. Condenser, including an Rola dynamic speaker (less tubes, less cabinet). Cat. DICK @ $12.99

FOUNDATION UNIT, consisting of drilled metal subpanel, 13.0 x 9.0 x 3/4", three pentagrid tubes, 0.00035 mfd., brass plates, trimmers, full shield; shield for the 56 and 57 tubes; six sockets (one for speaker plug); two 8 mfd. electrolytic condensers; set of three coils. Cat. DSCW (less cabinet) @ 17.19

Kit of five Eveready-Raytheon tubes for this circuit. Cat. D5F @ 4.97

FOUR-TUBE MODEL

The four-tube model is similar, except that there is one stage of t-r-f and a two-gang condenser is used. Tubes required, one 56, one 57, one 47 and one 97. Condenser, including a Rola dynamic speaker (less tubes, less cabinet). Cat. DICK @ $12.99

FOUR-TUBE MODEL

The four-tube model is similar, except that there is one stage of t-r-f and a two-gang condenser is used. Tubes required, one 56, one 57, one 47 and one 97. Condenser, including a Rola dynamic speaker (less tubes, less cabinet). Cat. DICK @ $12.99

INDIVIDUAL PARTS

Travelling light vector dial, full-vision, bakelite, covered, with various projection indicators for receiver tuning. 34 or 36 volt lamp, 60 volt; electrical work, 25 cent. 50-100 for 5 tube dia. 100-200 for 4 tube dia. Cat. D7S @ 2.05

FOUNDATION UNIT, consisting of drilled metal subpanel, 13.0 x 9.0 x 3/4", three pentagrid tubes, 0.00035 mfd., brass plates, trimmers, full shield; shield for the 56 and 57 tubes; six sockets (one for speaker plug); two 8 mfd. electrolytic condensers; set of three coils. Cat. DSCW (less cabinet) @ 17.19

Super Diamond parts in stock.

DIRECT RADIO CO.

143 WEST 45TH STREET
NEW YORK, N. Y.

Wide Choice of ROLA SPEAKERS

31-1/4, Speaker for 12-TUBE DIAMOND, $21

Special semi-tuned coupler, for a variety of uses. It consists of three independently related windings on an aluminum shield, 1/4 tubes diameter, 3 inches in length, standard on the lower frequency extreme of the broadcast band. Secondary is center-tapped.

The semi-tuned transformer may be used as a so-called untuned with M-r-f feeding the detector, to make the amplification more nearly even throughout the band of radio frequencies by increasing the gain at the low frequency end. For general use the effected center tap on the secondary may be ignored.

If the duplex diode-triode is to be used in t-r-f sets, this transformer may be connected for full-wave detection with primary in preceding plate circuit, extremes of secondaries (green and green with white tracer) to anode of the diode (55, 55), to cathode through a resister of 0.5 meg. This is one of the most practical ways of applying the diode to t-r-f sets, with or without automatic volume control, as the problem of a grounded rotor of a condenser and a return that cannot be directly grounded is avoided.

The coil may also be used for a-v-c pickup, by putting one choke winding in the plate circuit of the detector, with no condenser from plate to ground, but condenser from other end of this coil to ground, and thus using the pickup of the secondary to feed the a-v-c circuit.

The transformer may be used as an antenna coupler.

The windings consist of twelve 300 volt coils of 2,500 turn, one secondary for the diode, with the green and red and yellow primary; green and blue and red, one secondary for push-pull output; red and black with red traced second primary. Con-
**Quick-Action Classified Advertisements**

To a Word—$1.00 Minimum
Cash With Order

**CAPACITY MULTIPLIER**, over eighty different models in stock using standard, inexpensive parts. Schematic, $1.00. MICRO-INSTRUMENTS, 545-5th St., N.W., Washington, D.C.

**ENVELOPES**, $1.39 per thousand; we pay postage. Sample sets Young Printing Company, Fairfield, Penn.

**URUGUAY STAMPS**—100 different stamps, $1.00. Additional sets (100-500 stamps) $1.40 per 25 (900-1000 stamps) $1.80. Dail, condenser, coil, $1.62; double-insulated, $1.85.

**PUSH-PULL, SUPER DIAMOND**: Construction and trouble-shooting article and double-page picture in Radio World of March 16, 1933. 15c. a copy, any 8 issues, $1.00. Radio World, 145 W. 45th St., New York City.

**NEW SERVICE EQUIPMENT**

De Luxe Analyzer Plug, with new seven-pin base, with 250 ohm cable (not shown), two alternate grid connector caps and grid socket at bottom that connects to both grid and plate wire. Double-shielded, 8-pin cap assures adaptability to future tube designs, including tubes with screens and control grids. 8-pin cap soon to be released to the public.

The eighth lead connects to the two grid caps and stub socket which is a broadcast input. Standard adapters for the De Luxe Analyzer Plug will be shipped direct from Uruguay. $1.00. 

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


**MULTIPLE SWITCH**

For switching to two different positions, enabling owner to change frequencies at will. One position gives a different current path for each of the broadcast bands. 20-25 cent. by interruption, while the rimer puts the other position back to the otherwise open circuit.

**SCREEN GRID COIL CO., 14 W. 44th Street, New York 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

**Matched Combination of Dial, Condenser, Coil**

- Travelling light dial, built, etched, Chromed, and Blacked.
- Short-Wave Condenser
- Dials obtainable with either of two combinations, or with frequency scale.

**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 seen pass. Modern Canadian stations were tuned in from New York, Chicago, and other cities.

The circuit, an improved superheterodyne, with automatic volume control, has the following features: 1. A 6-V 60-cycle external battery, and a 1.5 volt power supply for the oscillator. 2. A 100,000 watt output valve. 3. A four-stage intermediate frequency amplifier, with a gain of 6000. 4. A 10-stage high-frequency detector. 5. A switch for selecting between broadcast and intercity circuits. 6. A washable cabinet, with a control panel for adjusting the frequency. 7. A built-in test oscillator, with a frequency of 100,000 kc.

Wired model, licensed by R.C.A., with complete instructions includingRCA's $1.50 book, $3.50.

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

BOOKS AT A PRICE

"The Superheterodyne," by J. H. Anderson and David A. Sanders, McGraw-Hill, 1932. (Catalog 750, postpaid $1.00.) The book is a study of the fundamental principles, and the design and practice of the superheterodyne, as used in amateur radio equipment. It contains information on the theory and practice of the superheterodyne, as used in amateur radio equipment. It contains information on the theory and practice of the superheterodyne, as used in amateur radio equipment. It contains information on the theory and practice of the superheterodyne, as used in amateur radio equipment.

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