# TUNING IN FOR BYRD BROADCASTS


# RADIO WORLD

REG. U.S. PAT OFF

The First and Only National Radio Weekly

*611th Consecutive Issue - Twelfth Year*

DEC. 9
1933


POINTERS
ON
BETTER
SHORT-WAVE
RESULTS

NRA
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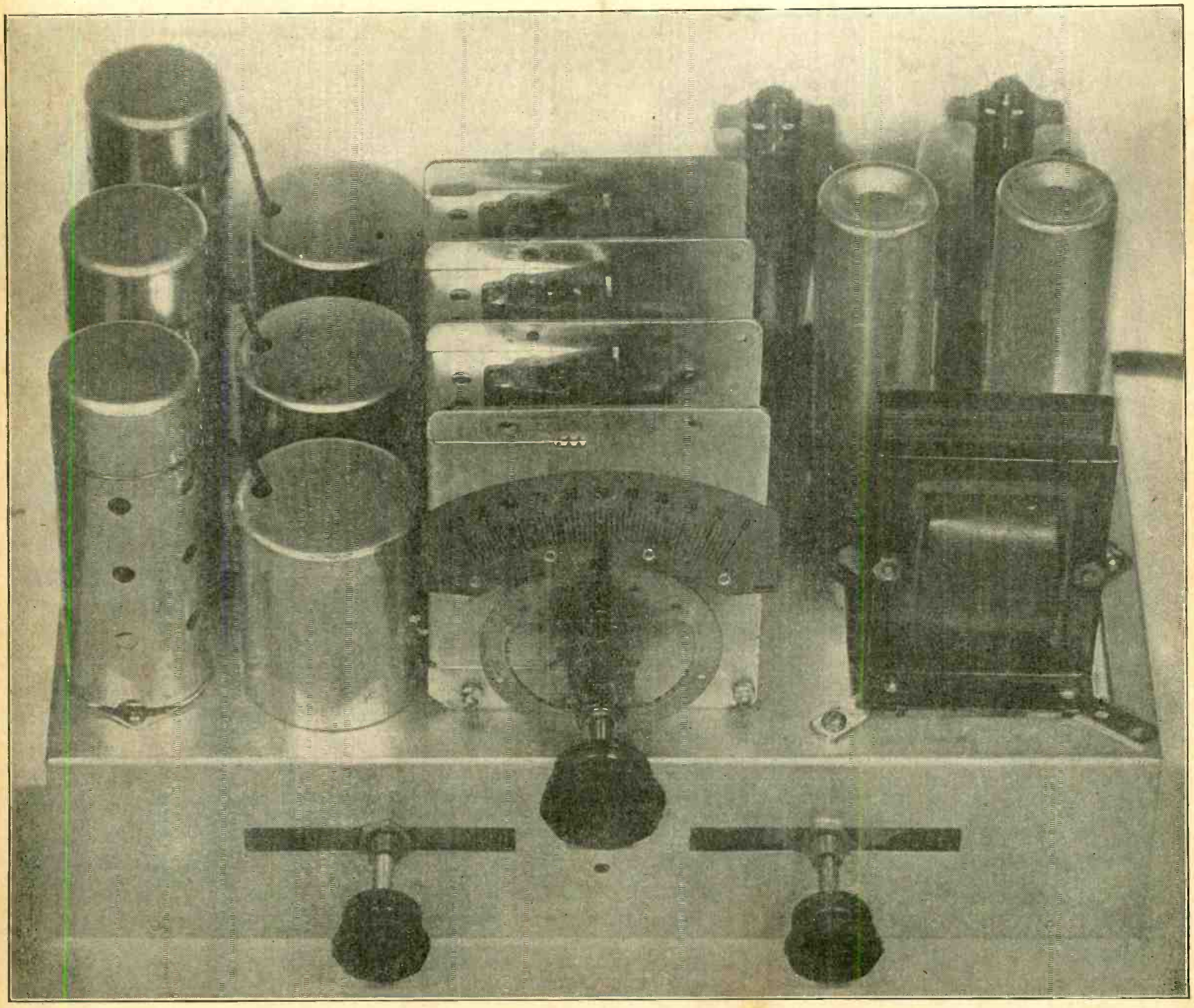
# 6-TUBE D-C T-R-F RECEIVER



The Manhattan, a six-tube tuned-radio-frequency receiver for operation from the 110-volt direct-current line, designed by Robert G. Herzog, B.S., E.E. It is designed for high gain.

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RADIO
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WORLD

*The First and Only National Radio Weekly*
*TWELFTH YEAR*

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# FIVE OSCILLATORS for Ultra Frequencies

## *By J. E. Anderson*

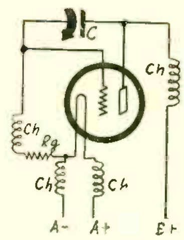


**FIG. 1**
**An ultra-short wave oscillator of the ultraudion type in which the leads to the condenser constitute the inductance.**

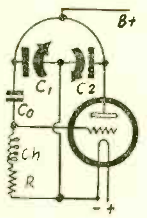


**FIG. 2**
**A balanced short-wave oscillator called the Colpitts but in reality is a tuned grid, tuned plate type of oscillator.**

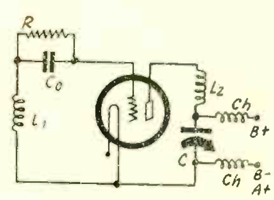


**FIG. 3**
**This is an ultra-short-wave Hartley oscillator in which the grid to plate capacity is the main tuning reactance.**

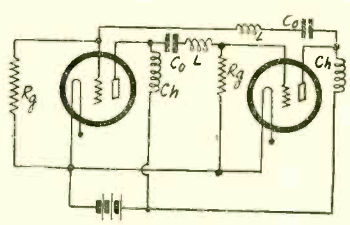


**FIG. 4**
**This two-tube oscillator has a resonant circuit composed of the two grid-plate capacities, in series, and inductances.**

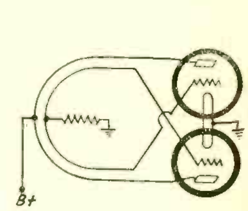


**FIG. 5**
**A push-pull oscillator that can be made to oscillate on very high frequencies by balancing two inductance loops.**

MOST of the original work that is being done in radio now is in the ultra-high frequency range, or the ultra-short wave field. That is, most work is being done below 10 meters.

The circuits required for producing waves shorter than 10 meters are extremely simple. As a rule, the simpler they are the better they work. In Fig. 1 we have a simple oscillator which consists mostly of choke coils and a tube. The resonant circuit that determines the frequency is the loop containing the leads to the plate and the grid and the condenser C. The grid to plate capacity completes the circuit. The object of the chokes is to insure that nothing else enters in any appreciable way into the resonant circuit. There is one choke in each of the filament leads, one in the grid circuit, and one in the plate circuit. All these chokes should be of high inductance, but the term high is relative. Actually each of the chokes may consist of a few turns of wire on a pencil, or on air.

### The Frequency

We can estimate the frequency that will result if we know the inductance of the loop of wire and the capacities of the two condensers involved. Suppose the tube is a 30. This has a grid-plate capacity of 6 mmfd. We can readily make C of the same value, or even smaller. But let us say that it has a value of 6 mmfd. The capacity of the two equal condensers in series is then 3 mmfd. Now let us suppose that the frequency we wish is 30,000 kc, that is, the wave-length is 10 meters. What inductance is needed? We need 9.39 microhenries. That is a fairly large inductance that requires more than a single loop of wire. By reducing the size of the loop and the diameter of the wire it is quite possible to get an inductance of 0.05 microhenry. With 3 mmfd. capacity across it the frequency would be 410 megacycles, or the wave-length would be 73 centimteres.

### Balanced Colpitts

In Fig. 2 we have another simple short-wave oscillator. This is a balanced Colpitts in which condensers C1 and C2 are the usual tuning condensers in the Colpitts circuit, Co is the grid stopping condenser. Ch is a grid choke, R the grid leak, and the semicircle above the two tuning condensers is the inductance. The circuit is called balanced because the B supply is put into the circuit at the voltage node on the inductance, that is, at the point that has the same potential as ground. It is for that reason that the choke is omitted from the B supply line. If C1 and C2 are equal the voltage connection should be very nearly at the center of the inductance wire.

The circuit as drawn includes all the coils and condensers used in hooking up the circuit. But these do not constitute all of them, and it is not permissible to assume that the frequency is determined by the inductance of the loop and the two condensers. There is a small capacity between the plate and the grid. This and Co in series are in shunt with the tuning condensers. in series. Then there is a capacity between the plate and ground and another between the grid and ground. These two in series are in shunt with the grid to plate capacity. If the circuit were solved for frequency and the condition for oscillation it would be found that all these capacities enter into the circuit. Not only that, but the inductance of the various leads. Of course, the plate to ground capacity is naturally added to C2.

### A Simple Hartley

In Fig. 3 is a very simple oscillator which really is a Hartley circuit. There may or may not be mutual inductance between the two coils L1 and L2. The capacity in the circuit is made up of three condensers in series, the grid to plate capacity, the stopping condenser, and the variable condenser marked C. Now if the tube is a 30 which has a grid to plate capacity of 6 mmfd., the effective capacity in the circuit must be less than this regardless of the values of the capacities of the other two condensers. Neither of these can be very small for there must be inductance in the plate circuit as well as in the grid circuit.

If L2 and C are so related that their natural frequency is higher than the frequency of the oscillating circuit the conditions for oscillation are not satisfied. The same applies to Co and L1. But C is a convenient means for varying the frequency by small amounts as well as the intensity of oscillation.

This circuit as well as all other ultra-short wave oscillators will not oscillate at as high frequency as is determined by the two inductances and the three condensers because of the effect of the grid to ground and the plate to ground capacities.

The frequency of oscillation will be higher if there is no mutual inductance between the two coils, but the conditions for oscillation will be more readily satisfied if there is mutual.

### Two-Tube Oscillator

In Fig. 4 is a two-tube oscillator which at first thought does not appear to be oscillatory. It oscillates because of the inter-electrode capacities of the two tubes. First of all we have a reversal of phase twice by the tubes. Hence, there should be two equal phase reversals in the couplers. We have two plate to ground and two grid to ground capacities. These four, which may be regarded as pure reactances, will reverse the phase one complete revolution.

The oscillator circuit is composed of the two inductances L and the two grid to plate capacities. Therefore, if the two tubes are exactly equal and the two condensers Co as well as the two inductances L, the frequency is determined by LCgp. Of course, the shunt capacities, the two shunt chokes, and the two series condensers Co will have some effect on the frequency.

It would seem that the circuit in Fig. 4 would be capable of a high frequency for the effective capacity is small and the inductances may consist simply of the leads.

### A Push-Pull Oscillator

In Fig. 5 is a simple push-pull oscillator which depends for oscillation on the inter-electrode capacities. Just what determines the frequency is difficult to say. The circuit may function as a tuned plate oscillator or as a tuned grid. If it is a tuned plate the two plate to filament capacities are in series and are then across the plate loop. If it is a tuned grid oscillator the grid to filament capacities are in series and are across the grid loop. No doubt, the oscillation is not determined by either the plate circuit or the grid circuit but by a combination of the two. While this looks very simple on the drawing and is simple to build, it is extremely difficult to analyze. In addition to the plate-cathode and grid-cathode capacities we also have the two grid-plate capacities. It is quite conceivable that the resonant circuit that determines the frequency, principally, is the loop formed by the two grid-plate capacities and the two inductance loops. This would probably give the highest frequency because the two grid-plate capacities are very small and they would be in series besides.

One of the reasons this circuit is extremely complex analytically is that it has so many mutual inductances in addition to the many capacities. There is first the mutual inductance between one plate half-loop and the other. Then there is the corresponding mutual for the two grid half-loops. Then we have the mutual between the grid and plate loops.

### The Balanced "Colpitts"

It was stated in connection with Fig. 2 that the circuit was a balanced Colpitts. This requires modification. If the impedance between B plus and ground is negligible the circuit is not a Colpitts at all, but a tuned grid tuned plate oscillator in which the two tuned circuits are coupled by a small mutual inductance. As such the circuit has two frequencies at which it can oscillate, just as a doubly tuned transformer has two frequencies at which the gain is maximum. Such an oscillator is not a desirable one, because it is not very stable and will not oscillate at the mean frequency of the two circuits.

In order to make Fig. 2 a Colpitts it is necessary that the impedance between B plus and ground be infinite. This may be done for practical purpose by putting a moderately high resistance in the B supply lead, or a radio frequency choke of high reactance at the oscillating frequency. Then the circuit will oscillate at the frequency determined by the whole loop and the two condensers in series.

There is a way of stabilizing this oscillator at the frequency determined by the inductance of the loop and the capacity of the two condensers in series, and that is to put potentiometer of about 1000 ohms between the junction of the condensers and the tap on the coil and then to connect the cathode to the slider. There is a point on the potentiometer which will make the circuit stable when the cathode is connected to it.

Success in getting down to the ultra-short waves depends on making the leads as short as possible, for the frequency is limited by the residual inductance of the leads. The capacities involved are those between the elements of the tubes, and they cannot be reduced except by selecting tubes having low capacities. Screen grid tubes can often be used advantageously in getting down to the short waves.

Perhaps the best way of getting down to the short waves is to use a dynatron oscillator with a very low negative resistance. When this is done the resulting oscillator is commonly called the Barkhausen-Kurz oscillator. In such an oscillator there is only one tube capacity that is involved, and that is the plate to ground capacity. The simplification of the circuit is considerable.

### Low Resistance Circuits

In all high frequency oscillators is it essential that the radio frequency resistance of the tuning coils be as low as possible because the criterion for oscillation is that L/RC be large, in which L is the effective inductance in the oscillating circuit, C is the capacity, and R the radio frequency resistance. At best the ratio of L to C is small in ultra-short wave oscillators, and therefore there R must be small if the value of L/RC is to be large enough for oscillation.

# Universal Type Of Short-Wave Converter Handy

THE BAIRD short-wave converter described by Herman Cosman in the November 4th issue is characterized by utmost simplicity. A single tube is used for both mixing and oscillation, and a single tuner besides. The tube is the 6A7 pentagrid, which can function simultaneously as an oscillator and a detector. It is of the 6.3 volt, 0.3 ampere type and therefore is economical in operation. Being of the heater type, it can be used with a-c or d-c on the filament.

Since the circuit is to be universal type and must be operative on a-c, a rectifier is necessary. This is the 25Z5, which also takes 0.3 ampere on the heater but a voltage of 25 volts. Being of the heater type it can be used in a d-c or a-c circuit without loss of the 25 volts for the plates, as the heater and plate circuits can be put in parallel. The total heater voltage is 31.3 volts while the line voltage is 115 volts on the average. Therefore a 250-ohm, 20-watt ballast resistor is put in series with the heater circuit.

### Choice of Power

Power of course is taken from either the a-c or d-c line. When the voltage is alternating there is no polarity so the plug can be inserted either way. When the power supply is d-c, however, it will work only when the plug is inserted in the outlet so that the positive side of the line is toward the anodes of the 25Z5 rectifier.

There is electron coupling due to the unison of the streams of the modulator and oscillator in the common cathode sleeve, and therefore the oscillator will beat with all the incoming waves, but only the mixture frequency desired will be accepted by the intermediate amplifier (your receiver).

The relationship of the intermediate frequency to the desired frequency is the simple one—the difference between the modulator and the oscillator frequencies.

### Tuning Reflected

A radio-frequency choke of high inductance in the output circuit makes coupling to the primary of the transformer in the set's antenna circuit satisfactory. This choke may be in the 2 or 3 millihenry class for satisfactory results, and of course may be higher. The stopping condenser is 0.01 mfd., and the transfer is good therefore at all the frequencies concerned.

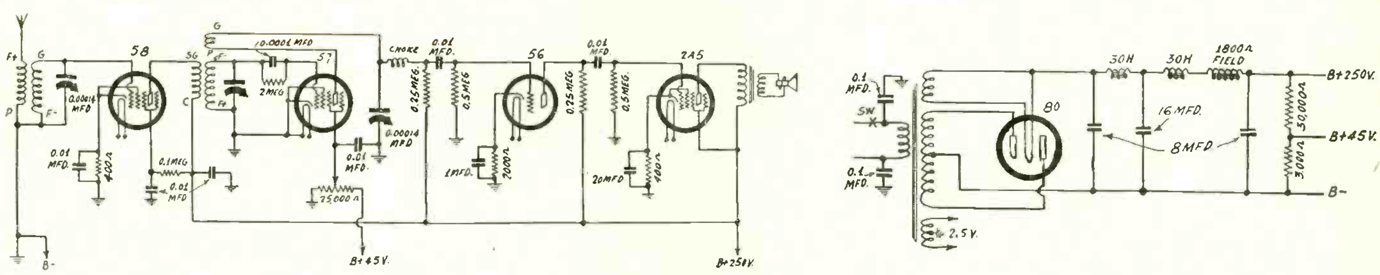
The tuning of the first stage of the set is reflected back into the converter by the method of coupling converter output to receiver input, because the plate-to-ground circuit of the converter is substantially in parallel with the grid-to-ground circuit of the receiver. This is true because of the coupling media. The proper safeguards against d-c shorting are taken, of course, since "ground" is a radio-frequency description in this instance, and B plus therefore is at an r-f ground potential.

# SHORT-WAVE BENEFITS

## Applied to a Simple, Effective Set That has Receiver and Power Supply Separate

*By Edwin Stannard*

*Supertone Products Corporation*



**One of the most acceptable methods of building a small short-wave set for a-c operation is to have the receiver separate from the B supply, to reduce hum to practically nothing. Ordinarily there may be some hum trouble from unified receivers, unless they are of the de luxe class. Some hints as to the construction, choice of parts, and easy tests for improving the results as obtained from such a separate output as diagrammed will be found in the text.**

ONE of the most satisfactory of simple and inexpensive short-wave sets is that using five tubes, in a tuned radio frequency and regenerative detector circuit, with audio amplification and rectifier. The preferable practice seems to be to have the B supply separate, as it has been found that it is thus easier to kill off hum. The receiver diagram is shown at left, the B supply diagram at right, both of them admittedly simple.

The performance from such a set, using plug-in coils, is satisfactory to critical short-wave fans, and while there is nothing whatever original in the circuit, perhaps that is a blessing, and confirms the acceptability of the circuit as demonstrated by long use and practice.

### Mainly for Selectivity

It is a few years now since a stage of t.r.f. became necessary, since that extra meed of selectivity for separation of two short-wave stations not far removed in frequency, and both foreign, scarcely can be attained in any other way with such a circuit.

Also, of course, the sensitivity is increased, but the main reason for the inclusion of the tuned stage ahead of the detector is selectivity.

Few parts are used, and it has been found in short-wave practice that, as a general proposition, the fewer the parts the better the performance.

There are some simple precautions to be taken. One of them is that the circuits that concern the high frequencies should have mica bypass condensers, except that the feedback condenser is of the air dielectric type, which is still better. The impedance of electrolytic condensers would be too high, and paper wound condensers naturally would be inductive to an extent that would be objectionable at high frequencies. Thus, the condenser across the 400-ohm biasing resistor in the cathode leg is 0.01 mfd. mica, and that from screen to ground in the same tube circuit is likewise. From B plus to ground is the same type of condenser.

### The Plate Choke Coil

Also the resistors have to be considered. The wire-wound type does not prove so satisfactory, generally, because it has an inductive effect, too, so carbon or metallized resistors would be used.

The detector grid condenser should be mica, too, and the grid resistor naturally would be carbon or metallized, because such high resistors do not come wire-wound except for meter multipliers.

After the choke coil in the detector plate leg the frequencies are exclusively audio, or ought to be. The plate choke should be of high enough inductance to insure this. Also, the distributed capacity of the choke must be small, otherwise the choke would act more as a condenser at the high frequencies. That is, the impedance of the capacity component would be low, and erratic results would be certain. To attain low distributed capacity honeycomb type of winding is used, for the more turns, the lower the distributed capacity (due to the turns being as condensers in series), and the higher the inductance. Therefore, coils are connected in series, for space conservation, or, rather, to enable the extra room to be taken up in the length of the assembly, rather than in the diameter of the coil, and, also, the distributed capacities of the respective segments are themselves in series, resulting in a choke coil of such a low capacity it is hard to measure it. The capacity may be as low as 1 mmfd., though the inductance may be 85 mililhenries.

### Drop in Plate Resistor

The plate load is a resistor of 250,000 ohms, and the voltage drop is considerable,

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### LIST OF PARTS
#### For the Receiver

**Coils**

One set of UX-base short-wave plug-in coils, four coils to a set
One set of six-pin, three-winding, plug-in coils, four coils to a set
One Hammarlund radio-frequency choke coil

**Condensers**

Three Hammarlund 0.00014 mfd. tuning condensers
Six 0.01 mfd. condensers
One 1 mfd. by-pass condenser
One 20 mfd. electrolytic by-pass condenser
One 0.0001 mfd. grid condenser

**Resistors**

Two 400-ohm pigtail resistors
One 0.1 meg. pigtail resistor
One 2 meg. pigtail resistor
Two 0.25 meg. pigtail resistors
Two 0.5 meg. pigtail resistors
*All above resistors are 1-watt*
One 25,000-ohm potentiometer

**Other Requirements**

Four six-pin and two UY sockets (extra UY is for voltage cable, extra six-pin per coil; one UX socket, for other coil
One dynamic speaker for 2A5 output, with output transformer built in; field coil, 1,800 ohms. Cone diameter is 6 inches
One chassis
Two vernier dials
Two knobs
Two tube shields and bases
One 58, one 57, and one 56 and one 2A5 tubes
One front panel

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## LIST OF PARTS
### For Power Supply

**Coils**

One power transformer
Two 30-henry B chokes
(Field coil in speaker is listed under receiver parts)

**Condensers**

Two 0.1 mfd. condensers (not electrolytic)
Two 8 mfd. electrolytic condensers
One 16 mfd. electrolytic condenser

**Resistors**

Two 30,000-ohms (0.03 meg.) pigtail resistors, 1 watt

**Other Requirements**

One a-c cable and plug
One output cable and UY plug. (Grey grid, 45 volts; Brown cathode, B minus; yellow plate, maximum B voltage; H and H, 2.5-volts a.c.)
One chassis
One shield box for chassis
Two UY sockets (for speaker and voltage supply) and one UX socket (for rectifier)
One 280 tube

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so that with meters ordinarily used (current-drawing type), little or practically no plate voltage reading is obtained. This is due largely to the meter shorting the resistor, for at half a milliampere the effective plate voltage would be half the applied voltage of 250 volts.

The radio-frequency amplifier is a 58, and it is so circuited and voltaged as to produce its usual gain. The antenna coil treatment may be such as to emphasize the selectivity rather than the pick-up or sensitivity, for there will be sufficient volume, due to two stages of audio, of which a pentode is the output tube, not to mention the actual audio amplification in the detector, which is considerable.

The 57 is the detector. It is more sensitive than the 58, but any who desire to use the 58 should bear in mind that the plate load resistor then might have to be considerably reduced.

### Bias of Detector

At least this is true for biased detection, and it ought to be true also for grid leak detection which, despite the difference in circuiting and in nomenclature, is grid bias detection nevertheless. Grid current changes the bias on the tube, and due to the accumulation of electrons at the grid side of the condenser, electrons can not escape fast enough through the leak when stopped by the condenser, so the direction of bias is the same as in the other case, i.e., negative.

It so happens that the so-called grid bias type of detector causes the plate current to increase with signal, while this one causes plate current to decrease with signal, but the difference is due simply to the operating points on the curvature. The unbalance or lopsidedness necessary for detection is on the one side in one instance and on the other side in the other instance.

The variation of the screen voltage on the detector gives a satisfactory and smooth control of regeneration. It replaces the movable tickler type of control that has passed into oblivion with the coming of plug-in coils. The circuit is most simply and suitably built with a four-connection. two-winding antenna coil and a six-connection, three-winding interstage coil, for the transformer between stages is superior to the choke and stopping condenser method, for wide frequency coverage.

### Bias for the 56

The output of the detector is fed to the 56 driver, which in turn feeds the 2A5 tube. The negative bias on the 56 need not be as high as usually recommended, and 2,000 ohms will yield about 3 or 4 volts, but if one lives near some strong short-wave stations he may desire to increase the bias on this stage, which he may do by increasing the resistance to 5,000 ohms or more.

The working mu of the stage, or gain, may be around 4, as it usually turns out to be about half of the theoretical mu of the tube. Here we have a very large plate load for a 56 tube, but hum is kept down that way, and besides the working mu is elevated. If the bias on the power tube is 16.5 volts, and the mu of the stage ahead is 4, there is no particular need for a bias of more than 4.1 volts plus an allowance for grid current conditions that develop in the cathode type tubes as biases of less than 0.8 volts negative, so, as a safety, say 5 volts would do. With a meter of 1,000 ohms per volt sensitivity, the 5 volts may be read across the resistor well enough if a 100-volt scale is used, but if a 10-volt scale or so is used the actual voltage with meter out of circuit may be almost twice what it is with meter in circuit. As a compromise, using 1,000-ohm-per-volt meter at its 10-volt scale, accept a reading of 4 volts as being satisfactory, since the actual voltage will be suitably higher with the meter out.

### Loss of 2A5 Bias

The 2,000-ohm resistor is practically standard in the plate circuit of the 56 when a transformer winding alone is there (primary of an audio transformer or even an r-f transformer), but since the plate resistor cuts down the current so much on a practically low-mu tube, the bias will be low at 2,000 ohms, compared to a transformer circuit.

In the grid circuit of the power tube is a resistor of 0.5 meg., but if you use a newly-made power tube, it will have characteristics that limit suitably the grid emission so that this resistor may be raised to 1.0 meg.

This may be accomplished, if desired, by putting two 0.5 meg. resistors in series. The object of avoiding much grid emission is that the plate current of the power tube, on strong passages, runs up too high, for the tube then is losing bias. There is no grid stopping condenser (for the stopping condenser is between two circuits), hence the electron accumulation we found present in the detector does not exist to shift the bias phase properly.

### 20 Mfd. Bypass

Across the biasing resistor of the 2A5, to prevent degenerative effects, hence support low-note reproduction is a very large capacity. It is marked 20 mfd. and is obtainable in compact form as an electrolytic condenser. Since the voltage rating need be only a low one, this capacity, two and a half times as great as that of the filter electrolytic in the B supply, is nevertheless smaller in size. The reason is the B electrolytic has a 500-volt rating.

The speaker is shown as part of the receiver, but the field coil is used in the B supply as an additional choke, and physically the field is inside the speaker. So to this extent the physical separation suggested by the diagram is fictitious.

### Condensers in the Line

The a-c line has a condenser from either side to ground. It is assumed the ground connection to the set is obtained from the preferred cold water pipe, hence that a good ground exists. Usually one side of the a-c line is grounded. Thus one of the condensers would seem superfluous. But the lead from the a.c., though grounded at a transformer on a pole in your back yard, may be at an elevated r-f potential in your home, so there is wisdom in the presence of the two condensers. They tend to reduce noise and assist stability, and while usually make no noticeable difference in or out, when the circumstances are such that a condenser is needed, there is a vast difference, even including hum reduction where hum originates from carrier modulation by the a.c.

### The Extra B Chokes

The rectifier is an 80 tube, and has the field as one choke, as stated, and in addition, as an extra precaution against any hum, there are two separate 30-henry chokes. A tapped choke of 60 henries would not do. The cores must be separate if this filter is to be fully effective, with 8 mfd. at each end, and 16 mfd. at the middle.

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## Small Sets at Geneva Small Help to Delegates

Some experiments have been conducted in radio at Geneva, to ascertain if it is practical for delegates and newspaper reporters to hear the proceedings of the Disarmament Conference when they are in the lobby or at the bar, but so far the results have not been remarkable.

The small set, which could be fitted into a vest pocket with little stretching of the lining, requires such close attention to the earphones, and reception is so thoroughly prevented when there is the slightest competing noise, that footfalls in the lobby or the good-fellowship exclamations at the bar prove a serious deterrent to the success of the experiment.

A Swedish radioist is sponsor for the attempted solution of a standing problem, and it looks as if he will have to take the problem back home with him.

# A. V. C. IN T-R-F SET

## 2B7 Detector-Amplifier, 56 Driver and Push-Pull 45 Output

### *By Richard B. O'Connor*

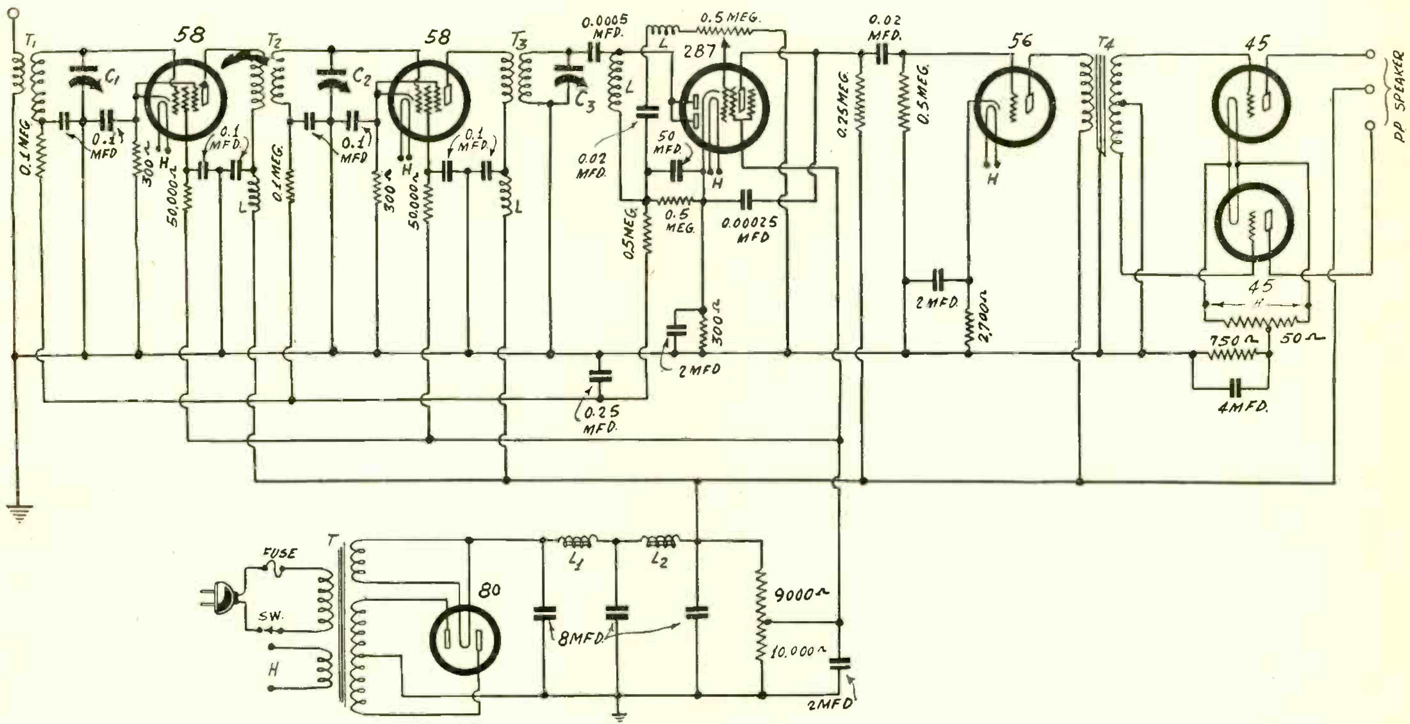



**FIG. 1**

**This seven-tube tuned radio frequency receiver is capable of an undistorted output of about 3.2 watts. It is equipped with diode detection and automatic volume control and has a high sensitivity.**

LET US leave the superheterodyne for once and describe a tuned radio frequency receiver. There are many sound connoiseurs who claim that this type of receiver is unbeatable in respect to quality, and we are not prepared to say that this is not a fact. Indeed, we are inclined to agree with the assertion, for certainly, the tuned radio frequency receiver is not subject to countless squeals and grunts which may be the regular thing with superheterodynes, assuming that the tuned radio frequency receiver has been stabilized. It is true that the superheterodyne can be quiet, too, but that condition is not so easily achieved as it is for the tuned radio frequency receiver.

This time we present a seven-tube circuit in which the two radio frequency amplifiers are 58s, the detector and first audio frequency amplifier is a 2B7, the second audio amplifier is a 56, the power amplifier is a push-pull stage of two 45s, and the rectifier tube is an 80.

#### Three-Gang Tuner

The circuit is diode detection, automatic volume control and a manual volume control, which is put in the input circuit to the pentode section of the 2B7, that is, the input to the first audio amplifier.

There are three tuned circuits in the selector, all controlled by a single control as C1, C2, and C3 are a gang of three equal condensers. The three radio frequency transformers T1, T2, and T3 are also equal and the secondaries are such that they fit the condensers. The transformers should be thoroughly shielded and so should the tubes, for the success of the circuit depends on the absence of undesired coupling. The leads from the stators of the condensers to the grids and to the coils should be kept away from each other or there should be a grounded shield between them. The same applies to the leads from the plates to the primaries and from the antenna to the first primary. Much depends on the minimization of the coupling between these leads.

As a further aid against coupling between the stages all the supply leads are thoroughly filtered. In each plate lead of the two radio frequency amplifiers is a choke L, of 10 millihenries, and between the junction of each with the primary and ground is a condenser of 0.1 mfd. Thus the radio frequency currents in the plate circuits are confined to the tubes and are not allowed to stray into the power supply.

The screen leads are similarly treated, and for the same reason. However, 50,000-ohm resistances are used in place of chokes. From each screen to ground is a 0.1 mfd. condenser. Thus there is no chance for the radio frequency currents to enter the power supply by this route.

#### Cathode Filtering

A biasing resistor of 300 ohms is used in each of the cathode leads to establish a minimum bias. These must be by-passed in order to keep the radio frequency currents out of the common leads, and for that reason a 0.1 mfd. condenser is connected between each cathode and ground.

The two 58s are also on the same automatic bias supply. Hence there must be additional filtering. Therefore a 0.1-megohm resistor is put in series with each grid return, and to make these resistances effective a by-pass condenser of 0.1 mfd. is connected between the coil of each circuit and ground. Of course, these condensers are also necessary to complete the tuned circuits. As a further means of reducing the common impedance between the two grid circuits, a 0.25 mfd. condenser is connected between ground and the common bias lead.

#### The Detector

In order to permit grounding of the third tuning condenser and still use diode detection without tuning the primary of the last tuning coil, a stopping condenser of 0.0005 mfd. is put between the joined anodes of

## LIST OF PARTS

**Coils**

T1, T2, T3—Three shielded radio frequency transformers for 350 mmfd. tuning condensers
T4—One push-pull input transformer
T—One power transformer having one 115-volt primary, one 2.5-volt secondary, one 5-volt secondary, and one centertapped secondary having 400 volts across each half
L—Four 10-millihenry radio-frequency choke coils
L1—One 30-henry, 100 milliampere choke or loudspeaker field
L2—One 30-henry choke

**Condensers**

C1, C2, C3—One gang of three 350 mmfd. condensers
Eight 0.1 mfd. by-pass condensers
One 0.25 mfd. by-pass condenser
One 0.0005 mfd. condenser
One 0.00025 mfd. condenser
One 50 mmfd. condenser
Two 0.02 mfd. condensers
Three 2 mfd. by-pass condensers, or larger
One 4 mfd. by-pass condenser
Three 8 mfd. electrolytic condensers

**Resistors**

Two 0.1-megohm resistors
Two 50,000-ohm resistors
Three 0.5-megohm resistors
One 0.5-megohm potentiometer
One 0.25-megohm resistor
Three 300-ohm bias resistors
One 2,700-ohm bias resistor, 3-watt rating
One 750-ohm bias resistor, 5-watt rating
One 50-ohm, centertapped resistor
One 9,000-ohm, 3-watt resistor
One 10,000-ohm, 3-watt resistor

**Other Requirements**

Sw—One line switch (mounted on volume control potentiometer)
One one-ampere fuse with holder
One vernier dial for tuning condensers
Three four-contact sockets
One five-contact socket
Two six-contact sockets
One seven-contact socket
Three grid clips
One seven-tube chassis
One loudspeaker with push-pull output transformer for 45s

the 2B7 and the top of the tuned circuit and then a choke L is connected between the anodes and the load resistance. If the inductance of this choke is 10 millihenries it will not materially change the tuning characteristic of the circuit. The only purpose of the choke is to permit the rectified current to flow around the anode circuit as well as the audio modulation on the current.

A load resistance of 0.5 megohm is employed on the anode, and this is shunted by a condenser of 50 mmfd. This condenser might be made a little larger, up to 250 mmfd., if it is desired to get better relative response on the low audio frequency notes.

The other 0.5-megohm resistance connected to the choke serves the purpose of preventing the audio output of the detector from shorting through the filters in the grid bias. Incidentally it also serves to improve the filtering of the automatic bias voltage.

### A Delay Voltage

The anode load resistance is connected directly to the cathode of the 2B7 but the signal voltage is applied between the anode and ground. The cathode and ground differ in potential by the drop in the 300-ohm bias resistor serving the 2B7 pentode, which amounts to about 3 volts. Therefore the signal peak must exceed 3 volts before there is any detection. This amounts to a delay voltage of 3 volts. This is a desirable condition, for often a delay voltage is applied, and a much higher one. If the bias on the pentode were much higher, however, it would not be desirable to use this connection for it would make the set less sensitive without any appreciable advantage to offset the decrease in sensitivity.

Across the 300-ohm bias resistor is a 2-mfd. condenser which is used to prevent reverse feedback in the pentode. This is important for when the gain in a tube is high, as it is in the 2B7 pentode, the reverse feedback is also very high. The value of 2 mfd. is good for average tone quality, but if it is desired to increase the response on the very low audio frequencies it can be done by making the by-pass condenser larger. Conversely, if the low notes are too strong, the condenser can be reduced in value. However, due to the small value of the resistance across which the condenser is put, a large variation in the capacity will have to be made before there is any noticeable effect.

In the lead to the grid of the pentode is a stopping condenser of 0.02 mfd. and a choke L of 10 millihenries. The purpose of the condenser is to insure that the bias on the pentode be fixed and the purpose of the choke is to prevent radio frequency current from reaching the grid. A 0.5-megohm potentiometer is used for grid leak, and it is connected between the choke and ground, the grid being connected to the slider. As a further means of preventing radio frequency currents from straying into the audio frequency amplifier a 0.00025 mfd. condenser is connected between the plate of the pentode and the cathode.

### The Audio Amplifier

A coupling resistor of 250,000 ohms is used in the plate circuit of the pentode. This is followed by a 0.02 mfd. stopping condenser and a grid leak of 0.5 megohm. Then we come to the 56 audio frequency amplifier, which is used for the purpose of enabling the use of a push-pull transformer. The 56 is biased by a 2,700-ohm resistor and this in turn is shunted by a 2 mfd. condenser. Minimization of reverse feedback is the object of the condenser. Since the 56 is a low mu tube and the bias resistance is high, the 2 mfd. condenser is quite effective in reducing the reverse feedback.

The push-pull stage is coupled to the 56 by means of a push-pull input transformer T4, which should be of high quality. The two 45s are biased by means of a 750-ohm resistor, which should have a power rating of 5 watts. This resistor is shunted by a 4 mfd. condenser, used mainly for the purpose of by-passing harmonics. The bias resistor is connected to the center point of a 50-ohm resistor placed across the filament. This resistor should be accurately centered because if there is unbalance there will be hum in the output.

The output power of this amplifier is little over three watts without appreciable distortion. As high as 5 watts can be obtained without noticeable distortion. This assumes, of course, that the speaker transformer matches the tubes and the voice coil.

### The Power Supply

The power supply consists of a power transformer giving 2.5 volts for all the heaters of the tubes and the filaments of the 45s, 5 volts for the 80 rectifier, and a high voltage for the plates of the 80. The voltage across each side of the high voltage winding should be such that the voltage across the voltage divider on full load is 300 volts.

The total drain on the B supply is about 100 milliamperes. Hence the two chokes in the filter should have a rating in excess of this.

One of the chokes may be the field of the loudspeaker, provided that it be wound to have a suitable resistance. Instead of putting all the tubes on both chokes, the plate returns of the two 45s may be connected to the junction of the two chokes. This will make the second choke more effective in filtering the supply to the remaining tubes.

In case the first choke is the loudspeaker field, the power transformer must give a higher voltage, because the drop in the field may be about 100 volts. That would require that the voltage on full load be about 400 volts. Such transformers are available.

The voltage divider consists of two resistances in series, one of 10,000 ohms next to ground and another of 9,000 ohms on the high potential side. They are figured on the basis of a bleeder current of 10 milliamperes.

### TRIPLETT MODEL 1179

The Triplett Electrical Instrument Company, Bluffton, Ohio, reports there was an error in its advertisement in the November Issue of "Radio Retailing," in which the new 1179 instrument was described. This instrument is a combination of the Triplett Perpetual Tester and the Free-Point Set Tester Adapter No. 1166 in one case. The correct list price is $52 and the net price to dealers and service men at discount of 33⅓ per cent is $34.67. If cash discount of 2 per cent is given, the net resale price will be $33.98.

# METROPOLITAN OPERA ON AIR BEGINNING CHRISTMAS; $300,000 FUND MEETS COST

M. H. Aylesworth, president of the National Broadcasting Company, announced the third season of grand opera broadcasts over NBC networks direct from the stage of the Metropolitan Opera House, will begin with the special pre-season performance of Humperdinck's "Hansel and Gretel" on the afternoon of Christmas Day.

During the 14-week opera season NBC audiences will hear many of the new productions in addition to standard operas.

A score or more of the season's operas will reach a nation-wide audience over NBC networks this season, according to the arrangements perfected by Gerard Chatfield, who is in charge of the Metropolitan broadcasts for the National Broadcasting Company.

The continuation of grand opera at the Metropolitan this season was made possible by a popular guarantee fund of $300,000, obtained through radio and stage appeals last Spring. NBC co-operated with a committee headed by Lucrezia Bori to raise this fund.

Paul D. Cravath, chairman of the Board of the Metropolitan Opera Association, said:

"The National Broadcasting Company is entitled to great credit because it has not only borne the necessarily heavy expense of broadcasting but has made a very substantial direct money contribution toward the support of the Metropolitan Opera Company."

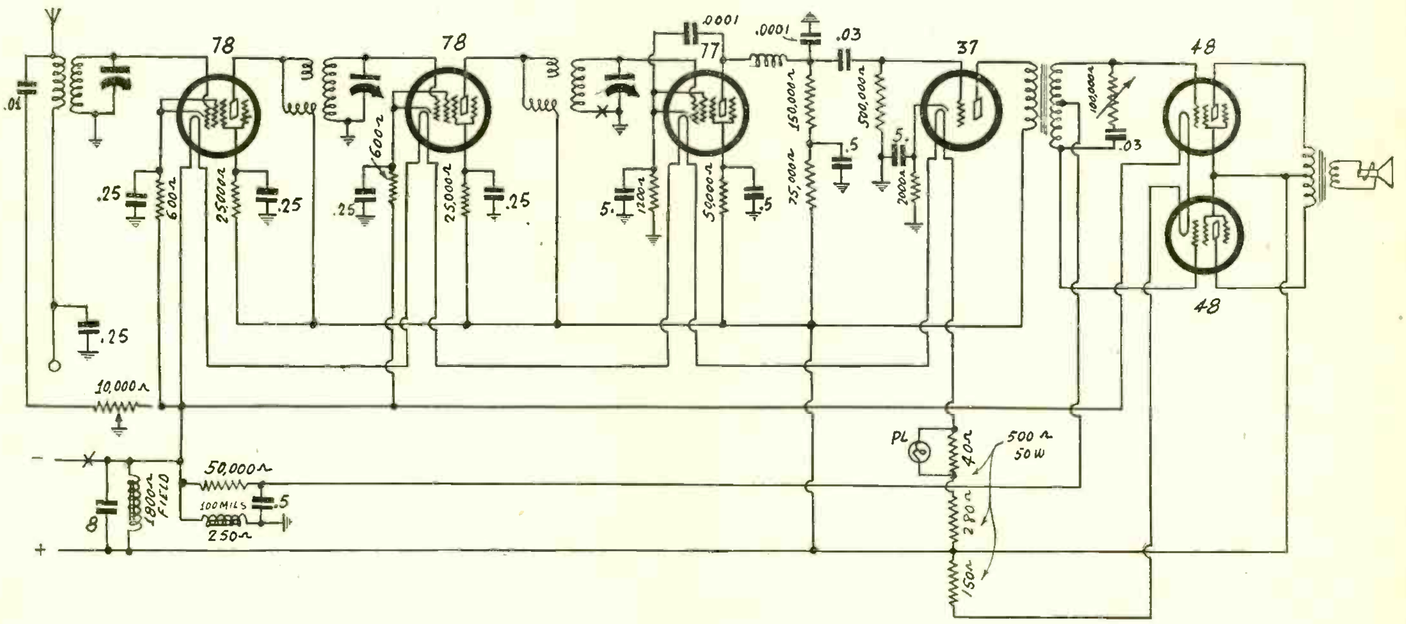
Mr. Aylesworth stated that O. B. Hanson, NBC manager of technical operations and engineering, has perfected technical details which will bring the voices of the singers to the radio audience with the same accuracy of tone quality and diction as if heard from the Golden Horseshoe. Ten microphones, including several of the ultra-sensitive "ribbon" or velocity type, will be placed in the wings, footlights and on the proscenium arch to register every note sung by the artists as they move about the stage. The control board will be in a parterre box, with the commentator in a glass-enclosed ante-room from which he can see the action of the opera and describe it without being heard by the audience in the auditorium.

# GREAT PEP FROM 48's

## In 6-Tube Push-Pull Output of D-C Set

*By Robert G. Herzog, B.S., E.E.*

*Chief Engineer, Thor Radio Company*




**This is the circuit of the Manhattan six-tube, high gain, tuned radio frequency receiver. Each tube used is a special purpose tube most suitable for the particular function it performs. Output power is about 4 watts.**

THE metropolitan enthusiast with the supposed disadvantage of direct current power supply has always hoped for a receiver that would equal the a-c operated circuit in tone and distance-getting ability. In the Manhattan six-tube tuned radio frequency receiver his hopes are realized.

The completed receiver is capable of delivering approximately four watts of undistorted power and it is extremely sensitive. Besides being sensitive it is also exceptionally selective. The usual d-c troubles —blown pilot light, blown tubes, feathering of tone on low volume, blown condensers—have been completely eliminated.

### Type of Circuit

The circuit employed is of the super control, grid tuned, radio frequency type using high-gain coils. The latest type tubes is employed in each stage, and the most suitable tube for each function. There are three radio frequency tuners to insure high selectivity.

To prevent overloading of the pilot light and the filaments of the tubes drawing only 0.3 ampere, these are put on one circuit and the two 48s, which require 0.4 ampere, are put on a parallel circuit, there being a suitable ballast in each. A single slider type of resistor is employed for economy, but it is so connected that different sections can be in the two parallel branches.

The screens of the radio frequency pentodes are isolated from each other by means of a 25,000-ohm resistor in each lead, each screen being by-pass by a condenser of 0.25 mfd. capacity. The radio frequency cathodes are similarly isolated by a 600-ohm bias resistor in each lead and a 0.25 mfd. condenser from each cathode to ground. Ground in this case mean the chassis, which is not the same as the external ground. This is isolated so that there is never any danger of short-circuiting the line.

### LIST OF PARTS

**Coils**

One antenna coil
Two high-gain radio frequency coils
One 800-turn radio frequency choke
One push-pull input transformer
One speaker with push-pull output transformer for 48 tubes and one 1,800-ohm field

**Condensers**

One 350 mmfd. three gang condenser
Five 0.25 mfd. condensers
Two 0.5 mfd. by-pass condensers
Two 0.03 mfd. condensers
Two 0.0001 mfd. condensers
Two 5 mfd. condensers, 35 volt rating
Two eight mfd. electrolytic condensers

**Resistors**

One 10,000-ohm volume control potentiometer
One 100,000-ohm tone control with line switch attached
One 500-ohm slider type resistor, 50-watt rating
Two 600-ohm resistors, ½ watt
Two 25,000-ohm resistors, ½ watt
Two 50,000-ohm resistors, ½ watt
One 12,000-ohm resistor, ½ watt
One 150,000-ohm resistor, ½ watt
One 75,000-ohm resistor, ½ watt
One 500,000-ohm resistor, ½ watt
One 2,000-ohm resistor, ½ watt

**Other Requirements**

One metal chassis
Seven tube sockets
Antenna and ground posts
Phono posts
One vernier dial
Knobs for two controls
Line cable
Tube shields
Three grid clips
Hardware.

### The Plate Circuits

Since only three tuned circuits are used plate isolation was not found essential and therefore it was left out for economy reasons. However, there is adequate by-passing of the common lead. As a test for the adequacy of the filtering, the set is remarkably stable even when adjusted for highest sensitivity.

In order to obtain filtered d-c for the 48 plate supply without losing voltage in the choke, this is placed in the negative leg and the drop is used for bias on the 48s. This gives the additional advantage of fixed bias. The filter condensers used are of the non-polarized type to protect the circuit against mishap in case the line should accidentally be reversed.

All the by-pass condensers, especially those on the audio and detector bias, are considerably larger than those usually employed. This is to insure good quality from the lowest to the highest volume.

No oscillator is needed to align the tuners in this circuit, for all is done by maximum output. First the main tuning control is

*(Continued on next page)*

# The Lure of Home Experimenting

A DECADE ago kitchen mechanics made radio receivers and had a great time doing it. It was a thrill worth weeks of effort, burned fingers, and the ire of the wife to be able to turn on the receiver and hear a few squeaks, sometimes distinguishable as music or speech but mostly attrocious medley of unearthly noises. Some people grew sentimental about. If they were of a superstitious frame of mind, their belief in the supernatural was augmented. If they were of a logical mind they marveled at an achievement they did not yet understand. But they all got a thrill out of the noises. What marvelous quality; it was so good that you could recognize every word a speaker uttered, every tune the violinist played! Those were the days when demands on the radio receiver were not so severe as they are today.

### Short Wave Field

Now not so many build their own receivers for several reasons. First, commercial receivers are relatively inexpensive and the economic reason for home building is not so strong now. Second, all receivers, commercial as well as home built, are much more complex now than they used to be. It is more difficult to make them work as well as they should. Yet there are very many still who make their own. There is always the possibility of improving the receiver in some way, such as getting a little better sensitivity, a little better quality, a little more sensitivity, or to make it fit better into the individual's surroundings. Then there are always the chance of trying out pet ideas. But the vast majority of those who build sets now do it just for the fun of accomplishment during spare time. Some do it just to keep themselves from going places where they would spend much more money than they would staying home building radio receivers.

A vast field for the home experimenter lies in the short-wave band. There is almost unlimited space below 200 meters, and thousands of unsolved problems. Amateurs have solved most of the problems that have been solved up to the present. They will solve a large percentage of those that will be solved during the next decade. Boys who are just now getting curious about how things work will do most of the work, when they get a litlte bit older. But even many who are now grown will contribute much as soon as they have reached the stage where they have more leisure—more time in which to do the things they like to do in place of things they have to do.

Work in the short-wave field has the advantage that it is inexpensive. Boys can get the wherewithal from "the old man" by a little extra coaxing. Retired men have enough, even though they have not retired into a life of luxury.

What are some of the problems that confront radio men? One is the stabilization of the high frequency oscillator without the expense of crystal control. While a crystal is not unreasonably expensive, it costs more than a small condenser and a few turns of wire. No doubt, it is possible to stabilize the high frequency oscillators so that when someone is broadcasting or sending out code signals, others can receive the signals steadily and not have to change the tuning every few minutes. Another problem is the form of the best and most suitable antenna for the various short wave signals. While communication companies have solved this in their own elaborate way, there must be simpler ways which the individual experimenter can apply. The working out of satisfactory superheterodynes and converters for the short wave signals is another problem that has not yet been solved. That is a practical one which anybody can try. In one sense this is about the same problem as the working out of stable oscillators, for the success of the superheterodyne and the converter depends on the performance of the oscillator.

### Other Applications

Oscillators have many other applications than to radio reception and for that reason they deserve special study. It requires no special knowledge beforehand to ferret out their characteristics. The knowledge is gathered by experimentation with them, if it is done in a systematic way, that is, in the scientific way.

Oscillators are used for the measurement of time. It is possible by means of oscillators to measure time with at least the same accuracy as it is measured by the rotation of the earth. Clocks can be constructed in this which can be applied to the measurement of time so short that the earth standard would not be practical. Oscillators can also be used for the purpose of measuring minute distances, or for minute changes in angles. The beat oscillator is the most sensitive device that has ever been suggested for this purpose.

Another application of high frequency oscillators is to artificial heating for stimulation of plant growth and inducement of artificial fevers as a fight against disease. This application is coming into wide use. About the only requirement of such oscillators is that the frequency be high and that the power be suitable to the application.

Experimentation with these special applications of oscillators might result in inventions that would prove highly profitable.

While there are literally thousands of applications of thermionic tube oscillators to fields outside radio, that field remains the most prolific and is the most easily entered by the general experimenter.

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(*Continued from preceding page*)

adjusted until a high frequency broadcast station comes in. Then one of the trimmers is adjusted until the volume is loudest. The volume is reduced if the signal becomes too strong. Then the second trimmer condenser is adjusted in the same way. Again the volume may have to be reduced by the volume control. Finally the third trimmer is adjusted for maximum volume. During these adjustments the main dial is not touched after the first setting has been made. It is convenient to select a station about 15 on the dial at which to make the adjustment of the three trimmers.

### Phono Provision

A desirable feature of the circuit is the provision for phonograph playing. The 48 tubes in push-pull are admirably adapted for this purpose. Moreover, the phonograph plug-in terminals are placed so that the entire amplification in the audio amplifier is available for the phonograph. The phono terminals are placed in the tuned circuit between ground and the coil. Since one of the terminals is at ground potential there is no harm in leaving the phonograph output permanently in the circuit, provided that the terminals be shorted when the set is to be used for radio reception.

Another feature is that the last tuning condenser is put across the phono pickup output. Therefore the condenser may be used as a tone control. For the transmission of the high audio notes the condenser is set wide open, that is, the maintaining dial is set at zero. If the high notes are to be suppressed a little the main dial can be set at 100. There is variation of about 350 mmfd. across the pick-up terminals. Of course, this is in addition to the regular tone control that is put across the input terminals of the push-pull amplifier, which can be used for controlling the tone on radio reception. It is also available when playing a phonograph record.

The volume control is placed ahead of the audio amplifier. Hence it is not available for controlling the output when playing a phonograph record. But there should be because the amplification in the audio level is very high, and therefore the output tubes may become overloaded even when the pickup unit employed is relatively insensitive. This, of course, is a desirable feature in one sense, but it does require that a volume control be used with the pickup unit. This does not require a separate device, for nearly all pickup units are furnished with a control.

## Sunday Programs in Britain Secularized

The problem of Sunday programs is agitating the British now, somewhat as it agitated the Americans eight years or so ago. In this country the general Sunday offering was religious in nature, and while considerable of the religious program remains on the Sunday air, the rule for the day as a whole is that secular programs greatly predominate.

The British Broadcasting Corporation maintained a dead air from 6 to 8 p.m. in deference to the churches, which were in session then, and from 8 to 9 p.m. broadcast sermons. A new rule has been adopted whereby light music is sent out from 6 to 8 p.m., the sermons remaining on the schedule for the following hour.

Some protests have been made against this move, notably by Viscontess Snowden, who formerly held an official position in the British Broadcasting Corporation. She says that the new attitude reflects an absence of faith, but the radio authorities state that they have acted in a manner consistent with the ascertained desires of the listening public, and that while many no doubt would prefer the continuation of silence from 6 to 8 p.m. on Sundays, the majority wants programs secularly attractive.

## New Nickel Records Improve Broadcasts

By recording with a sharp cut on a wax plate, and then making duplicate records by an electroplating process, two inventors have been able to improve discs for broadcast reproduction. The use of recorded programs, specially made for broadcasting, is growing, and inventors have been hard at working trying to devise improvements. The state of the art is such now that it is practically impossible to distinguish the better-grade special records from a personal broadcast.

The two inventors who brought out the new process are Michael Errico and Ralph Nicholls, who stress the fact they use a special nickel disc of great durability. Needle scratch, they say, is practically eliminated, and the wear on the needle is very slight indeed. The two considerations naturally go together.

"We played one record 1,000 times," said Nicholls, "and there was scarcely any loss of tone quality when the record was rotated for the thousandth and first time."

# SWITCH-CC

## For 145-450 kc and 54(

### By Hermar

BY using somewhat larger shields than are found in the general run of receivers, a larger diameter for winding, and increasing the wire diameter with frequency, coils can be wound for wide-frequency coverage, and the convenience of switching enjoyed.

There are several choices that are available in attempting to solve the switching and ratio problems, and it may as well be said right now that the selection made was one that dispenses with as much as possible of the extra and external parts that complicate the wiring and crowd the under side of the chassis so that the layout would look like a maze otherwise.

The only padding is that for three bands of oscillator tuning. Indeed, two bands might suffice, but there is just a little extra edge in padding for the intermediate short-wave band (1,674 to 5,090 kc in the computations) and so this has been included.

### When Half of Dial Is Used

For higher frequencies (5,000 to 40,000 kc), no padding is practical, since the percentage of difference is small between the station carrier frequencies and the oscillator frequencies. The difference sometimes looks important even in part of these ranges and even shows up as a ratable percentage, but in actual practice the difference is insignificant, because the attenuation is not so strong in the pre-selecting circuits.

An idea previously broached in these columns has been embodied to avoid a lot of extra padding. The coverage is from 145 to about 450 kc for the low-frequency range, then 90 kc are skipped, and tuning of the broadcast band begins, while the first or intermediate short-wave band is subject to the same frequency ratio as the previous bands. Thus the intermediate frequency of the receiver itself, 465 kc, is not within the signal tuning range, and this avoidance saves a lot of squealing, particularly since there is nothing of any account in the skipped band.

The frequency ratio thus far is 3 to 1, but beginning at 5,000 kc, the frequency ratio is 2 to 1, so that here will be fairly satisfactory spreadout. By using a dial with a high ratio of planetary reduction, it is acceptable to use only about half of the condenser capacity for these higher frequencies and with typical condensers straight frequency line tuning results. Discarding use of the major part of the capacity would be serious were it not for the mechanical substitutes of electrical means to effectuate spread-out, introduced by having the dial ratio as stated, and a large scale to boot. There are dials obtainable that afford almost ten inches for half the scale circumference, so that for the 2 to 1 frequency ratio there would be 5 inches to accommodate the frequency designations.

### Circuit Analyzed

To make this general system practical the minimum capacities of the tuned circuits are to be theoretically alike. Actually there will be some difference, for the low-frequency coils are honeycombs, with extremely low distributed capacity, while the other coils are solenoids on 2-inch diameter, with relatively high minimum capacity. However, as the change is in the same direction for the different circuits no particular attention need be paid to this.

Also, since the oscillator and the signal level minima are the same, there will be a slight discrepancy in tracking for the low-frequency and the broadcast band, but this, too, is an acceptable compromise in a receiver that, for its wide frequency coverage, must, like all other multi-range sets, include some compromise.

The circuit is essentially an eight-tube superheterodyne, with automatic volume control, full-wave diode detection, resistance-coupled audio and 2A5 pentode output. If a few dead spots show up at the higher frequencies, or if oscillation practically disappears around 20,000 kc, then it will be necessary to parallel the oscillator unit of the 2A7 pentagrid converter tube with a 56, as shown, making the total nine tubes, but this 56 may be put on a socket shelf underneath, and so even a chassis designed for eight-tube construction can be utilized. The 56 in such a physical position would be lying flat, so to speak, parallel with the top of the chassis, though underneath that top, of course, and the tube should be so placed that the heater pins are perpendicular, one atop the other.

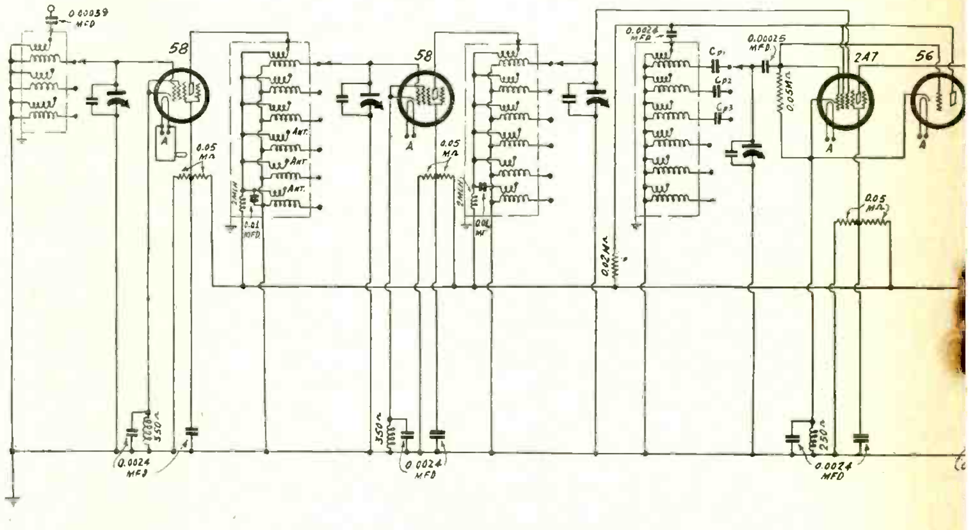
### Two Novelties

The only novelties in the circuit proper are the use of r-f choke coils of prescribed d-c resistance, so they serve as biasing resistors, too, and the fact that the antenna is switched to the first r-f tube for the low-frequency, broadcast and first short-wave bands, but not for higher frequencies. The reason is that with present tubes it is too difficult to avoid oscillation in the r-f amplifier if there are two stages of t.r.f. for these higher frequencies.

It is preferable to switch the antenna this way, rather than use a choke input and retain the first stage in service for high frequencies, because the choke would have a high capacity across it (considering the effect of the antenna and the frequencies concerned), and also the output capacity of the first tube would create an unwelcome extra detour of energy.

A notation is made on the diagram of the points to which the antenna is switched. The reason for the series condenser in the antenna circuit is to avoid a short of the B supply if by accident the antenna, wherever it may be, becomes grounded.

A table is given on page 14 that informs the proposed constructor of the essentials of the frequency coverage and of the coil winding. No data are given for the low-frequency coils, save the inductance value but the 2,800 microhenry secondary would be of about 500 turns and the 700 microhenry coil, also a honeycomb, of about 300 turns. Any desiring special commercial in-




FI(

**A superheterodyne that covers 145 to 450 kc and 540 to stage, and enabling switching. A table gives the numb at maximum. This is close to what ac**

#### LIST OF

**Co**

One antenna coil assembly, as described (s
Two interstage coil assemblies, as described
One oscillator assembly coil, as described (s
Three intermediate-frequency transformers, tu
Two 2 millihenry r-f chokes
Four 350-ohm r-f chokes (may be replaced b series)
One 250-ohm r-f choke (may be replaced b series)
Four 10 mh r-f choke coil
One power transformer.

**Conde**

One four-gang condenser, commercial rating 3
Three 0.00039 mmfd. fixed condensers
One 0.00025 mfd. fixed condenser
Three padding condensers, Cp1, Cp2 and C
Eleven 0.0024 mfd. fixed condensers
Five 8 mfd. 500-volt electrolytic condensers
One 50 mmfd. condenser

**Res**

One 0.02 meg. resistor
Eleven 0.05 meg. resistors
Three 0.25 meg. resistors
One 0.5 meg. resistor
One 3,500-ohm resistor
One 1.0 meg. resistor
One 600,000-ohm potentiometer with switch
One 410-ohm resistor
One 1,700-ohm 5-watt resistor

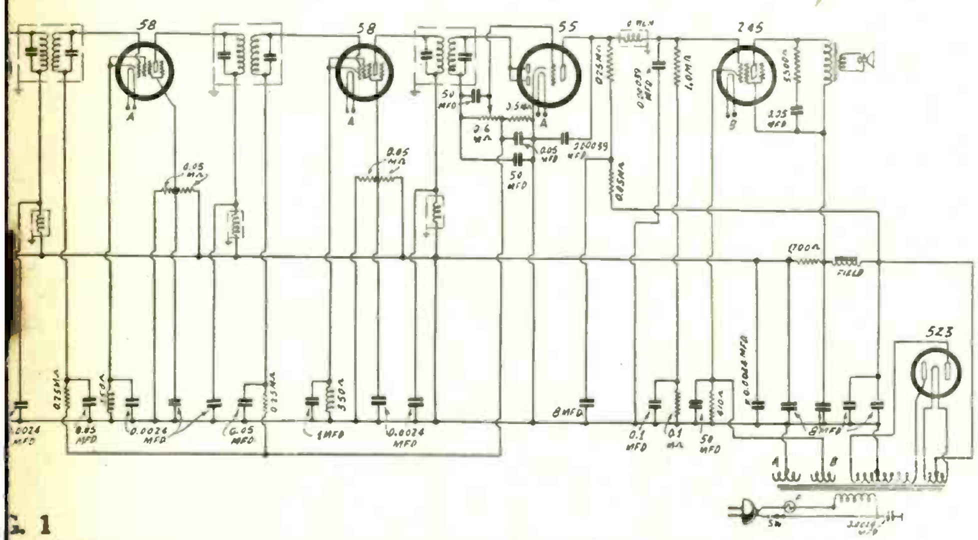
**Other Req**

One dynamic speaker with 1,800-2,500-ohm fiel
One vernier dial, escutcheon and pilot lamp
Six grid clips
One a-c cable and cord
One 2-ampere fuse
Six six-hole sockets, one five-hole socket, o speaker plug (usually UY)
One chassis.
One four-pole, three- six-throw switch
Three knobs

# )IL DESIGN

## ) to 40,000 kc Receiver

*ı Bernard*




**G. 1**

**10,000 kc, using a coil assembly in a single shield for each**
**pers of turns. The tuning capacity assumed is 420 mmfd.**
**tually exists with the run of condensers.**

## PARTS

**ils**

ix transformers on one tubing)
(six transformers one one tubing)
x transformers on one tubing)
nable to 465 kc

y 300-ohm resistors and any r-f choke in

y 200-ohm resistor and any r-f choke in

**nsers**

0 mmfd.

p3, as detailed in table on page 14.

**tors**

**uirements**

d coil, output transformer for 2A5 built in

e four-hole socket and an extra socket for

formation on suitable honeycomb coils may obtain it by addressing Trade Editor, Radio World, 145 West Forty-fifth Street, New York City.

### Primaries Considered

No data are given on the primaries, or on the feedback windings that may be regarded as primaries, but since the winding of these is not a critical matter, a general rule may be followed. In the case of the honeycomb coils, by having two coils about 1/8 inch away from each other (measured from end of one coil to beginning of other), the primaries may be almost of the same inductance as the secondaries. For the broadcast and first short-wave bands the primaries, next to secondaries, 1/16-inch separation, consist of one-quarter the number of secondary turns, and may have finer wire than on secondaries. For the next band (5,000 to 10,000 kc) the same ratio prevails as in the next previous instance, except that the separation is 1/4 inch, while for the highest frequency band the separation is one-half inch, the primaries have the same ratio, 1 to 4, and the separation is 3/4 inch.

There is a difference in regard to the ticklers. For the low-frequency band, same separation as for r-f, the ratio of turns is 1 to 2, primary to secondary; for the broadcast band it is 1 to 4; for the first short-wave band it is 1 to 3; for the second short-wave band, 1 to 2; for the third short-wave band, 1 to 1, and for the last band the tickler may require an extra turn or two more than the secondary. The separation may be uniformly 1/8 inch. Whatever is done, the tickler should be close enough to the secondary, or have enough turns, so that the tube will oscillate all over the band of frequencies that it should cover.

### Chart Analyzed

Using 2-inch diameter tubing, the coils do not attain any considerable height, and can be fitted nicely into shields about 3½ inches in diameter and 4½ inches high, of which there is an assortment on the market.

The table gives the data for the signal level and for the oscillator level. Also, it graphically portrays the changing condition, one level in respect to the other, as the bands of frequencies are increased. For the higher frequencies the oscillator and signal level inductances are the same, or practically so, representing the same idea as already set forth, that the percentage of difference in frequency between the two levels becomes negligible, from the viewpoint of actual practice.

To attain wide coverage it is necessary to use a gang condenser with equal sections and to pad the oscillator for two or three bands. Here three are padded.

### Difference Noted

The lower the frequency the greater the difference between the oscillator and the signal level, for instance, the low-frequency comparison is approximately 145 to 450 kc, signal, and 610-915 kc, oscillator, so that the oscillations are actually in the band of broadcast frequencies. Naturally the capacity ratio must be less for the oscillator than in any higher frequency band, so the series padding condenser must be smaller. This is obviously true, since for the highest three frequencies there need be no padding condenser.

So, for the three bands utilizing padding, the respective capacities are Cp1, 131 mmfd., Cp2, 420 mmfd., Cp3, 821 mmfd. These may consist of mica moulded condensers of the fixed type, of less than required capacity, with a small air-dielectric trimmer across the fixed condensers, to enable adjustment.

If any other ranges of frequencies are preferred, or other low frequency inductance used for a different span for this part of the service, the inductance for the coils for succeeding bands of equal frequency ratio may be reduced by the capacity ratio.

### The Ratios

If the frequency ratio is determined experimentally by dividing the low frequency setting into the high frequency setting, the number resulting should be squared (multiplied by itself) to yield the capacity ratio. Suppose this is 9. Then the inductance for the next highest frequency band should be one-ninth of that used for the band in which the experimental data were obtained.

Some attention has been paid to the effect of shielding in determining the number of turns, since the shield reduces the inductance a bit. However, for the three highest frequencies of coverage some extra experimenting may have to be done to be sure that the frequencies come out exactly as intended. Use of a different type of shield might account for such a difference, as would indeed even the direction in which wires are led and their placement in respect to other wires and to chassis.

The voltages for the intermediate level are practically independent of the effect of the r-f, modulator and oscillator, except for the plate current of these circuits reducing the B voltage somewhat, so the intermediate amplifier can be built and lined up, with complete audio and rectifier functioning.

### Curing Feedback

To insure absence of oscillation it is usually necessary to use shielded wire on the leads to overhead grids in the intermediate amplifier, including the 55 grid, though that handles audio principally, for a little r-f may get into this circuit.

When there is no oscillation this way, there will be none when the extra tubes are worked. If an i-f tube does oscillate, discover its identity by touching the grid cap and listening for the plop, or cessation of oscillation, and decrease the resistor from screen to ground in that tube circuit until oscillation is completely absent. The test

*(Continued on next page)*

# Frequency Adjustments in a Super

The adjustments of frequencies in a superheterodyne still trouble some experimenters. By proceeding carefully and in an orderly fashion the work can be satisfactorily accomplished.

### Don't "Retouch"

Note that the adjustment of the various circuits proceeds in an orderly fashion. Once an adjustment has been it should not be tampered with. The first adjustment is the tuning of the intermediates, one at a time. When one has been tuned there is no reason for touching the trimmer again, unless as a matter of practice it is desired to do the work over again. When the intermediates have been tuned the next step is tuning the radio frequency circuits at the high frequency end. The oscillator trimmer is tuned first, then the two radio frequency trimmers. The trimming is done so that the 1,500-kc signal will come in when the main dial is set at a low value between 10 and zero, preferably close to 5. When this trimming has been done there is only one thing left, and that is the series condenser in the oscillator circuit. That is the final adjustment. The only reason for converting the circuit to a t-r-f receiver while doing this is to find out where on the radio frequency dial the selected signal comes in loudest. If the radio frequency tuners had been calibrated previously this step would have necessary. But the conversion is much easier than calibration and just as effective. In fact, it is better. The only thing that is turned while the circuit is in the t-r-f condition is the main dial. The series condenser is not touched until the circuit has been restored to a superheterodyne. After the main dial has been used for finding out where the signal comes in loudest in the t-r-f set it should not be touched for the accuracy of the padding adjustment depends on leaving it alone. After the series trimmer has been used to tune in the signal, the adjustment is complete and then only the main dial should be turned.

### Adjusting Without Oscillator

In the absence of a calibrated oscillator it is still possible to make the necessary adjustments of the various trimmers. However, it is necessary to guess at the intermediate frequency. A guess will not be far off. Leave the circuit as a superheterodyne and set the dial on some strong station near 1,500 kc. Tune it in with all the trimmers, the wo r-f, the oscillator, and the four intermediates. Begin with the oscillator trimmer and do the two r-f trimmers next. If the station is strong the signal will come through the intermediate amplifier even if the trimmers are off. As soon as the short-wave station has been heard at all, trim all the circuits accurately, first the oscillator and then the other trimmers in any order. Reduce the amplification as the sensitivity increases. This adjustment lines up the intermediate and radio frequency tuners as well as the oscillator.

### Series Trimmer

The next step is to adjust the series trimmer in the oscillator. This is done exactly in the same way as it was done before. The circuit is converted to a superheterodyne and a station between 570 and 600 tuned in with the main dial. Then, leaving the main condenser alone, the circuit is put back to a superheterodyne and the signal brought in by adjusting the trimmer condenser alone.

When the adjustments are made in this manner by guessing at the intermediate frequency the final adjustment may not be as good as if the intermediate had been tuned exactly to 456 kc, but it will be reasonably good, and it may be fully as good. It all depends on how close the guess was. If it does not seem to be as good as it ought to be the intermediate can be changed a litle one way or the other. This, of course, require retrimming of the radio frequency circuits and the oscillator.

### I-F Elimination

When trying to bring in a station on 1,500 kc or near that frequency before the intermediates have been lined up at some frequency, it may fail because the available station is not strong enough to force its way through the badly detuned intermediate. In that case it may be well to eliminate one of the intermediates temporarily by moving a grid clip. The clip that normally goes on the intermediate tube would be put on the cap of the second detector. While this removes most of the intermediate frequency gain it at the same time removes most of the attenuation so that a net gain may result. If anything at all comes through it is but a moment's work to tune the remaining circuits, after which the amplifier could be put back. Then the second intermediate can be tuned.

## Unionization is Pressed on Two Flanks of Radio

Organized labor is making a drive on the radio industry, both in its manufacturing and broadcasting aspects, to perfect unionization. It is claimed that wages are too low in the manufacturing end, and to enable collective bargaining, union agents are pressing their unionization plans upon employes outside the plants.

The manufacturing industry is operating under the code now, so that minimum wages and maximum hours are provided for, and since collective bargaining is guaranteed, union representatives desire to have the employes organized so that benefits now enjoyed will be preserved. The pay being better in the broadcasting end, it is maintained that it should be still better, as proposed under the code for broadcasters, but the code has met some opposition from management.

## Kennedy Builds Programs and Comments at NBC

John B. Kennedy, lecturer and associate editor of "Collier's," plays an important part in designing special programs to be heard over NBC networks.

Mr. Kennedy himself is heard in several broadcasts each week in addition to his production work on program presentations. He frequently has appeared before NBC microphones as guest speaker, and as an associate of the company he will continue his succinct radio comments.

# An All-Wave Superheterodyne

(*Continued from preceding page*)

should be made with volume control at "full-on" position.

The screens have grounded resistors in every instance, the reason being the ease with which oscillation trouble may be cured, and also the preliminary likelihood of absence of oscillation, because each circuit has independent screen and cathode resistors, hence individual plate, screen and cathode filtering, and there is hence no coupling through common devices. Besides, grounding the screen through a resistor, which is bypassed, has the effect of holding the screen voltage fairly constant, as otherwise the screen voltage would decrease considerably as the signal increased, which is degenerative in its effect.

### Tone Filter

Intermediate frequency oscillation may be related to the audio amplifier, in the sense that some i.f. gets into the a-f channel, but a choke is included to stop that and besides there are two 0.00039 mfd. condensers to add their bypassing. These capacities are not too high, in the light of the pentode inclusion in the output, as the high audio-frequency component will stand some attenuation. Indeed, a special filter is included for tone compensation in the same direction, composed of a 3,500-ohm resistor and a condenser of 0.05 mfd. If it is desired to bring out the high audio frequencies more strongly, then this condenser may be reduced in capacity.

In the broadcast band the signals may be so strong on some locals as to choke up the amplifier of the 55, so the plate of that tube is returned through a bypassed 0.05 meg. resistor to the highest B voltage, next to the rectifier, and the stronger the signal, the better the triode of the 55 is able to cope with it, for the effective plate voltage actually increases with signal.

### Voltage Values

The voltage applied to the previous tubes should not exceed 250 volts and may be somewhat less. The bias will run around 3 volts or so, and the screens should not have more than 100 volts ever, particularly not the screen of the quadrode of the 2A7. If the receiver is noisy this may be remedied by reducing the screen voltage on this tube in the same manner as previously directed for reducing screen voltages of other tubes.

Less than the full a rectified voltage in the second detector (55 diode) is applied as extra bias to the two intermediate stages, so that sensitivity will not be reduced below the desired point. Since only d.c. is desired for such bias, it may be obtained from the drop in 0.5 meg, which is about half the total rectified component, as the potentiometer is 0.6 meg., or may be 0.5 meg., so that just half will be correct. Then if a large condenser is put across the fixed resistor in the diode load, practically the whole signal still will go into the 55 grid.

The speaker field resistance is not given, since it is not critical, and especially since the voltage obtained from the power transformer and rectifier tube has an influence. Values from 1,800 to 2,500 or even 3,000 ohms may be used.

### SIGNAL LEVEL

| kc | C | L | 2" Turns | Ratios C | Ratios f |
|---|---|---|---|---|---|
| 145- 449.5 | 43.7-420 | 2.800 | Honeycomb | 9.61 | 3.1 |
| 540- 1,674 | 43.7-420 | 208.12 | 30 en. 56 | 9.61 | 3.1 |
| 1,674- 5,090 | 43.7-420 | 21.66 | 28 en. 15 | 9.61 | 3.1 |
| 5,000-10,000 | 43.7-175 | 5.41 | 18 en. 8.2 | 4.0 | 2.0 |
| 10,000-20,000 | 43.7-175 | 1.35 | 18 en. 3.6 | 4.0 | 2.0 |
| 20,000-40,000 | 43.7-175 | 0.36 | 14 en. 1.8 | 4.0 | 2.0 |

### OSCILLATOR LEVEL

| kc | C | Cp | L | 2" Turns | Ratios C | Ratios f |
|---|---|---|---|---|---|---|
| 610- 914.5 | 43.7-110 | 131 | 700 | Honeycomb | 2.465 | 1.57 |
| 1,005- 2,139 | 43.7-210 | 420 | 120 | 28 en. 48 | 4.54 | 2.13 |
| 2,139- 5,555 | 43.7-280 | 821 | 19 | 28 en. 14 | 6.4 | 1.88 |
| 5,555-10,465 | 43.7-175 | 0 | 5.4 | 18 en. 8.0 | 4.0 | 2.0 |
| 10,465-20,465 | 43.7-175 | 0 | 1.35 | 18 en. 3.6 | 4.0 | 2.0 |
| 20,465-40,465 | 43.7-175 | 0 | 0.36 | 14 en. 1.8 | 4.0 | 2.0 |

*All the coils for a particular stage are wound on one tubing 2 inches in diameter, 3½ inches high. Coils are shielded. Four coil assemblies and four shields are required.*

# Radio University

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

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

### Electron Coupling

WILL YOU PLEASE show a method of electron coupling in a mixer, where one does not use a converter tube, and contrast this with the use of the converter tube?—K.E.C.

There are a few ways of introducing electron coupling where the pentagrid converter tube is not used, but two separate tubes in separate envelopes. The diagram at left on this page shows one way, where the oscillation voltage is fed to the screen, as this voltage normally will run around 80 to 100 volts. That is, the screen of the modulator takes the oscillation voltage, and the unison takes place in the space stream of the modulator. Another way would be to let the cathodes of the two tubes have a common resistance for part of the bias-voltage drop, no condenser across this part. The pentagrid converter tube takes care of the operation in one envelope, as the cathode is common to both tubes inside the same glass, as diagramed at right.

* * *

### Modulation of a Dynatron

IS IT possible to modulate the output of a dynatron oscillator by putting an audio signal in at the control grid? If so, how should the control grid be biased?—W. H.

It should be possible because the control grid bias varies the negative resistance of the plate circuit, and it is the negative resistance that determines the amplitude of the generated wave. Increasing the grid voltage would decrease the output and decreasing the bias would increase the output. The voltage impressed on the control grid should be low, say not more than one volt r.m.s., assuming that the screen voltage on a 224 dynatron is 90 volts and the plate coltage is about 20 volts. The fixed bias on the control grid may be zero, or it may be equal to the peak of the impressed audio voltage. If the control grid goes too much negative oscillation will stop and therefore if the audio voltage is too great oscillation may stop during part of the audio cycle. This would result in a kind of interrupted continuous wave.

* * *

### Crossing the Carrier

IN SOME superheterodynes that I have built there is terrific squealing in the middle of the band and no stations can be received clearly. I suspect that the fault is in the padding but so far I have not been able to determine just what he trouble is. If you have met any similar trouble will you kindly give an explanation?—W. H. L.

Undoubtedly you have a case of crossing the carrier. When you adjust the trimmer condenser on the oscillator you select the lower of the two possible frequencies, that is, the one which appears when the trimmer condenser is the more tightened. This adjustment is possible only on the high frequency end of the tuner. When you adjust the padding condenser to bring in a low frequency station, say 570 kc, you must necessarily select the higher of the two possible oscillator frequencies, because the lower is away outside the tuning band. Now you have selected the lower oscillator frequency at the higher signal frequency and the higher oscillator frequency at the lower signal frequency. Somewhere in between the oscillator frequency must necessarily equal the signal frequency, and at that frequency you get squealing as well as over a region about that frequency. You can not receive any of the middle frequency stations. Yes, we have met this trouble many times. It is such an easy mistake to make because the two oscillator settings at the high frequency end are not far apart. Both can be tuned in with the trimmer condenser alone.

* * *

### Setting Oscillator

THE oscillator I have constructed cannot be set accurately at the high frequency end and therefore I have trouble making adjustments on superheterodvnes. Using a high frequency broadcast station is not satisfactory because the signals are not strong enough to make preliminary adjustments. Can you suggest a way of using the oscillator and setting it accurately so that I can use it?—T. L. A.

If you can receive the short wave stations loud enough to be able to identify them, using a regular receiver, you can always set the oscillator to zero beat with it. Having set your oscillator in this way to exactly the frequency you want, you can use it for making adjustments. If there should be no broadcast station on exactly the frequency you want, you may be able to adjust at a slightly different frequency, or you may be able to beat the oscillator against some strong station having a frequency one-half what you wish. Thus if you want to set your oscillator at 1,500 kc you can beat it against a station operating on 750 kc. There is any number of possibilities with an adjustable oscillator and about 600 broadcast stations.

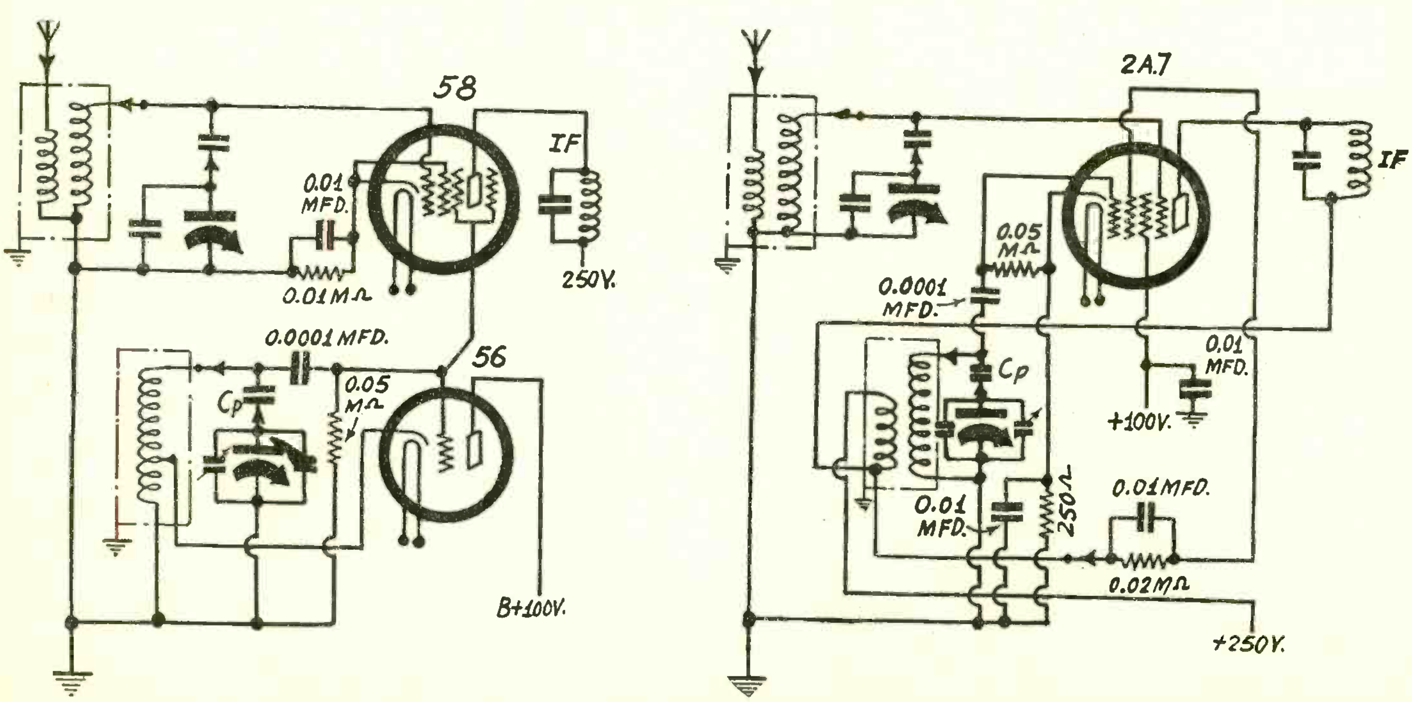
* * *

### Potential and Voltage

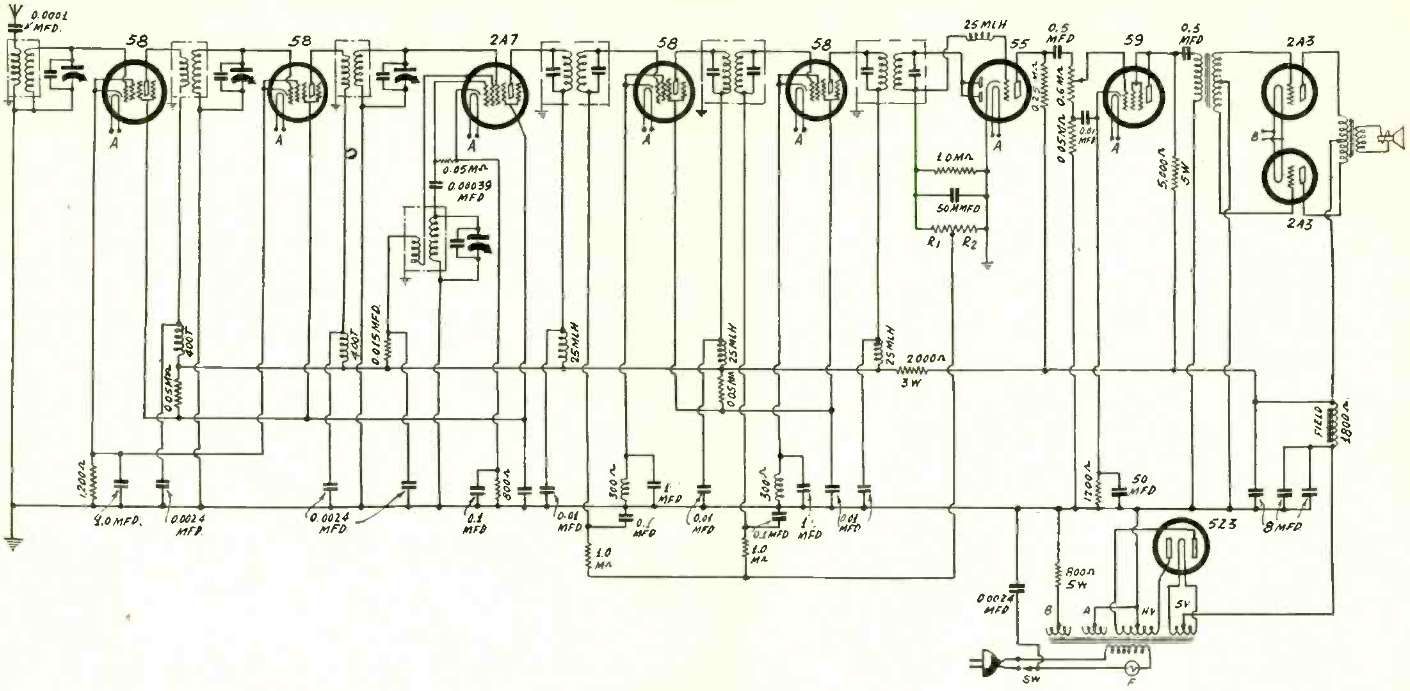
WHAT IS the difference between potential and voltage? It seems to me that these two terms are used interchangeably. If they are the same why should there be two terms?—W. H. C.

The two terms are frequently used interchangeably, but erroneously so. It is no more correct to speak of voltage when we mean potential than it is to speak of wattage when we mean horsepower. The difference of potential between two points in a circuit, or in space, can be expressed in volts, and then it is voltage, but it can also be expressed in some other unit of potential, and then it is not voltage. It is only voltage when the potential difference is measured in volts. Likewise, power is not wattage unless it is measured in watts. If it is measured in horsepower than it is "horsepowerage." Electric current is not amperage unless it is measured in amperes. There are several electrical units that are misused out of sheer laziness.

(*Continued on next page*)




**Two examples of electron coupling. At left two separate tubes are used. At right the pentagrid converter tube (2A7) is used. In the first example the tubes are the 58 and the 56.**




**The problem of getting rid of oscillation at the intermediate level may be solved in any of a number of ways, but some solutions make for better performance than do others. For instance, filtering the cathods legs, and especially using large capacity across the choke, is an acceptable method. This is a diagram of a powerful 10-tube superheterodyne, using the pentagrid converter tube and 2A3 push-pull output.**

(*Continued from preceding page*)

### Use of Beat Note Oscillators

BEAT note oscillators have been designed to generate audio frequencies and also to measure small changes in distance and angle. What are the requirements in the two cases? It seems to me that they are entirely different in the two.—G. B. A.

When the beat oscillator is to be used for producing audio frequencies the circuit must be designed so that a very large change in the tuning dial produces a comparatively small change in the beat frequency. If it is not done this way it will not be possible to calibrate the audio frequencies accurately. When the beat is to be used for measuring small changes in angle or distance, the circuit must be arranged so that a very tiny change in the angle or the distance will produce a large change in the beat. That is, they are diametrically opposite to each other. It is easy to get either arrangement. For an audio beat oscillator a tiny condenser can be put in parallel with a large one to get a slow change in the beat. The small condenser can be made up of a large variable condenser in series with a very small one. Varying the large one in this case will change the frequency very slowly and it is possible to calibrate the dial for audio frequencies. When the change in the beat note is to be rapid a small condenser and a large inductance can be used in the oscillator. Moreover, the capacity can be varied by varying the distance between condenser plates that are already very close together.

* * *

### Comparative Efficiency of Coils

HOW IS it possible to compare the efficiencies of different coils that are to be used as tuners? I know how to do it with a thermo-galvonometer but I have no such instrument. I have plenty of vacuum tubes and other equipment.—A. S. J.

You can rig up a vacuum tube voltmeter or rectifier. Just a grid biased detector will do. The coils to be tested should be connected in the plate circuit of the tube with which they are intended to go. In other words, the coil and its tuning condenser should be wired into the amplifier circuit exactly as it should be, using a detector of the biased type after the coil. Impress a constant signal voltage on the grid of the first tube and note what the milliammeter in the plate circuit of the biased detector reads. Now put in another coil and test that with the same voltage on the grid of the first tube. If the plate current in the milliammeter is larger now, the second coil is superior, if it is less it is inferior. The performance is very closely proportional to the deflection in the milliammeter, especially if there is a high resistance in series with it. This is as quick a way as any of testing coils and transformers. If the device to be tested is designed to operate at different frequencies, the frequency of the input voltage to the first tube should be varied in suitable steps and tests made at the different frequencies.

* * *

### Cures for I-F Oscillation

AFTER HAVING constructed several superheterodynes of the a-c type that have two intermediate-frequency stages, I have come to the conclusion that the coils generally obtainable have a degree of coupling more suitable for a single-stage of i.f., since there is a tendency to i-f oscillation when three coils are used for two stages. Is this not true? What are some remedies? —O.W.D.

Yes, your conclusion is substantially correct. In many installations there is a resulting oscillation when the i-f transformers are peaked. One remedy, not a good one, is to detune the plate circuit condenser of the first i-f transformer a bit, but it is better to use some other method. The screen voltage on the first or second i-f tube may be reduced, to cure oscillation, by connecting a resistor of 50,000 ohms between screen and ground. It is assumed that the circuits are suitably filtered with plate chokes and bypass condensers, *also* screen resistors and bypass condensers. Radio-frequency chokes in cathode legs help a great deal, especially when the bypass capacity across them is of the order of 1 mfd. See the diagram. A simple remedy, not quite so good as the extra cathode filtering, is to put a resistor across the primary of the first i-f transformer, of a low enough value to stop oscillation, but not so low as to reduce sensitivity much. A value of around 25,000 ohms is suggested as a trial. If the coupling between primary and secondary were still looser, which is a factor beyond any change the experimenter might readily apply, there might be no cause for oscillation complaint. At all hazards, stop the intermediate amplifier from oscillating, for if you do not you will get a squeal every time you tune the r-f to a carrier.

* * *

### Test Oscillator Range

AS I DESIRE to build a test oscillator, will you please give me some idea of the lowest intermediate frequency it will be necessary to reach, as I shall have a limited frequency ratio, possibly 2-to-1, or a bit more, and will depend on harmonics for the broadcast band?—I.R.

A suitable frequency range, on a 2-to-1 basis, would be from 450 to 900 kc. Therefore the fundamental would tune in the intermediate band and part of the broadcast band. Harmonics will yield sufficient results for higher frequencies, particularly as the second harmonic would cover 900 to 1,800 kc, and thus exceed the broadcast band's highest frequency limit. Such a test oscillator could be made very compact and also could be circuited for universal use, that is, batteries, d.c. or a.c. The tube suggested is the 30, with a 1,750-ohm 10-watt series resistor to take care of the filament. A parallel fixed condenser cut in by switching could take care of 175 kc.

* * *

### Frequency Changes with Temperature

IN WHAT manner does the frequency of an oscillator change as the temperature of the coil and the condenser changes, the operating voltages being kept constant? How can it be estimated?—W. N. L.

It is not easy to say how the frequency changes with temperature because it depends on how the coil and the condenser have been constructed. The inductance of the coil is likely to increase as the temperature increases, and this would cause a lowering of the frequency. What happens to the capacity is not so easily seen. If it were just a matter of the expansion of the plates, the capacity would increase, but the frame also expands. This might move the plates farther apart to reduce the capacity. It is quite possible to construct a condenser so that it changes in capacity at exactly the same rate as the inductance changes, but in the opposite direction. If that were done the frequency would not change with temperature. But in a circuit without this compensation there will be a change in the frequency. The only way to find what it is in any oscillator is to measure it. This is easily done. First tune the circuit to a standard of frequency, such as a high class broadcast station. Note the temperature of the room and wait until the oscillator has settled down to a steady frequency. Without touching the tuner let the room warm up or cool off and note the new temperature. Wait until the frequency has settled down to its new value. Note the beat frequency now. If it had been adjusted to zero beat in the first instance the change in the frequency is equal to the beat. Divide this by the change in temperature in degrees and the result is the coefficient of frequency change with temperature.

* * *

### Grid Leak Detector

WHEN a grid leak type of detector is used the plate supply voltage is always low, while when grid bias detector is employed it is often many times higher. Why is this difference? If the grid acts as a diode rectifier in grid leak type of detection, why would it not be just as well to use a high plate supply voltage?—T. B. F.

As far as the rectification is concerned the plate voltage on the tube has practically nothing to do with the function. But in grid leak detection the tube not only acts as a rectifier in the grid circuit but as an amplifier of the rectified and detected signal, and for amplication both the grid and the plate are necessary. If the applied plate voltage is too high the tube will not amplify well because the bias is not right. If the grid and the rectifier anode were separated, the plate voltage could be increased, and that is the case in a tube like the 55. In this tube the applied plate voltage may be much higher than in a grid leak type of detector.

* * *

### Properties of Thermocouples

WHEN directions for the calibration of thermocouples with direct current are given it is usually stated that deflections will be different depending on the direction the current flows through the couple, and that the average of the two deflections should be taken. Why does the couple cause more current to flow in one direction than in the other in the thermo-electric circuit?—F. E. W.

The lack of symmetry is due to defects in joining the wires. As a rule short lengths of the two dissimilar wires are crossed and permanently joined together by hard soldering. In doing so the solder may short circuit a tiny portion of the wires. That is, the junction is not at a point but is at two or three points. This causes a voltage drop in the secondary circuit due to the d-c voltage applied for calibration. Since the couple produces an e.m.f. in a given direction, this stray voltage, as it might be called, will either add to or subtract from the thermo-electric voltage as it appears in the secondary circuit, depending on which direction the calibrating current flows in relation to the thermo-electric voltage. When the average deflection is taken this effect is neutralized. When later alternating current is used it flows in both directions and there is an automatic neutralization of the defect. Sometimes the two dissimilar metals are spot welded together, and when they are there is less chance that the defect occurs.

* * *

### Short-Wave Battery Set

KINDLY SHOW A CIRCUIT diagram for a short-wave speaker-operating receiver, using as few as possible of the 2-volt tubes, and provided with earphone outlet.—I.H.

The diagram is printed on this page. The tube marked 30-S is a special type of 30 tube with low electrode capacity for short waves, and is suitable as detector. While the same type tube is used as audio amplifier, this tube may as well be a 30. In fact, the 30 will work as detector, too. The connections for the 30-S are special. The 30 connections of course are standard. The receiver uses four tubes, of which the first is a 34 with untuned input, but with tuned plate. Thus a regenerative detector is employed, with untuned r-f amplification. The connections for the tubes are shown in the socket diagrams. Note that the 30-S metal cap is the plate, the unusual feature referred to, and the grid is opposite the positive filament.

* * *

### Inductance Values

WILL YOU PLEASE state again what is the inductance relationship of the higher frequency coils in an all-wave receiver, when one knows the coil for a given band of lower frequencies?—J.E.D.

The capacity ratio of the condenser is divided into the inductance of the known low-frequency coil to obtain the inductance for the next coil, and so on. Thus, if the capacity ratio is 9, and the inductance is 180 microhenries for the broadcast band, the next coil would have an inductance of 20 microhenries (180/9) and the next 2.22 microhenries (20/9). The capacity ratio is the square of the frequency ratio.

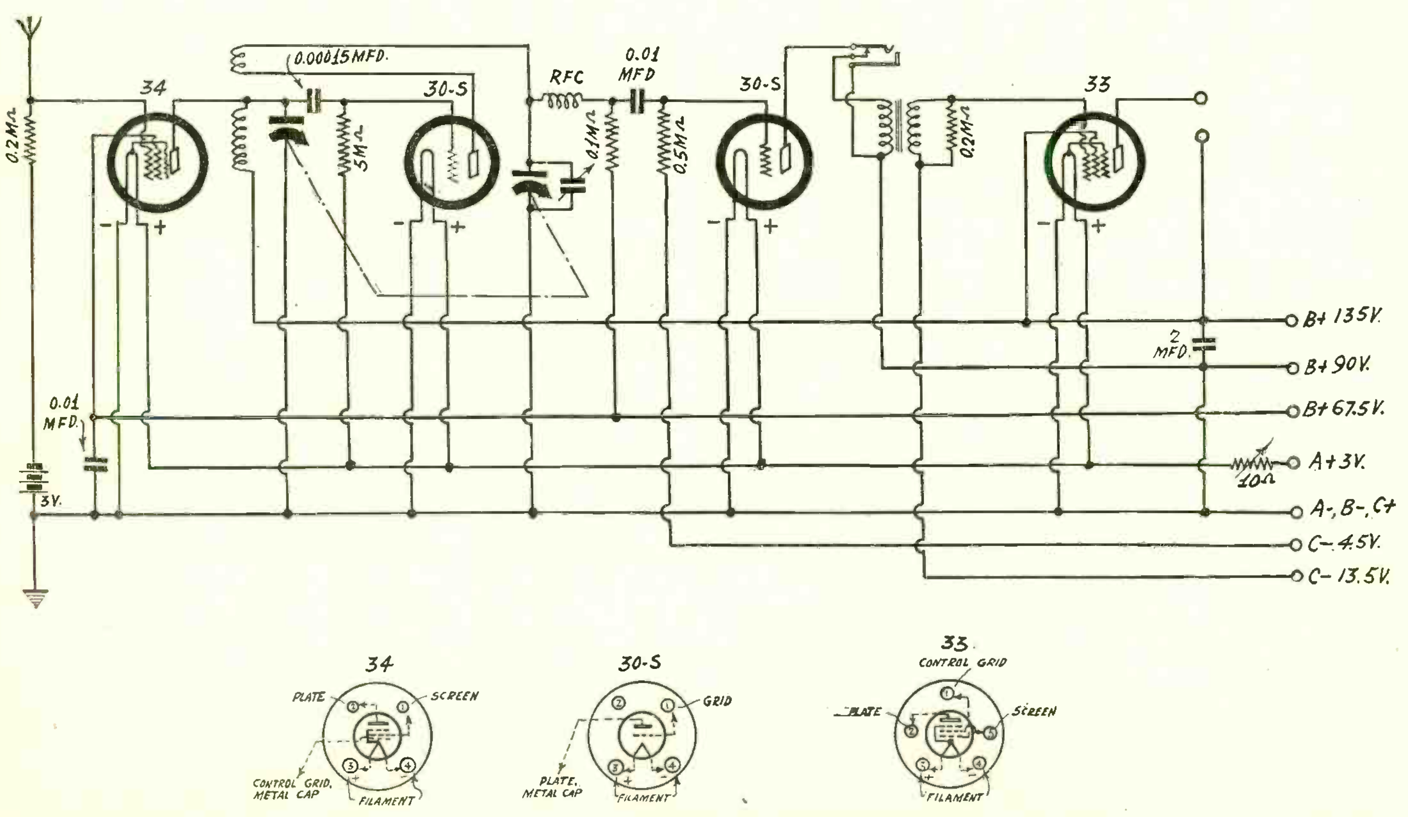
* * *

### Measuring the Mu of a Tube

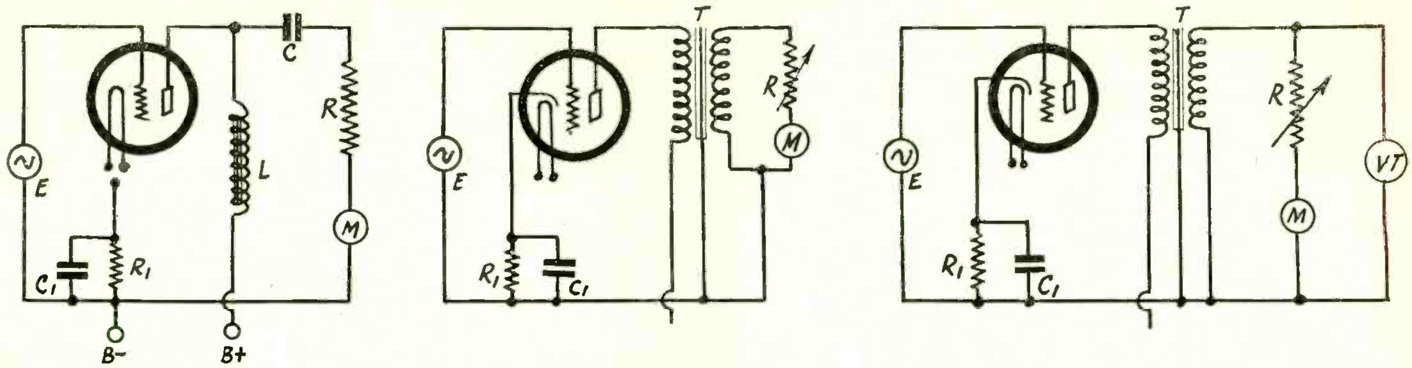
I HAVE two voltmeters and sources of voltage which I can vary to any value. Do I have enough material to measure the amplification factors of tubes?—W. E. R.

Not quite. You also need a milliammeter. Apply a suitable voltage on the plate of the tube and use one of the voltmeters for measuring it. Also apply a suitable voltage on the grid and use the other voltmeter for measuring it. Put the milliammeter in the plate circuit of the tube. Reduce the grid bias by a small amount, say 0.5 volt. The current in the plate circuit will increase. Decrease the plate voltage until the plate current was what it was originally. Read the new plate voltage. Now increase the bias by one volt. The plate current will go down. Increase the plate voltage until the plate current was as before. Read the new plate voltage. The difference between the two plate voltages will be the amplification factor of the tube, and it will be at the original grid bias and original plate voltage. That is, it will be at the mean value of the two different grid bias voltages and very nearly at the mean of the two plate voltages. It might work out something like this. The plate voltage is first 135 and the grid bias 13.5 volts. The bias is made 13 volts. The plate voltage may have to be reduced to 130 volts to restore the original plate current. Now the bias is made 14 volts. The plate voltage may have to be increased to 140 volts to restore the current. The amplification factor is then 10, and it is measured at 13.5 volts on the grid and 135 volts on the plate.

*(Continued on next page)*




**A short-wave battery-operated receiver, for speaker operation, using the minimum number of tubes, and plug-in coils. The socket connections are diagramed. The 30-S is a special short-wave type 30 tube of low internal capacity.**




**These circuits show three different methods of measuring the output power of a power amplifier. They are based on measuring the current through a known resistance or measuring the current through it and the voltage across it.**

(*Continued from preceding page*)

### Separate Oscillator or Pentagrid

I AM planning on building a short-wave receiver but am uncertain what kind of oscillator and mixer to use. I can use the 1A6 as mixer and oscillator both or I can use a 32 for mixer and a 30 for oscillator. Which would you recommend? Please give reasons for your choice.—S. E. T.

There is strong coupling between the two elements of the pentagrid, and it may be too strong for a short-wave set. There is no means of varying this coupling when the 1A6 is used for both functions. That is about the only reason for not selecting this type of mixer-oscillator in place of the two separate tubes. There is more fun in using two tubes when you can make separate adjustments with the object of making improvements in the performance.

* * *

### Choice of Intermediate Frequency

WHAT happens when the intermediate frequency of a broadcast superheterodyne is in the broadcast band? Would it be possible to receive all the stations clearly or would there be some that could not be received?—B. F.

The intermediate frequency would be with a few signal frequencies and make clear reception of them impossible. You no doubt have operated a receiver in which the intermediate frequency was one-half of some broadcast frequency. There is a strong squeal on that frequency. If the intermediate were equal to this frequency the intensity of the squealing would be many times greater. It is bad enough to have the second harmonic of the intermediate frequency beat with the signal. The reason intermediate frequencies like 456 kc are selected is that it is possible to avoid the squealing. The harmonic of this frequency is 912 kc. This is very close to the 910 kc channel but it is possible to detune the circuit sufficiently to receive this station clearly without appreciable loss in sensitivity. The third harmonic of the intermediate is 1,368 kc. which is close to the 1,370 channel, but as before the squeal can be avoided.

* * *

### Measuring Output

WILL YOU KINDLY explain how the output of various kinds of amplifiers can be measured with the aid of a universal meter which measures both voltage and current?—W. N. O.

In the figure above are three different circuits. In the first the output is delivered to a resistance R through a very large condenser C. R should have the value specified as the optimum load resistance of the tube. If the meter M measures alternating current, the output power is the product of the resistance R and the square of the current in amperes as read on the meter. Your universal meter probably does not measure the current so in this case the instrument should be a thermocouple or a hot wire instrument. In the second figure the output is delivered through the load through a step-down transformer. The variable resistance R should be adjusted to such a value that the tube looks into a resistance equal to its optimum load. What R should be depends on the step-down ratio. It should be the optimum load resistance divided by the square of the ratio. Of course, R should be less than the load resistance. The power as before is the product of R and the square of the current. This also requires a thermocouple or hot wire instrument, unless a step-up transformer is used such that the current is less than one milliampere, which can be measured with the universal. When the ratio is known the current can be obtained from the indicated voltage and the power is the current squared multiplied by the resistance. In this case you have to take the total resistance, including that of the meter. The third figure is similar but the current is measured with one meter and the voltage across the resistance by another. The power is the product of the voltage across the resistance and the current.



## NBC Museum Houses Relics Large and Small

Radio's history is graphically depicted in the National Broadcasting Company's new Radio City headquarters, where relics of the early days of broadcasting are surrounded by the most up-to-date facilities.

With the idea in mind of establishing a permanent radio museum, NBC has gathered together an extensive collection of early broadcasting equipment, which contrasts vividly with the modern wonders on view in the main control room of Radio City.

In the collection are odd radio tubes from all parts of the world, ranging from some as small as a thumb joint, to 100,000 watt bulbs. The first loop ever used instead of a receiving antenna also is included in the collection, which is housed in the lobbies of the mezzanine, fourth and fifth floors.

Also on view are an OP-3 amplifier, a portable pick-up amplifier which was used at WJZ in 1924, original experimental television apparatus and a fourteen coil "mixer" used in the first grand opera broadcasts with a large number of different microphone pick-ups.

The microphone section of the exhibit is of unusual interest. There is the original "globe" microphone, bigger than a basketball: early carbon mikes, the huge six-foot parabolics, and the small and trim ribbon velocity microphones which are the very latest development.

In addition to the equipment exhibited, both old and new., there is a large collection of photographs.

# The Review

## *Questions and Answers Based on Articles Printed in Last Week's Issue*

### Questions

1. In the measurement of alternating currents, if the current to be measured is no smaller than about 5 milliamperes, what type of instrument is commonly used?

2. What is the limitation of a rectifying type meter in the measurement of alternating current, so far as frequency is concerned?

3. Name and briefly describe two instruments not previously mentioned in your answers that will measure small alternating currents.

4. Briefly state how small differences in distances may be measured with the aid of a vacuum tube.

5. What is a multivibrator?

6. What are the advantages of a stage of tuned radio frequency amplification ahead of the mixer in a superheterodyne?

7. Describe what bandspread is as popularly employed and state by what means it is worked.

8. Why can as many stations normally be received with a set that has six or seven tubes, as with a set that has, say, ten or twelve tubes?

9. Does the practical sensitivity increase with increased length and height of the antenna, or does it decrease, and state why?

10. What is the transposed leadin, on what principle does it work, and state two specific applications.

11. Does automatic volume control eliminate fading? If so, why? If not, why not?

12. If shielded wire is used on the overhead grid leads of the r-f section of a superheterodyne, or at radio frequencies in a t-r-f set, and the grounded sheath is close to the conductor wire, what may be the effect on frequency coverage, and why? State a remedy.

13. How does the pentode tube as output compare with the triode?

14. State how the 55 may be circuited to be able to put out more without approaching saturation.

15. Does automatic volume control have an effect on frequency? If so, at what level is the effect least?

16. In general, for broadcast band coverage, should the minimum capacity of the oscillator circuit be greater or less than that of the signal level circuits, by about how much, and why?

17. State the formula for obtaining the value of the padding condenser for an oscillator, when the maximum capacity of the tuning condenser is known, and the desired resultant capacity also is known, that is, the effective resultant capacity after the unknown padder is inserted.

18. As the bands of frequencies to be tuned in increase in a multi-range set, what is the requirement of the oscillator capacity range?

19. Which is more sensitive, diode biasing or bleeder biasing or biasing due to plate current of the biased tube passing through a resistor?

20. How are meters converted to megacycles and megacycles to meters?

### Answers

1. A thermocouple is commonly used for measuring alternating currents of about 5 milliamperes and more. The thermocouple consists of two dissimilar metals through which the current is passed, causing heat to be generated at the junction, and this causes electric current to flow through a d-c meter that is in parallel with the junction.

2. The rectifying type meters are good for frequencies up to about 30 kc. but for higher frequencies the error becomes too great to make the meters of any practical use in determining absolute values.

3. The balometer bridge and the Duddell thermo-galvanometer will measure small alternating currents. The Duddell instrument is expensive. The alternating current heats a platinum wire. A strong permanent magnet is used, as on any galvanometer, and between the poles is a single loop of silver wire having practically no resistance. A small mirror is attached to the loop for indication. The heat principle is used. The balometer bridge consists really of three bridges, so balanced that when a-c is applied to one leg it flows through the four branches of the secondary bridge. The wires constituting the bridge will heat up and change their resistance. A d-c voltage applied to another leg restores balance. The d.c. is equal to the effective (rms) value of the a.c. flowing in the secondary bridge.

4. If an oscillator is constructed, and a small condenser is put in parallel with a larger one, the small one having a plate movable to and from the fixed plate, small differences in distance can be accurately measured by noting the resultant change in frequency.

5. A multivibrator is a two-tube circuit coupled by resistances and capacities in such a manner that it will oscillate. Also, it is very rich in harmonics. All frequencies may be covered.

6. It has several advantages. First, it makes the set more sensitive by the use of one more high-gain tube and one more tuner where the signal voltage is stepped up. Second, it makes circuit more selective, thus excluding more external noise as well as all stations not desired at the moment. It is in respect to the second point where the extra tuner is essential, for if there is not a high selectivity in the radio frequency level, frequencies which cause heterodyne whistles would come through to the mixer and hence cause much squealing in the loudspeaker. This squealing is usually attributed to harmonics. A tuned radio frequency stage is the best preventive.

7. The bandspread is a method of covering a smaller band of frequencies, so that there will be greater spreadout on the dial for the frequencies that are covered, and tuning will be easier. It is applied to frequency spectra where otherwise there would be considerable crowding. The method applied is to cut in parallel variable condensers, thus reducing the capacity ratio (maximum divided by minimum) and reducing the frequency ratio.

8. Multi-tube receivers with modern trimming such as squelch control and automatic volume control have these advantages at the expense of sensitivity, hence if the compensation by extra i-f and audio gain is not equal to the sacrifice, a set with fewer tubes will do as much, though not quite in the same manner.

9. The practical sensitivity increases as the antena height or length is increased as this is equivalent to increasing or tightening the coupling.

10. A transposed leadin consists of bringing down two wires instead of one from the roof. Wire A is the regular lead connected to aerial as usual, and in the house the other end of this same wire is connected to the antenna post of the set. Wire B at the roof is soldered to the most appropriate ground connection there, or to a ground clamp attached to a standpipe that connects to the cold water system. The other end of this wire is connected to the ground post of the receiver in the home, and to this ground post also is run a wire from the cold water pipe in the house. However, the two wires are crossed several times on the way down. One way of introducing this system is to use a-c twisted pair cable. Thus very numerous twists are automatically introduced. Another is to use transposition blocks (insulators) with individual wires crossed at the blocks.

11. Automatic volume control may reduce fading a bit, where it is present on a fairly strong station, but does not eliminate it. Since the worst trouble from fading occurs on very weak stations, there is little if any correction due to a.v.c., as the rectified signal voltage on which a.v.c. depends is too small to be material.

12. Closely-shielded wire on overhead grids introduces a high capacity to ground and therefore may result in failure of a set to attain the higher frequencies of the tuning band. A remedy would be to use shielded wire that has a thick cotton covering over the internal conductor, so that the capacity between the grounded sheath and the inside conductor is small.

13. The pentode is much more sensitive than the triode, but does not quite come up to the triode in quality.

14. The plate voltage applied to the 55 may be increased considerably above 250 volts, provided the plate load resistor is 0.25 meg. or somewhat higher. If the B choke is in the positive leg, the plate or the 55 may be returned through two series resistors to the rectifier filament, a condenser of 8 mfd. connected between joint of the resistors and ground. The extra resistor should be around 50,000 ohms.

15. Yes, since automatic volume control changes the bias, it changes the frequency, for resistance is a factor in frequency determination, and change in bias introduces a change in plate resistance. The effect is of least importance at the intermediate level.

16. The minimum capacity of the oscillator should be greater by about 8 to 10 mmfd. because the capacity curve of the oscillator crosses that of the r-f level for tracking.

17. The formula for obtaining the series padding capacity is as follows:

$$Cx = \frac{C1 \times C2}{C1 - C2}$$

where Cx is the unknown series capacity and C1 and C2 are the maximum capacity of the tuning condenser and the effective capacity when the unknown is included in the series circuit. C2 is always the smaller of the two.

18. The oscillator capacity range more closely approaches that of the r-f or signal level capacity range for higher frequency bands, because the difference between the two circuits becomes a smaller and smaller percentage. Finally the difference is usually so small at the highest frequency band in a multi-range receiver that it may be neglected.

19. Diode biasing is most sensitive, bleeder biasing comes next, and cathode-resistor-drop biasing is next.

20. Divide 300 by either and you get the other. That is, if you have a wave of 5 meters, you have a frequency of 300/5, or 60 mega-cycles. Or if you have a frequency of 20 megacycles you have a wavelength of 300/20, or 15 meters.

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## Early Ordering for Christmas Advised, Supply Is Limited

To those who figure on making this Christmas a radio one it will be a good policy not to wait too long. While most of the radio mail order houses are in excellent position to take care of immediate orders, one can never tell exactly just how the transportation agencies are going to be pushed on late deliveries. It looks like a big year, so get that order in early and if all the money is not available, send along what you can. The balance you can have shipped C.O.D.

# Station Sparks

## *By Alice Remsen*

### SOMETHING FOR NOTHING

A third network—rumors regarding which have been prevalent for some time—is now an actual fact. The Federal Broadcasting Company, operating Station WMCA, New York, is feeding programs from its home studios to three out-of-town stations—WIP, Philadelphia, W P R O, Providence, and WHDH, Boston—with a considerable line-up of stations coming in very shortly. It is probable that the network will extend to the Middle West, and even to the Pacific Coast, for WMCA has very strong financial backing definitely interested in radio. . . . The sustaining programs now being heard over WMCA are reported to have talent that looks for payment only if a sponsor is obtained. This is something I cannot understand, since WMCA has such high financial backing. The artists have difficulties performing without compensation.

### BYRD BROADCAST IMPROVES

Listened again to the Byrd broadcast; the second came over better, but still was almost indistinguishable in spots; nevertheless, a most marvelous demonstration of the power of radio to eliminate distance, it was the more interesting to me because I am re-reading that epic of the Arctic, "Thirty Years in the Golden North." . . . Very glad to know that my old friend, Seymour Simmons, is now featured over a WABC-Columbia network on a program sponsored by the Sparks-Withington Company; the program emanates from Detroit, Seymour's home town; each Saturday at 8:30, with the beautiful Dorothy Paige as the featured vocalist. . . . Del Campo, the new Columbia tenor, is a Chilean; his full name is Francisco Flores del Campo; the young man, he is twenty-six years old, has created a stir in the musical world, and his voice presages a great artistic future; he may be heard over a WABC-Columbia network each Friday at 5:15 p.m. and Tuesdays at 7:30 p.m.; he is accompanied by Freddy Rich's orchestra. . . . Another new series on Columbia marks the return to the air of those clever comedians, Colonel Stoopnagle and Budd; Wednesdays and Saturdays at 9:15 p.m.; sponsored by the Pontiac Division of General Motors. . . . Guy Lombardo now has two pianists in his band. The latest addition is Hugo D'Ippolito, who will share honors with Freddy Kreitzer. . . .

### COLUMBIA'S NEW ANNOUNCER

Another announcer from below the Mason-Dixon line has joined the staff of Columbia; he is Bill Randol, of Baltimore; Bill came to New York in an endeavor to sell a script act, instead of which he sold himself, which isn't such a bad idea. . . . Tell me, is there such a place as Oologah, Oklahoma? And have you heard "The Voice of America" show over WABC and Columbia network? Sponsored by the Underwood-Elliott-Fisher Company and featuring Alex Gray, Patricia Dorn, Donald Burr, Professor William Lyons Phelps and Nat Shilkret's Orchestra; every Thursday night at 8:30 p.m. . . . The first broadcast ever to be attempted from India to the United States is scheduled for December 13th over WABC and Columbia outlets, at 7:00 a.m.—if you get up that early; the program will be produced by the British Broadcasting Company and relayed by them to America by short wave. . . . The Tony Wons-Keenan and Phillips program has a schedule change; it may now be heard every Tuesday and Thursday at 11:30 a.m., WABC and network. . . . Tony will be heard by himself on Monday at the same time. . . . Fred Waring has bought himself a superb twelve-room house in Bronxville, New York; it is the first home he has ever owned, having lived in a suitcase from hotel to hotel ever since he can remember; Fred has domiciled his bride, the former Evalyn Nair, in the new home, and now Evalyn is busy superintending the cook, housemaid and what-have-you . . . Marion Hopkinson owns the "Mrs. Roosevelt Ghost Voice" heard on the March of Time series. . . . The hair of Don Voorhees is always in his eyes when Don is waving a baton. . . . Connie Gates is very shy. . . . Jacques Renard is really losing weight. . . . Another new "find" is ten-year-old Judy Talbor, of Chicago; Judy was "discovered" by the combined radio editors of Chicago's newspaper world and recommended for an audition; now she is heard over Columbia networks. . . . Eddy Duchin is back on the Columbia air-waves; he is at his old stamping ground, the Central Park Casino in New York, and may be heard on three late spots over WABC and network. . . .

### WOR DOING WELL, THANK YOU

Station WOR, Newark, New Jersey, with studios also in New York, has its share of commercial programs this season and plenty more in the offing after the first of the year. This station is a fifty-thousand-watter and covers considerable territory. . . . Basil Ruysdael is still philosophizing on the Red Lacquer and Jade programs over WOR at 6:00 p.m. each Sunday night; This is a very colorful and worthwhile program. . . . Another of this station's most popular Sunday programs is The Choir Invisible, a George Shackley presentation, on which Louise Smith "subbed" for Veronica Wiggins recently, when the latter was too ill to sing. . . . If you have wondered what became of Ralph Wentworth, who was at one time one of NBC's star announcers, I can tell you that he has been very busy making electrical transcriptions, and is also doing freelance announcing; one of these jobs is on WOR each Thursday morning at 11:15 a.m. over WOR on the Radio School of Cookery. . . . Lee Cronican, who is not only an able announcer, but also a very fine classical pianist, will resume his recitals over WOR early in January, which is very good news. . . .

### THOSE CHAMPION COMMUTERS

Julia Sanderson and Frank Crummit call their home at Longmeadow, Springfield, Mass., "Dunrovin"—and when they named it they thought the title would really mean something to them—but they have not done rovin' by a long shot; in fact, they are the champion radio commuters—a four-hour motor ride to New York; two broadcasts, phonograph recordings, and then a four-hour ride back; only two days in the city, but their hearts are at home; the rest of the week is spent in the peaceful occupations of planting flowers, sitting on the sun porch, or bicycle riding down to the village, by heck! . . . Harry Breuer, of Erno Rapee's Orchestra, has invented a "whatchamacallit"; it is a rather complicated affair, and the only one of its species in existence; it is a combination xylophone-marimba-vibraphone. Henry needs a name for it that will not be quite such a mouthful for announcers; have you any suggestions? . . . why not xylomarbraphone! . . . And now we find out that Ed Smalle is a grandfather; his twenty-five-year-old daughter is the mother of a lusty four-year-old son! . . .

### ROMANCE IN NASHVILLE

There is a romance brewing down in Nashville, Tennessee, between those two young college kids—Ruth Carlin and Red Paris, Station WSM's two "R's" of harmony; too soon for congrats, but hope it's so! . . . Ruth Cornwall, author of the Death Valley Days stories told by the Old Ranger over NBC every Sunday evening, is always collecting odd local color stories; one in her collection is from a Barstow, California, newspaper and reads: "Bill Jarrett worked for six weeks on the graveyard shift for the Corpse Mining Company in the Coffin Mine located in Dead Man's Canyon in the Funeral Range at the edge of Death Valley. Bill leaves next week for a prospecting trip to the Devil's Playground in Hell's Half-Acre." . . . And if I don't get this copy to my editor very shortly I'll be heading for that sort of a trip myself, so here goes!

### A THOUGHT FOR THE WEEK

*IT'S A SHORT, SAD STORY! She's a nice young woman with an excellent voice, a fine stage presence and apparently stood an excellent chance of making good before the microphone. Audition time came around and she was ready at the studio to go on and "do her stuff." The orchestra leader raised his baton, the girl raised her voice—and while she started to sing one song, the orchestra played the accompaniment to another. She sang three or four bars before she discovered that the mike connection had been shut off. The representative of the possible sponsor came forward and said something heated about lack of co-ordination, careless rehearsing and other things. Milady grew red in the face, put on her wrap and walked out of the studio—and she hasn't been back since.*

*What would you have done?*

# BYRD'S RELAY FROM PACIFIC THRILLS FANS

Radio engineers combat hostile forces of distance and atmospheric interference in the broadcasts from the Byrd Antarctic Expedition over the Columbia network. The first program, while marking one of the few double relay short-wave broadcasts ever attempted, was also the first broadcast to originate from a ship more than 5,000 miles from the central receiving point. The following Saturday the distance was increased to 11,000 miles.

The ship Jacob Ruppert, tossing about in stormy weather in the southern Pacific Ocean, 5,800 miles from New York, was the origination point of the first broadcast. The signals were transmitted from the small 1,000-watt station, KJTY, aboard the ship, to a relay station in Buenos Aires and thence to the receiving station on Long Island. The time at the receiving end was 10:00 p. m., while the ship's time was 8:30 p. m.

### Studio Problems in a Storm

The storm, through which the ship was riding, gave Charles J. V. Murphy and John N. Dyer, the CBS men aboard, a bit of a problem in "studio" production. As Admiral Byrd said, when he started his brief talk:

"This ship is pitching and tossing so much, I'm having a hard job staying set before the microphone."

The noise of wind and water seeped into the mikes, and with current atmospheric conditions rather unfavorable, the reception of the signals in New York was rated at 40 per cent according to the CBS engineers, who expect to get anywhere from 100 per cent to zero reception during the weekly series from the expedition.

On this venture, involving transmission over a great distance with a sending station one-fiftieth the power of a regular network station such as WABC, the forces of nature combined to present one of the greatest obstacles a group of radio engineers has ever faced. A rapidly shifting heavyside layer injected a large amount of fading into the short-wave-realm.

Well before time to put the broadcast from the S. S. Jacob Ruppert on the air, attempts were made by New York to get in direct touch with the ship, but its signals could not be picked up well enough to rebroadcast. Therefore, the relay at Buenos Aires was employed. Taking into consideration the position of the ship at that particular time, a direct link would have been preferable.

### Risk in Double Relay

In a double relay there is always the disadvantage of getting a double "fade" in the signals. That is, if the signal from the ship to the relay point, Buenos Aires, should fade 20 per cent, and the signal from Buenos Aires to New York fades 20 per cent during 15 minutes of transmission, 40 per cent of intelligibility is lost. On the other hand, a 20 per cent fade in the ship to New York link still allows 80 per cent intelligibility. On the double relay, if both links fade at the same time, the entire signal may be lost. That is another one of the hazards the engineers have to face.

About 11:00 p. m., half-an-hour after the broadcast had been concluded, the signal was brought to New York directly from the ship with strength and clarity comparable to the best results achieved in many tests conducted during the weeks before the actual broadcast.

Another short-wave hazard faced by the engineers until the Byrd party arrives in Little America is the difficulty of broadcasting on an east and west line. North and south short-wave broadcasting, in experiments to date, has been more dependable.

When the expedition reaches Antarctica, the same transmitter now being used on the ship will send the signals north to Buenos Aires for relay to New York. The use of the Buenos Aires or other relay will be necessary then because of the 10,000 miles distance that separates Little America from the ultimate receiving station. In Little America, too, the transmitter will be equipped with its own directional antenna, pointed at Buenos Aires, whereas, at sea, it has had to depend on an ordinary ship's antenna, subject to the absorption characteristics of the ship's funnel and other metal parts. The tests to date, according to the engineers, have been remarkable when these factors are taken into consideration, and the excellent results have led the most hard boiled among them to admit that most of the books already written about short wave transmission will have to undergo revision.

The ship is moving away from the receiving antennas at the rate of 230 miles a day, and by the time of the next broadcast it will have opened enough additional space to make the venture still more interesting. Engineers will continue to try again to pick up the S. S. Jacob Ruppert direct instead of through the Buenos Aires relay.

### The Second Program

The second broadcast used a relay system by way of Honolulu. Results were better, though static was plentiful. One of the scientists with the expedition, Dr. Thomas C. Poulter, had an electroscope aboard, and put the rat-tat-tat of cosmic rays on the air. Despite its scientific interest, this sounded like just so much more static. It is believed the cosmic rays are stronger at the Poles due to deflection causing concentration, and thus the expedition vies with such stratosphere scientists as Auguste Picard, Lieut. Commander T. W. G. Settle and Maj. C. L. Fordney.

Byrd told of the tossing of the ship and of plans for a base at the edge of the ice plateau, the base to be as far from Little America as "Chicago is from Washington."

Great interest is being shown by listeners in these weekly broadcasts, which are sponsored. Saturday at 10:00 p.m. EST, 9:00 CST, 8:00 MST, 7:00 PST is the time to tune in on the Columbia station you get best.

## KYW Gets Final O. K. to Move to Philadelphia

Washington.

KYW, Westinghouse station long prominent for its transmissions from Chicago, finally has been granted corroborated permission to move its transmitter to Philadelphia, although under restrictions to minimize the interference with New York stations. The station operates on 1,020 kc, at 10,000 watts. The New York stations on 1,010 kc, the adjoining channel, are WHN, WPAP, WQAO and WRNY, all 250 watts. There are no stations in or about Pennsylvania, New York or New Jersey on 1,000 or 1,030 kc.

The dispute concerning the 1,020 kc channel has been of long standing, and the Federal Radio Commission, which has granted the authority for the removal, has been considering the case for more than a year.

Directional broadcasting will be employed by KYW from its new transmitter, just outside of Philadelphia, so as to avoid interference to stations in New York City.

# NEW NETWORK BEING FORMED BY M'CLELLAND

The resignation of George F. McClelland as vice-president and general manager of the National Broadcasting Company was followed by his announcement that he was forming a new chain. It is expected that there will be an outlet in every State, with numerous stations in some of the more thickly populated states.

Under the plans of Mr. McClelland, who is a radio executive of long experience in large affairs of broadcasting, each member station will be independent, and will be recompensed for the actual expenses it defrays in sending out a chain program. The chain itself will be of the mutual type of business institution, whereby the profits of its operation will be distributed to the member stations on a dividend basis, much in the manner of the mutualized life insurance companies.

An announcement is expected any day of the officers and directors of the new chain, as well as of the name, which is something to which special attention has been given.

The legal work of organizing the chain is being undertaken by Joseph Schultz, a well-known New York lawyer of large corporation practice. One of the points to be stressed by the chain is that commercial credits, as the trade announcements on sponsored programs are called, will be decidedly curbed. Part of the programs will deal with news broadcasts.

In general the scheme for programs is expected to follow that successfully used by the National Broadcasting Company and the Columbia Broadcasting System.

Mr. McClelland entered broadcasting as commercial representative of WEAF about ten years ago and was intimately connected with the progress of NBC and an important official in many of its most ambitious undertakings. He has been vice-president and general manager since 1926, when NBC bought WEAF.

## Concentration on Ground Wave Improves Radiation

DX-ers in New Zealand, and Newcastle-on-Tyne and Birmingham, England, have picked up programs from WBNX, N. Y. City, 1,350 kilocycles, in the past month, it was revealed recently by Dr. Herbert Wilson, consulting engineer for the station. The reception was so good at Newcastle-on-Tyne that the DXer was able to make a recording of the program as it came over.

"The ability of any station to be picked up at great distances depends on the construction of the antenna and the counterpoise," Dr. Wilson said. "The fact that WBNX, operating with only 250 watts and on a broadcast frequency, could be picked up in those out-of-the-way places is perfect evidence of that fact.

"In the past month we have added a new type of antenna with a strong ground wave to radiate the maximum power. Our output circuits are perfectly matched and the transmission line is of special construction to insure the widest coverage and strongest signal. Since we have constructed this new antenna our signal strength has increased 80 per cent," Dr. Wilson held.

The ground wave, as now defined, is that part of the total wave that travels close to the ground, i. e., the horizontal component, and does not mean the wave that enters the ground, which is rapidly dissipated.

## Izenstark is Victor in Suit Over Vision Venture

An echo of the halycon days when Charlie Izenstark, of Chicago, was an enormous buyer of distress merchandise, and sought to branch out into television, was heard in the Supreme Court, White Plains, N. J., when a jury before Justice Horton decided in Izenstark's favor in a $50,000 suit.

Joseph B. Ferguson, of Flushing, N. Y., sued for that amount, charging that he had rendered services in connection with the transfer of patent rights in this country by the Baird Television Development Corporation and Television, Inc., concerning the patents of the Scotchman, John Logie Baird.

Ferguson said that he made a few trips to England at Izenstark's solicitation, that he actually brought about a transfer of the patents as affecting rights in this country, but that he had never been paid.

## RCA Flag Flies Atop 70-Story Building

The highest flag in New York City, and probably the highest flag above ground level in the world, was raised over the 70-story RCA Building, the central structure of Radio City and Rockefeller Center.

The flag is the house emblem of the Radio Corporation of America, carrying the RCA monogram in white on a field of red surrounded by a blue border. It flies 890 feet above Rockefeller Plaza.

### Literature Wanted

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

Wm. Mimna, Radio Shop, 2864 Broaday, New York City.
Ernest F. Kronewitz, 727 Lawn Drive, Lovers Pk., Rockford, Ill.
Philip Porter, 2227 Arapahoe St., Denver, Colo.
Robert Colman, Owner. Gold Radio Service, 2831 Prytania St., New Orleans, La.
R. M. Douglas, 4410 Chesapeake St., N. W., Washington, D. C.
Sherzer's—Radio, 395 93rd St., Stoneharbor, N. J.
Charles V. Kase, 363 Washington Ave., Belleville, N. J.
Aaron Krasnoff, 42 Lincoln St., Webster, Mass.
N. M. Mackenzie, 16½ So. Main St., Barre, Vermont.
Howard W. Avery, M. E., Onondaga Road, Skaneateles, N. Y.
Theodore F. Harrison, Radio Serviceman, 148 High Street. Pawtucket, R. I.
F. T. Thomas, Proprietor, Automobile Accessories, Tires and Radios, Hecla, So. Dak.
Oscar W. Johnson, 152 Grant St., Portland, Maine.
John Henderson, 21 N. Walter Ave., Trenton, N. J.
R. P. Strassburger, 2041 So. Bonalone St., Philadelphia, Pa.
E. M. Allen, c/o N. Y., N. H. & Hartford R. R. Co., Waterbury, Conn.
John Skov, c/o Standard Oil Co., Albert Lea, Minn.
W. Chas. Sachse, 3437 Pierce Ave., Chicago, Ill.
Leo Freni, 1241 Wolf St., Phildelphia, Pa.
John Lord, 2305 Pearl St., Jacksonville, Fla.
W. K. Parker, 1317 Penna Ave., Dallas, Tex.
Gordon Ashley, Lexington, Miss.
E. H. Mackinlay, 6001 Pickford St., Los Angeles, Calif.
Mack's Radio Shop, Leon A. McFarlane, 1108 5th Ave., South. LaCrosse, Wisc.
W, R. Smith, 2140 Walton Ave., Pittsburgh, Pa.
H. D. Smith, 323 East Lake Drive, Sta. E., Atlanta, Ga.
George Peterson, Armour and Company, Union Stock Yards. Chicago, Ill.
Frank H. Farrington, Radio Sales & Service, Wilmington, Vermont.

### CORPORATION REPORTS

Weston Electric Instrument Corporation and domestic Subsidiary—Net loss after depreciation, taxes, and other charges, for the nine months ended Sept. 30, 1933, $70,065. compared with net loss last year of $129.239. Net profit after deduction of the same charges, for the quarter ended Sept. 30, 1933, $9,121 which equals 24 cents a share on 37.400 no par Class A shares, against net loss of $31.888 in preceding quarter and $29,-785 loss in third quarter of 1932.

# TRADIOGRAMS

*By J. Murray Barron*

Radio City Labs., 30 Rockefeller Plaza, in Radio City, New York City, announces the release of its all-wave receiver. In this set will be found a number of new ideas. Literature is available.

* * *

At the last meeting of the New York Chapter of The Short Wave Club, held at the Stuyvesant High School, Fifteenth Street and First Ave., New York City, a large number of the hams and short-wave fans showed up. It is the purpose to introduce through the Winter many novel and instructive ideas for the benefit of the members and guests to develop interest in short-wave reception. Code lessons are given at these meetings, also a series of lectures on the whys and wherefores of radio by Sol Perlman, E.E. He demonstrates from time to time various gadgets for the improvement of radio reception.

* * *

Thor's Bargain Basement, 167 Greenwich Street, N. Y. City, announces that Eddie Downey has joined the staff in the repairing and servicing department. There are few men in the Metropolitan area that have the knowledge and all-round experience with all types of radio receivers than Downey. In the retail department the organization is stocking replacement parts for the Mallory-Elkon B Eliminator and also Philco replacement parts. A 5-amp. mercury Tungar General Electric charger is featured for car owners who desire to charge the batteries.

* * *

An interesting conversation was overheard the other day at the Hammarlund-Roberts set department about the Comet Pro shortwave receiver. A woman had purchased one of the complete outfits from a retailer and had made the visit to the laboratory of Hammarlund-Roberts, at 424 West Thirty-third Street, New York City, and complained that she only received England, Germany, France and Spain during the day. Oh yes, she received these well, but why not Australia and Russia and so forth?

* * *

A visit to the radio stores this season shows a most complete array of receivers, all models and combinations. Never before could one buy so much for his dollar. The mail order houses are also listing a wide choice of receivers, kits and equipment with prices low. Those who figure on making this a radio Christmas should get an early start. Perhaps the set needs new tubes, or if you have an external speaker, give the folk a treat and buy a new one, or how about that small extra set for brother, or upstairs or in the den? If the old folk are alone why not cheer them up with a surprise set? It's a wonderful time now to make radio gifts and the program will be fine and dandy during the long winter evenings that are ahead. A big new idea to most folk this year is short-wave radio. And what a thrill! Reception from all over the world! England, Germany, Spain, France, South America and the far East! But better still, there is that great satisfaction of pulling in the mysterious voices from lands afar. Learn the customs of the other fellow.

The displays of sets for Christmas are extensive in shops throughout the country and the offerings are attractive in price and performance.

* * *

Solar Manufacturing Corporation, 599 Broadway, New York City, manufacturers of fixed condensers, announces the appointment of sales representatives as follows: H. W. Burwell, 143 Le Bron Avenue, Montgomery, Ala. L. H. Jackman, 2043 East 77th Street, Cleveland, O., and Howard P. Hardesty, 356 East Grand Boulevard, Detroit, Mich.

* * *

A 43 power pentode tube that operates in 13 seconds has been announced by the Arcturus Radio Tube Company, Newark, N. J. This is in comparison with forty to sixty seconds and more. John Glauber, chief engineer, said: "A slow-heater draws no plate current and has a low filament resistance, until the tube is completely heated. Inversely, a quick-heater reaches the value of hot or high filament resistance in a shorter time. Consequently, a slow-heating, low-resistance type 43 diverts much of its applied voltage, which is divided among the other tubes in series. This results in overload and tends to burn out the other tubes much more quickly than would normally be the case."

# Closer to Profits

Radio manufacturing companies are beginning to show improved financial reports. Some of the set makers are now able to report a profit. Others in this group, as well as in the parts and instrument fields, show profits for the third quarter, although for nine months the net result may still be a loss. Nevertheless the trend is unmistakable, and the upswing is most important, since it comes at a critical time beyond which many concerns scarcely could continue doing business.

The general rule of losing money in the operation of a business, noted in practically all corporation reports for the past few years, has resulted in increased indebtedness. Only very imposing corporations with surpluses could draw on these reserves to tide them over, but in the radio field the surplus has been something to wonder at, and the consumption of capital to defray running expenses has created a large percentage of debt.

It is therefore to be expected that the radio group will consider itself a debtor class, and as such favor some form of inflation, since the idea behind inflation is to deny the creditor 100 per cent. payment as an actuality, and let him take the same number of dollars in payment, but in dollars that will buy approximately half.

The burden of debt carried by individuals, corporations, firms and partnerships is more than will be paid in full anyway, for in that sense the debtors are insolvent. What form the concealment of the biting fact will take has not yet been announced, but from the activities at Washington it may be expected that inflation of a subdued rather than extreme type will be instituted as an acknowledged fact. The equivalent of inflation has been going on since last April, when we went off the gold standard, and the administration encouraged the gradual reduction in the purchasing power of the dollar in domestic and foreign markets.

Superior American workmanship in receiver manufacture, plus large-scale production possibilities, increased interest in the export market, and with a cheaper dollar more exports are expected. Following the abandonment of the gold standard general exports unexpectedly declined, but since then have risen sharply, to the 1931 level, consistent with economic theory. Debts owing by American importers to foreign factors are accumulating, the creditors seeking American merchandise they can buy, as they can not afford to change the devalued dollar into the currency of their own country without taking a big loss.

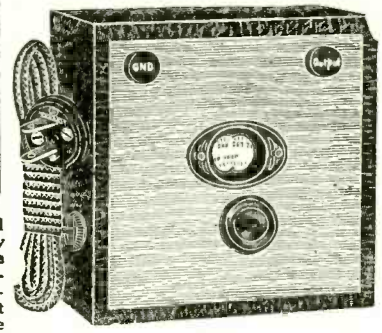
So American exporters, with business on the upgrade, swell the ranks of the opportunists and hope for even a cheaper dollar.

# Valuable Gifts with Subscriptions for RADIO WORLD

## A *NEW* TEST OSCILLATOR

### That Works A.C., D.C., or Batteries!

SHOWN ONE-THIRD ACTUAL SIZE



A NEW TEST oscillator, Model 30, has been produced by Herman Bernard, so that all the requirements for lining up broadcast receivers, both tuned radio frequency and superheterodyne types, will be fully and accurately met. This device may be connected to 90-120-v a.c., any commercial frequency, without regard to polarity of the plug, and will function perfectly. It may be used also on 90-120-volt d.c. line, but plug polarity must be observed. One of the plug prongs has a red spot, denoting the side to be connected to positive of the line. If you don't know the d.c. line polarity, you may connect either way, without danger. The oscillator will work on d.c. only when the connection is made the right way. Moreover, 90 volts of B battery may be used instead of either of the foregoing, simply by connecting two wires between the plug at the batteries, observing polarity. No separate filament excitation is required. The oscillator is modulated with a strong, low note under all circumstances. It uses a 30 tube.

THE dial of the Bernard Model 30 Test Oscillator is directly calibrated in kilocycles, so there is no awkward necessity of consulting a chart. The fundamental frequencies are 135 to 380 kc, so that nearly all commercial intermediate frequencies as used in present-day superheterodynes are read on the fundamental. The points for other intermediate frequencies, e.g., 400, 450, 456 and 465 kc, are registered on the dial also, two harmonics, with which the user need not concern himself, being the basis of these registrations. Besides, the broadcast band is taken care of by the fourth harmonic and the dial is calibrated for that band, also.

The divisions on the dial for the fundamental band, 135 to 380 kc, are 1 kc apart from 135 to 140 kc, 2 kc apart for 140 to 180 kc and 5 kc apart for 180 to 380 kc. For the broadcast band, 10 kc apart from 550 to 800 kc, 20 kc apart from 800 to 1,500 kc.

The test oscillator may be used also for short waves, by resorting to higher harmonics.

*Over-All Size Is Only 5x5x3"! Dial Reads Frequencies Directly!*

Send $12 for 2-year subscription for RADIO WORLD and order Cat. BO-30 sent free, with tube (prepaid in United States and Canada).
Another model, BO-30-S, same as above, except frequencies are ten times as high, hence instrument is for short-wave work only, is available on same basis.

## 540-4,500 kc Tuning Units

The Tuning Units consist of a four-gang 0.00046 mfd. condenser, with trimmers on it, 3/8-inch diameter shaft, 1 1/8 inches long, mounting spades, condenser closing to the left; and a set of four shielded coils. The condenser is the same for tuned radio frequency sets or superheterodynes, but for superheterodynes a series padding condenser is supplied also. For t-r-f sets the four coils are alike. For supers three coils are alike and there is a different coil for the oscillator, with a selection for 175 kc, 456 kc or 465 kc intermediate frequency.

For t-r-f construction, three stages of t-r-f and tuned detector input, four equal shielded coils, tapped for the police band and properly matched to the tuning condenser which is supplied also. Order Cat. TRFTU, which will be sent free, postpaid, on receipt of $10.00 for 86-week subscription for RADIO WORLD (86 issues).

For superheterodyne construction, two stages of t-r-f, tuned oscillator and tuned input to modulator, three identical coils and an oscillator coil, with the proper padding condenser and the four-gang condenser, are supplied as noted below:

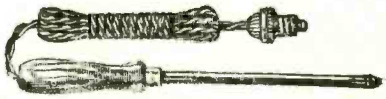
**175 kc**—For use with 175 kc intermediate frequency. Unit includes four-gang condenser, three r-f coils, the proper oscillator inductance and 800-1,350 mmfd. padding condenser. Send $12.00 for two-year subscription and order Cat. SUTU-175, which will be sent postpaid.

**456 kc**—For use with 456 kc i.f. order Cat. SUTU-456. Padding condenser is 350-450 mmfd.

**465 kc**—For use with 465 kc order Cat. SUTU-465. Padding condenser is 350-450 mmfd.

Those desiring to use the short-wave feature will want a switch, which is sold outright and separately. This is a long switch that has sections very close to where the wiring would have to be, and thus insures short leads. The switch is Cat. 4GSW @ $2.25 postpaid.

## SOLDERING IRON



A reliable soldering iron of 40-watt capacity, suitable for radio work, and equipped with a long cable and a snappy plug. This iron may be used in either alternating current or direct current, 85 to 135 volts. It is a serviceable iron and has stood up well, as we have been offering this iron for three years and have yet to receive a complaint about its value and dependability. Send $2.00 for 16-week subscription for RADIO WORLD, order Cat. SO, and get this soldering iron free (postpaid). Please remit with order.

## "The Inductance Authority"

### By EDWARD M. SHIEPE, B.S., M.E.E.

THE ONLY BOOK OF ITS KIND IN THE WORLD, "The Inductance Authority" entirely dispenses with any and all computation for the construction of solenoid coils for tuning with variable or fixed condensers of any capacity, covering from ultra frequencies to the borderline of audio frequencies. All one has to do is to read the charts. Accuracy to 1 per cent. may be attained. It is the first time that any system dispensing with computation has achieved such very high accuracy and at the same time covered such a wide band of frequencies.

A condensed chart in the book itself gives the relationship between frequency, capacity and inductance, while a much larger chart, issued as a supplement with the book, at no extra charge, gives the same information, although covering a wider range, and the "curves" are straight lines. The condensed chart is in the book so that when one has the book with him away from home or laboratory he still has sufficient information for everyday work, while the supplement, 18 x 20 inches, is preferable for the most exacting demands of accuracy and wide frequency coverage.

From the tri-relationship chart (either one), the required inductance value is read, since frequency and capacity are known by the consultant. The size and insulation of wire, as well as the diameter of the tubing on which the coil is to be wound, are selected by the user, and by referring to turns charts for such wires the number of turns on a particular diameter for the desired inductance is ascertained.

There are thirty-eight charts, of which thirty-six cover the numbers of turns and inductive results for the various wire sizes used in commercial practice (Nos. 14 to 32), as well as the different types of covering (single silk, double silk, single cotton, double cotton and enamel) and diameters of 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 3/4, 2, 2 1/4, 2 1/2, 2 3/4 and 3 inches.

EACH turns chart for a given wire has a separate curve for each of the thirteen form diameters.

The two other charts are the tri-relationship one and a frequency-ratio chart, which gives the frequency ratio of tuning with any inductance, when using any condenser the maximum and minimum capacities of which are known.

The book contains all the necessary information to give the final word on coil construction to service men engaged in replacement work, home experimenters, short-wave enthusiasts, amateurs, engineers, teachers, students, etc.

There are ten pages of textual discussion by Mr. Shiepe, graduate of the Massachusetts Institute of Technology and of the Polytechnic Institute of Brooklyn, in which the considerations for accuracy in attaining inductive values are set forth. These include original methods.

The curves are for close-wound inductances, but the text includes information on correction factors for use of spaced winding, as well as for inclusion of the coils in shields. The book therefore covers the field fully and surpasses in its accuracy any and all mechanical aids to obtaining inductance values.

The publisher considers this the most useful and practical book so far published in the radio field, in that it dispenses with the great amount of computation otherwise necessary for obtaining inductance values, and disposes of the problem with speed that sacrifices no accuracy.

The book has a flexible colored cover, the page size is 9 x 12 inches and the legibility of all curves (black lines on white field) is excellent.

Send $4.00 for 34-week subscription for RADIO WORLD and order Cat. PIA sent free, with supplement, postpaid in United States and Canada.

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

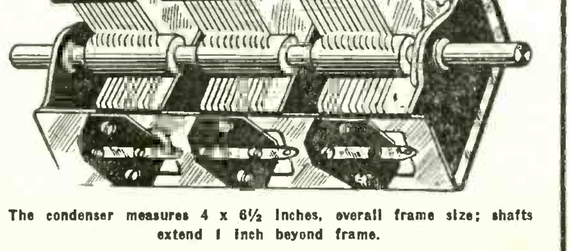
## What Radio World Is

RADIO WORLD, now in its twelfth year, is a weekly periodical devoted to the scientific side of radio, and presenting accurately and promptly all the news of the latest developments and circuits in radio, for broadcast and short-wave frequencies. Receiver and test oscillator construction are featured in its varied aspects. Testing in all its branches is given authentic and extensive treatment. Not only how to build, but how to measure what you've built, are featured regularly, and all receiver and test oscillator construction includes coil-winding data, if the coils possibly can be wound at home or in the ordinary laboratory or shop. Articles by leading authorities are augmented by carefully-checked station lists. A subscription for RADIO WORLD is one of the first requisites for the service man, home constructor, experimenter, student and teacher. Leading schools and laboratories subscribe for it and you will be in excellent company. Send in your subscription NOW.

## An Extraordinary Bargain!

### Three-Gang Condenser FREE with 13-week Subscription @ only $1.50

THE highest grade commercial gang condenser made, die-cast frame, brass plates, 3/8" diameter shaft extending at both ends. Condenser can be used therefore with either direction of dial rotation. Rigidity is of highest degree. Rotors can be shifted on shaft and locked tight for peaking at high-frequency end of band, thus dispensing with trimmers. Capacity, 0.0004 mfd. Full band coverage 1,500 to 540 kc (and more) with coils intended for 0.00035 to 0.00041 mfd. Premium sent express collect (shipping weight 5 lbs.) on receipt of $1.50 for 13 weeks subscription for Radio WORLD (13 issues).



The condenser measures 4 x 6½ inches, overall frame size; shafts extend 1 inch beyond frame.

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

## LAPEL MICROPHONE

A single-button carbon-granule lapel microphone, impedance 200 ohms, requiring 4.5-volt excitation, of good frequency characteristics, and both handy and inconspicuous. Outside diameter, 1 5/8 inches. The case is chromium-plated brass. The excitation may be provided by introducing the microphone in a cathode circuit carrying around 20 to 25 milliamperes, or a 4.5-volt C biasing battery may be used. Net price, $2.95.

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115 Circuit Diagrams of Commercial Receivers and Power supplies supplementing the diagrams in John F. Rider's "Trouble Shooter's Manual." These schematic diagrams of factory-made receivers, giving the manufacturer's name and model number on each diagram, include the **MOST IMPORTANT SCREEN GRID RECEIVERS.**

The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual," to make the manual complete.

Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A.C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

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