500TH CONSECUTIVE ISSUE

Oct. 24
1931

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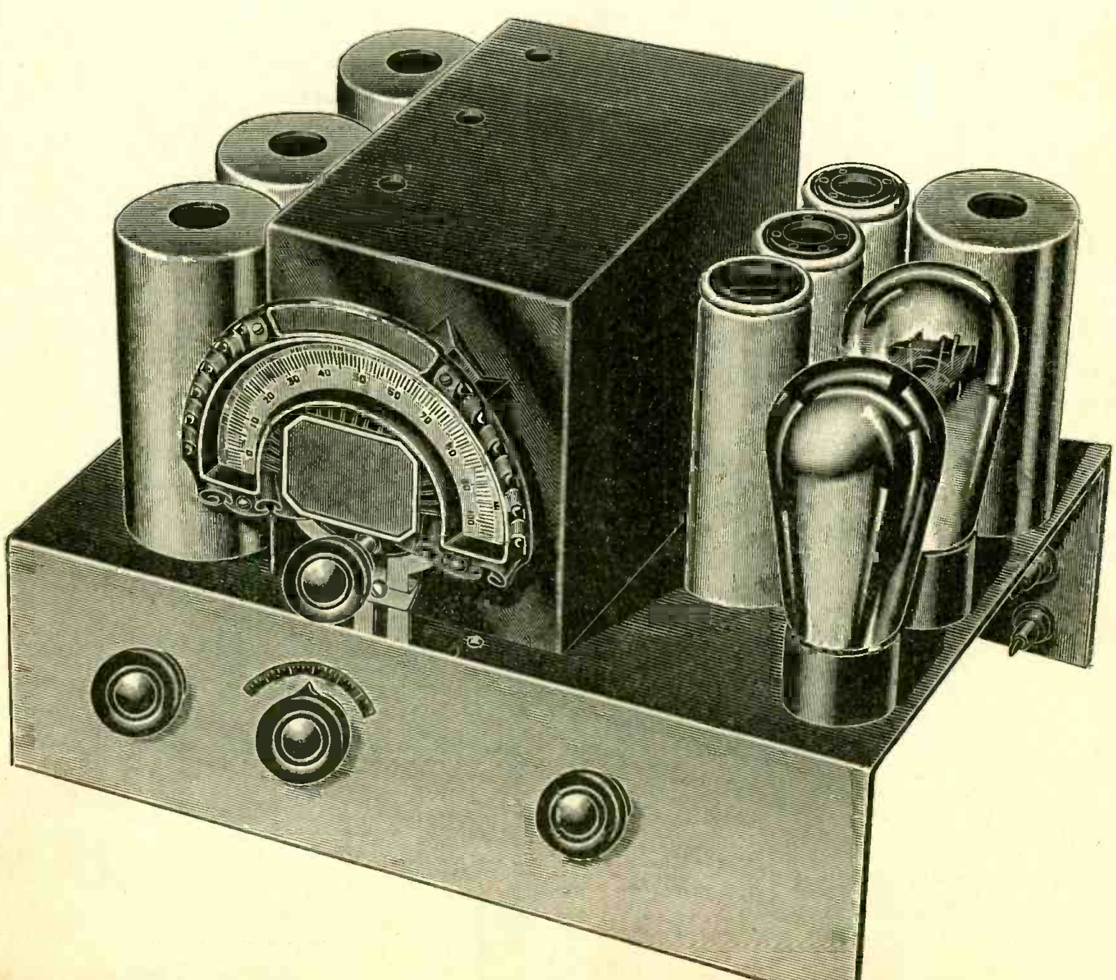

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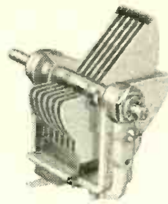

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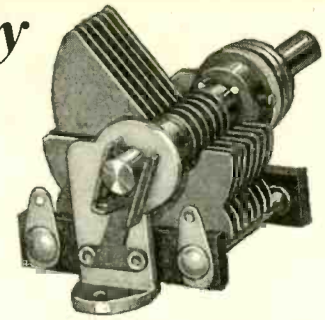

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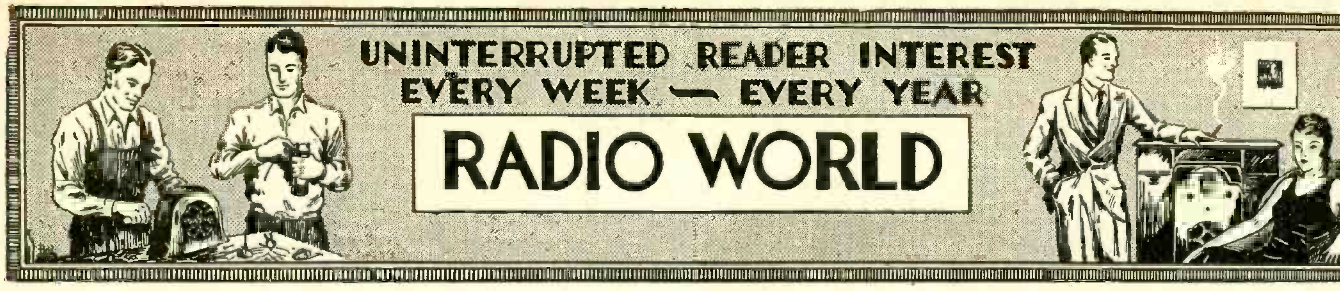

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Commercial Midgets

A Report on Elimination of Trouble

By J. E. Anderson

MANY problems arise in the development of a commercial receiver which must be solved before the receiver can be put in production and before it will be acceptable to the public. First, there must be a satisfactory volume control which varies the volume gradually from the maximum to an inaudible minimum, and this must be such that there is no modulation distortion or cross modulation. Second, the circuit must not oscillate at any setting of the tuning control or at any setting of the volume control. Third, the quality must be satisfactory to the most discriminating critic. Fourth, there must be no audible hum about a foot from the speaker. Fifth, the receiver must stand up.

The Volume Control

One of the most popular of the volume controls is that depicted in Fig. 1. It is used in virtually all modern midget sets. Naturally, this popularity is due to certain advantages which it possesses. With one continuous operation it varies the grid bias, thus varying the amplification in the radio frequency amplifier, and it also varies the signal input. The signal impressed on the first tube decreases at the same time that the amplification decreases. Thus it is not necessary to increase the bias as much as it would have to be increased if the signal input were not varied in the same direction as the amplification.

But this volume control is not free from objections. It may be found with a little experimentation that a set provided with this volume control develops more set noises than one in which the volume is controlled by grid bias variation alone. The reason is not obvious. It will be noted that one portion of the potentiometer P is always across the input coil L1. When the control is set at minimum volume on a local station the part of P which is across L1 is very low and the input voltage is very low. This means that the amplification has to be comparatively high, which in turn means circuit noises. Now suppose we wish to receive a weak distant station. We set the volume control for maximum gain in the amplifier and also for maximum signal input. Then the entire resistance of the potentiometer is across L1. It would seem that the conditions are most favorable for clear reception of the distant station. But that is not so.

Let us figure a little. Suppose the resistance of the potentiometer is 10,000 ohms, which is a common value. This is in shunt with the primary L1. It so happens that in modern circuits the primary is a choke coil having an inductance of approximately 10 millihenries. The impedance of this coil at the lowest frequency in the broadcast band is 34,600 ohms. Hence we have a 10,000 ohm impedance in parallel with a 34,600 ohm impedance. Most of the signal will go through the potentiometer, and the voltage developed across the primary is only a small fraction of what it would be if the shunt were not used. The decrease in the input voltage must be made up by amplification in the circuit, and that means noise due to high amplification. At the high end of the band, that is, at 1,500 kc, the situation is worse, because the choke has a higher impedance and the potentiomenter relatively less.

Of course, there is no objection to this volume control on account of noise originating outside the receiver, for that is cut down in the same proportion as the signal voltage.

Bias Control

These objections do not apply to the volume control in which the bias alone is varied. The input to the primary coil is always the entire voltage that the antenna develops. To convert the circuit in Fig. 1 to this type it is only necessary to cut the line connecting the potentiometer to the antenna. This was tried on a commercial set during the course of development and it was found to be more satisfactory. Of course, if it did not control the volume sufficiently it would not be satisfactory but it was found that the 10,000 ohms resistance was enough. A resistance of 25,000 ohms was tried but there was no marked advantage. Neither was there any disadvantage so either may be used. If the circuit had more gain than the one under test, the higher resistance would undoubtedly be the better.

The objection to the bias resistance volume control has been that it introduces cross modulation and hum. But this does not apply when exponential tubes like the 235 are used. At any rate, neither hum of this variety nor cross modulation showed up although other conditions were favorable for it. Hence this type of volume control was retained. That is, P is used as a rheostat.

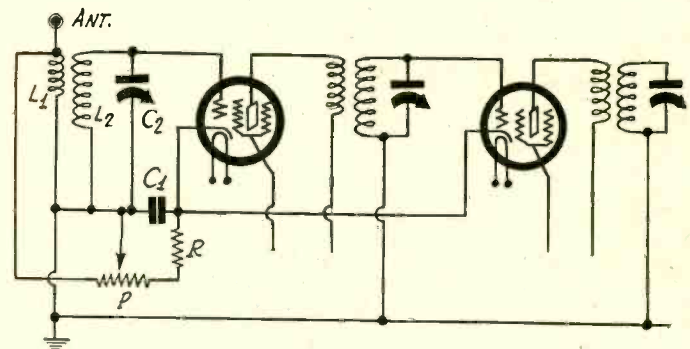

FIG. 1
This circuit illustrates one of the most popular volume controls. Using the potentiometer exclusively as a grid bias resistance is a preferable way.

Oscillation Control

The oscillation in a receiver must not be merely controllable but it must be totally absent on all settings of the tuning and volume controls. While radio men may prefer to have a circuit that can be made to oscillate, because they know that when it does they get the maximum sensitivity, the public will not have it. Commercial receivers are made for those who will have no oscillation.

The volume control is a good oscillation control, and this suggests a way of avoiding oscillation and yet take advantage of all the possible regeneration. In series with the volume control there is a resistance R, which determines the minimum grid bias and the maximum amplification. If this resistance is made too small, the circuit will oscillate at times. If it is made too large, the maximum amplification will not be obtainable. Hence it is necessary to compromise and choose such a value that the circuit is just short of oscillation

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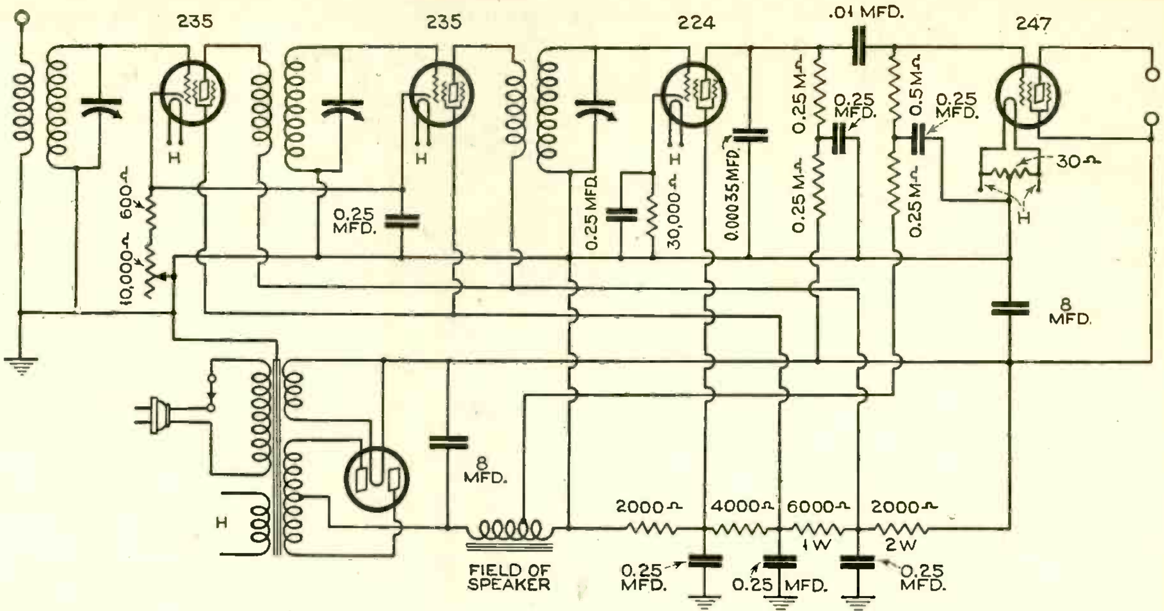

FIG. 2
This is the circuit of a complete five tube midget receiver which has a good volume control, is stable both at radio and audio frequency, and does not hum.

(*Continued from preceding page*)

at the most critical frequency when the volume control is set at maximum gain. A value of 600 ohms was selected for the receiver about which we are talking. This prevented oscillation provided that certain other conditions were met.

It was found that the circuit always oscillated when either the antenna or the ground was omitted, or when both were omitted. Not only that, but it oscillated if either was poor. Hence the other conditions for non-oscillation are that a good antenna and a good ground must be used. Since the receiver was a midget, it was designed for use with both of these so these conditions did not impose anything that had not been anticipated.

Another thing had a bearing on the stability of the circuit. There are three live grid leads running out of the shielded coils to the grid caps. These leads were unshielded and run parallel. Hence they are probable causes of feedback, regenerative or degenerative. They can be made either by connecting the leads to the coils in the proper way.

It was found that the connection which made the feedback degenerative detracted too much from the gain in the circuit, and therefore the coils were connected so as to make the feedback regenerative.

With this connection it was found that the position of the grid leads affected the oscillation. If the middle lead was placed half way between the other two and made as short as practical, the circuit would oscillate if the other two leads were pushed together as far as they would go and that it would be stable when they were pushed as far apart as possible.

The possible movement of each lead was not more than one inch in each direction and the mean distance between them was over six inches. Therefore they were quite critical.

It is rather convenient to have this means for controlling the oscillation. If for any reason the circuit becomes oscillatory, which may happen because of increased voltage or even because of changes in the weather, it is only necessary to push these leads a little farther apart. Conversely, if the set loses its high gain, it can be restored by pushing the leads a little closer together. Of course, it is of little avail to the owner of the set if he does not know this simple trick.

Tone Quality

Tone quality is primarily a function of the audio amplifier and the loudspeaker. The detector is always a part of the audio amplifier as well as of the radio frequency amplifier. Hence the tone quality depends also on the type of detector used.

There was no difficulty in getting good tone out of the set, using a medium size dynamic speaker, a small baffle board, and a resistance coupler between the detector and the power tube. But it was easy to ruin it by selecting improper values or by omissions. Referring to Fig. 2, which is a five tube job giving excellent all around results, it was found that with a bias resistance of 30,000 ohms on the 224 detector with a 0.25 mfd. condenser across it, an 0.01 mfd. stopping condenser between the plate of the detector and the grid of the power tube, and 250,000 and 500,000 ohm plate and grid resistors, respectively, the quality was good, provided the grid return of the power tube was made to the field as shown. If the grid return was made as in Fig. 3, which was attempted in an effort to get rid of hum, the quality was atrocious. All the low notes were missing. Clearly, this method of getting the bias in this particular circuit was out of

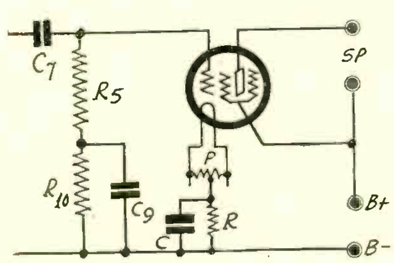

FIG. 3
This method of obtaining bias in the five tube set in Fig. 2 and the six tube set in Fig. 6 spoiled the quality. It could be restored by making C very large.

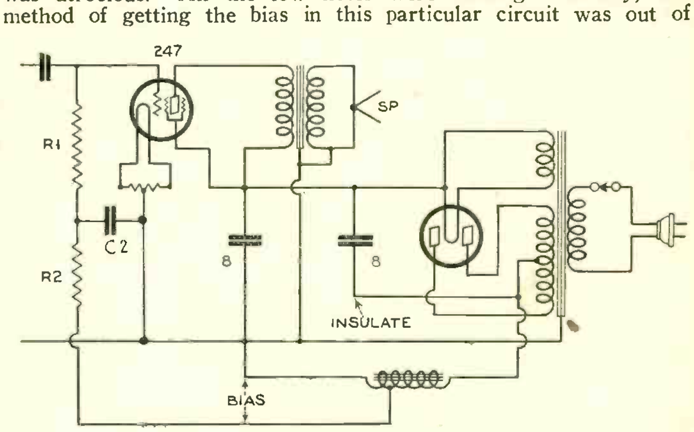

FIG. 4
This is the output stage of the five and six tube circuits, showing the arrangement that gave best performance, except that in the six tube set the left 8 mfd. condenser was made 16 mfd.

BLUEPRINT 527

THE diagram shown schematically in Fig. 2 is available in picture diagrammatic form, full scale, with large schematic and list of parts. If desired, a tap on the secondaries, and a three pole double throw switch may be included to give reception from 200 to 80 meters, besides the broadcast band otherwise covered. The blueprint shows how this is done, the tap on the secondary being two-thirds the number of turns down from the grid end. The price of Blueprint 527 is 25 cents.

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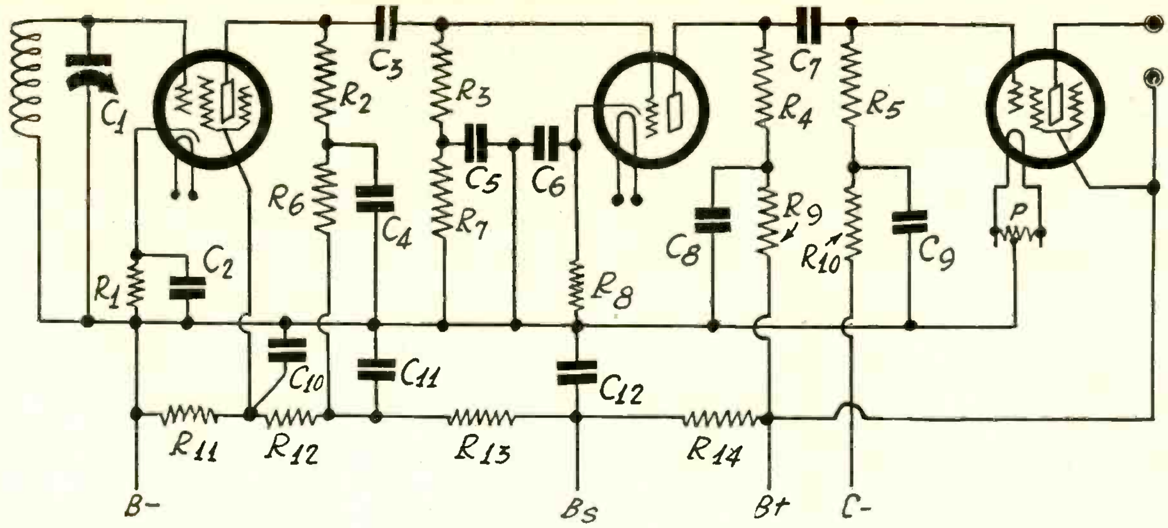

FIG. 5
The audio amplifier of the six tube set as it was during one stage of its development. Not all the parts were needed.

the question. This does not mean that it cannot be used advantageously in some other circuit and with another choice of values. Indeed, some of the very finest amplifiers have been built with this method of getting the bias for the power tube. It used to be the standard method, and in sets other than midgets it will continue to be used. If C is large enough the quality will be good, but it cannot be made large enough in a midget for space reasons.

Eliminating Hum

The greatest problem in the design of a-c circuits is the elimination of hum, which is serious when there is much audio frequency amplification and when the circuit is designed so that the low notes will come out in full force. In the five tube circuit in Fig. 2 there was comparatively little trouble due to the fact that there is relatively little audio frequency amplification. But even in this circuit it was necessary to do considerable filtering. Referring to 4, which is the output stage, it was necessary to insert the filter consisting of R2, a 250,000 ohm resistor in series with the grid leak, and C2, an 0.25 mfd. or 0.1 mfd. condenser across this resistance. A similar filter in the plate circuit was helpful. In this case the filter was connected between the plate coupling resistance and the high voltage line and the condenser, having the same value as C2, was connected between the junction of the two resistors and ground.

It was also helpful to ground the frame of the dynamic speaker as well as one side of the voice coil. With these precautions there was so little remanent hum that it could only be heard when the ear was put up against the baffle of the speaker.

"That's good" was the verdict of the critic who knew what his customers wanted.

Hum in Six Tube Job

The five tube circuit in Fig. 2 was changed by adding a stage of resistance coupled audio, using a 227 tube for the purpose. The volume went up tremendously and the quality was excellent, but there was a hum which did not pass the critic. To be sure, this hum was removed without reducing the apparent volume to the satisfaction of the critic, but then the engineers refused to pass the circuit on account of the absence of low notes.

The audio amplifier in the six tube circuit is shown in Fig. 5. The various parts had the following values: R1, 30,000 ohms; R2, R6, R7, R4, R9, and R10, 250,000 ohms; R3 and R5, half megohm; R8, 20,000 ohms; P, 30 ohms; R11, R14, 2,000 ohms; R12, 4,000 ohms; R13, 6,000 ohms. Condensers C3 and C7 were 0.01 mfd. units and the by-pass condensers shown each 0.25 mfd. Bs is the screen return for the 235 tubes in the radio frequency amplifier, B plus the highest voltage available, which was close to 300 volts, and C minus goes to the tap on the field coil.

The complete six tube circuit, as modified during the process of hum elimination, is shown in Fig. 6. This was not entirely hum free and it was not regarded as satisfactory from this point of view, although from other points of view it was good. The hum, however, was so weak that it could not be heard a few feet from the speaker, even when the speaker was well baffled.

Possibility of Hum Elimination

There is no particular difficulty in eliminating hum from a circuit of this type if the engineer is not restricted in the use of filters and the excellence of the quality. It must be removed by simple means.

Various bucking schemes were tried but all succeeded in making more hum, most of them of the 60 cycle variety, whereas hum present was of the 120-cycle variety. Of course it would be possible to eliminate the hum by a bucking scheme if the restrictions were less rigid.

The most effective method was increasing the capacity of the second filter condenser in the filter, the one across the voltage divider. When this was made 16 mfd. instead of 8 mfd. there was very little hum present. The use of this extra condenser was practical as well as effective.

Increasing resistance R9 reduced hum but it required 10 megohms before it was as weak as the hum in the five-tube set. At this value there was a very noticeable wave form distortion. It will be noticed that many of the parts in Fig. 5 are not used in the complete circuit in Fig. 6. By complete is not meant final, for the circuit is still under development. It will not be "final" until the engineers are satisfied with the quality and the critic representing the customer passes the circuit in respect to hum.

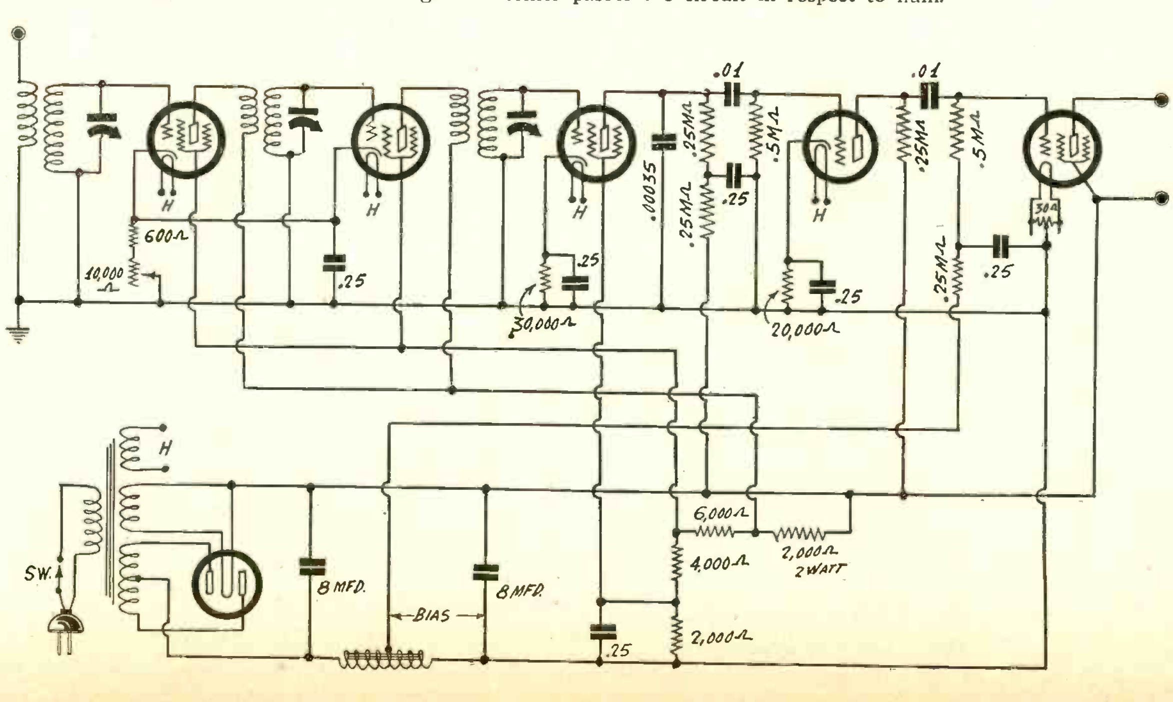

FIG. 6
The final circuit of the six tube receiver with unnecessary parts eliminated. A slight hum, however, remained.

A T-R-F Set with

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By Roland

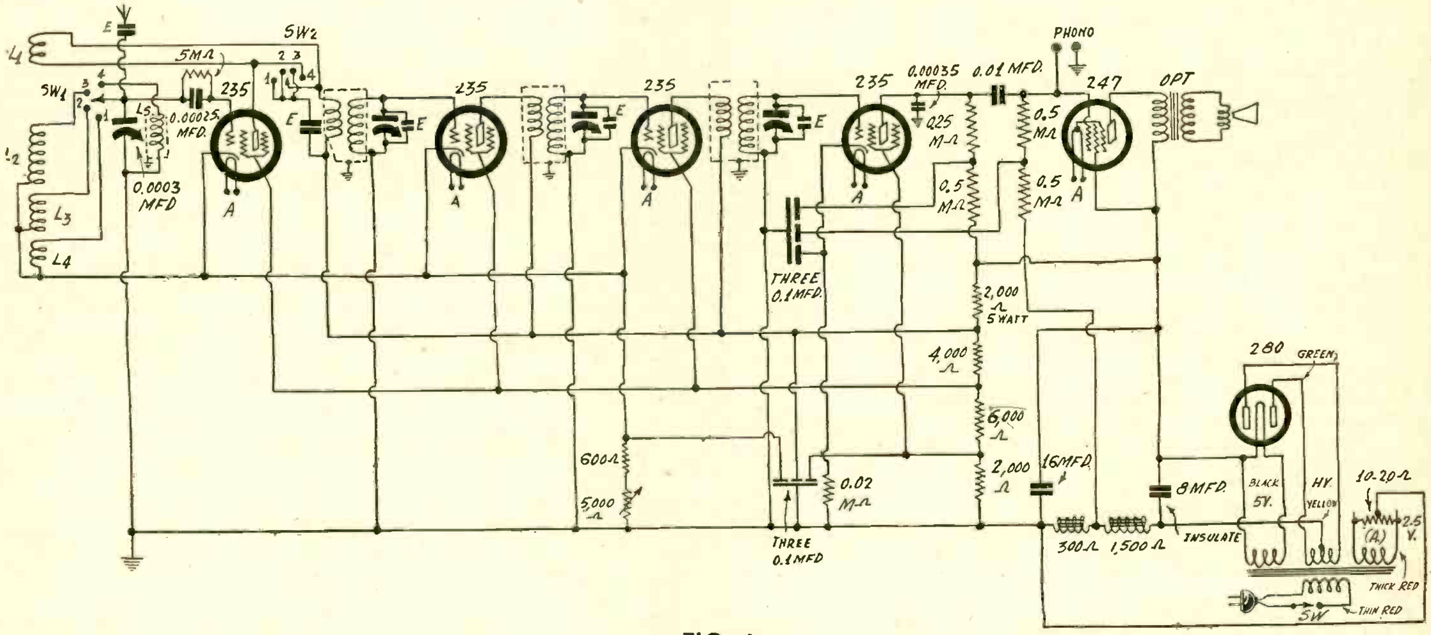

FIG. 1

The 15-550 meter receiver. Since this diagram was made it was found slightly preferable to transpose the 6,000 and 4,000 ohm resistors.

HERE is a new mechanical and electrical method of obtaining wide frequency coverage with a tuned radio frequency receiver. In fact, it is such a method as can easily be introduced in some existing sets, so that frequencies from 15 or 20 meters to 200 meters can be tuned in with the auxiliary device, without molesting the rest of the circuit, the present receiver. The only provision is that there must be room in the chassis for the extra socket, the coil system and the selector switch.

Since the method was worked out with a particular receiver, the entirety is shown in Fig. 1, and the constructional layout used is the front cover illustration this week.

We will start with the assumption that we have a good tuned radio frequency set, consisting of three stages of tuned radio frequency amplification, a stage of audio, and a rectifier system.

Changes From Strict Amplifier to Modulator

Now we find that if we hooked up the first radio frequency tube in standard fashion, with a primary and secondary, and tune the secondary, we will run into difficulty in trying to find an easy way to handle the switching problem for this stage. Therefore we use a series condenser, E, to reduce the coupling to about what it would be with the transformer method, and with aerial thus connected through the series condenser to one side of the grid leak, where the tuning condenser stator also is connected, we can switch this point from one coil to another. That part is very easy and anybody could solve it.

Now, it must be realized that what we intend to do is to constitute the tuner a three-stage t-r-f and detector unit for broadcasts, whereas for short wave work we shall need an autodyne circuit, which means a modulator-oscillator. Therefore the same tube has to be two different things—for broadcast purposes strictly an amplifier, for short wave work an oscillating detector. How can it be done?

Let us make an analysis of the coil switching system, for it is in that system that the whole solution resides, save for some auxiliary help at the first tube's output, as will be explained.

The First Tube as Amplifier

A rotary selector switch with two sections or decks is used, and it has four points. So this is a double pole, quadruple throw switch, also known as a double throw four point switch. It has ten connector lugs. Two are for connection to the indices, or pointers, which are not electrically connected to the switch in any way. One such lug goes to stator and of the condenser marked 0.0003 mfd., and to one side of the series condenser in the antenna circuit. The other lug goes to the beginning of the primary of the first radio frequency transformer.

At the tuned input, therefore, the condenser is moved from one otherwise free terminal of a coil to the same terminal of a succeeding coil. The rotation is to the left for short waves. Hence extreme right hand position (4) represents broadcast reception. We find that the 0.0003 mfd. condenser must be independently tuned, and not a part of a gang, and therefore we select a junior midline condenser, the highest capacity in this series, which is 0.0003 mfd. and will cover the broadcast wave band because of its 17 mmfd. minimum. The three other tuning condensers are ganged.

Notice that the chielded impedance coil L5 is picked up for the broadcast band, and that *its other extreme terminal goes to the grounded negative*. Therefore the bias applicable to the two succeeding tubes is also operative on the first tube, and is negative, so that the first tube is, as it must be, an amplifier for broadcast work. The cathodes of the three r-f tubes are tied together.

Let us carefully examine point (3) of the input switch, SW-1, and see what happens.

The first fact that presents itself is that we pick up another coil, this one not shielded. It is L2, and, as the diagram suggests, it has more turns on it than any of the other short wave coils, L3, L4, L1, but of course it has fewer turns than has L5. The reason is that not only will the L2 circuit tune to higher frequencies, so that we can begin at above 200 meters to go to lower wavelengths, but it it also true that the frequency should be higher than that of the incoming carrier frequency by the amount of the intermediate frequency. Hence we should make an early selection of the intermediate frequency. Let it be the lowest frequency the set will tune to, say 530 kc. Therefore we turn the dial that works the gang condensers until the plates are entirely enmeshed, that is, full capacity is used, the lowest possible frequency tuned in.

Wide Band of Coverage

Now we desire to start, let us say, a little beyond, to be certain of overlap, that is, no missout. Select 1,300 kc. Therefore the lowest oscillator frequency will be 1,300 kc+530 kc, or 1,830 kc. The frequency ratio will be about 3 for coil and 0.0003 mfd. capacity, which assumption is based on a test of a 0.0002 mfd. condenser of the same series, which had a frequency ratio with the correct coil of 2.73. So the oscillator will tune from 1,830 kc to 5,490 kc. The next coil, L3, would tune from 5,000 kc to 15,000 kc, while the third short wave coil, L4, would tune from 13,000 kc to somewhere higher, so the band coverage, in meters, may be from 15 or 20 to 231 meters.

But to constitute the circuit an oscillator, and particularly one that would work over all of this band, there must be a plate winding

Converter Built In

Economical and Has Brought in Europe

Tookle

LIST OF PARTS

Coils

Three shielded interstage radio frequency transformers, as described.
One shielded impedance coil for broadcast reception, as described.
Three separate coils on one form, for short wave reception, with plate winding, as described.
One power transformer for four heater tubes, one 247 and one 280.
(Note: Output transformer OPT, and dynamic field coil used as filter choke, are built into the speaker specified later.)

Condensers

One 0.0003 mfd. junior midline condenser.
One three gang tuning condenser 0.00035 mfd., 0.00046 mfd., or 0.0005 mfd.
Five equalizing condensers (E) of 20-100 mmfd.
One 0.00025 mfd. grid condenser with clips.
Two blocks, three 0.1 mfd. condensers in each block; black lead is common, to ground; reds go to any of the specified points interchangeably.
One 0.01 mfd. mica dielectric condenser.
One 0.00035 mfd. fixed condenser.
Three electrolytic condensers, one with insulating washers and case-connector lug.

Resistors

One 5 meg. tubular grid leak.
One 600 ohm flexible biasing resistor with pigtails or lugs.
One 5,000 ohm rheostat or potentiometer with a-c switch attached.
Three 0.5 meg. pigtail resistors.
One 0.25 meg. pigtail resistor.
One 2,000 ohm pigtail resistor, from maximum B plus to feed plates of r-f tubes, 5 watts.
One 4,000 ohm pigtail resistor.
One 6,000 ohm pigtail resistor.
One 10-20 ohm center tapped resistor, 5 watts.
One 2,000 ohm pigtail resistor.
One 0.02 meg. (20,000 ohms) pigtail resistor.

Miscellaneous Parts

One rotary selector switch, double pole, four point, with pointer knob.
One a-c cable and male plug.
One dynamic speaker, with 1,800 ohm field coil, tapped at 300 ohms; field coil used also as B supply choke.
One chassis (illustration dimensions).
Two plain knobs (volume control and dial).
One extra pointer knob for 0.0003 mfd. condenser.
Five UY sockets and one UX socket.
One vernier dial with pilot lamp, escutcheon and scale.
One front panel (or midget cabinet, if used, has own front panel).
One midget cabinet (optional).
One phonograph jack.
Two leads for antenna (brown) and ground (gray).

inductively related to the tuned winding, or some equivalent method of feedback. The plate coil is the easiest solution, since a wide band of frequencies will be covered, although it should be borne in mind that other considerations probably will stop oscillation at a wave lower than 20 meters, but stoppage occurs on the third short wave coil, not on the second one, L3. The location of leads, the method of layout, and other factors become enormously important at the very high frequencies, and it is not promised that results will accrue on 10 meters, but it is suggested they will not. Probably 15 meters will give some response. Theoretically 10 meters are reached.

Now let us see what happens when the switch is worked in respect to the other section, for the same operation actuates both tiers or decks of the switch at once.

Modulator Output

When the switch SW-2 is thrown to the extreme right, then the plate coil is short-circuited, and the first tube is not an oscillator. The shorted winding becomes a needed oscillation suppressor. We have said that for the broadcast band the tube is strictly an amplifier, and we shall show presently how it is a modulator-oscillator, rather than just an amplifier, when you are working on the short wave bands.

The principal function of the second deck of the switch, therefore, is to short out the plate winding when its presence is not desired. The auxiliary function is to pick up a small bypass condenser, E, for the short wave bands. The purpose of this condenser is to bypass the high radio frequencies of the oscillator out of the intermediate channel. Wherever E appears it designates an equalizing condenser of 20-100 mmfd. capacity, adjustable with a screwdriver. So we may adjust it for maximum or nearly maximum for use across the primary of the first interstage coupler, and the high frequencies will be bypassed.

Thus the system as shown has been explained completely, except for the change from strict amplifier to oscillating modulator (autodyne). The change takes place automatically as the switching is done, for although the fourth switch position picks up the broadcast impedance coil with its grid return to grounded negative, *the three other positions pick up the short wave coils with their grids returned to cathode.*

Detection and No Detection

Thus the grid leak and condenser for detection or modulation is effective when the short wave coils are picked up, because the bias is zero on the grid. But when the broadcast coil is in circuit the bias is negative, and *the detecting effect of the leak and condenser is killed.*

Not only is the oscillator effective over a wide frequency range with a single plate winding, but the coils L2, L3 and L4 are on one form, and the plate winding is at the end. L2, the largest short wave grid coil, is next, then comes L3 and next and last L4. Hence the physical separation is not the same for all coils. If it were the frequency band covered would be much less. Also, the intensity of the oscillation can be regulated, hence the amount of feedback, by the volume control. Thus coupling is automatically made to approach constancy, band for band, but can be varied likewise within any one band, which makes for a wider application.

The broadcast set need be no different than any other good one of the tuned radio frequency type, and may have different or more audio, but had better have as many tuned stages as shown. The broadcast part of the circuit is almost identical to that of a midget receiver on which J. E. Anderson has been working, except for the extra r-f stage, and the values stated are substantially those recommended by him, and they work out exceptionally well.

Ahem—That Squealing!

The subject of squealing at radio frequencies has to be discussed. Many an author wishes that it wouldn't have to be discussed and would rather avoid the topic, but if there is squealing it must be corrected. The subject comes up with two stage t-r-f and detector systems, so certainly it is a major problem when three stages of t-r-f are used.

The best way out is to use primaries with fewer turns, use shielded wire to grids (caps of the r-f tubes) and detector and to condenser stators, ground the shielding on these wires, use grounded tube shiels and of course grounded shields for the broadcast coils, all of them, four in number.

The effect of reducing the primaries is of course to increase the selectivity, and that is just what we want, for five-tube midgets (including rectifier) can be built with a sensitivity a little under 20 microvolts per meter, but the selectivity curve is not what it should be for congested areas, and indeed for any areas where short wave work is to be done with the broadcast part as the intermediate amplifier.

Virtually everything is produced by the broadcast part of the set, even for short waves, including virtually all the selectivity and all the sensitivity, except that the front tube on short waves furnishes the oscillation and modulation. And oscillate it will, so we have nothing to fear.

Choke Primary on One Coil

We do not want the intermediate amplifier to oscillate, and it should not, for the small primaries will take care of this, or the volume control can be retarded just a little, as that is a very effective oscillation squelcher.

Another expedient, and one worth while, is to use a radio fre-

(*Continued on page* 14)

Two Stages of Audio,

Reflected Effect of the Added

By Herman

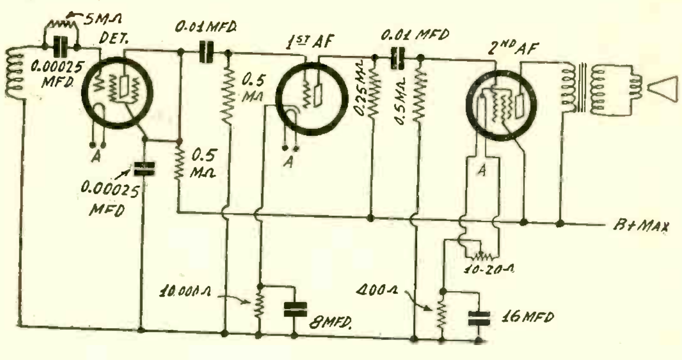

FIG. 1

A standard two stage resistance coupled amplifier. The only objection to it is a possible starting howl. The author reports on attempts to cure this trouble.

CIRCUITS that have one stage of audio, usually resistance coupling, have high radio frequency gain, otherwise the volume of sound would not be large enough, even though the output is a pentode tube, and even though that pentode will give greater amplification than would be expected, due to the use of audio regeneration in special circuits. So when, despite this augmentation, the r-f gain has to be high, means must be provided in modest sets for using large primaries on radio frequency transformers, for negative bias detection, or, if smaller primaries are used, grid leak-condenser detection may be substituted.

The standard five tube midget, including 280 rectifier among the five, must therefore have large primaries under one condition, or must have grid leak-condenser detection under the other, but the net result is about the same in selectivity and sensitivity.

The usual statement made is that leak-condenser detection is much more sensitive. So it is. But this statement is incomplete, for the r-f circuit is alterable to bring up the sensitivity. Even if you have only one stage of tuned radio frequency amplification the same situation obtains, that either type may be used, if the primaries are built up for negative bias detection.

Sum of Two is About the Same

Looking at the same situation from another angle, a certain value of voltage is desired at the detector output, for a definite value of antenna input. This may be accomplished by either type of detection, for the larger primaries in the one instance will build up the sensitivity, while in the other the more sensitive detector will build it up.

In every case where sensitivity is increased without additional tuning the selectivity is relatively decreased. If the selectivity and the sensitivity could be rated on a percentage basis, then it would be found that for a given number of tubes of equal types, one-half the sum of the two values or percentages would be the same for all systems, because as the selectivity increased the sensitivity decreased, and the change would be about the same, only in opposite directions. This statement is a close approximation to the fact, although it takes certain liberties for the sake of clarity.

It is therefore palpable that the aim is to establish a certain output at the detector for a given value of antenna input. If a lower value of detector output for the same input could be tolerated, then it would be practical to increase the selectivity without increasing the number of tuned stages. Therefore as the detector develops a certain value of output voltage at the power tube plate circuit, if more audio amplification is added we could enjoy still greater volume, or, if desired, could return to the original volume of sound, which was sufficient, and take out the difference in selectivity.

Effect of Audio on Selectivity

Therefore, although the audio channel is simply an amplifier of audio frequencies, it has a relationship to the tuner, and the greater the audio amplification, the greater the practical selectivity that may be used and still maintain the identical sound-volume level. It is therefore stretching a point to say the audio amplifier has nothing to do with selectivity.

The benefit in selectivity is not quite so great as would be imagined, however, even when the coupling is loosened in the r-f channel to a degree permitted by the extra audio, because of the greater audio amplification of all that comes out of the detector. This output may contain interference, and that would be magnified along with the signal. But the general proportion is in favor of the plan of an extra stage of audio where it is imperative that the selectivity be increased, for the loosened coupling results in increase not too seriously mitigated by the extra amount of audio amplification.

It is therefore proposed that those experimenting with methods of obtaining greater selectivity with three tuned stages try an extra stage of audio and reduce the primaries at least on the interstage transformers. In a given instance, using grid leak detection, with two stages of audio, the primaries consisted of 8 turns, and afforded as much volume of sound as did a five tube set, having the same type of tuner, but negative bias detection and one stage of audio, with 25 turns on the interstage primaries. But the selectivity was far greater with the "skinny" primaries.

Use of Extra Resistance Stage

So, in including an extra stage of audio, one will seek a suitable circuit. An easy way out is to use a general purpose tube as the first audio valve, and put an audio transformer between that tube and the output pentode. The ratio may be 1-to-3, primary to secondary, or somewhat higher. A first-class transformer will cost around $8, and in these days of economy many will ask if the situation can not be met with a resistance coupled stage. It can.

The standard practice in constructing a resistance coupled amplifier having two stages is diagrammed in Fig. 1. This requires large capacities. There is negative audio feedback in the 10,000 ohm cathode circuit of the first tube and in the cathode (filament to ground) circuit of the power tube that must be removed. This is substantially removed for audio frequencies by the capacities stated.

In three previous articles of this series there was a discussion of regeneration in audio amplifiers, illustrated with circuits, and with a statement of the performance of each. The September 26th and October 3d issues contained receiver circuits using a similar audio channel as in Fig. 1 herewith, and it was stated that the only drawback was a starting howl. Considerable investigation of this howl has been made since.

Reports of Experiments

It has been found that with quick heater tubes—some of these tubes "get going" in about 10 seconds—the howl is of only five seconds duration. With slow heaters, some of which took

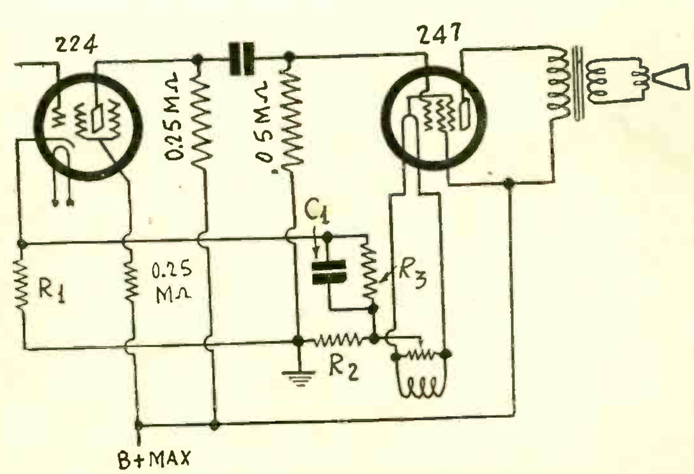

FIG. 2

A two stage system, using regeneration at audio frequencies, and including a tuning condenser, C1, the effect of which is explained in the text.

One Regenerated

Amplification on Selectivity

Bernard

almost a minute to get started, the howl lasted for twenty seconds or more. Therefore quick heater tubes are preferable by far, and also it is true that virtually all the heater tubes made in the last several months are of the quick type.

Another fact ascertained was that the howl was not present at all when a B supply choke coil of lower impedance was used in the rectifier filter. Of course, the howl is due to feedback in the audio amplifier, a feedback that starts just so soon as there is any amplification in the first audio tube, which always is within a few seconds of turning on the set. The last tube gets working virtually at once. The first and second audio tubes then for a short while constitute an audio oscillator. This was confirmed by the fact that when the set was playing properly the detector tube was removed, and the howl resumed and endured so long as the detector tube was out. A quick heater as detector and a slow heater as first audio were tried and at no time was there any howl.

Regenerative Audio

Of course even a circuit with such a shortcoming is not practical, or rather of commercial value, since nothing should be produced for public use except what has the trouble removed. For experimentation, however, the circuit surely should be tried, and as a great deal may be learned from it and its counterparts, including the new regenerative audio channels, meaning instances where the regeneration is willfully introduced and in which there is no trouble.

The standard circuit that infallibly will not howl at the start and that plays finely at the very beginning, despite the slowness, quickness or variety of the heaters, has not been developed yet, although work on it is continuing.

However, the regenerative circuit proves more engrossing. It omits the large bypass condensers, and therefore is economical. It may be operated well without a high current voltage divider, merely 1 watt pigtail resistors being used for voltage supply, or other resistors that are in the circuit anyway.

In Fig. 2 is shown a two stage amplifier, in which 224 actually was tried as the second audio tube, with the 247 as the third, but the same principles apply if the amplifier is confined to two stages, that is, the 224 is the detector.

R1 is the grid bias resistor for the 224, R2 is the grid bias resistor for the pentode, while R3 is the feedback resistor. The phases of the voltages in R1 and R2 are different, as well as the voltages themselves, so R3 is used to limit the amount of voltage fed back. Only a small voltage is desired, so if R1 is 5,000 ohms, then R3 may be 25,000 ohms. The screen of the 224 is returned through a high resistance to B plus maximum, but if this tube is the detector a radio frequency bypass condenser should be across the resistor (e.g., 0.001 mfd).

Tuning Characteristic

C1 is shown because it is a tuning condenser. It tunes the audio channel. The low note reproduction becomes enormously greater, and the middles and highs are cut down badly and volume in general is low, except in the favored region, even if this condenser is only 0.1 mfd., which is regarded as a low value in the light of audio frequencies. Yet the tuning is quite noticeable to the ear beginning with 0.001 mfd., while more than 0.05 mfd. can not be used without sharp reduction in volume. The condenser is of course a distorting device, a fixed tone control, and all tone controls are distorters. However, if three different capacities are used, say 0.001 mfd., 0.01 mfd. and 0.05 mfd., a tap switch will give you a good tone control, although one that reduces the volume when the control is used, which is, I believe, true of every tone control, certainly of every one I ever heard. Many persons like to accentuate the bass on orchestral reception, and this method enables such accomplishment with a vengeance. For a pure tone amplifier all the way through, however, omit the condenser C1 entirely.

The circuit is not endowed with the greatest stability, however, and the value of the resistors 0.25 and R3 may have to be increased to correct this condition.

If the circuit has a grid leak type detector and only one audio stage, there will be no R1 in it, so the circuit would have to be altered. Fig. 3 shows one way in which this was done, where the filament positive B voltage of the 247 is used as the screen voltage of the detector, or the bias may be taken in the same manner for a negative biased detector (224), as shown in Fig. 4.

The volume of sound is not large enough by the Fig. 4 method, due to the voltage limitation. There are 16.5 volts on the screen in the case of the leak-condenser detector, or 10.5 in the other case, as 6 volts would be expended on bias.

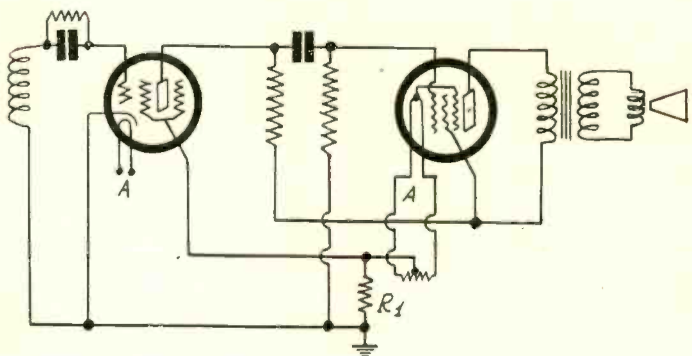

FIG. 3

Regeneration due to coupling of the preceding tube to voltages existing in the succeeding one. Leak condenser detector is shown.

Smallness of Screen Voltage

The 10.5 voltage is too small, even though screen grid detectors do work better with a lower voltage than required for amplifiers. Also, for detection the plate's d-c load may be 0.5 meg., or 1 meg. (due to a resistor-capacity filter circuit) and even if the full voltage is applied (267.5 volts), then 10.5 volts is still too small. There is no way to increase it, using this circuit, without at the same time increasing the bias on the pentode. However, the thought will occur to many that 245 tubes are still in abundant use, and these take 50 volts negative bias, so there would be more voltage available under the Fig. 4 circuit as thus amended.

Results from the two stage system have not yet been completely satisfactory, although the quality is excellent. The drawback so far is that the gain is not so great as one should have, since the gain of only 10, as against a single stage, is not impressive. It makes a great difference to the ear, of course, but the hope is that the gain can be safely advanced to around 20, so that at a little less than 1 volt detector output the power tube will be overloaded, though worked at its maximum undistorted power output on the basis of normal voltage recommendations.

They Do Work Well, But—

The gain so far from a screen grid stage of audio has been not much greater than that from a general purpose tube stage, and while it may be true that no greater gain can be well

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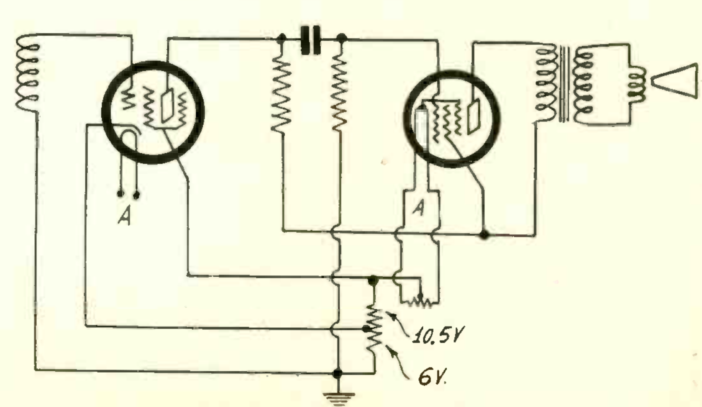


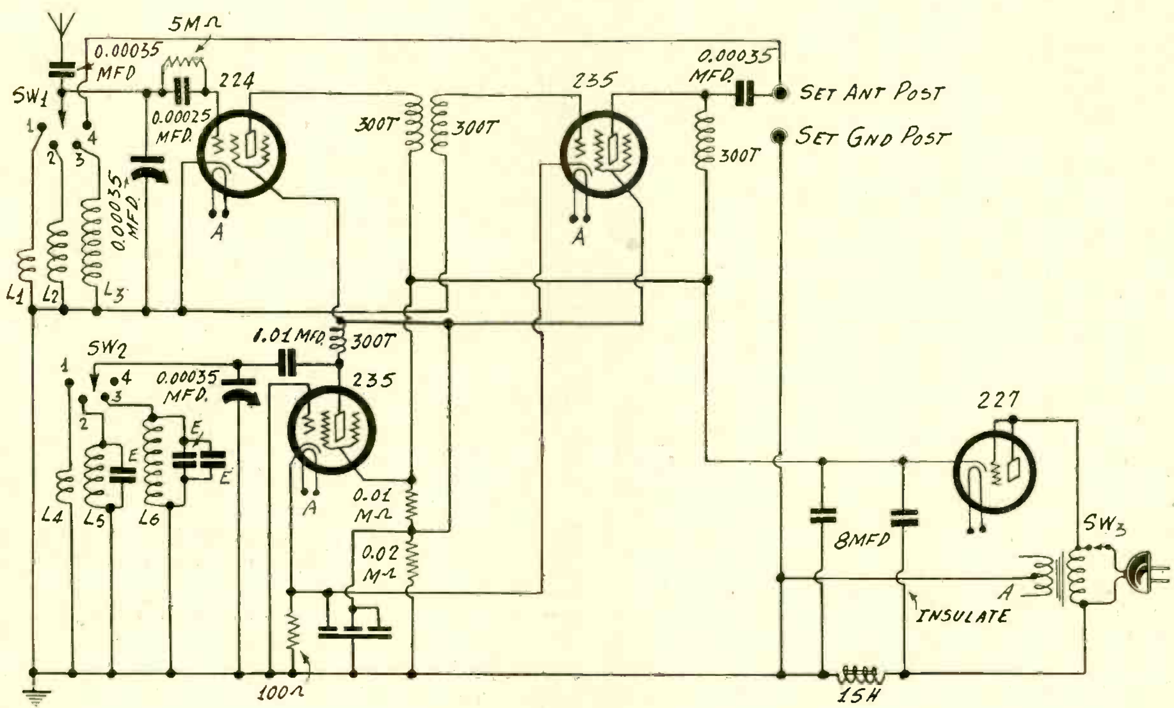
FIG. 4

The same system as in Fig. 3, applied to the screen grid tube.

A Converter with Separate

Individual Coils Picked Up by Pa

By Henry



A converter with rectifier and wave switch.
FIG. 1

IT is a little more trouble to use separate coils, picking up one at a time, or one pair at a time, in a short wave converter, instead of a tapped coil, but the results are better. It is of course true that you get results from tapped coils, just as it is true that the separate coils, if not interrelated when they should be isolated, afford more distance. And when one experiments with short waves of course he wants distance. That is the big thrill. Europe or Nothing, is the motto. And it must not be nothing. So here goes for Europe!

The dynatron oscillator is used, which means the voltages, inductance and capacity must be such as to insure oscillation. One voltage combination will hold for all bands. If oscillation stops on L4, increase the L-C ratio.

Small Diameters Popular

Compactness may be achieved by using small forms. It is almost common practice to do so nowadays. While larger diameters make for better coils, there is no place to put such bulky apparatus, and besides the niceties of shape factor, spacing, etc., are not requisite in a converter, the principal object being achieved when the oscillator oscillates. In fact, it can be said that almost the only thing that stops reception is stoppage of oscillation, stations coming in whether the modulator is tuned or not, and often even if the modulator grid is open.

Tuning of the modulator is an advantage, in that selectivity is improved, while, of course, sensitivity goes up as well. However, on loud signals the effect of the modulator tuning seems small, and turning the separate dial as a test makes the modulator condenser behave then like a coarse volume control on loud signals. But on faint ones the advantage is apparent.

Degree of Coupling

To maintain the interity of the modulator tuning it is necessary that the coupling be not tight, between modulator and oscillator circuits. Both coils may be wound on one form, so there would be three separate forms to accomodate in reality six coils. The coupling can be different for each, and then about the best practical solution is reached, as one can not well go beyond the point of changing the degree of coupling for less than the full frequency coverage with a given inductance.

If the coupling is too strong the two circuits will tend to tune as one, which means in effect that the advantage of the modulator tuning is lost, and the circuit behaves as if the oscillator alone were tuned. Many have built converters, and good ones, too, where only the oscillator was tuned, but in these fastidious days it is well to choose to tune the modulator.

Many, also, have built converters wherein the two circuits looked as if they were separately tuned, and felt as if they were, but scarcely behave as if they were. That is obviously enough a case of too close coupling between modulator and oscillator, and arises from incorrect conclusions from experimental results. It is a fact that if the coupling is tightened the volume goes up considerably, but the advantage of tuned modulator virtually disappears, and the extra selectivity is lost. That extra selectivity enables the reception of foreign stations more readily, while on the sensitivity score one must rely considerably on the receiver.

Sets of Low Sensitivity

Yet it is not a good idea to rely too strongly on the receiver, because it is astonishing how much is expected of a converter connected to a set that has a sensitivity of unmeasured mediocrity, but which one may assume to be around 40 microvolts per meter, something beyond the state of toleration in these days. Yet plentiful thousands of such sets were manufactured and they grace—or is it disgrace?—the homes of teeming thousands. While no world records need be expected to be broken when any converter, by whomsoever conceived or wired, is joined to such a broadcast set, yet the converter should be so good that it will give fair results on the poor set it may be linked with, and therefore it will give great results on a good set. Moreover, it should be the type of converter that behaves gracefully when confronted with the duty of working into

Two Stage Resistance

(Continued from preceding page)

accomplished, and that therefore a 227 will serve as well as a 224 or 235 with slight circuit change, the subject is under investigation, and it is hoped that more encouraging reports will be forthcoming.

It must not be understood from the foregoing that the two

Tuning and Intermediate Stage

nel Switch—Oscillator a Dynatron

B. Herman

a set that is itself a superheterodyne, a condition where so many converters prove nearly useless.

So into this converter has been built a stage of intermediate frequency amplification, not tuned with condensers, even fixedly, because the stage is purposely broad enough to cover whatever intermediate frequency you will select, which of course will be within the broadest band, or not far outside.

Intermediate Stage Effects

Two 300 turn honeycomb coils, the proper distance apart, constitute this coupler, and the transfer is fairly even throughout the broadcast band, except for a falling off from 650 kc up. Not only is this a region in which the set is not likely to be worked for an intermediate frequency, but is also well beyond the frequency limit in mind in the construction of the coils.

Where gang tuning is used there must be some idea of the intermediate frequency. In fact, the conclusion of an intermediate stage right in the converter decides, to a greater or less degree, what the intermediate frequency must be. The more sharply the intermediate stage is tuned, the smaller the range of intermediate frequencies from which to select, and the intermediate stage, by sharp tuning and regenerative assistance, could be so confining on the set that only three or four channels of the broadcast spectrum could be open for use. That would be too much of a restriction, and particularly since the modulator is tuned, it is satisfactory to build up the amplification largely in the intermediate stage, without much increase in the selectivity.

However, separate tuning of modulator and oscillator provides greater frequency leeway.

Sharply Tuned Intermediate

Those who would add tuning may put on equalizing condensers—the little semi-fixed trimmers—of equal capacity across the primary and the secondary of the intermediate transformer, and get a sharper peak. The capacity not to exceed 100 mmfd. The plate condenser will be found more critical than the one in the grid circuit. A low intermediate frequency then must be used.

The modulator, using 224 tube, is of standard grid leak type, for this is more sensitive than the negative bias method. The oscillator is a dynatron. The built-in intermediate stage, like the oscillator, uses a 235 variable mu tube, while the rectifier is a 227.

There is every possible element of simplicity in the circuit and layout. The mutual inductive coupling of the coils is a great help in achieving compactness, while the rectifier, designed for such converters as this one, does not require a power transformer.

The wave band selection is done by a single front panel switch. This switch has two layers, with five lugs on each layer, total 10 lugs. One of the five is the index connection, or pointer, which is insulated from everything. The other lugs are for the three coil terminals, and, the fourth lug is for antenna changeover, which calls for the disuse of the corresponding lug on the other deck.

Antenna Switching

This convenience permits putting the antenna to the set instead of to the converter, or vice versa, as a front panel operation. The only other act necessary is to run on or off the juice to the converter.

There will be no objectionable hum whatsoever, using the rectifier as diagrammed, because the 16 mfd. of filter capacity, plus the B supply choke, will take care of satisfactory elimination. To say that there is no hum at all is nonsense, as I have never heard or measured any a-c device that did not have some hum, even though the hum could be heard only when no program was coming in. That is the type of filtration that obtains in the present instance.

By using two tuning controls, that is, separate condensers for tuning, we avoid a great deal of adjustment and compensation, for although the oscillator dial would far outrun the modulator dial for the first short wave band, there will not be much of a difference on the next band, and the two will almost track on the third band.

The practical result is that the oscillator for the first band may tune from 2,800 kc to 8,400 kc (position 3 on the switch SW-2), while the modulator will tune from 1,300 to 3,900 kc. When the modulator is at 3,900 kc the oscillator is not an effective instrument for a frequency higher than 5,200 kc, so from 5,200 kc to 8,400 kc there would be no reception, or very weak reception, although the next band would of course begin with an original carrier frequency or incoming frequency of 5,000 kc, and the oscillator coil proportioned to reduce the disparity.

No Frequencies Missed

That is, no frequencies are missed, but the oscillator's full sweep is far from effective on the first band (position 3), being limited by the slower pace or smaller span of frequencies of the modulator, because the modulator starts at a lower frequency. An extreme case has been taken as the example, where 1,300 kc was the intermediate frequency.

Now this condition can be corrected somewhat, at next to no trouble or expense, by putting a fixed condenser across the oscillator tuning for the first stage, so that the frequencies useful in its tuning are spread out more on the dial. Then the inductance should be less. Two equalizers of 0.0001 mfd. maximum capacity (20-100 mmfd. variation) may be put in parallel with the coil for the first band and adjusted until the dials read alike somewhere near the middle. In the next band the difference will not be so much, a range of 5,000 to 15,000 kc for the modulator, while the oscillator tunes from 6,300 kc to 18,900 kc. This is a difference at the highest extreme of 3,900 kc out of 18,900, and the disparity is not serious where separate tuning is employed.

For the third coil (position 1) the modulator and oscillator inductances may be the same.

The figures just cited are not actual values. For the first band the frequency ratio of 3-to-1 may be expected from a 0.00035 mfd. tuning condenser, which was in mind. For the next band the ratio will not be quite so large. Therefore the difference between the two circuits when both have their condensers at minimum capacity will be less than stated. Moreover, the oscillator has a blocking condenser of 0.01 mfd., and this is effectively in series with the tuning condenser, therefore the oscillator section always is less than 0.00035 mfd. At maximum capacity the reduction is to about 0.0003 mfd. These differences are small and inconsequential on account of the individual tuning of the circuits, although they would become of serious magnitude if ganging were used.

RESISTOR IN SCREEN CIRCUIT

WHAT is the effect of a high resistance in the screen circuit of a tube like the 235? Does it increase the amplification or does it have the reverse effect? Does it tend to keep the screen voltage constant?—A. B. V.

It decreases the amplification but it increases the undistorted output. It does not hold the screen voltage constant but it has the reverse effect. It makes the screen voltage vary in nearly the same way as the plate voltage, that is, the effective plate voltage. That is the reason it reduces the amplification.

Audio Systems

stage systems do not work well, using regeneration, but that they do work very well, only it is hoped to pep up the sound volume still more.

The reason for adding a stage of audio, to constitute two stages, is that more r-f usually can't well be added without considerable squealing.

List Prices of Tubes

The following table gives the prevailing price lists of the various tubes:

Tube	Price	Tube	Price	Tube	Price
227	@ $1.25	551*	@ $2.20	240	@ $3.00
201A	@ $1.10	224	@ $2.00	WD-11	@ $3.00
245	@ $1.40	171A	@ $1.40	WX-12	@ $3.00
280	@ $1.40	112A	@ $1.50	200A	@ $4.00
230	@ $1.60	232	@ $2.30	222	@ $4.50
231	@ $1.60	199	@ $2.50	BH	@ $4.50
226	@ $1.25	199	@ $2.75	281	@ $5.00
237	@ $1.75	233	@ $2.75	250	@ $6.00
247	@ $1.90	236	@ $2.75	210	@ $7.00
223	@ $2.00	238	@ $2.75	BA	@ $7.50
235	@ $2.20	120	@ $3.00	Kino	@ $7.50

*This tube comparable to the 235.

Grand Island Monitor

Short Wave Reception is by T-R-F and

"RADIO Activities of the Department of Commerce" is the title of a new publication from the press of the United States Government Printing Office. The booklet recounts the origin of the radio division of the department and describes its work as a checking and correction agency in various branches of radio.

Concerning the central frequency monitoring station, Grand Island, Nebr., the following is published in the booklet:

For several years it has been apparent that the radio division was in need of accurate means by which the frequency of radio stations, not only in the United States but throughout the world, could be measured. Inasmuch as the interests of the United States were of first importance, it was obvious that any centralized frequency measuring system should be located in the middle of the country where the best chances would obtain for receiving the maximum number of stations. For this reason, a very extensive study of receiving conditions was made in Kansas, Iowa, and Nebraska. This study covered all frequencies now in use in the radio spectrum, and as a basis for conclusion contained as subjects of investigation signal strengths, static levels, noise levels, fading possibilities, and the proximity of near-by radio stations which might cause interference.

A most extensive search indicated that the flat prairie regions of central Nebraska best served these needs. For that reason a site was selected approximately 6 miles west of Grand Island, Nebr.

The site for this Central Frequency Monitoring Station is more than 3 miles from the nearest power lines, which obviates the possibilities of man-made interference. It is approximately one-half mile north of the Lincoln Highway, the main east and west highway connecting the Atlantic and Pacific coasts.

On it was erected a building specifically designed and arranged for radio-reception purposes. The building is constructed in the shape of a cross, contains one long room extending what might be called through the arm direction of the cross, in which are centered all the radio activities, the bottom and the top of the cross containing, respectively, office quarters, dining room, kitchen, workshop, battery room, and motor generator. A second story over the office quarters is used as a dormitory. Another building of one story only combines the facilities of two rooms used, respectively, as power house and garage.

Station a Complete Unit

The station is a complete unit in itself, generating its own electric power by means of Diesel engines, having its own water-supply system, and its own sewage system. It is entirely independent of all outside facilities, with the exception of telephone and telegraph wires, which come to the station in an underground lead cable.

The property on which the station is located consists of a square plot of land containing 50 acres. At various places on the grounds are located the antenna systems. The systems are, with but two exceptions, directional in nature.

Directional antennæ point toward Europe in such a way that all radio stations on this continent are on their lines of directivity. These antennæ are of the famous Beverage short-wave multiple doublet unidirectional type, and are in some cases located as much as 800 feet from the receivers. Connections between the antennæ and the receivers are provided through transmission lines. These antennæ receive in one direction only, and therefore tend to reduce static to a minimum as well as interfering signals. They are supported on 60-foot wooden poles, 10 poles being required for each antenna, and each antenna extending approximately 300 feet in length. The antenna might be described as a composition of 39 individual antennæ coupled together through a common transmission line. The individual units of the antenna lie in the horizontal plane. A duplicate of this installation points toward Port Allegro, South America. This antenna is capable of receiving all short-wave stations on the South American continent.

Broadcast reception is accomplished by means of a single wire Beverage type antenna system; one of these units points toward New York City and is capable of receiving signals unidirectionally over a sector principally effective over the major part of the Atlantic seaboard. The action of this antenna can be reversed so that signals from the west only are received.

Beverage Broadcast Antenna

For the reception of the very long waves, two large loops arranged at right angles and crossing at centers are used; these loops are approximately 250 feet long by 40 feet high. By the use of a goniometer arrangement and a separate single wire L-type antenna, this system becomes unidirectional throughout 360 degrees. In other words, it is unidirectional at the will and control of the operator in any direction.

Besides these antenna systems there are also the familiar half-wave single doublet types of antenna, connected through transmission lines to the receivers, and a vertical antenna similarly connected. All of these antennæ are mounted on 60-foot wooden poles. These last-mentioned antennæ function for the intermediate ranges, starting with the upper end of the short-wave band, about 5,000 kilocycles, and extending into the broadcast band. A combination of the single-wire Beverage systems and the ordinary L-type receiving antenna functions from the top of the broadcast band, 550 kilocycles, up to about 100 kilocycles.

The antenna systems are capable of covering in specialized fashion, in a most efficient way, the entire range of frequencies in use in the world to-day. Because of the specialized functions of the systems the station is very international in character, there being no trouble in the interception of signals from foreign countries. In fact, radio signals, both telephone and telegraph, from every civilized country in the world are regularly heard.

Measures Frequencies

The prime function of the station is the measurement of frequencies. To do this there are installed in the station two frequency standards, one of which is secondary in nature, deriving its frequency from a calibrated device, the other of which derives its frequency from the earth's rotation. These standards recognize only the Bureau of Standards as the primary measurement of frequency. The function of the frequency standard is the supplying of standard frequencies throughout the radio spectrum, by comparison with which unknown frequency values may be determined in an accurate fashion. The standards are carefully housed in screened rooms and

T-R-F- Set with Co

(*Continued from page* 9)

quency choke coil, say a honeycomb coil of 300 turns, as the primary of the interstage coupler ahead of the detector. This is usually used as an antenna coil, but can't be with this hookup. However, it makes little difference, as to frequency sensitivity, where this choke primary coil transformer is located, so putting it ahead of the detector is quite satisfactory. It has the effect of building up the r-f at the low radio frequencies, and as we shall use the set at such a frequency, it is simply fine to increase the sensitivity in this region, at the same time flattening out the broadcast sensitivity curve, which otherwise would have a rising characteristic (greater amplification the higher the frequency).

The choke primary transformer results in squealing (if any is present) at the two extremes, which is a good sign, of course, and renders the solution quite simple, as reducing primary turns will correct at once for both conditions.

This is not the greatest system in the world for short wave reception, for it would be preferable to have two tuned circuits in the mixer. Here we have only one, as the incoming frequencies of all sorts, and the oscillator, by tuning, is made to beat with one, then with another, so that selection is afforded. Moreover, the results are good, though not the best, and it is no trick to bring in foreign stations.

The point about this system is that it is simple and very inexpensive, and enables you to enter the short wave arena virtually with a reporter's pass, rather than at the outlay of a considerable bundle of dollars. The result obtainable from the costly short wave apparatus are superior, but we are thinking now about the man who has hardly anything to spend on short wave joys, but who would like to become a short wave listener if only a few dollars were at stake.

If you have a t-r-f set with two stages and detector, all tuned, you can find room perhaps for the extra tube, the coil system, 0.0003 mfd. condenser and the switch. The coil switch is usually easy to accommodate, as an existing volume control probably has no switch on it, and by substituting a volume control with a-c switch attached you render available a front panel position for the coil switch.

Also, if you have an a-c set, or want to build the one shown, be sure to have extra capacity at the end of the filter. For Fig. 1 the capacity is shown as 16 mfd., consisting of two 8 mfd. electrolytic condensers in parallel, but for an existing set, if the hum now is low, simply add 8 mfd., which can be done by soldering the lug on the can of a dry 8 mfd. condenser to the can of an existing condenser in the set. The reason for the extra capacity is that if any hum is present it is brought out objectively when short waves are tuned in. The filtration for short waves therefore must be much better than it is for broadcasts.

While the system outlined is one for a t-r-f receiver with built-in short wave converter, it is a method that makes it possible, indeed necessary, to work all the tubes all the time. Therefore it is not a case where for broadcasts you use, say six tubes, while for short waves you use two more, these two not being used when broadcasts are tuned in. The idea of using all the tubes all the

Effectuates World Range

Regeneration—10 to 30,000 kc Covered

maintained to conditions of constant temperature, every precaution being exercised to insure the utmost accuracy.

Receiving equipment consists of specially designed receivers, designed for the three specific purposes: One group of receivers handles all frequencies from 10 to 100 kilocycles, another group handles all frequencies from 100 to 1,500 kilocycles, and the third group handles all frequencies from 1,500 kilocycles to the highest known radio frequency in commercial use to-day. The receivers receive their energy for filament supply from storage batteries, in order that they may be absolutely quiet to the last degree. They are exceptionally selective and sensitive, to meet the exceptional demands of the service to which they are put.

Continuous Watch

During the course of operations a 24-hour watch is maintained at the station. The watches are divided into three periods of eight hours each. During these watches each receiver is in operation as well as both standards. The operations are so divided that one engineer's duty is that of reception at a particular receiver, while another is on duty measuring the output of this receiver and determining the frequency of the station being received.

By this means all classes of stations are being received and measured during the entire time the station is in operation. While reception is taking place careful notes are made of weather conditions, barometrical pressure, and other items which tend to furnish information on transmitting conditions. Approximate signal strengths are noted, as well as any other characteristics of the received signal. By reason of this information it is expected in the course of time to be able to predict under given circumstances transmitting conditions by means of which it will be known in a general way what stations can be received under certain conditions and at what times reception will be the best.

It is expected that this station will become valuable, through this analyzation, to make possible the maximum intensive use throughout the world of the radio spectrum. Technical information on transmission possibilities, the degree of advancement of radio in foreign countries, and a knowledge of world-wide transmitting conditions will be collected.

Control for Secondary Stations

Besides its frequency checking operations of national and international stations, the Grand Island station also serves as a control over the other nine secondary standard stations installed at strategic points throughout the United States. These secondary stations may be cross checked at any time with the Grand Island station, so that a maximum condition of accuracy pertains at all times. The frequency measuring facilities of the radio division, therefore, become a closely knit organization, capable of fast manipulation with accurate results.

At the present time, this combination of a central frequency measuring station with the nine secondary standard stations places the United States far in the lead of any other nation in the world in this field.

Secondary Monitors

As secondary frequency monitoring stations the division uses installations at various locations, the booklet also discloses.

To provide the supervisors of radio in charge of the nine radio districts with proper equipment for observing the operation of radio stations within their respective districts and for the purpose of ascertaining that stations are adhering to their assigned frequencies, the secondary frequency monitoring stations are of a high order of accuracy and are installed at Hingham, Mass., in the first district; Fort McHenry, Baltimore, Md., in the third district; Atlanta, Ga., in the fourth district; New Orleans, La., in the fifth district; San Pedro, near Los Angeles, and Larkspur, near San Francisco, Calif., in the sixth district; Portland, Oreg., in the seventh district: Detroit, Mich., in the eighth district, and Chicago, Ill., in the ninth district. A secondary frequency monitoring installation has been completed at the Grand Island, as previously explained. Observations and measurements of carrier frequencies at these secondary frequency monitoring stations are not, however, confined to stations located in the same districts as the monitoring stations themselves.

The intercepting and measuring equipment of the secondary frequency monitoring stations consist of three special units, a low-frequency receiver, a high-frequency receiver, and a secondary frequency standard, all contained in special steel racks, together with the necessary power-supply equipment.

Low and High Frequencies

The low-frequency receiver has a tuning range of 100 to 1,500 kilocycles, or 3,000 to 200 meters. A series of plug-in coils and 3-loop antennæ are provided to cover the entire frequency band, although provision is made for the use of an external antenna system.

Four individually tuned stages of radio-frequency amplification, an individually tuned, regenerative detector stage and an audio amplifier, consisting of one stage of resistance-coupled amplification and one stage of impedance-coupled amplification, are employed in this receiver. Vacuum tubes of different types, all of 5-watt power rating, are employed, and audible reception is by means of either head phones or dynamic loudspeaker.

The high-frequency receiver has a tuning range of 1,500 to 30,000 kilocycles, or 200 to 10 meters. This receiver is not supplied with loop antenna, external antennæ being employed exclusively.

Three individually tuned stages of radio-frequency amplification, an individually tuned, regenerative detector stage and an audio amplifier similar to that employed in the low-frequency receiver are employed. Screen-grid vacuum tubes are employed in the radio-frequency stages, while the tubes employed in the detector and audio stages are identical to those employed in same stages in the low-frequency receiver. Audible reception is by means of either head phones or dynamic loudspeaker.

"Radio Activities of the Department of Commerce" is made available for distribution by the Superintendent of Documents, Government Printing Office, Washington, D. C., at ten cents a copy.

nverter Built in

time the set is in use, regardless of the band, is one of strictest economy, and besides one that works well.

However, as intimated, the scheme does not spell perfection. There is no painstaking provision for dial adjustment, as a knob simply points to a small scale, although at a little extra cost this may well be a vernier knob, and then you will tune in greater distance more easily.

You can wind the coils yourself on the basis of these directions, selecting any diameter you desire, although 1.75 inches is probably as large as the chassis dimensions will stand, and as small as 1 inch may be used. Leave room for the plate winding at one end of the long form, and put on as many turns for L5 as will bring in 1,300 kc or thereabouts when the broadcast set is tuned to lowest frequency, and the 0.0003 mfd. condenser is at maximum capacity (position 3). Put on one-third as many turns for the plate winding, leaving a space of 1/8 inch between the two. It matters not which way the plate winding or other is put on. Oscillation will result with the windings bearing only one of two possible relationships, so reverse the connections to the plate winding if oscillation fails. Now leave 1/2 inch and put on as many turns for L3 (same direction winding as for L2) as will bring in at nearly maximum of the 0.000 mfd. condenser a station heard on the other coil at nearly 0 of the dial. You may have to wait until you hear a station at 5 or so on the dial of the larger short wave coil before you can wind a smaller coil to bring in that same station at or near the other dial extreme. And for the third coil use the same reference system, but comparing with the second coil, L3. Use 1/2 inch separation again.

As you will use the same intermediate frequency all the time, you can calibrate the short wave stations, and the same ones, if on the same frequencies, will come in at the same points on the small dial, without variation.

The only thing to remember is that some stations will come in at two points on the dial, but calibrate for the point representing the smaller capacity setting of the condenser. For the first short wave coils these two settings will be a few or several degrees apart at ahe dial, but for the next two coils they will be very close together. Only a few stations, those of largest intensity, should be audible at two dial points. It is just possible, however, that harmonics of broadcast stations may be heard on occasion, and these should be observed, so as not to confuse you in calibrating the finished set, or in winding the coils, which, by the way, may be wound of No. 28 enamel wire for L2, L3 and L4, while finer wire may be used for the broadcast impedance coil.

For the broadcast band, L5 may consist of 120 turns of No. 31 enamel wire on 1 1/8 inch diameter tubing, consisting of a single winding. The primaries of the interstage coil may be wound over the secondaries. The number of turns, same size wire and tubing, would be 100 for 0.00035 mfd., 85 for 0.00046 mfd. and 78 for 0.0005 mfd. The primaries would have 15 turns, which may be reduced if squealing results, although there was stability at 15 turns in the set under consideration.

If a choke primary is used for the plate circuit ahead of the detector, a honeycomb to fit inside the form may be used.

Some Shortcomings of All

Use of Small Condenser Required for

By Eina

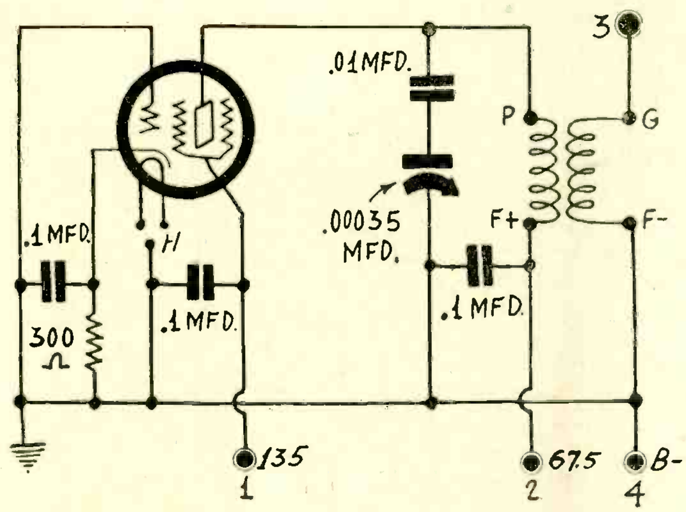


FIG. 1
The circuit of a simple dynatron oscillator covering the broadcast band of frequencies.

LIST OF PARTS

One oscillator coil as described (broadcast band).
Three 0.1 mfd. condensers, all in one unit.
One 0.01 mfd. condenser.
One 350 mmfd. tuning condenser.
One 300 ohm grid bias resistance.
One UY socket.
One UX socket.
Four binding posts (1, 2, 3, and 4).
One vernier dial for the tuning condenser.
One grid clip.
One filament transformer with center tapped 2.5 volt winding and provided with plug and cord.
One toggle switch for the primary.
One 235 type tube.
A suitable panel and cabinet.

THE dynatron oscillator continues to be popular among engineers and experimenters. Just why it should be more popular than the standard oscillators is not obvious for it does not possess any outstanding technical advantages and it does possess certain disadvantages not possessed by the others. It is said that the frequency stability is much greater in the dynatron than in any other type of oscillator. If this be true it is an advantage where extreme accuracy of calibration is essential but for routine testing and calibration of receivers any oscillator is sufficiently frequency stable.

On advantage of the dynatron is its simplicity. Only one winding is needed on the oscillator coil whereas the ordinary oscillator requires two. To offset this advantage the oscillation stability of the dynatron is not so great. That is, it may oscillate with a given tube and a given tuned circuit or it may not. The ordinary oscillator is quite dependable in this respect.

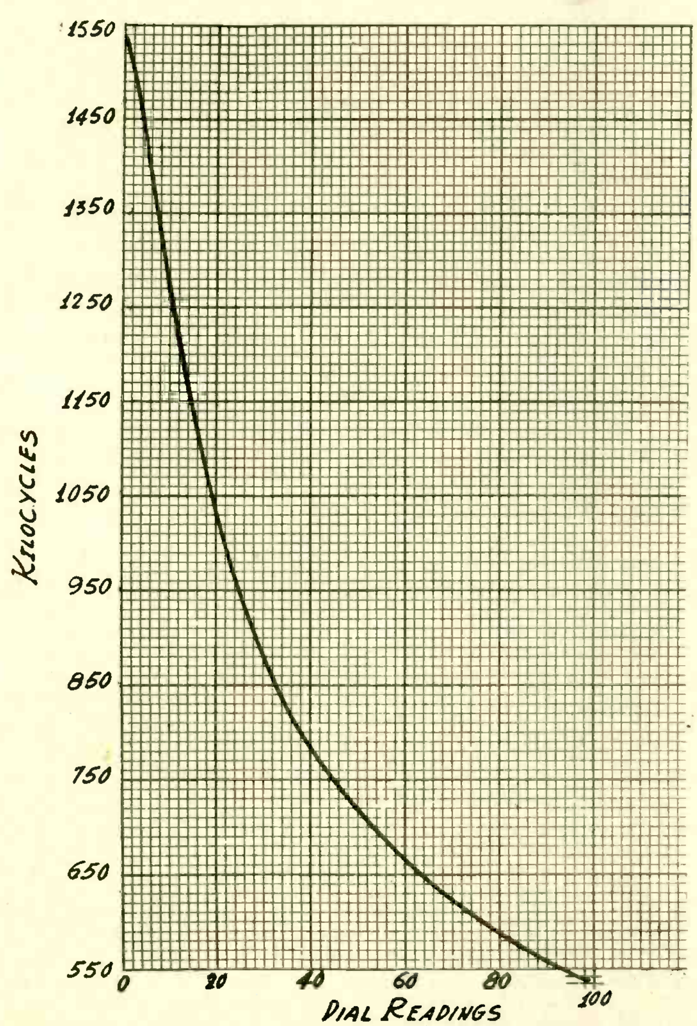


FIG. 2
The calibration curve of the dynatron oscillator showing a range from 538 to 1,538 kilocycles.

Behavior of Dynatron

It has been said that the dynatron does not oscillate on the short waves and that it is always dependable on the broadcast band. Again it has been said that it will oscillate on any frequency from a few cycles per second up to the highest useful frequencies but that oscillation depends on the particular tube used and on the voltages applied, which are supposed to be critical.

All these statements are true, more or less, for the oscillation depends on the relative voltages on the control grid, the screen grid, and the plate, as well as on the voltage on the heater. Obviously, it also depends on the characteristics on the particular tube used. But the voltages may be adjusted to the optimum values on a certain frequency range, and a particularly good tube may be selected yet the circuit may not oscillate at all on some other frequency band. For example, the oscillator in Fig. 1 was adjusted until it oscillated vigorously on the broadcast band but when it was tried on higher frequencies it would not oscillate at all. Why did it not oscillate?

Perhaps it would oscillate if the voltages were changed, or if a new tube were used. At first the voltage on the control grid was changed to see whether this had any effect. It could not be made to oscillate by a change of this voltage. Yet on the broadcast coil the circuit oscillated over a wide range of control grid voltages.

The plate voltage was maintained at 67.5 volts and the screen voltage at 135 volts. With this combination the circuit oscillated on the broadcast coil for all negative voltages up to 22.5 volts, but not when the voltage was increased to 24 volts. It also oscillated with positive voltages on the control grid up to about 7.5 volts. Therefore it cannot be said that the circuit is critical in this respect. It seemed to oscillate best when the bias on the grid was the same as that required when the tube is used as an amplifier and for that reason a 300 ohm bias resistance is connected in the circuit to maintain the grid at a low negative value. This resistance was shunted by a condenser of 0.1 mfd.

Screen and Plate Voltages

No critical adjustment of the screen and plate voltages were necessary, either. Holding the screen voltage at 135 volts, the circuit oscillated well on the broadcast coil for all voltages between 30 and 90 volts on the plate. And holding the plate voltage at 45 volts, the circuit oscillated for all screen voltages down to 67.5 volts. It seemed that 67.5 volts on the screen and 135 volts on the plate made the optimum combination. It cannot be said, therefore, that any of the voltages are very critical.

Not all the tubes tried had the same range of voltages. Hence it is necessary to select a good tube for oscillator.

Three coils were used, one just covering the broadcast band and the other two covered the rest up to 12,500 kc. Only the broadcast coil yielded oscillation notwithstanding the fact that the short wave

Wave Dynatron Oscillators

Vide Coverage, to Uphold the L/C Ratio

r Andrews

coils were wound with heavy wire while the broadcast coil was wound with No. 36 double silk covered wire.

The failure to oscillate was not due to high resistance in the coils nor to increase of frequency directly, for the broadcast coils had considerably more resistance than the other coils, at least low frequency resistance. With one tube, which was a particularly good oscillator, and with the voltages on the elements adjusted to what appeared optimum, the circuit oscillated on the middle coil when the condenser was set at less than one-fourth its maximum value. This shows that it is not due to increase of frequency that the circuit stops oscillating. If it had been due to increase of frequency the circuit should have oscillated when the tuning condenser was set at maximum rather when it was set at minimum.

Influence of the L/C Ratio

Apparently, the failure to oscillate was due to a decrease in the ratio of the inductance to the capacity, that is, to a decrease in the L/C ratio. In this respect the dynatron does not differ from any other oscillator, for any oscillating circuit will stop oscillating when the capacity in the tuned circuit becomes too high for the inductance. This is easily tested on either audio or radio frequency oscillators. Suppose, for example, that an oscillator is hooked up with an audio output transformer for oscillator coil. Without any capacity across either winding, except the distributed capacity, the circuit might oscillate vigorously at 10,000 cycles per second, as occurred in one instance. As capacity is added across on of the winding the frequency falls, as well as the intensity of the oscillation, until at a certain value of capacity the oscillation stops. What the critical capacity and the lowest attainable frequency are depends on several factors but mainly on the inductance in the oscillatory circuit. Naturally, it depends on the excellence of the tube and on the amount of feed back through the reaction coil. It also depends on the alternating current resistance of the coil. Possibly the Q of the circuit is the principal determining factor, the Q being defined as Lw/R, in which L is the inductance of the oscillating winding, w the frequency in radians, and R the effective resistance in the tuned circuit. At any rate, the higher the Q of the circuit the better is the oscillator and the more vigorous the oscillation.

The same experiment can be performed with a radio frequency tuner and the result is the same. For example, an oscillator such as is used in a superheterodyne can be made to oscillate at lower frequencies by adding more capacity in parallel with the tuning condenser, and a value can always be found above which the circuit will not oscillate. The case seems to be exactly the same with the dynatron oscillator, and there is no technical reason why it should be any other way.

Efficiency of Amplifiers

It will also be remembered that a radio frequency amplifier is more efficient, that is, its gain is greater, when the L/C ratio of the tuned circuit is greater. The aim always is to make the inductance as large and the capacity as small as possible. The limiting factor is the band coverage. As a rule, to cover the broadcast band the condenser cannot be smaller than 350 mmfd. unless every precaution be taken to reduce the distributed capacity in the tuned circuit. Even this condenser does not cover the band in all cases, and rarely where there is excessive shielding of the coil and when a trimmer condenser is used.

When the tuning condenser has a value of 350 mmfd. the required inductance to tune the 550 kc is 240 microhenries. Therefore the L/C ratio is 685,000 ohms squared. At the other end of the broadcast band, namely, 1,500 kc, the capacity in the circuit is 47 mmfd. and therefore at this end of the range the L/C ratio is 5,100,000 ohms squared. Therefore the L/C ratio is 7.45 times greater at the upper frequency end than at the lower and we might expect that the oscillation should be correspondingly vigorous. Note that 7.45 is the capacity ratio.

Now let us see what the L/C ratio of the next coil is at the two extremes of its tuning range. Suppose that the lowest frequency is 1,500 kc. When the condenser is set at 350 mmfd. the inductance should be 32.2 microhenries. Therefore the L/C ratio is 89,200 ohms squared. Assuming that the capacity ratio in this tuner is exactly the same as that of the broadcast circuit, the L/C ratio at the upper frequency end is 665,000 ohms squared. The highest frequency on these assumptions is 4,100 kc.

Oscillation in the circuit in Fig. 1 stopped when the L/C ratio was somewhere between 89,000 and 665,000 ohms squared.

Lowest L/C Ratio

The L/C ratio of the smallest coil in this set was about 90,000 ohms squared at the higher frequency end and only 9,200 at the lower frequency end. The total variation in this ratio is therefore very large, and if it is the determining factor there seems very little hope of getting oscillation on the smaller coils in the dynatron hook-up.

We have expressed the value of L/C as ohms squared because the square root of the ratio is a pure resistance expressed in ohms. If we extract the square root of the ratios we find that the variation is from 2,200 ohms to 95.8 ohms. The oscillator studied stopped when the resistance was between 300 and 815 ohms.

It will be observed that there are two condensers in series with the 350 mmfd. tuning condenser in the circuit in Fig. 1. But these series condensers are so large that they do not appreciably affect the L/C ratio. The distributed capacity across the circuit, which was not allowed for, is sufficient to make up for the decrease in capacity due to the series condensers.

It will be noted that the plate circuit of the dynatron in Fig. 1 is tuned and that the load on the plate is the resistance at reasonance of the parallel tuned circuit. This is practically equal to L/RC, in which L is the inductance of the coil in henries, C the capacity of the tuning condenser in farads, and R is the radio frequency resistance of the coil at the reasonant frequency. It is a pure resistance for it is a resistance squared, that is, L/C, divided by another resistance R. If the L/C ratio is large and the resistance of the coil is small, this load resistance, that is, L/CR is large. Hence the dynatron oscillates when the load resistance is large.

(Continued on next page)

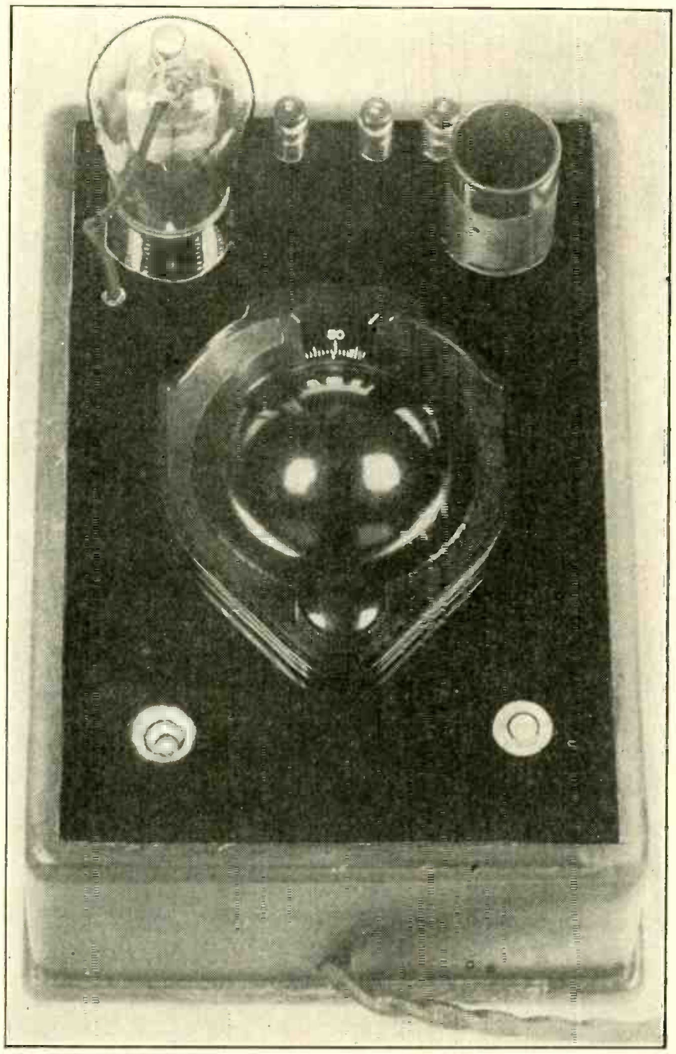


FIG. 3

The dynatron oscillator when completed. Besides the line switch there may be another for introducing line hum for modulation. A condenser of 0.00025 mfd. may be connected from cathode to heater for such modulation.

Three Modulated Oscilla

Circuits for Battery and A-C Operation

By Burton

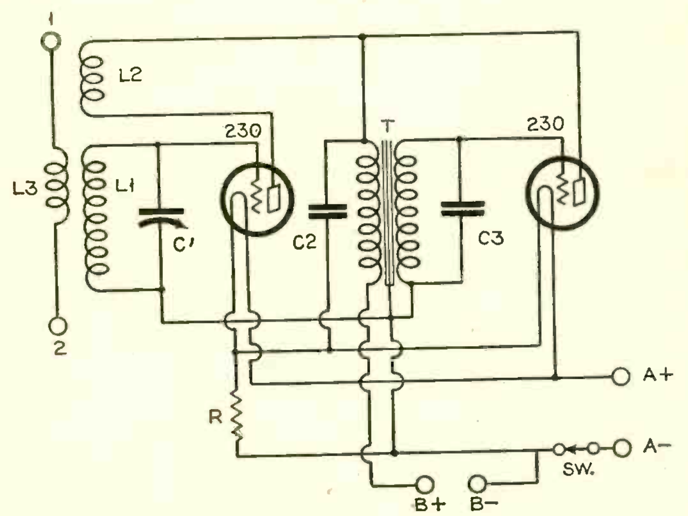


FIG. 1

A midget modulated test oscillator employing two 230 tubes and designed for battery operation.

THERE is always demand for test oscillators for lining up radio receiver tuners and for measurement purposes. Most of them must be modulated so that they can be used to take the place of broadcast stations.

Many such oscillators have been described, both simple and complex. Some are built for a-c and others for d-c operation. Some contain a single tube while others contain two or more tubes. Some are midgets employing the two-volt tubes while others are comparative giants containing radio frequency amplification and power output tubes. The type of any oscillator depends on the use to which it is to be put and the amount of money that is available for the construction.

There are modulated oscillators which have no other power supply than the unrectified voltage from the power line. These are the simplest, but they are limited as to the modulation frequency. If there is no rectifier or plate battery alternating current is used on the plate and the only frequency of modulation is the 60 cycle line frequency. This is not suitable for many tests because it is so low that many amplifiers and loudspeakers do not reproduce it. An audio frequency oscillator is a useful part of a tester of this type provided it is designed so that different audio frequencies or at least so that a high modulation frequency can be obtained.

We shall describe a number of modulated radio frequency oscillators in which an audio frequency oscillator will be incorporated to supply the modulation frequency.

Two Tube Midget Tester

In Fig. 1 is a very simple modulated oscillator which contains only two 230 type midget tubes and which is designed for battery operation. At first sight it appears to be a two-tube receiver consisting of a regenerative radio frequency detector and a stage of audio frequency amplification, but a closer study reveals that it is not a receiver at all, but a miniature transmitter.

Both tubes are oscillators, the first generating a radio frequency and the second an audio frequency. The two tubes are coupled together so that the circuit forms a Heising modulator. Both are tuned grid oscillators and each has a tickler coil.

L1C1 is the tuned circuit determining the radio frequency and L2 is the tickler which induces oscillation. L3 is a pick-up coil by means of which the modulated radio frequency signal may be obtained for application wherever needed. For most purposes the pick-up coil is not needed at all unless the coil system is completely shielded.

Ths coil system L1, L2, L3 may be a regular three circuit tuner in which L1 is the large winding, L2 the tickler and L3 the primary. The condenser C1 may be any variable condenser of a capacity which with the inductance of L1 will cover the frequency range desired. For example, if L1 has been wound for a 350 mfd. condenser to be used as a tuner in a receiver of broadcast signals, this combination will cover the same frequency range in the oscillator.

Audio Oscillator

The audio oscillator has essentially the same circuit as the radio frequency oscillator It contains an audio transformer T with a tuning condenser across the winding that is connected in the grid circuit. If the two windings on the transformer are different the larger of the two should be connected in the grid circuit, and the tuning condenser C3 should be connected across this winding. A suitable transformer is one that has been designed as an output transformer between a power tube and a magnetic speaker. There are many such transformers available at a very low price because millions of them have been made and very few are now in use in receivers. It may be push-pull or ordinary, and if it is push-pull either the entire center tapped winding or half may be used. The choice depends on which will oscillate the better and which will give the more desirable frequency with the condenser that is available for tuning.

Ordinary audio frequency transformers usually give a frequency that is entirely too low and for that reason they are not desirable. Often they give a frequency lower than the 60 cycle line frequency. Filament transformers either do not oscillate at all because the inductance is too low or they oscillate at a frequency that is too high, and if an attempt be made to lower the frequency with condensers the L/C ratio becomes so low that oscillation stops. No such difficulty is likely to be encountered if the output transformer mentioned is used. One such transformer which, connected without any condensers across either winding, gave a frequency of about 10,000 cycles and a condenser of only 0.00025 mfd. brought the frequency down to about 2,000 cycles, which is satisfactory for testing receivers and for lining up tuners. This circuit also oscillated at a frequency as low as 200 cycles when a larger condenser was put across the secondary. Hence it is possible to adjust the frequency to the 400 cycle standard test frequency.

Tune Either Winding

In case the desired frequency is not obtained by putting a condenser across the secondary, or grid winding, it may be obtained by putting across the plate winding. In Fig. 1 there is a condenser across each winding. C2 across the plate winding is

A Diagnosis of Dy

(*Continued from preceding page*)

When anything is connected to the second winding on the coil form the circuit does not oscillate as readily as when this winding is left open. When a wire connected to point (3) was looped once around the oscillating coil of another oscillator and grounded at the other end, the dynatron oscillator stopped at the reasonant frequency while the other oscillator, or the ordinary type, did not. The dynatron was, apparently, the weaker oscillator.

One of the admitted weaknesses of the dynatron is that it will not deliver much power. However, the use of an oscillator in most instances is such that practically no power is required. As a rule, it is used only for calibrating other tuned circuits, and this can be done with exteremely loose coupling between the dynatron and the circuit to be calibrated. One way would be to connect point (3) to the grid of a radio frequency amplifier. Considerable power could then be taken from this amplifier without appreciably affecting the stability or the frequency of the dynatron. If the amplifier is a 247 pentode as much as 5 watts would be available. If the output of this amplifier were modulated with the output of an audio frequency oscillator generating a suitable frequency, a large number or receivers could be calibrated and trimmed simultaneously. Two such test circuits are described elsewhere in this issue.

All the values of the parts in the dynatron oscillator are given on the circuit diagram, with the exception of the coil. This was wound 110 turns of No. 36 double silk covered wire, the terminals of which were connected to the P and F plus prongs on a form that fits a UX socket. A pick-up winding of 10 turns of the same wire was connected to the G and F minus prongs on the form. The form has a diameter of 1.25 inches. The windings of the other coils in the set will not be given because of the failure of these coils to oscillate. The large winding just covered the broadcast band as will be seen from the calibration curve reproduced in Fig. 2. The range is exactly 1,000 kc, from 538 kc to 1,538 kc.

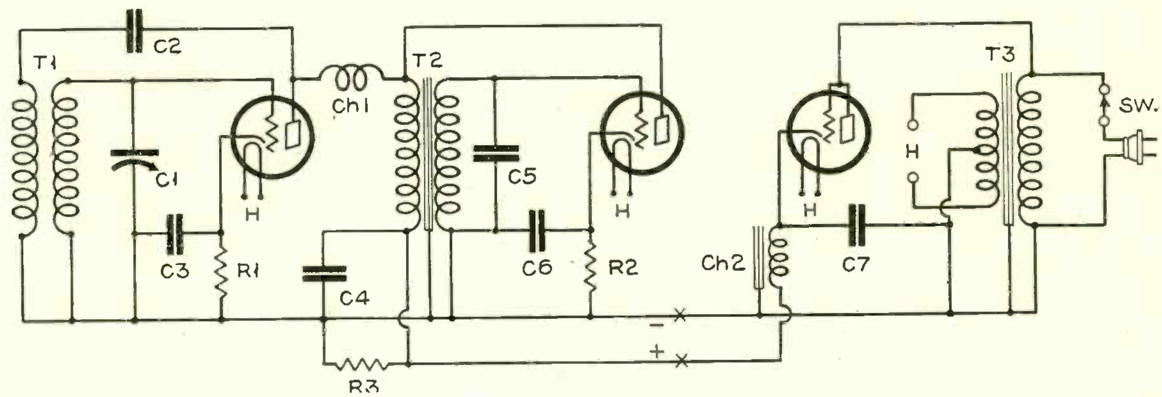
The calibration was done by comparing the dynatron with a previously calibrated oscillator. At first the coil between P and F plus had 113 turns but this winding did not cover the band satisfactorily.

tors for Receiver Testing

Facilitate Laboratory and Production Work

Williams

FIG. 2
A modulated test oscillator employing 227 tubes and designed for a-c operation. The plate voltage supply is built in.



for the purpose of by-passing the radio frequencies and to give the radio frequency oscillator a chance to work. This condenser need not be larger than 0.0005 mfd. It may be that it will be the only condenser that is needed, as it may give the desired audio frequency, or it may be that a somewhat larger condenser will do the work. A little experimenting will determine whether both condensers are needed or only one of them and also how large the capacity should be.

If the audio oscillator does not work the first time it may be either because the L/C ratio is too low or because the phase of the connection is wrong. Or it may also be that the circuit is oscillating but that the frequency is so high that it cannot be heard. First try small condensers across the windings to see whether the frequenly can be brought within audibility. If nothing happens the circuit may not be oscillating. Then reverse one pair of leads, either the secondary or the primary, but not both. If oscillation results try various condensers as suggested until the desired frequency can be brought within audibility. If nothing happens a different transformer will be needed. This, however, is unlikely, for almost any transformer in which the turns ratio is low will oscillate when the leads are properly connected, and also provided that the capacity is not too large for the inductance.

It is advisable to ground the core and the case of the audio transformer. It is also desirable to place the entire circuit inside a grounded metal box, bringing out only the leads to coil L3. If this winding is not used everything by the radio frequency coil may be put inside the metal box. Of course, it is not essential that the metal box be used.

Voltages

Both tubes will oscillate with voltages as low as 22.5 volts and upward in most cases. Forty-five volts will surely make it oscillate and it is not necessary to go any higher unless the circuit requires it for oscillation. If oscillation fails at 45 volts it may be best to try better tubes or possibly a little higher filament voltage. The type of oscillators used in this circuit do not oscillate as readily on low voltages as oscillators having positive grid return and a grid leak and condenser. But it is better to use a little higher voltage and the negative biased tubes.

If the tubes are 230s the filament terminal voltage should be 2 volts and it is sufficient to use two dry cells in series for A battery. The voltage is one volt in excess of requirements and therefore a ballast resistance R is used to drop it. The total current in the filament circuit is 0.120 ampere, and this current flows through R. Hence R should have 8.33 ohms. There will undoubtedly be oscillation in both tubes if the resistance be made 10 ohms. If the batteries are built into the circuit and put in the metal box, which is recommended, a filament switch Sw is a convenient part.

A-C Operated Oscillator

In Fig. 2 is a similar oscillator circuit designed for operation on alternating current. It contains three tubes, two oscillators and one rectifier.

The radio frequency oscillator in this circuit differs from that in the preceding circuit in that it is arranged for parallel feed. The audio oscillator is the same as the preceding circuit. Since the radio frequency oscillator is of the parallel feed type we need the condenser C2 in series with the tickler, and this condenser need not be larger than 0.001 mfd. We also need the choke coil Ch1, which should be one of about 10 millihenries. One of the 800 turn duolateral coils used in 175 kc intermediate transformers is recommended.

The radio frequency transformer T1 is the same as that in the preceding circuit and the third winding, not shown, may be included if desired. The only requirement of C2 is that it be of the capacity for which the coil was wound.

The audio tuning condenser C5 is connected across the secondary or grid winding. But as before it may be connected across the plate winding if that gives the desired frequency with the capacity available. T2 is subject to the same conditions as T in Fig. 1.

Bias Resistors

It will be noted that the radio oscillator in this circuit may be converted to the series feed type used in the preceding oscillator by putting the tickler in the position of Ch1, that is, between the plates of the two tubes. C2 is then omitted, as is Ch1. Of course the tickler winding remains on the form of the tuned winding.

Each of the two resistance R1 and R2 may be either 1,000 or 2,000 ohms. It makes no difference which, except that if it is

(*Continued on next page*)

natron Oscillators

The frequency was too low at the low end as well as at the high end. A turn at a time was removed and the lowest frequency measured until the measured frequency was 538 kc when the condenser was set at maximum. This required the removal of three turns, leaving 110 turns of No. 36 single silk on 1.25 inch diameter. With this winding the frequency was 1,538 kc when the condenser was set at zero. There was no big change in the frequency between 98 and 100 on the dial.

In winding the coil it is best to put on at least five turns more than the expected final turns in order to allow for small variations in the circuit, and especially in the variable condenser.

In case a calibrated oscillator is not available, the dynatron can be calibrated against broadcast stations. Run a wire from the antenna serving the broadcast set to the dynatron, but do not connect it. Leave it open and near the oscillator. Tune in any broadcast station. Then turn the condenser of the dynatron until a squeal is heard in the broadcast set. Leave the condenser at the point of zero beat, that is, in the middle of the squealing region. Note the setting of the dynatron condenser and also the frequency of the station tuned in. This gives one point on the calibration curve. Repeat for as many broadcast stations as can be tuned in with the broadcast set.

In case points all over the dial cannot be found by this method, it is possible to utilize harmonics. Suppose the station tuned in is 660 kc. The first harmonic will have a frequency of 1,320 kc. There will be two points on the dynatron oscillator dial at which squeals will be heard. One is 660 and the other is 1,320 kc. This can be repeated for several other frequencies. It is also possible to use the reverse method. The local station tuned may have a frequency of 1,320 kc. From this the 660 point can be found. By using harmonics it is possible to obtain at least 20 calibration points from which to construct the curve. The curve in Fig. 2 was constructed from 21 readings, several of which had to be obtained from harmonics because the calibrated oscillator used covered a frequency range from 510 to 1,230 kc. Harmonics had to be used between 1,230 and 1,538 kc.

Oscillators for Testing

Modulation Provided by an Extra Tube

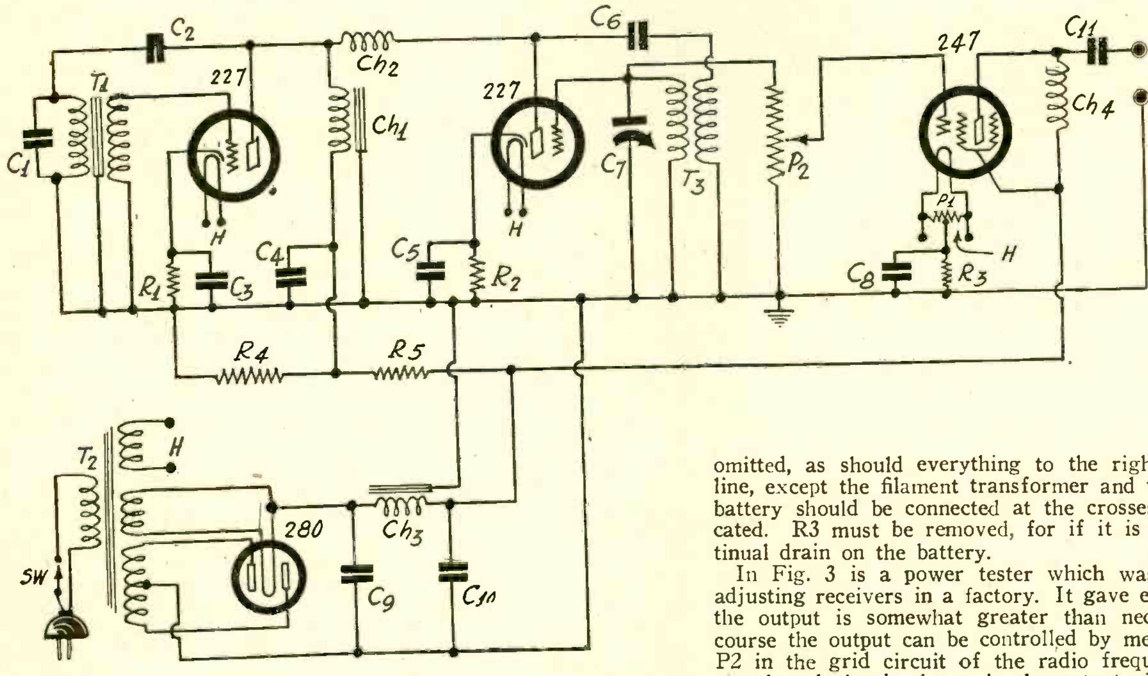


FIG. 3
A high power modulated test oscillator designed for a-c operation. It utilizes two 227 tubes for oscillators and a 247 radio frequency amplifier for output.

(*Continued from preceding page*)

desired to limit the plate current the higher resistance is preferable. Condenser C3 should have a value of no less than 0.001 mfd., but it is unnecessary to make it larger than 0.01 mfd. C6 should be at least one microfarad.

The plate voltage is provided by a 227 rectifier and the voltage to be rectified is taken directly from the a-c line. T3 is the filament transformer supplying the three tubes. C2 should be a 30 henry choke, C7 an 8 mfd. electrolytic condenser, and C4 a similar condenser or one of 4 mfd. R3 is only a bleeder current resistance to prevent the voltage from rising excessively. Twenty thousand ohms will do nicely.

If it is desired to operate this tester with a B battery, it is sufficient to use either 45 or 90 volts. In this case R3 should be omitted, as should everything to the right of the crosses on the line, except the filament transformer and the line switch Sw. The battery should be connected at the crosses with the polarity indicated. R3 must be removed, for if it is not it will cause a continual drain on the battery.

In Fig. 3 is a power tester which was constructed for use in adjusting receivers in a factory. It gave excellent results, although the output is somewhat greater than necessary for the job. Of course the output can be controlled by means of the potentiometer P2 in the grid circuit of the radio frequency amplifier. No coil or other device is shown in the output circuit of the power tube, but in practice a small loop was used. Ample output was obtained with a few feet of wire connected to the upper output post, but then the plate of the output tube got red hot.

When his oscillator is used care should be taken that it does not become a nuisance in the neighborhood, for it is capable of much interference due to its high power. It should be placed in a metal box and the output should be cut down to the lowest value that will do the work required.

LIST OF PARTS

(*for Fig. 3*)

Condensers

C1—A small fixed condenser to be determined by trial to give the desired audio frequency. (Capacity used was 0.00025 mfd.)
C2, C3—Two 1 mfd. condensers.
C4—One 2 mfd. condenser.
C5, C6, C8, C11—Four 0.01 mfd. condensers.
C7—One 350 mmfd. tuning condenser.
C9, C10—Two 8 mfd. electrolytic condensers.

Coils

T1—One 1-to-1 audio frequency output transformer (designed for magnetic speaker and 171A power tube, or similar use.)
T2—One small power transformer having one 2.5 volt winding, one 5 volt winding, and one center tapped 600 volt winding.
T3—One radio frequency, shielded transformer, designed for 350 mmfd. tuning condenser.
Ch1, Ch3—Two 30-henry filter chokes.
Ch2, Ch4—Two 800 turns duolateral wound radio frequency chokes, or coils of about 10 millihenries.

Resistors

R1, R2—Two 2,000 ohm bias resistances.
R3—One 400 ohm bias resistance.
R4—One 10,000 ohm resistance.
R5—One 8,000 ohm resistance.
P1—One 30 ohm center tapped resistance.
P2—One 500,000 ohm potentiometer.

Other Parts

Three UY sockets.
One UX socket.
One vernier dial for C7.
One line switch, toggle type.
Two 227 tubes.
One 247 tube.
One 280 rectifier tube.
Suitable chassis and metal box.

Radio in Latin America

The extent to which manufacturers and merchants in Latin American countries employ radio to present their commodities and services to the buying public is revealed in a bulletin on broadcast advertising in those areas which the Commerce Department has just issued. The information embodied in the bulletin was submitted to the Department by its own representatives and consular officers in the respective countries surveyed.

With the exception of those that are Government-owned, practically all radio broadcasting stations in Latin America accept commercial advertising derive their main income from this source. Unlike the usual practice in the United States, it is customary for Latin American broadcasting stations, rather than the advertisers, to provide the entertainment. The American system of radio "hours" has been tried out in Argentina but has not been found suitable to the country. However, there are some large advertisers in that country that engage their own talent and conduct their own broadcasts.

Outside of Argentina and Mexico, programs of the great bulk of Latin American stations are made up of phonograph records. Argentina has the largest number of receiving sets of all Latin American countries and elaborate programs are offered by its larger broadcasting stations. Orchestras especially skilled in rendering "national" music are frequently on the air and programs also include dramatic selections, addresses, recitations, etc.

Mexico City stations also provide exceptionally good programs, including first-class singers and excellent bands and orchestras.

Brazilian broadcasts almost invariably consist of phonograph records. In Chile merchants use the radio to advertise such products as automobiles, household appliances, etc. In Venezuela the most important broadcasting station is owned by an American concern which employs a staff of entertainers under contract. Although all of the seventeen stations in Habana, Cuba, do some broadcast advertising, Cuban advertisers have not been very quick to make use of this form of publicity.

While radio advertising in Latin America has a long way to go before it arrives at the position enjoyed in the United States, it seems to be gaining impetus as increasing numbers of receiving sets are installed. Lack of variety of programs, it is pointed out, is a factor which impedes any marked development. Advertising rates for radio broadcasts vary widely in different countries.

Non-Magnetic Watches

Radio Workers' Timepieces Immunized at Hairspring

EVERY radio worker knows how erratic a watch may become if brought into contact with a magnetic field. This drawback has been eliminated by a great scientist whose primary object was to overcome effects of temperature on a watch.

Temperature changes have a definite relation to the accuracy of a watch, and have always presented a distinct problem in watch designing.

Heat reduces the elasticity of the usual carbon steel hairspring (weakens it) while cold has the opposite effect. Were there no automatic compensating device in a watch, these ups and downs of temperature would cause a loss or gain of approximately seven seconds a day for a change of 1° Fahrenheit.

Watchmakers long ago realized this, but until 1766 no really adequate means had been devised to offset temperature effects on the hairspring.

How Temperature Effects Are Neutralized

Automatic neutralization of the error, at two extremes of temperature, has been accomplished by using a balance wheel so constructed as to create an effect opposite to that brought about by the change in the elasticity of the hairspring.

This effect is obtained by making the wheel rim of two metals with different coefficients of expansion—steel on the inside, brass on the outside. This bimetallic rim is cut at two places in its circumference, on opposite sides and near opposite ends of the balance arm, as the one full diameter "spoke" of the balance wheel is called. These cuts give two large rim sections with free ends.

As brass expands or contracts more rapidly than steel, these free ends are forced inward toward the center when temperature rises, outward when temperature falls. Thus the diameter of the balance wheel is reduced or enlarged and its rate of oscillation is maintained despite the decrease or increase of the elasticity of the hairspring. The changes in the diameter of the balance wheel counteract the respective effects of temperature variation on the hairspring.

Scientist Creates New Alloy for Hairsprings

This compensating balance wheel is now rendered unnecessary because an alloy called elinvar has lately been perfected for use in the hairspring of a watch. This and other nickel steel alloys won for their originator, Dr. Charles Edouard Guillaume, the Nobel Award in Physics, in 1920. For the past five years two American watch manufacturers have been carefully and exhaustively testing the use of elinvar in watch hairsprings and have recently placed them in railroad models of their standard watches.

As the elasticity of an elinvar hairspring is unaffected by temperature changes, it permits the use of a solid rim balance wheel of monometallic construction.

Elinvar cannot be permanently magnetized. This quality adds another radically important advantage to the use of elinvar in a watch hairspring. Watches equipped with elinvar hairsprings have solid rim, non-magnetic balance wheels and are safely worn around electrical apparatus.

They are immune to magnetization unless held right in an exceptionally strong magnetic field. Even in that case an elinvar equipped watch resumes running as soon as withdrawn from a magnetic field of such strength as to permanently magnetize every steel part, and which put entirely out of commission watches with carbon steel hairsprings and bimetallic balance wheels.

A More Practical Watch for Rádio Men

These characteristics of elinvar have made possible the construction of a watch of more practical usefulness to those whose work requires their being in varying temperatures, or in contact with electrical apparatus—mining, metallurgy, smelting, metal working, radio, engineering, railroading and street railway operation, aviation, power production, refrigeration, foundry work, welding, etc.

In this mechanical age we are constantly in contact with electrically operated machinery in home, office, mine, factory or farm. Our daily migrations in this day of electric transportation, extensive touring and aviation necessarily bring us near to magnetic fields and into rapidly varying temperatures.

As elinvar is also resistant to rust, it overcomes another frequent cause of erratic timing.

FOR OUR BUENOS AIRES SUBSCRIBER

SOON I leave for Buenos Aires. I shall desire a short wave converter, since I am informed there are times that the static down there is so bad that reception of broadcasts, on the regular channels, is out of the question. Will you please let me know what wave range the converter should cover?—K. H.

You could build or obtain a converter, using two tuned circuits, with two fixed coils, to cover the band from 16 to 45 meters, as the short wave stations on which the residents of Buenos Aires rely are all within that band. It would be practical to use a tuned modulator, tuned oscillator and a built-in rectifier and A power supply, for alternating current operation. But the device must be for 220 volts, 50-60 cycles, which would require a special power transformer. The method of introducing a series resistor to take up the voltage difference (110 volts) is all right electrically, but bad economically, as it it doubles the power used at no increase in any other direction.

PLACEMENT OF PRIMARY

IN constructing a radio frequency transformer should I put the primary next to the secondary, on the same bakelite form, or on a separate form inside, or, using insulating fabric between, wind the primary on top of the secondary?—J. G. D.

It makes little difference which way the transformer is constructed, since the degree of coupling is the main consideration. The same degree of coupling may be achieved by any of the methods. It is easier to put the primary next to the secondary, rather than over it or on a separate form inside. The placement inside is used for mechanical reasons where the primary is a radio frequency choke coil. Sometimes, when the choke is not the primary, and is not to be inductively related, it is mounted inside the secondary form, at right angles electrically, just to have a handy place to put it.

THE following is a list of some of the new members of the Short Wave Club. Virtually every week new names are published. There are no repetitions.

Joseph Zorro, 32 Midland St., Hartford, Conn.
Leslie Bertie Smith, 55 South George St., Belleville, Ont., Canada.
Wallace Scappini, 20 E. Main St., Waterbury, Conn.
Beryl A. Wallace, 20 Royce Ave., Middletown, N. Y.
C. A. Rudolph, Box 26, Independence, Mo.
Teddy Spiegelman, 134 Suffolk St., New York, N. Y.
Dwight De Ward, 30 Lakeview Terrace, Grasmere, S. I., N. Y.
Harry Weber, Jr., 4601 Wayne Ave., Philadelphia, Pa.
Morgan Malm, 1014 Anderson St., Montreal, P. Q., Canada.
Allan E. Benson, R. No. 1, Box 58, Emmett, Idaho.
Paul Madigan, R. R. No. 10, Anderson, Ind.
T. R. Cancino, 1916 Vera Cruz St., San Antonio, Tex.
George Griswold, Goshen Road, Litchfield, Conn.
George Griswold, Conn. Junior Republic, Litchfield, Conn.
Samuel Michaels, 1362 Washington Ave., Mobile, Ala.
Francis Campbell, So. Whellock Road, Lyndonville, Vt.
C. R. Jenks, 422 W. Elm St., Stillwater, Minn.
Hugh Metcalfe, 735 Jenkins, Norman, Okla.
Frank Jarosz, 64 Delafield St., Poughkeepsie, N. Y.
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Harold F. Arnold, 129 Pine St., Springfield, Mass.
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Anthony Fazio, 811 Wylie Ave., Pittsburgh, Pa.
Bill Wightman, 1366 Challen Ave., Jacksonville, Fla.
Chas. W. Yeager, 1316 S. Date Ave., Alhambra, Calif.
Tommy Thompson, 210 7th. N. E., Ardmore, Okla.
Harry E. Weintraub, 443 York St., Jersey City, N. J.

Short Wave Club

ARE you interested in short waves? Receivers, transmitters, converters, station lists, trouble shooting, logging, circuits, calibration, coil winding—what not? If so become a member of Radio World's Short Wave Club, which you can do simply by filling in and mailing attached coupon. Or, if you prefer,, send in your enrolment on a separate sheet or postal card. As many names and addresses as practical will be published in this department, so that short wave fans can correspond with one another. Also letters of general interest on short wave work will be published. Besides, manufacturers of short wave apparatus will let you know the latest commercial developments. Included under the scope of this department is television, which is spurting forward nicely.

Short Wave Editor, RADIO WORLD, 145 *West 45th St., New York.*

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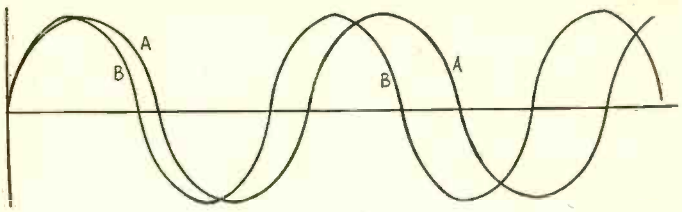

FIG. 960
Diagrammatic representation of a difference in the phase of two alternating voltages

Difference in Coupling in Converters

AFTER having read several articles regarding short wave converters I am still perplexed as to the coupling between modulator and oscillator. If there is a single coil, tapped, for each tuned circuit, and there is a winding on the oscillator coil to couple the cathode of the modulator to the oscillator, is not the coupling the same for all frequencies, whereas it should be different? How is the compensation made for this obvious disparity? Does not the universal coupling adversely affect some of the frequencies?—T. M.

Use of the same number of turns, or identical winding, for coupling at all frequencies results in a change in the coupling with frequency, because the mutual impedance increases with frequency. You are in error in supposing therefore that the same inductance results in the same coupling. You mention compensation. The ideal solution would be to have the coupling the same for every frequency, but this is impractical. What is done in the circuits of best design is to have the coupling the same for the geometric mean of the band to be covered by a single coil or tapped section. You will be pleased to know that even the same inductance used over a very wide band of frequencies does very well for coupling, but different coupling for the different bands covered by particular coils of course is some improvement.

* * *

Volume on Resistance Audio

IN using regeneration in the audio channel, as you have been showing in recent issues, you have at least a two stage resistance coupled amplifier. What I would like to know is whether the volume of sound is much greater than from a single stage?—T. G. F.

No, it is not much greater. The extra tube serves readily the purpose of providing the means of regeneration. The same system can be used on single stage and on two stage resistance amplifiers. In fact, it is even applicable to other forms of coupling. The reason why not much more in volume of sound can be accomplished is that the intensity of the amplification is one of the factors governing the amount of feedback. This amplification can not well exceed a certain overall value without causing the oscillation to become greater. Then when a corrective is applied the amplification is less. So resistance coupled amplifiers at audio frequencies may be regarded as self-limiting to this extent, a point which we believe has never been disclosed in this manner before. However, the maximum undistorted power output may be much greater in a two stage system if the output tube used is one that makes that possible. If the same type tube is used, e.g., 247 pentode, of course the maximum undistorted power output is the same no matter how many stages precede it. The regenerated audio system is important in making it possible to tune the audio channel, hence the sluggishness of speakers and in fact the unified system, in respect to low notes, readily can be overcome, without overemphasis of middle or high notes, and even a bull fiddle can be heard on a 7-inch dynamic in one of those midget cabinets.

* * *

Winding Converter Coil

WILL you please state a simple way to determine experimentally the number of turns to put on tuned secondaries to be used with a gang condenser in a superheterodyne type converter?—J. E. R.

For the first and second bands you may use the following method. Calibrate the condenser to the extent of maximum and minimum frequencies on the broadcast band. This is easy, as you can select 1,500 kc and 550 kc or a little lower than 1,500 kc or higher than 550 kc, if the extremes do not come in at your locality, and six points in between. Draw the curve on plotting paper. This will give you the frequency ratio and the shape of the curve. For the next band, say, 1,400 kc up, put on just enough secondaries to tune in 1,400 kc at 95 to 97 on the dial. Register this frequency as one extreme and draw the curve, which may be traced from the one made for the broadcast band. This will give you the numerical settings of different frequencies, say, from 1,400 kc to 4,200 kc. Note the number of turns. Convert this tuned winding into an oscillator by adding a plate coil, in inductive relationship, of about one-third the number of secondary turns. Now put a series condenser between stator of the tuning condenser and the coil secondary terminal, and put a trimmer across the series condenser and another across the coil. Adjust these capacities until the extremes, or near the extremes, give the same dial readings for frequencies greater than the original ones by the amount of the intermediate frequency. The series condenser may have to be around 0.0005 mfd. for the first band. For the next band it would be larger, or, if a manual trimmer is across the modulator, then for the second band no special compensation of the oscillator will be necessary. The third coil has to be done experimentally, because the frequency ratio is upset by capacity and other conditions that become very effective on these extra high frequencies. Tune in a station near 0 on the dial for the second coil, then wind an oscillator coil so that this station comes in instead at near 100. The modulator and oscillator coils may have the same number of turns for the third band. Of course you will use an intermediate frequency within the broadcast band. The lower the frequency the smaller the difference between the two tuned circuits.

* * *

Phase Difference

WILL you please explain what phase difference is? Suppose there is only one voltage, how can it be a different voltage than what it is? If it is one voltage there is no difference of any kind, is there?—J. R. D.

If the voltage is alternating there may be a difference in the time when any selected value of voltage is reached, even though the voltage is the same, because alternating current is governed by a time factor, that of frequency per second. With direct current there is no alternation, hence no phase difference. When direct current is pulsating, an introduced alternating current is converted into changing values of direct current, and here phase enters also. Fig. 960 illustrates phase difference graphically. Suppose that B and A represent the two alternating current voltages of the same value. It can be seen that B reaches an equal value earlier than does A, hence the voltage of A lags behind that of B, and B is said to have the leading voltage. Note that at two points for each cycle the lines cross. But at those instants the voltage of one is rising while that of the other is falling, so they are still out of phase.

* * *

Work Done on Ultra Frequencies

HAS much work been done on the ultra frequencies, those in the light region? What sort of a hookup is necessary?—Y. T.

Compared to what has been done on the broadcast band, and also in the short wave region, little has been done in the ultra frequency span. The ultra frequencies are compared to light frequencies, not because the two are close together, for they certainly are not, but because the behavior of ultra frequency transmission is much like that of light transmission. The waves don't follow the curvature of the earth and are limited in useful range to the distance of visibility. This is around 25 miles. However, sometimes the waves travel a little farther, and dip around the curvature. The waves are not subject to the effect of the Kennelly-Heaviside layer, since there is no upshooting sky wave. The ground wave is quickly dissipated. The light similarity is borne out also by the obstructive effect of opaque objects on ultra frequency transmissions. The hookup necessary is one that will sustain oscillations. Special tubes are used, and sometimes the Barkhausen oscillator is employed. This works on the principle of negative resistance in the tube, occasioned by reversal of the usual voltage conditions, whereby the plate is maintained negative and the grid highly positive. No coils are used, but some arrangement consisting of Lecher wires, or the like, whereby the useful portion is limited to a quarter wavelength. Therefore the wave can be measured with a yardstick. Only highly specialized laboratories have accomplished much with the ultra frequencies. The American Telephone and Telegraph Company, RCA Communications, General Radio Company, and some foreign experimenters either working

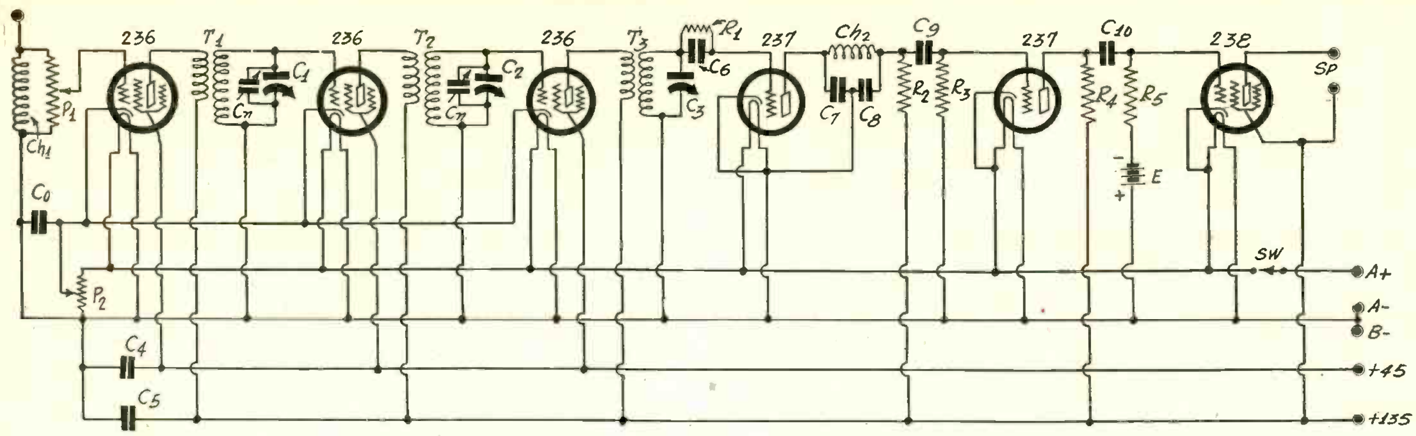

FIG. 961

A circuit suitable for the construction of an auto set, using the automotive tubes, heaters supplied by the car storage battery, while 135 volts of B battery are recommended, also 10.5 volts for pentode bias (additional), and a 6-volt dynamic speaker with pentode output transformer built in.

for large laboratories or subsidized by patrons, have accomplished results. Voice is unusually clear and distinct. Television is now being tried on waves of a few meters and soon may be tried on the ultra frequencies. The Calais-Dover experiment, where 18 centimeters wavelength was used for voice, received world-wide publicity, and renewed interest in these frequencies, which have been the subject of intense experimenting by a few laboratories for from two to three years, resulted. Nothing is as yet ready along this line for the home experimenter. Also scheduled transmissions are lacking.

* * *

Band Shifting

VARIOUS methods have been shown for band shifting. At first we had plug in coils, next came switching in several forms. Now, is it not a fact that plug in coils are far better? What about a coil that is tapped, one tap after another being picked up, for inductance change?—K. E. R.

Plug in coils give excellent results, and switch arrangements can not give any better results. When it comes to switching, the method used, and other details, determine the effectiveness. A tapped coil is mechanically the easiest way, but electrically not the best. It has the effect of increasing the noise-to-signal ratio. If the coil is tapped, rather than short out unused turns, or leave them open or dead-ended, it is preferable to attach the coil terminal to the grid, and by means of the switch move the stator to the various positions, extreme, first tap, second tap, etc. A drawback is that some dead spots may result. The reason for dead spots is some absorption circuit related to the tuned circuit. The frequencies not heard are simply trapped out by this absorber. With a tapped coil, even the one mentioned, the total inductance, with its distributed capacity, may have a resonant period naturally at some frequency you are trying to tune in with the condenser at a lower tap. The absorption effect also prevails on harmonics of the fundamental natural period cited. Yet with tapped coils, using the exampled method, good results are obtainable. Better results prevail when separate coils are used, and of course they must be maintained free and clear of mutual coupling with one another, otherwise the same trapping effects and resultant dead spots must be expected. Some switching methods, using separate coils, where the coils are not coupled when they shouldn't be, work just as well as do plug in coils. This season's crop of switching circuits is far superior to last year's so much so that manufacturers are guaranteeing against dead spots on the dial.

* * *

Multi Mu Volume Control

IN working the variable mu tube, is it better to control volume by varying the grid bias or by varying the screen voltage?—J. H. D.

Either method may be used and both ways work well. When the grid bias is varied, the higher the signal level the higher the bias manually introduced, and the greater the selectivity where supposedly greater selectivity is needed. If the screen voltage is varied, the current through the fixed biasing resistor is lowered as the screen voltage is increased, so the handling of larger volume is accomplished at a lower bias, although of course at a lower amplification factor. The difference is not of great practical importance, however. It is to be noted that tube manufacturers recommend, and set manufacturers most generally use, the grid bias variation method.

* * *

Quality From Midgets

HAVING been reading up on radio for three years, I have naturally been taught that large bypass condensers are necessary, husky, matched output transformer, and large diaphragm cone. So how can this be reconciled to the crop of midget receivers, some of which sound fine, and a few of which leave next to nothing to be desired, in the way of tone?—H. E.

In orthodox circuits the large bypass capacities are essential to rid the grid biasing resistors of negative feedback. However, for this season's midgets there is pretty good standardization on a circuit that permits of excellent tonal results, despite the absence of large bypass capacities, due to the special hookup. This hookup provides regeneration in the pentode output tube, and of course regeneration can do all that bypass condensers can do, for regenerations can be brought up to the point where the signal current is equal but opposite, hence there is no signal current through the impedance concerned. More, regeneration can overcome the effect of small sized primary of output transformer, small cone and limited baffle area. Circuit improvement, therefore, is the reason why fine results are obtainable, even with only a radio frequency bypass condenser across the biasing resistor of the detector, and no capacity across the part of the B supply choke coil, in the rectifier's negative leg, for biasing the pentode. The October 10th and 17th issues contained detailed data on this point.

* * *

Low Price of Midgets

PLEASE state how it is possible for any one to sell a good set, albeit a midget, at $20 or thereabouts. Speaker, wired, chassis, cabinet, but no tubes are included.—P. S.

The lowered cost of parts, the economical choice of parts, whereby they are limited to utter essentials, and the assembling and wiring sets and buying of cabinets in quantity, account for this. A good midget set can be made by a set manufacturer at a cost of $12.50 for a five tube tuned radio frequency model, to sell to the public at around $20. Several manufacturers are doing this. They make $2.50 on such a set and the retailer, who buys direct from the manufacturer, makes around $5. This is so close a margin that warnings have been issued by economic organizations that such practice is unsound. Another way of merchandising is through jobber to retailer, as done by the very large manufacturers, whose economies due to great production enable about the same consumer prices. However, the largest manufacturers are leaning toward midgets, to sell at around twice as much, due to the use of the superheterodyne circuit. Nevertheless even the large makers are going to try the market with a five tube superheterodyne to sell at around $37.50 with tubes. The prices previously stated do not include tubes.—R. W. C.

* * *

Circuit for the Automobile

PLEASE show a diagram of a circuit suitable for automative tubes in a car set. I would like to use the pentode output tube if you do not think that the third harmonic distortion is serious.—K. J.

See Fig. 961. The radio frequency choke coil Ch1 used as input should be of the 300 turn honeycomb variety, wound to take up not more than 1 inch diameter. Such a winding will give the set a strong input at the higher wavelengths, which is advisable, because of the low capacity of the antenna to be used in a car, and the low pickup generally. The 236 tubes are screen grid tubes, the 237 is the general purpose tube, and the 238 is the pentode you request. The third harmonic distortion is not serious. Curves we took disclosed none. The car storage battery may be used for the heaters, which call for 6.3 volts, the value of a freshly charged battery, although the tubes are not critical as to heater voltage. The primaries may have one-third the number of turns of the tuned secondaries, while the resistors R2 and R4 are 0.25 meg. and the grid leaks R3 and R5 as high as they can be, without motorboating. Values of 0.5 meg. or 1 meg. virtually always satisfy this requirement. C9 and C10 may be 0.01 mfd., while Ch2 may be a 300 turn honeycomb coil, C7 and C8 being 0.00025 mfd. each. P2 may be any value from 5,000 ohms up. E, for bias, may be 10.5 volts.

A THOUGHT FOR THE WEEK

FIVE-HUNDRED—that's a lot o' pins,
or lollipops, or roars, or grins;
But half a thousand weekly sheets
Like this you hold—why each one greets
A million eyes or so, we wis.
Well, anyhow, good friends—here 'tis!

RADIO WORLD

The First and Only National Radio Weekly
Tenth Year

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

Our 500th Issue!

NOT so advanced in years, according to the calendar, but old when it comes to service. Producing 500 separate issues of anything, and doing it according to a time schedule, is not exactly an infant's job, but we've been happy—and successful—through it all.

RADIO WORLD began its work when the crystal set was in its glory and more ambitious developments were accompanied by the squeals and howls which have almost disappeared from every well-regulated radio family. The paper has taken an active part in the progressive movements which have made radio what it is today and can point even with some degree of pride to certain original developments which had their birth in its columns.

RADIO WORLD was the first national weekly in its field. It still lays claim to being the only national radio paper, and it looks forward happily to another 500 weeks of activity and service.

We intend to render even greater service to our readers than heretofore, and with the new developments in ultra frequencies and television we promise we shall be right up front. No technical extravaganza or wild anticipations, but solidarity and substantiality. With this policy our readers fully agree.

Let's make an appointment! We are all to meet here again 500 issues from now. We, the publishers, promise to do our best to serve all of our many thousands of readers as honestly and intelligently as we have in the past. You, our readers, are to judge the results. We shall abide by your verdict.

Leaders Send Their Felicitations

Plays a Useful Part

RADIO WORLD:

FIVE hundred consecutive numbers of a radio journal! What eloquent tribute to the exhaustless wealth of research, inventive skill, and manufacturing development is evidenced by this record!

The title you selected, RADIO WORLD, has proven profoundly significant, for during the decade of your journal's life our entire civilization has indeed been transformed into a radio world.

The influence of radio upon all men, upon all manner of thought, upon the formation of sentiment among different communities, nations; our home life, our tastes in entertainment, our sources of information and instruction, has during these past ten years been without parallel during any similar period through any other agency in all the world's history.

RADIO WORLD has played well its part in encouraging, moulding and chronicling this amazing institution. May it continue its useful career through the decades to come, to record accurately radio's future growth, in comparison with which its present achievement will prove to be but vague and nebulous promise.

LEE DE FOREST.

* * *

500 Seems Extraordinary

RADIO WORLD:

ON the occasion of the publication of the 500th number of RADIO WORLD, I desire to extend my felicitations to you and your staff, and to express the hope that the service rendered by your publication to radio may be long continued. Compared with a great many other important industries, radio is still youthful, and an occasion in which the number 500 occurs seems extraordinary.

I congratulate you on never having missed a weekly issue in this long period of your publication.

Sincerely yours,
DAVID SARNOFF.

* * *

Popularity Indicated

RADIO WORLD:

CONGRATULATIONS on the issue of the 500th number of RADIO WORLD. The popularity of your magazine indicates how great a factor radio has become in the world today.

E. F. W. ALEXANDERSON.

* * *

Tribute to Merit

RADIO WORLD:

THE Columbia Broadcasting System is happy indeed to congratulate RADIO WORLD upon the publication of its 500th issue.

I understand that this issue will represent the highest consecutive number ever reached by any radio paper, and that during all this while the ownership has remained unchanged. Such a history is an eloquent tribute to both the publisher and editors, and to the evident merit of your excellent weekly.

I am sure that all of the 87 stations embraced in our System individually join me in wishing for you many similar joyous occasions.

Sincerely yours,
WILLIAM S. PALEY.

* * *

Advantageous Efforts

RADIO WORLD:

RADIO is the voice and the symbol of progress. Your efforts in keeping the voice effective have been advantageous to all friends of radio.

J. H. DELLINGER.

* * *

Good Wishes Expire 2031

RADIO WORLD:

HEARTY congratulations on the 500th issue of RADIO WORLD.

You are to be congratulated that in the face of the general depression and the present status of the radio industry, you have made it possible to continue publishing your fine magazine without miss-

(*Continued on next page*)

Forum

Wants More on Battery Sets

A LETTER from R. L. Stanley, of Los Angeles, in your Forum, is very much to the point and is my idea exactly on the subject of the University Club Service. Non-members of the University Club should be allowed to pay for questions they want answered.

Another comment, which probably has been brought up before but will bear repeating, is that I find there are not sufficient news, hook-ups and data for the subscriber, like myself (who is located in a district where there are no electrical facilities), covering battery operated radio. Of course this may be met with the reply that you do now publish a certain percentage of this information from time to time, and that the very great majority of your subscribers and readers using electrically operated sets requires that they be catered to accordingly, and there may be many other good reasons for the scantiness of the class of matter referred to.

However, to repeat what has no doubt been pointed out to you by others, possibly many times, there is a large and influential minority using battery operated sets, and experimenting with hook-ups, either by choice or necessity, more consideration might be shown in this regard. I quite recognize that a good many of the hook-ups appearing are not applicable to battery operation, but the point is this, that the battery operating set reader, when he receives his weekly copy of RADIO WORLD, naturally looks for something in this line and finding through several issues very little except what applies to electrically operated, is keenly disappointed like myself, and says: "If I don't see a little more of the battery operated radio I will have to try another magazine that will show more of it."

Now for the remedy. I suggest that in *each* issue of RADIO WORLD there should be a page devoted to information, etc., for the battery operated set fan, or, where possible, give alongside, *always*, the battery operated equivalent of a-c hook-ups.

I have been building and experimenting with radio sets for my own pleasure since 1922, but, unfortunately, always located in a district where there are no electrical facilities, as is the case with so many in the western prairie parts of Canada. Also at present I subscribe for "Radio News," "Radio-Craft," "Short-Wave Craft," "Radio-fax," "QST," "Amateur Radio Call Book," "International Short Wave Bulletin," and am an abnormal devourer of any literature appertaining to radio.

With best wishes for continued success of your publication,

G. M. MCGUIRE,
Box 12, Acadia Valley, Alberta, Canada.

* * *

Advises Critics to Study

RADIO WORLD has given me excellent service in all the years I have been a subscriber.

I know some persons are never satisfied, and they never will be. I also noticed in some of the issues complaints concerning errors in diagrams and articles. Well, a person who wants to read a diagram should first learn the principles about radio, second he should put his mind into the circuit, and not read the text word for word. And last but not least he should at least use one ounce of common sense.

Anybody can build a set if you give him the parts and a true sized blueprint, but he will even drill a hole through a fixed condenser to screw it down onto the baseboard, against specifications.

The other day I met a fellow who had been tinkering with radio for three years and he asked me which of the two small pins on the tube base is the grid and which is the plate. These are the kind who ask foolish questions, and when you explain to them they make a very "smart" face and know just as much as before, because it all is Greek to them.

Well those fellows should take their girl out only once in a while, and spend a little more money on books concerning the principles of radio.

Where I was born the people say: "Only he, who knows *better*, should criticize, otherwise keep his mouth shut." This would be a good thing to remember for some of the readers who are always kicking.

WALTER STUDEMAN,
513 West 176th Street, New York, N. Y.

Rapping the Broadcasters' Knuckles

THE following editorial appeared in The Standard-Star of New Rochelle (N. Y.), on October 9th. Read, and agree or disagree, as you see fit:

THE RADIO TRUSTS

THE radio listener who claimed broadcasting has lost its lure through chain-station hook-ups is right. Now, no matter where one twirls the dials he finds as a rule one of two chain programs. There is no longer the lure to seek distance for whatever station one finds, the same program is coming from a dozen other stations nearer home.

But that is not the worst of the radio trusts. Radio advertising is coming closer and closer to propaganda. Even the schools are being invaded in subtle fashion. The masters of the microphone are seeking to rule the minds of the nation of the next generation.

The National Education Association and the American Bar Association have warned against this menace to governmental control of education. But the radio broadcasting companies have tremendous influence. Only public opinion can match strength with them.

When wave-lengths were tentatively granted broadcasting stations, there were waivers by the companies to any inherent rights or permanent possession. Now they have grown stronger and are demanding perpetual franchises for these wavelengths. And a spineless Federal Radio Commission dares not oppose them.

Only an outraged public opinion can regain the rights to free radio broadcasting, similar to those of freedom of speech and freedom of press.

RADIO WORLD has been under the impression that the outstanding broadcasting companies were serving the public in an excellent manner. For instance:

Who would pay the big stars of the stage and grand opera, of the film and other fields of entertainment, if the big stations were not strong enough to engage their services or did not have sufficient public appeal to sell time to commercial enterprises? Certainly the smaller stations could not afford to pay for this talent.

How would President Hoover and other American executives be able to send out their messages to the whole country without the present great broadcast facilities?

Who believes that we have a "spineless" Federal Radio Commission? Certainly not the great radio interests that have been disciplined by this body as occasion required.

At any rate, we are wondering how many other newspapers throughout the country have adopted the editorial attitude of The Standard-Star in its treatment of radio broadcasting in general.

RADIO WORLD would be glad to hear from its readers, who are to be found in every nook and corner of the radio field, regarding the editorial we have reprinted, and our comments thereon. Let us know how you feel in the matter.

Notables Send Congratulations

(*Continued from preceding page*)

ing a single issue during the past ten years. It is certainly a marvelous record of which you may well be proud.

I hope your magazine will continue to prosper for the next 100 years.

Cordially and sincerely yours,

H. GERNSBACK.

* * *

Fills Useful Need

RADIO WORLD:

AS a regular reader of RADIO WORLD I take pleasure in congratulating you upon the 500th number of this publication, which fills a useful need. I wish you continued success.

Sincerely yours,

W. D. TERRELL.

* * *

Played an Important Part

RADIO WORLD:

ON behalf of the Radio Manufacturers Association, Inc., please accept congratulations on the 500th issue of RADIO WORLD. The life of RADIO WORLD practically covers the active life of the radio industry, in which it has played an important part.

J. CLARKE COIT.

* * *

Contributes Much

RADIO WORLD:

I CONGRATULATE you upon your 500th number of RADIO WORLD. This periodical has contributed much to the cultivation of genuine interest in the many beautiful features of the radio art. I hope that you will continue your splendid efforts in this direction.

Sincerely yours,

M. I. PUPIN.

FEEBLENESS OF GANDHI'S VOICE IS OVERCOME

"We now take you to London, England!" With this announcement the Atlantic Ocean is spanned and through the efficient modern radio a renowned son of Mother India speaks quietly before a microphone in the British metropolis at 7 P. M., while audiences in eastern American cities listen to him during the early afternoon and those on the Pacific Coast in the morning.

"From the London residence of the speaker," explained J. R. Poppele, chief engineer of WOR, "the voice is carried over telephone lines of the British government to a short wave transmitter on the English coast, thence across the ocean to the receiving station of the American Telephone & Telegraph Company at Lawrenceville, N. J., from which point it is relayed to the plant of the New York Telephone Company at 24 Walker Street. There the circuit is linked, as in the case of the Mahatma Gandhi program, to WOR and the National Broadcasting Company.

Several Channels Worked

"It is necessary to maintain many channels for the trans-Atlantic service, both long and short waves. While this involves a tremendous investment in equipment and personnel and incidentally explains the high toll-rate, it is essential because certain frequencies are required for transmission during the day and night and even during certain hours of these periods.

"It is customary to receive a trans-Atlantic program on two channels, which means that it is transmitted over two stations, the better of which is connected to the destination point of service.

"The telephone company also maintains a long wave trans-Atlantic receiving point at Houlton, Maine. Because of atmospheric conditions between here and England it becomes necessary sometimes to route the program via the Maine pickup station.

Limitation Overcome

"The marvelous improvement in the trans-Atlantic service is commented upon frequently by those familiar with the early attempts to span the ocean. The advancement in telephone engineering was particularly observed by those who heard Mahatma Gandhi in the news reels and on the recent broadcast from London.

"When this program was in preparation these observers pointed out that Gandhi's voice would be scarcely audible on an international broadcast, having in mind the feebleness of his voice as recorded on the film. How such physical limitations are overcome in telephone practice was indicated as perhaps never before in the case of the world wide address of the Indian leader."

WESTINGHOUSE DECLARES DIVIDEND

The board of directors of the Westinghouse Electric & Manufacturing Company, declared a dividend of 1¼ per cent, amounting to 62½c. per share, on both common and preferred shares (payable October 31, 1931, to stockholders of record September 30, 1931), payment of which will make a total of 7¾ per cent paid this year on the par value of both classes of stock, which compares with 10 per cent paid in 1930.

"In view of the reduced earnings of the company this year it is not thought advisable to pay more than this rate of dividend at this time, said A. W. Roberston, board chairman.

NOT LIKE THIS HERE

(Acme)
London, Eng., radio police track down unlicensed receivers with set that picks up their squeals.

MICROPHONE ON LAPEL BAFFLES

Engineers have devised a microphone so small that it can be worn on the lapel of a coat or kept concealed in the breast pocket. With this, a speaker can move around freely and yet continue to project his voice through loudspeakers or over the radio. He no longer has to stand directly in back of a stationary microphone.

The new device is connected with its amplifier by a pair of flexible wires. The speaker trails these with him. He can walk as far as he likes as long as he has enough wire.

In developing this system for the Western Electric Company, the Bell Telephone Laboratories had to cut down the rumble of sounds coming from the chest. They provided an electric filter which produces the proper balance between these sounds and the voice.

Sergius P. Grace, well-known lecturer on the marvels of the telephone, has frequently mystified his audiences by using this microphone. He wears the wires down the inside of his trouser leg. His listeners, hearing his voice coming over the loudspeakers, look in vain for the familiar microphone. The mystery deepens as Mr. Grace walks freely about the platform. Finally, he takes the tiny instrument from his pocket and explains.

Hoover to Be Heard at Broadcasters' Parley

Washington.

President Hoover has accepted an invitation to address the opening session of the Ninth Annual Convention of the National Association of Broadcasters, to be held in Detroit, Mich., Oct. 26th, 27th, and 28th. The two big chains will broadcast the speech.

The invitation was extended by the Association through its president, Walter F. Damm, Milwaukee, Wis.; Frank M. Russell, Washington, D. C., and Philip G. Loucks, Washington, D. C., managing directors.

NBC PROMOTES EXECUTIVES

Appointment of John F. Royal and Roy C. Witmer as vice presients of the National Broadcasting Company was announced by M. H. Aylesworth, president.

Royal, who has had a colorful career as a newspaperman and showman, will be vice president in charge of programs. He formerly was director of programs. Witmer, successively a bank accountant, engineer and industrial sales manager, will be vice president in charge of sales. He formerly was sales manager.

Both executives have won rapid recognition in the broadcasting field. Their new promotion was voted at a recent meeting of the board of directors.

Royal came to New York as program director in February, 1931, leaving his post as director and general manager of WTAM, Cleveland, an NBC associate station. He previously was general manager of the midwestern division of the B. F. Keith theatres, with whom he was associated for nineteen years as an intimate of many theater and world celebrities. He entered the show world as a press agent after earlier years as a Boston newspaperman.

The two men have worked their way up from humble beginnings. Royal first earning his way as a copy boy on the Boston "Post" and Witmer turning sod as a plough boy on a New York farm.

Royal was born and spent his youth in Cambridge, Mass., where he left high school to run copy for the night staff of the Boston newspaper. He subsequently was a reporter, covering everything from opera to sports. He had advanced to assistant city editor when he left newspaper work to join the Keith organization in 1910.

Two Additions Swell NBC Chain to 82 Total

Two broadcast stations of the Southwest, WWNC of Asheville, North Carolina, and WIS, of Columbia, South Carolina, each 1,000 watts, have become associated with the National Broadcasting Company networks.

WWNC is owned by "The Asheville Citizen" and "The Asheville Times" and is operated by The Citizen Broadcasting Company, Inc. It operates on 570 kilocycles or 526 meters. WIS is owned by the Liberty Life Insurance Company and is operated by the South Carolina Broadcasting Company, Inc. It operates on a frequency of 1,010 kilocycles, or 296.9 meters.

WIS is the first South Carolina station to become affiliated with the NBC networks and WWNC is the second North Carolina station, WPTF of Raleigh having been the first in that state.

The addition of the two stations makes a total of 82 stations associated with NBC, including WEAF and WJZ, the two New York outlets.

Goldsmith New Head of Movie Engineers

Dr. Alfred N. Goldsmith, vice president and general engineer of the Radio Corporation of America, was elected president of the Society of Motion Picture Engineers. Dr. Goldsmith succeeds J. I. Crabtree, retiring president, and will hold office during 1932. The headquarters of the Society are in New York.

Dr. Goldsmith's election evidences the increasingly close relationship between the radio and the sound motion picture industries.

Station Sparks

By Alice Remsen

The Sea Romances staged by the Scott's Emulsion Company, over WABC, are based upon real happenings. They are excellently produced and very well acted. Charles Previn conducts the orchestra which supplies the musical background.

* * *

Caught George Bernard Shaw in his talk on Russia over WABC on October 11th. His voice sounds remarkably young. He simply welters in Communism and yet one can't help thinking that his tongue must be in his cheek, and that he is more than half spoofing most of the time.

* * *

The Television Production Staff of Columbia has been augmented. Florence Kyte, formerly an accompanist in the Metropolitan Opera Studios, has become television staff accompanist. Born in Atlantic City, N. J., Miss Kyte studied piano with Isadore Phillipp in Paris, and with eminent teachers in New York and Philadelphia. She has appeared in concert recitals throughout the East and in talking pictures, and has also been headlined in vaudeville and radio productions.

* * *

Frank Luther, who recently autographed over a thousand photographs in one hour at the Radio-Electrical World's Fair, is one of the busiest singers on the air. He appears on five regular programs over the NBC networks; Three Bakers, Sundays, 7:30 to 8:00 p. m., WJZ; Firestone, Mondays, 8:30 to 9:00 p. m., WEAF; Corner Drug Store, Tuesdays, 7:30 to 7:45 p. m., WEAF; Esso, Wednesdays, 7:45 to 8:00 p. m., WJZ; and Esso, Fridays, 7:45 to 8:00 p. m., WJZ; in addition he makes phonograph records, personal appearances and recorded programs. Frank isn't worried about the depression, no, sir!

* * *

Lee Cronican, pleasant voiced announcer of WOR, is also an accomplished pianist and is heard frequently over the air in recitals alone and with Arthur Hale, another pianist-announcer, in a double piano program. Lee is also responsible for the musical background for that charming Basil Ruysdael program, the Weaver of Dreams. He selects the music and conducts the orchestra.

* * *

Morton Downey, Tony Wons and **Jacques Renard** receive on an average of 1,500 letters a day, among them. Of these, Wons claims 45%, Downey 40% and Renard the remaining 15%.

* * *

It Was With Mingled Feelings of joy and apprehension that I discovered Sydney Carroll, distinguished English film and dramatic critic, as guest speaker on the Footlight Echoes program over WOR on October 11th. Joy, because it is always a pleasure to listen to the speech of a cultivated Englishman, and apprehension, because Englishmen usually speak their minds, sometimes with drastic results. Mr. Carroll, however, treated us very fairly and only scolded us a little for not making our film villains real double-dyed black sheep and for misrepresenting our womanhood in the talkies.

Mr. Carroll was introduced by J. J. Apatow, director of the New York Playgoers Forum. The talk was divided into three parts and took the form of an interview, which made it more interesting for the lay-listener.

It appears that Mr. Carroll, who is president of the English Critics Circle, film critic for the London "Daily Telegraph" and special dramatic writer for the London "Sunday Times," is not over here in the capacity of critic. He has gone over to the other side of the footlights, and will produce two plays, one by John Van Druton, "After All," and Benito Mussolini's "Campo di Maggio." The latter, a Napoleonic drama, has been adapted into English by the able John Drinkwater.

Mr. Apatow introduced Mr. Carroll as a "full-blooded Englishman," to which appellation the latter strongly objected, pointing out that he was really half Irish, and more than half proud of it. He has fallen in love with honeydew melons, our comfortable theatre auditoriums and the quickness of uptake in our audience; he likes the style and ability of our dramatic critics; our crowds stun him, as do the soaring heights of our architectural frenzy; the glare and din of our city oppress him, but he has only been here for three weeks, so we must give him time to get used to us.

And let us hope that the American public and critics will be as kindly and gracious to the productions of Mr. Carroll as he has been to us.

* * *

THE HIGH ROAD

(Romances of the Sea. WABC Tuesday 9:30 p.m.)

HURRAH for the high road that leads to the sea!
The salt smelling high road just over the lea.
The stiff briny breezes that ruffle the hair,
And sing of the life for a devil-may-care!

Hurrah for the high road that leads to the sea,
And promises many adventures to be;
That leads to the sight of a spume-crested wave,
And all the delights that we sailor-men crave.

The watch under stars in the deep of the night;
The slow graceful curve of a seagull in flight;
The sting of the spray as it drenches the sail,
Billowing down in the teeth of a gale.

Oh! I'm longing to tread on a quivering deck,
To make fast the topsail, and hold her in check;
To hoist up the halyards, to stand by the helm;
For the boisterous sea is the sailor man's realm.

So here's to the high road that leads to the sea!
The salt smelling high road just over the lea,
That leads straight down to the stony gray quay,
And the tall-masted ship that is waiting for me.

—*A. R.*

SIDELIGHTS

Russ Columbo's full name is Ruggerio Rudolfo Eugenio Columbo. Russ is a nickname...**Vincent Lopez** has a library of more than 5,000 volumes...**Irene Bordoni** was born in Corsica...**Toscha Seidel** was once made honorary chief of a Maori tribe in New Zealand...**Jack Smart** is losing weight playing ping-pong...**Orrell Hancock** goes in for autograph collecting ...**Artells Dickson** was born in Oklahoma ...**Morton Downey** would like to be a politician...**Jimmie Kern** once studied law...**Freddie Rich** has twelve brothers and sisters...**Max Pilzer** has a remarkable memory for music scores....**The Street Singer** studied at the University of Pennsylvania...**Billy Comfort** and **Tommy Reilly** are entertaining down at The Village Barn...**Brad Browne's** hobby is song writing...**Lowell Patton** is fond of fried chicken...**James Wallington** has a new black and green sedan...**Len Joy** has a German shepherd dog that can tell the time...**Gene** parts his hair on the right and **Glenn** parts his on the left...**Frank Parker** now has his own quartette...**Maria Cardinale** lost a garnet bracelet last week; it was an heirloom...A burglar stole **Arthur Hale's** pants, containing valuable papers and $75...**Allan Woods** uses a ghost conductor...**George Shackley** has planted 1,500 silver blue spruce trees on his West Milford estate...**Eddy Brown** possesses a watch presented to him by King Edward VII...**Vera Brodsky** wears an ancient scarab ring presented to her by the former Crown Prince of Germany. ...**Sherman Keene** likes the solitude of the Maine woods...**George Vause** prefers Atlantic City...**Jack Arthur** likes Montreal. I wonder why? **Walter C. Kelly,** the Virginia Judge, is air-minded at last. Glad to hear it. He should be great.

* * *

Biographical Brevities

VAUGHN DE LEATH REMINISCES

Everybody who owns, or has ever owned, a radio set knows Vaughn de Leath, for Vaughn is the Original Radio Girl. She grew up with it and knows all about it. I think I had better let Vaughn speak for herself. Allow me to present, Miss Vaughn de Leath:

"How do you do, ladies and gentlemen of the Radio World. It is quite probable that Radio City looks like a gigantic proposition to most people, but I doubt if it will look quite as overwhelming to many as it does to me, who have watched radio grow from its swaddling clothes into sub-deb formals!

"I have sung from WJZ at three addresses (Newark, West 42nd St., and 711 Fifth Ave.) and I hope to be among those present at Radio City; also it will have been four addresses for WEAF (Walker St., 195 Broadway, and 711 Fifth Ave.) and Radio City. Ten years on radio!

"If anyone asked me why I have been able to sing for that period and still hold my audience, I'd say, because I have never given too much. An audience may applaud an artist who does a few songs, but who begs for more after too much in the beginning? Of course, in the early days I did sing more often, but then there weren't so many of us to fill the bill Not every voice lent himself to reproduction in those early days when the apparatus was crude and the transmission faulty.

"Ever so many people scheduled to broadcast never came; as a matter of fact, I won my first radio popularity by being a pinch hitter. Georgie Jessel, for instance, was advertised three times and failed to show up; the public, rather than have no program at all, put up with me; I sang when the Dolly Sisters didn't turn up—when Walter Huston, since famous in pictures, didn't arrange a passport to Jersey; when Al Jolson arrived an hour after it was all over. Eddie Cantor was one of the first stage stars to appear before the microphone and was brought to Roselle

(*Continued on next page*)

WARNING!

Television is coming into its own. It is progressing. It will be a great asset to the radio field—later on. It will take time and patience to bring it to the point of profitable merchandising. In the meantime the smart boys of Wall Street are casting covetous glances at the profitable money to be made out of offering television stock to the public. Perhaps some of them are busy now. Their scheme is not to prove that television works but that stock flotations work. Some concerns will be legitimate. Some quite the opposite. If any salesman offers you stock in a television promotion scheme, ask somebody who knows the game before you sign up. Ask your banker the chances such stock has of paying dividends. Be oh so careful!—and save those regrets.

MICROSCOPE SHOWS FLIGHT OF ELECTRONS

Rome.

At a meeting here of fifty world-famous physicists, Professor Robert A. Millikan, of the California Institute of Technology, Pasadena, who received the Nobel prize in physics for isolating the electron, announced the invention of a microscope for observing the movements of electrons and for measuring their velocities. He gave credit for the invention to Professors Jesse Dumond and Harry Kirkpatrick, also of California Institute of Technology.

Professor Millikan termed the instrument a multiple crystal spectrometer and said it employed X-rays for the detection of the electrons. Photographs taken by the instrument were projected by Dr. Millikan, who said that these gave the first evidence of the dynamic workings inside the atom, instead of the static condition. These photographs showed the movements of two electrons in beryllium, a rare silver-like but hard metallic element.

Although the electron is only about 1/1,700 as large as an atom, the new instrument caught it in its movements. The instrument opens up a vast field of research in atomic structure and work on other elements is now in progress.

The atom is conceived as a miniature solar system with a central nucleus, or proton, representing the sun and a large number of electrons revolving around it like the planets revolve around the sun. This conception was advanced by Professor Niels Bohr of Denmark, who received the Nobel prize in physics for this work. He also was present at the meeting and showed how he approached the study of protons by observing the behavior of electrons around the nucleus.

Pointed Opinions

BOND GEDDES, executive vice president, Radio Manufacturers Association, Inc.: "The radio listening public and the radio industry should give the Federal Radio Commission a rousing big vote of thanks for granting fifteen broadcasting stations increased power. The radio public will enjoy greatly improved reception. The high power will increase the signal strength and reduce static or other interference. Especially in the Southern and Western states will the benefit of the increased broadcasting power be appreciated. The broadcasting radius of fifteen of the finest and most representative stations of the country will be greatly widened. In some areas the improvement will be limited to better reception and less interference in the operation of radio receiving sets. In other sections where stations with low power have been unable to penetrate satisfactorily, the enjoyment of radio will be possible to many thousands of homes. To this extent the market for receiving sets and other radio products will be greatly extended."

SUNDRY SUGGESTIONS FOR WEEK COMMENCING OCTOBER 25th

Sun., Oct. 25: Footlight Echoes...WOR—10:30 p.m.
Mon., Oct. 26: Vaughn de Leath..WEAF— 6:30 p.m.
Mon., Oct. 26: Death Valley Days..WJZ— 8.30 p.m.
Tues., Oct. 27: Eddy Brown ......WOR— 9:30 p.m.
Tues., Oct. 27: Nocture: Ann Leaf and Ben Alley WABC—12:30 a.m.
Wed., Oct. 28: The Goldbergs ....WEAF— 7:45 p.m.
Wed., Oct. 28: Gene Rodemich's Orchestra WJZ—10:45 p.m.
Thurs., Oct. 29: Kaltenborn Edits the News WABC— 7:30 p.m.
Thurs., Oct. 29: Basil Ruysdael, "Weaver of Dreams" WOR—10:00 p.m.
Fri., Oct. 30: Hugo Marinai ......WEAF—12:15 p.m.
Fri., Oct. 30: Bob Ripley, "Believe It or Not" WJZ— 7:45 p.m.
Sat., Oct. 31: Little Symphony ...WOR— 8:00 p.m.
Sat., Oct. 31: Alice Remsen and Roger Bower WOR— 9:30 p.m.

TELEVISION ON 10 FT. SCREEN IN N. Y. THEATRE

Television will become a regular feature on the variety bill of the B. S. Moss Broadway Theatre, in New York, according to a statement issued by the management. It was first put on recently when bits of the productions of the Theatre Guild players were presented before the television "eye" and reproduced on a ten-foot screen in the two theatres to convey the images. The apparatus used was that developed by Ulysses Sanabria, of Chicago, and demonstrated at the Madison Square Garden radio show.

Regarding the feature Mr. Moss said:

"As soon as I had seen television on a large screen I was convinced that the time had arrived to make an important theatrical experiment. I believe television in the next few years will reach a stage of unusual perfection, that it will be developed basically with an eye to its theatrical possibilities, and that the theatre should begin to think as to how its future is to be linked with television. Probably we shall see more living actors. Thus the theatre will appeal to many millions and will have larger scope than ever. I believe that in the future ye will have as many television theatres as there are now motion picture houses."

Station Sparkles

(*Continued from preceding page*)

Park (WJY) by Luis Breau, on some of my first broadcast programs from the World Tower where Dr. Lee de Forest and Dick Klein were such rare hosts.

"I shall never forget the night I met Roxy. It was at a big radio gathering. Some 'mug' followed him around and pointed him out to strangers continually as 'Moxie—the big announcer.' When Mr. Rothafel was presented to me he was cordial and politely inquired; "Are you in radio, too?" 'Slightly," I replied. Later when he discovered who I was, he said; 'Pardon me, I didn't get your name at first' andadded tactfully, 'I thought you were a Russian Grand Duchess.' (He must have seen "The Student Prince.)"

"Radio brings many funny experiences. People are likely to recognize me from my voice. One day I asked a W.U. operator the charge to Chicago. She looked at me very intently. After I handed in the wire and she saw the signature she said! 'I thought you were Vaughn de Leath. I recognized you by your voice.'

"One day I gave a taxi driver the NBC address. 'That's a radio station, ain't it?', he asked. 'Yes,' I answered. 'Wouldja mind tellin' me yer name, lady?' 'Vaughn de Leath,' I replied. The car gave a lurch and he said; 'Gee whizz! Can yer beat it? This mornin' I drove Gene Tunney, this afternoon, you. My wife'll swear I'm a liar when I tell her my two favorites was fares today.' There's lots more I could tell you, but Miss Remsen says we'll leave that for another time. Tune in some night and let me hear from you. And until then—Happy landing!"

VAST ACOUSTICS IN WALDORF

The ceremonies opening the new Hotel Waldorf-Astoria in New York City were heard in all the hotel's public rooms by means of its elaborate network of loudspeaking equipment. The hotel's system for electrical distribution of entertainment, designed by the Bell Telephone Laboratories and installed by the Western Electric Company, is the most complete ever brought together under one roof.

Six different programs can be made available over the entire system, both to the 1,940 private rooms and to the many public rooms. These may be all or partly radio broadcasts picked up by the hotel's major antenna. Events going on in the hotel's public rooms, or the music of its orchestras, can be switched onto any of the channels. In addition, the hotel can supply recorded entertainment for its guests by means of two music reproducers.

Each of the two towers is furnished with a separate antenna. By means of these and selective devices, occupants of the tower suites may have radios of their own choice installed and receive any programs that are on the air. All the antennas are specially shielded from interferences that commonly arise in the mid-town area.

Twenty-two racks of amplifying and control equipment are located in the radio room on the sixth floor which is the nerve center for the entire network of distribution. Here all programs are under constant supervision to secure the best rendition over the system.

A variety of horns, varying from several taller than a man to many smaller ones, is concealed behind the walls and ceiling of the public rooms. There is a permanent sound picture system of the theatrical type for the grand ballroom and one portable set which can bring talking picture entertainment or lectures to the smaller public rooms.

Under full use, the system can take the voice of a speaker in one room and amplify it there, amplify it in every other public room, in the 1,940 guest rooms, and carry it by wire to three broadcasting stations. Simultaneously, five other programs can be available.

GOOD NEWS

U. S. Radio & Television Corporation, manufacturers of U. S. Apex and Cloritone radios, announces it earned $801,588.02 after all charges including federal income taxes, for the fiscal year ended July 31st, 1931, more than twice the $365,467.00, earnings for the preceding year. J. Clarke Coit, president, said earnings on the 146,205 shares outstanding were $5.48 as against $2.56 on the 142,705 outstanding on July 31, 1930.

Cash on hand at the end of the fiscal year totalled $1,066,588.93, an increase of $681,469.80 over July 31, 1930, while net working capital stood at $2,007,424.62 against $1,188,291.77 on July 31 of last year. Inventories decreased from $636,898.03 to $445,606.17. Mr. Coit announced that the company's cash balance had increased in the month and a half from July 31, this year, to September 15 to a total of $1,483,434.38.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, Radio World, *145 West 45th Street, New York, N. Y.*

R. C. Seavay, Jr., Box 146, Wilmington, Mass.
Wm. B. Venables, 504 Neville St., Oakland, Pittsburgh, Pa.
R. H. Heuer, 40 Stratford Terrace, Cranford, N. J.
Rensch Radio Sales, 3023 E. Third St., Dayton, Ohio.
T. J. Brown, Box 111, Elkhart, Texas.
George F. Baker, Jr., P. O. Box 13, Fort Pierce, Fla.
Albert C. Hensley, 1810 W. Summit St., San Antonio, Texas.
Alvin DeShane, 140 Godwin St., S. E., Grand Rapids, Mich.
Edwin Struckett, 335 Maitland St., London, Ont., Canada.
W. H. Sims, Richland, Ga.
Hans Schumacher, 68 Herkimer St., Rochester, N. Y.
Carl Kranz, 14 Carlstreet, Rochester, N. Y.
J. Edward Stannah, 2101 Bolton St., Baltimore, Md.
Ralph Adams, 1635 12th Ave., Los Angeles, Calif.
E. S. Miller, Radio Tutuila, Pago Pago, Samoa.
Gonzalo Serbiú Córdova, Box 666, Mayaguez, P. R.

New Corporations

Embassador Radio Corp.—Atty., A. E. Dubroff, 429 Miller Ave., Brooklyn, N. Y.
Marquette Radio—Atty., C. A. Levy, 110 William St., New York, N. Y.
Mycalex Corporation of America—Insulating devices. Attys., Crawford & Harris, 32 Liberty St., New York, N. Y.
Sheirr's Radio—Atty., L. K. Brown, 51 Chambers St., New York, N. Y.
Empire Auto Radio Corp.—Atty., G. J. Shields, Buffalo, N. Y.
Radio Appliances—Atty., R. F. Isaacs, 51 Chambers St., New York, N. Y.
Television Laboratories—Radio. Attys., Miller, Fieldman & Rosenthal, 1501 Broadway, New York, N. Y.
Universal Radio and Television Corp.—Radio, television. Attys., Schechter, Lotsch & Sulzberger, 500 Fifth Ave., New York, N. Y.
Automatic Telephones, Ltd., of Brazil.—Wilmington, Del., radios, other electrical instruments. Corp. Trust Co.
Dell Radio and Electric Service Specialists—Atty., J. Gitelman, Rochester, N. Y.

Broadcasters Withdraw Objection to a Station

Washington.

The Associated Broadcasters of America has withdrawn its objection to the erection in this city of a 250-watt booster station to give this city full time Columbia Broadcasting System service.

IMPORTANT NOTICE TO CANADIAN SUBSCRIBERS — RADIO WORLD will accept new subscriptions at the present rates of $6 a year (52 issues); $3 for six months; $1.50 for three months; (net, without premium). Present Canadian subscribers may renew at these rates beyond expiration dates of their current subscriptions. Orders and remittance should be mailed not later than October 31, 1931. Subscription Dept., Radio World, 145 W. 45th St., New York, N. Y.

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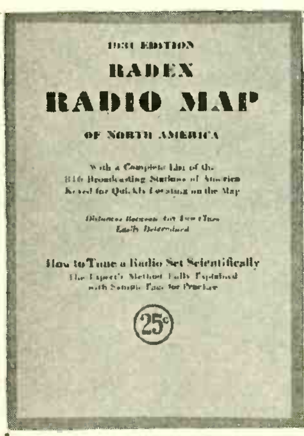

A RADIO MAP OF NORTH AMERICA

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

"RADIO FREQUENCY MEASUREMENTS", by E. B. Moullin, M.A., A.M.I.E., M.I.Rad. Eng. Second Edition entirely reset and greatly enlarged Illustrated. 487 pages, plus 12-page index. Indispensable for radio experts and engineers. $12.50. Radio World, 145 W. 45th St., N. Y. City.

U. S. BROADCASTING STATIONS BY FREQUENCY.—The Sept. 19th issue contained a complete and carefully corrected list of all the broadcasting stations in the United States. This list was complete as to all details, including frequency, call, owner, location, power and time sharers. No such list was ever published more completely. It occupied nine full pages. 15c a copy. RADIO WORLD, 145 West 45th Street, New York, N. Y.

"HOW TO WRITE FOR RADIO"—By Katherine Seymour, Assistant Continuity Editor of the National Broadcasting Company, and J. T. W. Martin, radio writer of the staff of Batten, Barton, Durstine and Osborn—the first authoritative book of its kind, by authors who know their business. The chapter headings are: Opportunities for the Radio Writer; Early History of Radio Writing; "Straight" Continuity; Dramatic Radio Writing; Radio Adaptations; Production (of Musical and Dramatic Programs); Sound-Effects the "Props" of Radio; Radio Advertising Writing; Properties of the Air. Price $3.00. Book Dept., Radio World, 145 W. 45th St., N. Y. City.

SITUATIONS WANTED

TWENTY-THREE YEARS OF AGE—High School graduate, two years college training of a technical nature, also graduate of R.C.A. Training Institute's Sound Course. Have had some experience in the vacuum tube industry. Would like to start as an apprentice in any branch of radio, and work up. Single, free and willing to travel. Salary no object. W. W. Kahn, 361 Newark St., Hoboken, N. J.

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