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NEW CONVERTER CIRCUIT

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WORLD
The First and Only National Radio Weekly
513th Consecutive Issue
TENTH YEAR

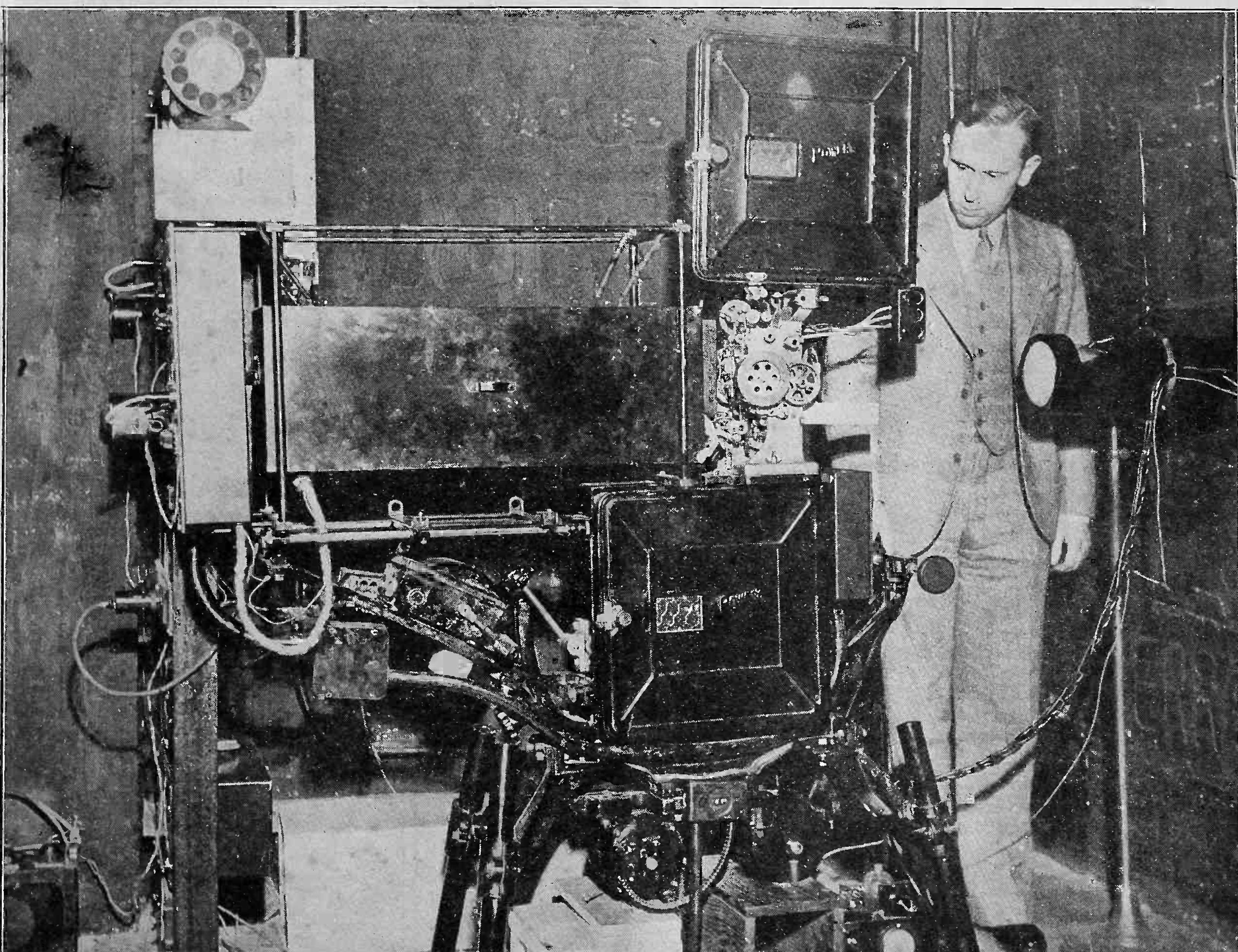
1,600 kc All-Wave Superheterodyne

Tube Service Sheets

Output Measurements

New Inventions

VISION SENDER SCANS WITH CATHODE RAY



Images are transmitted from a film by W6XAC, Los Angeles, on 44,500 kilocycles. The photograph shows Harry A. Lubcke, engineer, with the transmitter. Cathode ray scanning is used, but the pictures can be dissected with a disc, as the breakdown is 80 lines, 15 frames (900 r.v.m.)

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A New Converter Invention

Frequency Changed Twice in a Sensitive System

By Herman Bernard

THIS week's discussion of the short-wave converter topic concerns a device that will afford very high sensitivity and that can be worked with a broadcast receiver set at any intermediate frequency, despite the built-in stages of intermediate frequency amplification. In ordinary converters, where there is gang tuning, only a given intermediate frequency can be used, and the set may not be sensitive at that frequency. This limitation to a particular intermediate frequency holds even if there is no intermediate amplification in the converter, and is due to the intermediate frequency controlling the padding of the oscillator. If ordinary converters have modulator and oscillator independently tuned, and built-in amplification, restriction to one intermediate frequency applies.

The system about to be outlined was invented by the author on January 7th, 1932, at or prior to 3 p.m., and, besides being something of importance to converter constructors and the trade at large, is of course brand new. Never before has anything concerning it been published, nor has anything like it been heard of in radio history.

Theory of Operation

The theory of operation is that a received frequency (a) is combined with a locally generated frequency (b) to produce a frequency (c) that is amplified, and that after such amplification another locally generated frequency (d) is combined with the previous frequency (c) of amplification, so that the output will be at frequency (e).

In actual practice the result is produced by means of vacuum tubes, one being used as a combination original signal frequency input (a) and amplification frequency output (c), and as an oscillator to generate the local frequencies of oscillation (b), this type of oscillating modulator being known as an autodyne. The amplification frequency (c) is amplified in one or more stages at frequency (c), and as that frequency (c) is constant, the oscillator frequency or tuning is at a predetermined and constant difference in frequency from the carrier frequency (a).

Thus, if a coil and condenser combination be used for tuning the modulator or original carrier frequency, with familiar values, the tuning might be from 1,500 kc to 4,500 kc, whereas the frequency of oscillation would differ therefrom by a fixed amount, selected from a variety of possibilities. For instance, the oscillation frequency might be higher than the original carrier or input frequency by the amount of the amplifier frequency. If that amplifier frequency (c) were 175 kc, then the oscillation frequencies would be from 1,675 to 4,675 kc.

Wider Band

And if it is desired to cover a wider band of frequencies for mixing, thus extending the frequency range, other inductances or capacities could be used, for instance, the same inductance and other capacity, or, the same capacity other inductance. Assuming the same capacity, other inductance could be selected so that the oscillation frequencies (b) would range from 4,675 kc to 14,025 kc. Suitable choice of constants, as with equal inductances for the two, and extra capacity for variation, would establish the necessary difference frequency.

The amplifier frequency (c) is changed, if desired, to another frequency (d), so that a different frequency of amplification

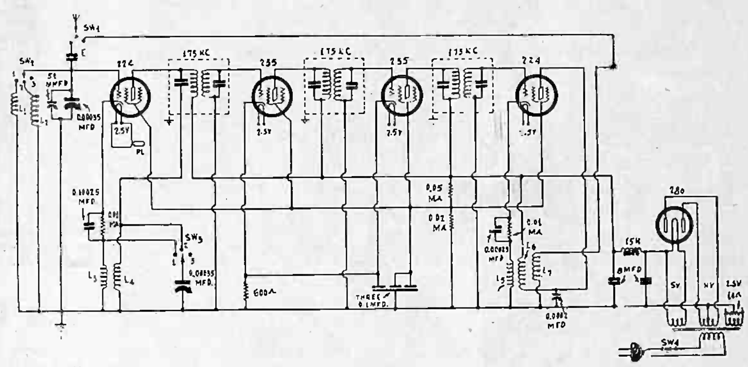

FIG. 1

By the method incorporated in the above design, sensitivity may be developed in a short-wave converter; an external amplifier and re-detector, such as a receiver, may be set at any frequency, and gang tuning may be resorted to in the first mixer. This system embodies a new invention by the author.

may be used further. This would be suitable for amplification obtainable in a broadcast receiver that tunes in the broadcast band, 1,500 to 550 kc, or any part of it or a little outside it. The system applies to the changing of an incoming or original frequency to some other frequency and the rechanging of this other frequency to a third frequency, no matter in what direction the change is made.

Aerial Capacity Coupled

An advantage that is quite distinctive, therefore, consists of amplification at a low and stable radio frequency, and at a difference from any subsequent frequency of amplification that eliminates stray coupling evils.

Considering a practical circuit the autodyne system has been used in the first tube shown in the diagram, Fig. 1, upper left, which is the modulator or first detector, and which receives the incoming or original carrier frequency. For such introduction an antenna is coupled to the grid circuit of the vacuum tube by any suitable means, in this instance a series antenna condenser E of 100 mmfd. capacity. Part of the output voltage of the plate circuit of this tube is coupled back to the grid or input circuit, and even again in part to the plate circuit, the phases being such as to produce oscillation, and the frequency of oscillation being controlled, so that the vacuum tube oscillates at a frequency differing from the incoming or original carrier or signal frequency.

Back Coupling

This inverse coupling from the plate circuit is done through a capacity in this instance, it being the condenser that normally would be across primary of the coupling transformer that feeds

(*Continued on next page*)

A 60-550 Meter Super Oscillator Tunes Entire

By Hanson

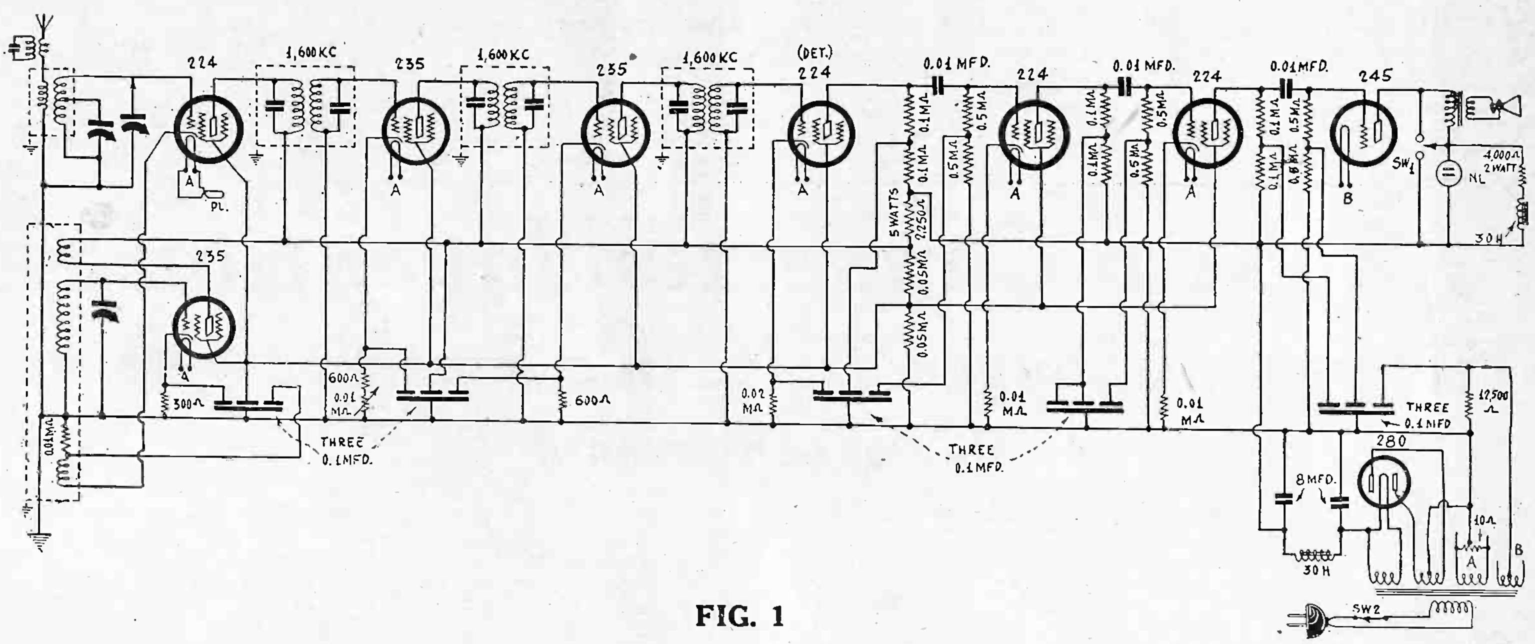

FIG. 1

THE use of a high intermediate frequency in a superheterodyne permits of a wide frequency coverage. For instance, if the intermediate frequency is 1,600 kc, for the broadcast band, oscillator tuning would have to start at 550+1,600 kc, or 2,150 kc. The other extreme is determined by the capacity ratio of the tuning condenser, and if this ratio is 10-to-1, then the frequency ratio, the square root of the capacity ratio, is about 3-to-1. So the oscillator will tune to 6,450 kc. Subtract the intermediate frequency of 1,600 kc and you get the modulator or signal frequency to which the system responds, which is 4,850 kc. So without any switching, but just by dial rotation, the oscillator permits bringing in signal frequencies of from 550 kc to 4,800 kc, or from 545 to nearly 60 meters.

One trouble is that the modulator can not keep pace, for it would exhaust its tuning possibilities with a given coil and condenser on the basis of the same ratio, 3-to-1, so would wind up at 1,650 kc at minimum capacity setting, whereas a frequency of 3,200 kc is required.

Needs Fine Vernier

If a two-gang 0.00035 mfd. tuning condenser is used, then a large manual trimmer, say of 0.0002 mfd. capacity, could be placed across part of the modulator secondary, whereupon it would be effective as a trimmer for the broadcast band, of course, and when the oscillator reaches the frequency equivalent to the end of the broadcast band, say, at 30 on the dial, the switch for the modulator section of the two-gang would be opened, and the trimmer and about one-third of the secondary would constitute the tuned circuit. In effect, of course, the modulator condenser's maximum is 0.00055, adding the two maxima, with minimum not raised much. The tap on the secondary must be so located that 0.0002 alone will tune from, say, 1,500 kc up, and as a frequency ratio of 2.6 prevails, the situation is fully met. We have seen the modulator need tune to 3,200 kc but the 2.6 ratio permits tuning to 3,900 kc. Since the modulator tuning is not critical, and a knob controls it largely for the broadcast band and exclusively for the higher frequencies, it would be all right to wind up at 3,900 kc.

So the oscillator dial will cover a great range. It is necessary that a vernier dial of high ratio be used, and one that can be read plainly. Fortunately there is an adjustable ratio dial that will do this, and it may be set at its maximum ratio, 20-to-1. It is National Company's VBD dial.

Choice of Intermediate

Since the two circuits, modulator and oscillator, are independently tuned, there is no necessity for padding the oscillator. Indeed, any padding would result inevitably in cutting down the wide frequency range covered, which wide coverage is the very purpose of the circuit.

The intermediate frequency is given as 1,600 kc, but it need not be exactly that. The frequency is the one used for describing commercial intermediate frequency transformers. It is well to have a selection, as some station on the intermediate frequency may be in the locality, and, besides, it may be advisable to have an intermediate frequency as low as possible, although higher than the highest broadcast frequency, so as to reduce the non-reception range to a span that would bring in no stations anyway.

Since the intermediate frequency is within the span of the tuning system, when the mixer is set for 1,600 kc (if that is used) there would be nothing but squealing. To get away from that a wave trap is put in the antenna circuit, consisting of a tuned circuit, the primary consisting of five turns of wire wound close to the honeycomb secondary, on the dowel on which the honeycomb is mounted. This honeycomb has a 50 turn winding on 3/8 inch diameter dowel, and the condenser across it is an equalizer, 20-100 mmfd., adjusted to the intermediate frequency.

Perhaps the easiest way to adjust the intermediate amplifier is to tune in a broadcast station on 1,500 kc, connecting aerial as

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Coils for Newly

(*Continued from preceding page*)

the output of the modulator tube to the input of the first amplifier tube.

The plate circuit has many component frequencies, principally those represented by the difference between oscillator and modulator frequencies, the sum of these two frequencies, the sum and difference of amplifier and modulator and amplifier and oscillation frequencies, and even order of harmonics of these, so any of these and of other frequencies present may be taken out. Since one of the frequencies that may be taken out is of the intended 175 kc in this instance, that frequency is amplified, and fed finally to the second detector or demodulator, the 224 tube at upper right in Fig. 1.

Now, substantially the same electrical system as was formerly used, for frequency changing in conjunction with a vacuum tube, is repeated at the final output to produce a frequency that differs from the previous ones. Since the assumed instance is that of 175 kc amplifier frequency, and the momentary intention is to deliver a final output to which a broadcast receiver will respond as previously outlined, the frequencies of oscillation may be, as to extremes, 1,500 + 175 kc and 550 + 175 kc, requiring an oscillator tuning range for this particular example of 1,675 to 725 kc. If a variable condenser accessible to the front panel is used, then from the front panel, by adjusting this condenser in conjunction with fixed or other inductances, the output will correspond in frequencies to the span of frequencies obtainable from a broadcast receiver.

An Excellent Method

This is the only known method of enabling the use of a predetermined frequency, such as is present in a broadcast set or other source of amplification at any frequencies, in conjunction with prior amplification to intensify an originally received frequency, and yet permitting the complete choice of the frequency in the converter or mixing-amplifying device, no matter what

at 1,600 kc Intermediate; Range Without Switching

W. Frament

shown, using only the manual trimmer (switch of the section of the gang condenser open), and the oscillator tube removed from its socket. In that way, also, you can check up on the correct position for the tap, on the secondary, for with the manual trimmer at maximum, connected from tap to ground, 1,500 kc or lower should be receivable. If the antenna coil consists of a 120 turn secondary, No. 31 wire or thereabouts, on 1⅛ inch diameter, then the tap would be at about 58 turns from the grid end, leaving 42 turns between tap and ground. This location of the tap actually may be used, but it is harmless to check up, and the present system permits the checkup.

When the 1,500 kc station is tuned in adjust the wave trap condenser until the signal disappears or becomes as faint as possible. It is often possible to kill off the signal completely, as such a trap is highly effective.

Lining Up the System

Now you haven't got the intermediate frequency you want, nor one you can use, but you know that decreasing the capacity of the condensers will increase the frequency. Turn the set screws the same distance to the left, about one eighth turn. Then put the oscillator tube in its socket and close the switch on the stator of the gang section in the modulator circuit. Tune in a station in the broadcast band. Turn the manual trimmer in the modulator for greatest response. Then readjust the condensers across the intermediate coils (leaving the wave trap intact) until signal strength is loudest. If the change is only for the worse, restore the previous condenser settings.

Now everything has been checked up except the wave trap. Tune the broadcast band to its high end, always remembering there is a manual trimmer in the modulator circuit to be adjusted, and then pull the modulator switch open and keep on tuning the oscillator to higher frequencies after having put the manual trimmer at or near maximum, whatever is required for greatest signal strength. If, in tuning toward the television band there is no big squeal at one point of the oscillator setting the wave trap is at the right frequency, but if there is a squeal, then readjust the wave trap condenser until the squeal disappears or is faintest.

It is to be expected that not only the carrier frequency equal to the intermediate frequency can not be received, but that perhaps 100 kc on either side will not be receivable. However, this missout need not concern any stations you would desire to hear, anyway.

Antenna Coil

Although 1,500 kc was the frequency recommended for test, any frequency near the high end of the broadcast band may be used, if you can't get a 1,500 kc station. Virtually everybody can tune in some station between 1,300 and 1,500 kc. in any part of the United States.

The primary of the antenna coupler may consist of 10 turns of any diameter wire, wound over the secondary, insulation fabric between, such as empire cloth, although even wrapping paper will do in a pinch.

The oscillator, if wound on 1⅛ inch diameter tubing, would consist of 30 turns secondary and 12 turns tickler, if the tickler is wound over the secondary, with high voltage insulation between but if the tickler is wound next to the secondary, then, with ⅛ inch space between, the tickler should have 20 turns. The wire may be No. 31 throughout, or any diameter near that.

Coupling of Mixer

The coupling between modulator and oscillator is effectuated by putting current from the modulator cathode through a winding inductively related to the oscillator secondary. This current is of course modulator plate current, but the pickup winding is both in the plate and grid circuits of the modulator, and is actually put into both the grid and plate circuits of the oscillator. However, the oscillator grid circuit is the one that has the far greater voltage, so the coupling is principally to oscillator grid. As the current in the pickup coil is small, loose coupling results even when more than the expected number of turns is used for the pickup. If ⅛ inch separation prevails, then the pickup winding may consist of 10 turns of any kind of wire, this direction to be added to the data given for winding the rest of the oscillator coil.

The modulator is a 224 tube, worked on the negative bias principle, but be sure not to put the bypass condenser across the pickup coil, as that would detour the coupling current. The condenser is one section of a three-fold 0.1 mfd. block. Black lead of this block is common and goes to ground. The three red leads are interchangeable to their destinations, so one red wire is connected to the joint of the 0.01 meg. biasing resistor and the pickup coil, the other end of the pickup winding going to modulator cathode direct.

The Audio Circuit

The oscillator and the two intermediate frequency tubes are 235's, while the demodulator (or second detector) is a 224, worked as a power detector, with twice as high value biasing resistor as in the modulator or first detector. The three audio tubes are two 224's and one 245.

The three-stage resistance coupled audio amplifier is stabilized by resistor-capacity filters and by the omission of bypass condensers across biasing resistors. If a circuit will motorboat it is a sure sign that there is very intense oscillation or regeneration at low audio frequencies, and there should be no augmentation of this feedback. Since the feedback voltage in biasing resistors is negative, this negative feedback is capitalized as a stabilizing agency by omission of the bypass condensers. The resistors affected are 0.02, 0.01 and 0.0125 meg., 20,000, 10,000 and 12,500 ohms respectively, of which the last should be of 5 watt rating. The 2,250 ohm resistor (or any value around 2,000 ohms) to drop maximum B to the r-f plate tuner plate values, should be of 2 watts rating at least, though marked 5 watts in the diagram. All the other resistors, except in the neon circuit, may be of 1 watt

Why 245 Is Used

The output tube is a 245 because the circuit may be used for television. This is true despite the higher order of selectivity than television theory ordinarily requires, but the present state of the picture definition, 60 lines per frame, 20 frames per second, does not afford a picture of such good contrast and sharpness as to make the extra selectivity any serious drawback at all. The 245 tube is more suitable for television generally, because if a 247 is used the complication of high screen voltage and low effective plate voltage, when the neon lamp NL is switched in, works the tube at an unfavorable point on its characteristic. The effective plate voltage will be around 50 volts when the screen has 250 volts. However, a series resistor in the screen, about 0.01 meg., 1 watt, would correct this, but would not be a complete cure. Besides, the 245 is more suitable for a three stage resistance coupled audio amplifier because of lower order of feedback.

nvented Converter

the predetermined frequency of external amplification may be. Moreover, the system at once averts lack of sensitivity in the mixer or converter itself, by permitting amplification without restriction of output frequency, and furthermore prevents the pre-amplification of signals of the final frequency of external amplification because the built-in stages of amplification are at a frequency diverse from such external amplifier and remodulator.

Coil Data

The coil system in the 224 tube at upper left in Fig. 1 may consist of two separate windings, and a switch is used to pick up one or the other as the impedance load on the grid circuit of that tube. With the capacities as specified, L1 may consist of 15 turns of No. 31 or approximate wire on a 1⅛ inch diameter tubing, and L2 of 42 turns of the same kind of wire on another tubing, the two not being inductively or otherwise related. L4 may consist of 40 turns of the same kind of size wire on the same size independent tubing and L3 of 15 turns wound on both of the turns of L2, with fabric separation between. The ratio of frequency for the final system of oscillation is a little more than 2.3-to-1 for 1,675 to 725 kc, therefore a 0.0002 mfd. condenser will be of sufficient capacity, as it affords 2.6-to-1 frequency span, and is compact, or a higher capacity condenser may be used, but not much lower. For 0.0002 mfd. L6 would consist of 100 turns of No. 31 or approximate wire on 1⅛ inch diameter tubing, L5 consisting of a radio frequency choke coil that fits inside the form, of 100 or 50 turns; while L7 consists of 25 turns wound over L6, with high voltage insulation between.

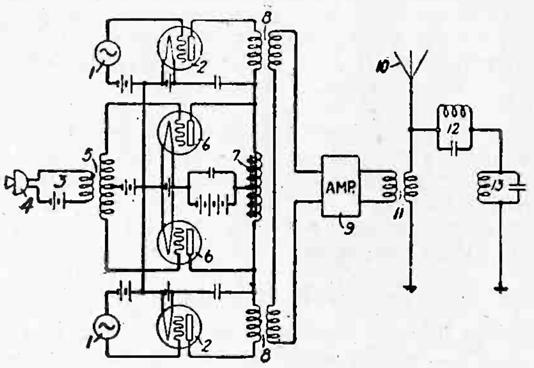
The diagram includes a complete design, with rectifier. The switch that picks up the different coils (in one instance, primary and in next secondary), also switches antenna from converter to receiver, if a three deck switch with three points per deck is used. The switch should have shaft insulated, as the shorting method is not used.

New Inventions

Illustrated Reports on Patents Issued

[Newly issued or reissued radio patents are recorded in this department. The number of the patent itself is given first. Usually only one claim is selected and the claim number also is cited. The code at the end of the title description (Cl., etc.) refers to the classification, the next number being the sub-division, which data define the nature of the patent. All inquiries regarding patents should be addressed to Ray Belmont Whitman, Patent Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.]*

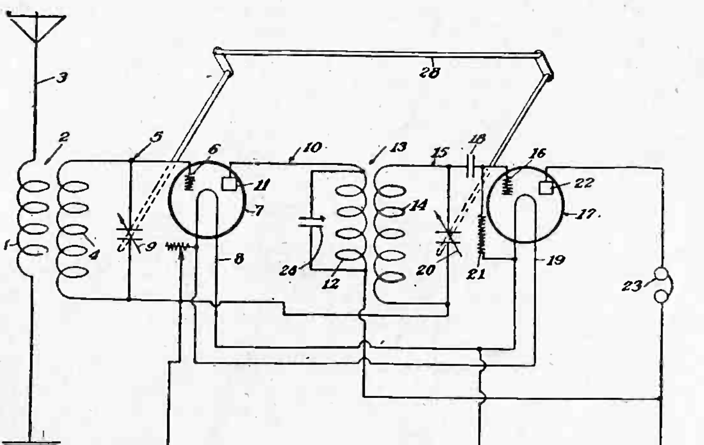
1,836,594. SIGNALING SYSTEM. Raymond A. Heising, Millburn, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a Corporation of New York. Filed Oct. 16, 1925. Serial No. 62,719. 8 Claims. (Cl. 250—10.)



1. The method of signal transmission which comprises simultaneously modulating two carrier waves differing in frequency with waves representing a common signal, combining the modulated waves and subsequently amplifying the combined waves, said modulating waves being oppositely phased whereby the amplitude of the combined waves does not exceed the maximum amplitude of one of the modulated waves alone.

* * *

1,835,934. APPARATUS. Warren E. Danley, Highland Park, Ill. Filed Mar. 25, 1926. Serial No. 97,273. 6 Claims. (Cl. 179—171.)

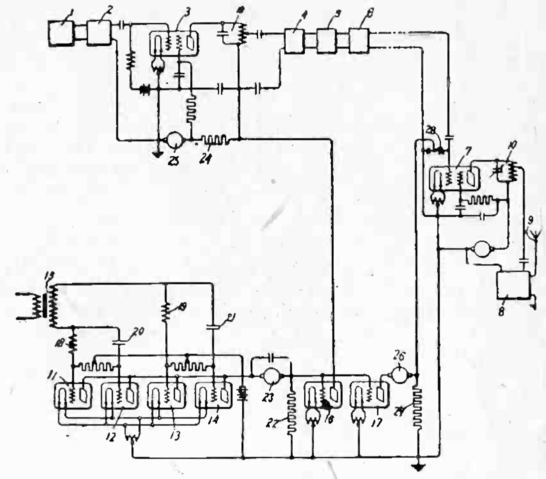


1. In a vacuum tube radio apparatus an aerial circuit, a grid circuit coupled to the aerial circuit, a variable condenser shunted across the grid circuit, a plate circuit coupled with the grid circuit, a second grid circuit coupled to the plate circuit, a variable condenser shunted across said second grid circuit, means for giving to the plate circuit substantially the same characteristics as exist in the aerial circuit, the coupling between the first plate circuit and the second grid circuit being adjusted to the coupling between the aerial circuit and the first grid circuit, so that the apparatus may be tuned by moving both of said condensers simultaneously and equally.

* * *

1,840,140. HIGH FREQUENCY TRANSMITTER. Donald H. Bance, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed Feb. 14, 1931. Serial No. 515,803. 5 Claims. (Cl. 250—8.)

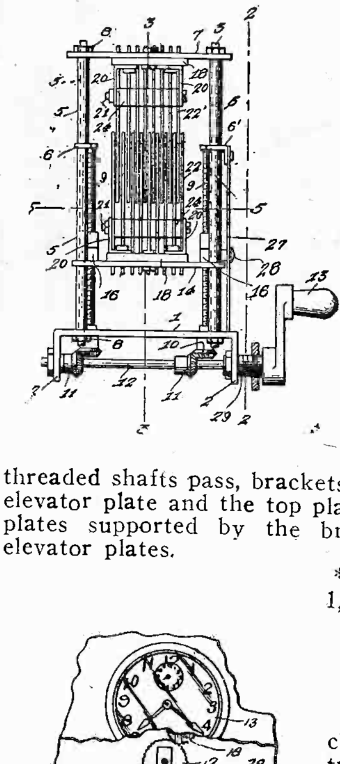
1. A high frequency transmitter, comprising a plurality of stages including an oscillation generating stage, and a plurality of amplifying stages, said amplifying stages being arranged for successive amplification of oscillations generated by said generating stage, and means to impulse said transmitter in accordance with desired signals, said impulsing means comprising means for rendering at least two of said stages which are



separated by one or more intermediate stages, inoperative in accordance with said signals, said intermediate stage or stages being maintained continuously in condition for operation.

* * *

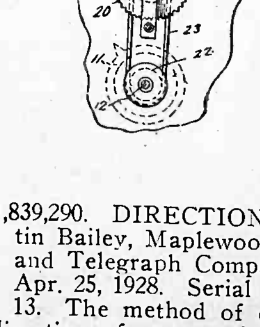
1,840,215. RADIO CONDENSER. Ralph C. Sordillo, East Boston, Mass. Filed July 19, 1929. Serial No. 379,484. 2 Claims. (Cl. 175—41.5.)



1. A condenser of the class described comprising a base, a number of uprights having their lower ends connected with the base, spacers on the uprights, a pair of plates perforated to receive the uprights, said plates being supported in an intermediate position on the uprights by the spacers, screw shafts each having its upper end journaled in one of said pair of plates and its lower end journaled in the base, a horizontal shaft journaled in the base and having a handle thereon, gears connecting the shafts together, an elevator plate slidably arranged on the uprights, nut members on the elevator plate through which the threaded shafts pass, brackets insulated from and carried by the elevator plate and the top plate and a group of diamond shaped plates supported by the brackets on each of the top and elevator plates.

* * *

1,839,947. RADIO TIME-SETTING CONTROL. Lemual Green Brown, Oklahoma City, Okla. Filed Mar. 7, 1930. Serial No. 433,952. 2 Claims. (Cl. 200—35.)

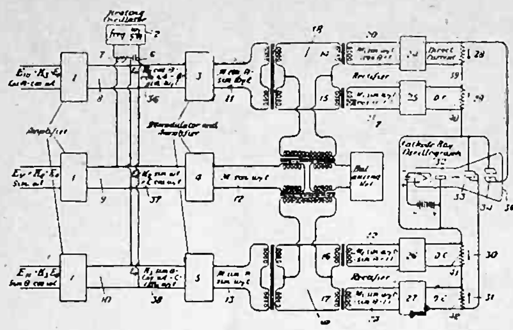


2. In a radio including a switch, clock mechanism having an alarm train supported thereby, a frame arranged within the radio, a gear journalled on said frame and connected with said switch, arms mounted on said frame for rocking movement, gears carried by said arms, and adapted to separately engage the first mentioned gear to rotate the latter in either direction, means for rocking said arms, and other gears mounted on said frame and connecting the above mentioned gears with the alarm train of the clock of and for the purpose specified.

* * *

1,839,290. DIRECTION FINDER FOR RADIO WAVES. Austin Bailey, Maplewood, N. J., assignor to American Telephone and Telegraph Company, a Corporation of New York. Filed Apr. 25, 1928. Serial No. 272,702. 14 Claims. (Cl. 250—11.)

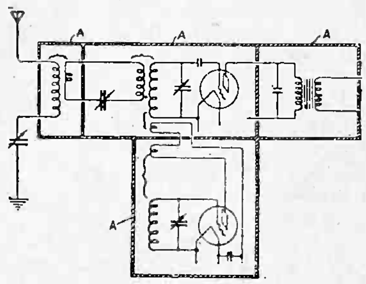
13. The method of determining the magnitude and absolute direction of propagation of radio waves, which consists in detecting components thereof, combining one of said components



with a second one of said components and a third one of said components with said second one, rectifying said combinations, deflecting an electronic beam in accordance with the difference of said first two rectified combinations, deflecting said beam at an angle thereto in accordance with the difference of said last two rectified combinations and causing said deflected beam to indicate the magnitude and absolute direction of propagation of said waves.

* * *

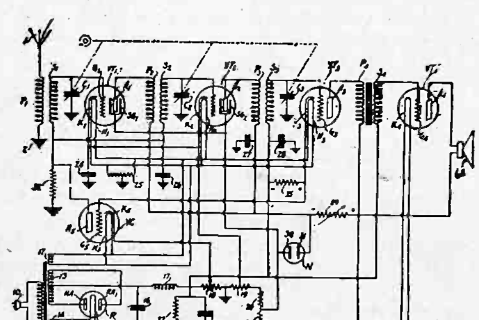
1,840,064. RADIO TELEPHONY RECEIVING APPARATUS. Edgar D. Tillyer, Southbridge, Mass., assignor to Radio Corporation of America, New York, N. Y., a Corporation of Delaware. Filed June 26, 1926. Serial No. 118,705. Renewed June 23, 1930. 10 Claims. Cl. 250—20.)



1. Receiving apparatus for a radio telephony set comprising means for receiving a modulated carrier wave, means for eliminating the carrier wave and one side band, means for generating a local carrier wave of the same frequency as the original unmodulated carrier wave, and means for combining the other side band with said locally generated carrier wave.

* * *

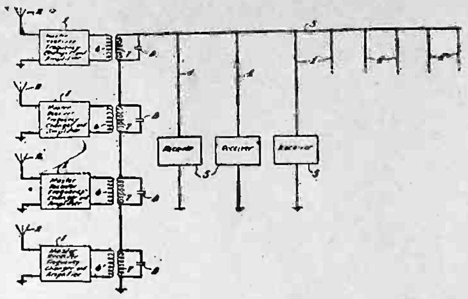
1,839,419. RADIO RECEIVER. Alexander Senauke, New York, N. Y. Filed Dec. 27, 1929. Serial No. 416,784. 9 Claims. (Cl. 250—20.)



1. Radio receiving apparatus comprising, in combination signal selecting means, a series of thermionic vacuum tubes arranged to receive incoming signals and having an input and an output circuit, a power supply circuit for energizing said vacuum tubes and including an impedance path having a voltage drop therein, means for selecting the frequency of signals to be received, a control for said frequency selecting means and a signal receiving indicator comprising a lamp connected between points on said power supply circuit including said impedance path between which there exists a potential difference which increases when signals are being received.

* * *

1,840,013. RADIO RECEIVING AND REPRODUCTION SYSTEM. Melvin Bernard Benson, New York, N. Y., assignor to Melvin B. Benson Corporation, New York, N. Y., a Corporation of New York. Filed Feb. 10, 1930. Serial No. 427,-092. 3 Claims. (Cl. 250—20.)



1. A radio receiving system including a multiplicity of radio frequency receiving means, each of said means including means for amplifying the signal currents and reducing the frequencies of the radio frequency currents received to a predetermined value above the audio spectrum, the receiving means being adjusted to widely different output radio frequencies, a common carrier circuit for relaying the converted radio frequency currents to a multiplicity of remote points and inductive coupling means between said common carrier circuit and each of the receiving means and a multiplicity of audio-frequency reproducing means connected with the said common carrier circuit and adapted to be tuned to the converted frequency of any of the radio frequency receiving means.

* * *

QUESTIONS ANSWERED

When should a design patent be taken out and when should a mechanical or ordinary patent be taken out? In other words, what is the difference between these two kinds of patents?—R. V. W., New York, N. Y.

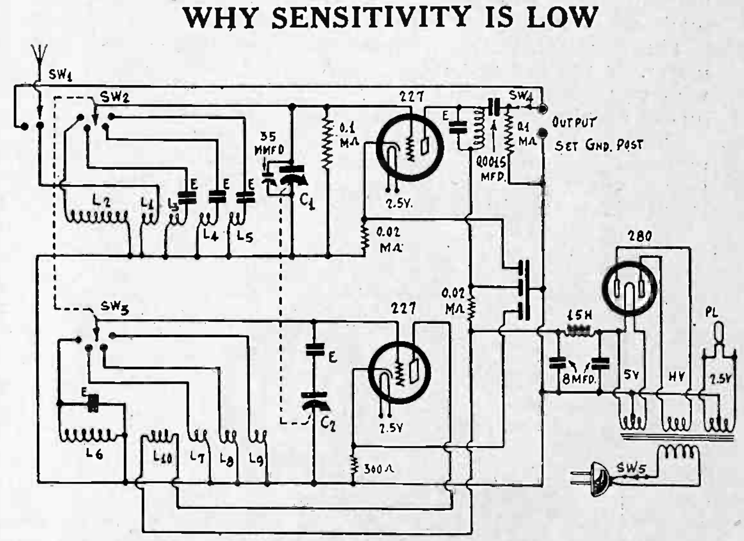
A design patent is directed to an invention in which the form or appearance of the invention is important from an aesthetic or ornamental viewpoint, whereas a mechanical or ordinary type of patent is directed to the function of the invention. Whenever possible take out a mechanical patent, for it is less easily avoided without infringement and therefore gives much better protection, and better prevents competition. A design patent may often be avoided by more or less simple changes in the appearance of the design without affecting the value of the new appearance.

* * *

Will the Patent Office issue a patent on the same thing to more than one inventor?—E. J., Fort Wayne, Ind.

No. The Patent Office can issue a patent to the first inventor only, although it sometimes happens that later inventors also get patents on somewhat similar things which may be modifications of or improvements over something previously patented. It is necessary for a patentee before utilizing this invention to determine by an infringement search whether there are any such other patents previously issued on part of his invention and which he would have to use in order also to use his own invention, for in that case he might infringe the claims of such prior patents and be stopped from the use of his own patent as a result.

WHY SENSITIVITY IS LOW



Series condensers E in modulation of converter divide voltage with C1 and cut sensitivity.

Adjustment of Receiv

Precise and Positive Results

By Brunsten

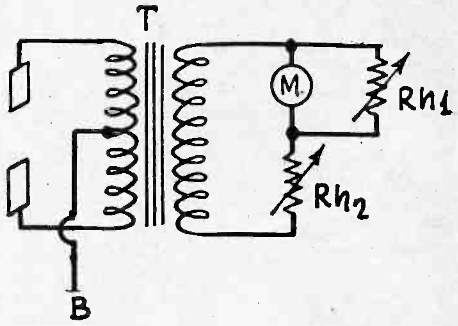


FIG. 1

The output of a receiver can be measured with an alternating current milliammeter connected in this manner. A steady tone is supposed to be delivered to the output stage.

WHEN experimenting with radio receivers the ear is usually used for telling the observer the effect of various changes. But the ear is notoriously a poor instrument for this purpose. It is too adaptable to different intensities of sound. This adaptability can easily be tested on any radio receiver. Turn up the volume to good intensity. At first the ear objects to the loudness, but after a while the sound does not seem so loud. Turn it down, and at first it seems that the volume is entirely too feeble, but after a while the ear adjusts itself and it seems that it is just as loud as it ever was. The ear can be used all right for observing the effect of changes provided that these are made rapidly, but if it takes more than a fraction of a second to make a change the ear is not at all reliable.

Because of this unreliability of the ear we need meters for observing the effects, meters which enable us to express the intensity in numbers. Whether these numbers are absolute or relative is of little importance in most instances, unless we want to compare two receivers measured with different instruments, in which case it is necessary to have absolute units, or at least the same arbitrary units.

Methods of Measuring Output

It is not necessary, to have expensive instruments for measuring the output, or for observing the effect on the output of certain changes in the circuit. We shall indicate a few simple methods of measuring output.

The simplest, perhaps, is the thermo-couple type of milliammeter, or the hot wire milliammeter. It makes little difference which of these instruments is used for routine work. Either measures alternating current, as well as direct.

Suppose we have one of these instruments and we wish to measure the output current in the secondary of the output transformer. We can connect the meter M as in Fig. 1. The shunt rheostat Rh1 is used only to protect the meter against overload, and the series rheostat Rh2 is used to adjust the load on the transformer to the desired value. Just what the values of these rheostats are depends on the load that should be on the transformer, or on what load is desired, and on the sensitivity of the alternating current meter. When only relative values are desired neither rheostat is critical.

It is assumed that the source of sound is a modulated radio frequency oscillator so that indications in the output of the receiver will be constant. A broadcast signal is too variable for making any comparisons. Any modulated signal will do, just so the modulating frequency is constant in amplitude and frequency We have described suitable test oscillators several times and there are also many laboratory oscillators available in many different price ranges.

As a means of protecting the output meter it is always possible to vary the input from the modulated oscillator to the set.

Noting Effect of Changes

Suppose it is a question of tuning an intermediate frequency amplifier. It is only necessary to adjust the condensers across the intermediate frequency coils until the meter M reads maximum, doing this for each of the condensers. Always, the amplification or the input should be reduced when necessary so that the output meter will not be overloaded.

Again, it may be a question of studying the effect on the output of changes in the grid bias in various stages. In this case the input and the amplification are adjusted once so that the output has a suitable value and then the adjustments are left alone. Changes in the bias are made and the change in the output noted. If the object is to get highest sensitivity, the bias which gives maximum output is retained. Similarly we may adjust for coupling, number of primary turns, changes of tubes, trimming, changes in screen voltages, plate voltages, and many other changes. The indicated effects are definite and not conjectural.

While the circuit shows a push-pull stage the method applies equally well to a single tube stage. Indeed, we may use the arrangement for studying the relative contributions of the two two tubes in a push-pull stage. To do this, the best way to kill one side is to short-circuit the input to one of the tubes and then of the other. This should be done in such manner that the bias is not changed We can also observe whether or not the two tubes contribute the same amount to the load by short-circuiting part of the primary of the output transformer, and then that of the other. Any changes in the circuit will be the same on either side.

Measuring Gain

In a multitube set we can measure the gain of one of the radio frequency stages by first noting the current with the stage in the circuit and then when it has been skipped. This is especially easy when the skipped stage contains a screen grid tube for then it is only necessary to move the grid clip to the next tube The ratio of the outputs, dividing the larger current by the smaller, gives amplification of the skipped stage. Since we have not changed the load impedance the ratio can be interpreted either as current or voltage amplification and the square of the ratio as the power amplification.

In the same way we can measure the gain of one tube over that of another. Suppose, for example, we want to determine how much better amplifier a 239 r-f pentode is over a 236 screen grid tube. We might first measure the output when the 236 tube is in the circuit and then when the 239 takes its place. To give the 239 a fair chance we should adjust the screen voltage to the proper value, that is, 90 volts when the plate voltage is 135 volts. The bias for the two tubes should be the same, and since the 239 tube takes more screen and plate current we should readjust the grid bias resistor in case the bias is obtained that way. The ratio of the two output currents will measure the relative merits of the two tubes. It is understood that there has been no change in the input signal between the two measurements.

Vacuum Tube Voltmeter

Perhaps the cheapest instrument to use is a vacuum tube voltmeter, especially as this may be used with any current meter that may be available. Even a voltmeter could be used provided that its internal resistance is not too high. Ordinarily, a milliammeter is connected in the screen circuit of the vacuum tube, but a resistance is usually connected in series with it to limit the current, especially when a sensitive milliammeter is used. But a voltmeter is nothing but a milliammeter with

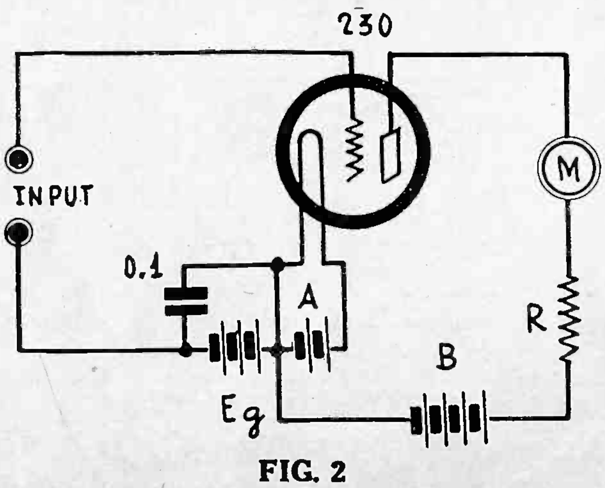


FIG. 2

A simple vacuum tube voltmeter like this circuit can be used for estimating the output and for adjusting a receiver to greatest output.

ers with Aid of Meters

Obtained with Simple Equipment

Brunn

a resistance in series with it. In Fig. 2 is shown a vacuum tube voltmeter utilizing a 230 type tube. R is a limiting resistor which should be adjusted so that the current is not too high for the milliammeter M. It is not critical and it depends on the sensitivity of the meter. B may be 45 volts, A should be 2 volts, and Eg should be just high enough to reduce the plate current to nearly zero when the input terminals are short-circuited.

Of course, a higher plate voltage may be used if desired, but it should not exceed 90 volts when the 230 tube is used. If the plate voltage is higher the grid bias Eg must also be higher. When adjusting the grid bias the resistance R should not be too large for if the current is reduced to a small value by means of this resistance there will be no change in the plate current when the signal is impressed.

A test for correct bias is to note whether a signal impressed at the input terminals increases the plate current. The greater the increase in the plate current for a given signal the better. In other words, the tube should be adjusted so that it is the most effective detector.

Meaning of Indications

The vacuum tube voltmeter does not give current indications nor voltage indications directly. Therefore one reading cannot be divided by the other to give true ratios as in measuring amplification, except when the meter has been calibrated in voltage. However, for making most tests it is sufficient to go by deflection alone. For example, when we are trimming up radio frequency tuners or intermediate frequency transformers all we are interested in is maximum output. The vacuum tube voltmeter is particularly suited for this. The peak in any such case can be located with great accuracy.

The vacuum tube voltmeter can be used in many cases where any current drawing instrument would give spurious readings It is also valuable because it is simple to construct of parts usually at hand. Nearly everybody has an extra socket, a tube, a meter of some kind, and batteries. It takes only a few minutes to hook the circuit up.

Use of Other Tubes

While we show a 230 type rectifier tube in Fig. 2, any receiving tube may be used in the circuit. If a heater tube like the 227, or the 237, is available that may be used. The only changes necessary are the filament voltage and the grid bias. A 237 tube is especially useful because it can be used either on a 6 volt storage battery or a 5 to 7.5 volt transformer winding. When a heater tube is used it is often possible to use the receiver under test as the source of filament voltage because it is not necessary to connect the heater and the cathode together and hence to limit the application of the tube. The only thing that should be guarded against is excessively high voltage between the cathode and the heater. Fig. 3 shows a circuit similar to that in Fig. 2 except that a heater tube is used. The two H terminals can be connected to any source of power having a voltage suitable to the heater tube used.

Using the Vacuum Tube Voltmeter

The vacuum tube voltmeter, of course, is used as a voltmeter. That is, it is connected in shunt with the device across which the voltage is to be measured. For example, it may be connected across the voice coil of the loudspeaker while the speaker is working. It may be, however, that this will not give much of an indication because the voltage across the voice coil sometimes is very low, especially in speakers in which the voice coil impedance is low. When a good indication is not obtained in this way, the input terminals of the voltmeter tube may be connected across the secondary of the input transformer to the output tube, or across the grid leak or transformer secondary ahead of the power tube. When this is done the grid bias for the power tube must not be included in the voltmeter tube input circuit.

Another way is to connect the vacuum tube voltmeter across the primary of the output transformer, but in this case it is necessary to connect a large stopping condenser in one side of the input to the voltmeter and a grid leak of about 100,000 ohms across the terminals. This is to keep the direct voltage in the plate circuit way from the voltmeter tube. This should be done even when the voltmeter is connected from plate to plate of a push-pull stage although, theoretically, there should be no direct voltage difference between these points. A voltage difference may exist because of unbalance in the circuit. This difference must be kept out of the voltmeter grid circuit, at least when we are interested only in the alternating signal voltage across the primary.

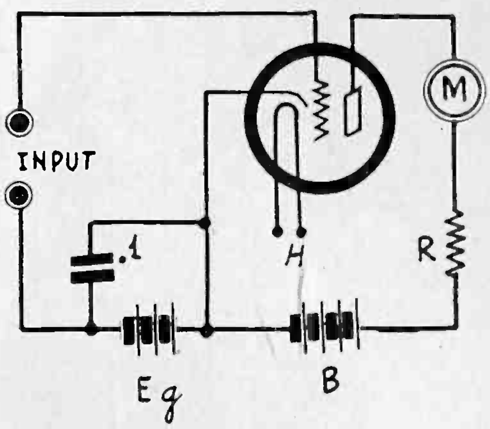


FIG. 3

This is a vacuum tube voltmeter circuit like that in Fig. 2 except that a heater tube is used in place of a filament type tube.

Using Tube in Set

In many instances it is possible to use one of the tubes in the set for measuring the output. A way is illustrated in Fig. 4, showing a push-pull stage. The output tubes are converted into detectors by increasing the grid bias to the point where the plate current is practically cut off. The indicating meter in this case should be a milliammeter of medium sensitivity. When no signal voltage exists across the secondary of the input transformer there is practically no plate current indicated by the meter, but as a signal voltage appears, the plate current increases, and the higher the signal voltage the greater the deflection on the meter. The tube is operated exactly in the same way as the tube in either Fig. 2 or Fig. 3. This method saves hooking up an extra tube, but it does necessitate increasing the bias on the power stage until the plate current is practically cut off, and this may require very high bias. Roughly, it requires about twice as high bias to convert the tube to a detector as it does to make it an amplifier. The 250 is an extreme case as it requires 84 volts for amplification. Therefore it would require 168 volts to convert it to a detector. The 247

(*Continued on page* 18)

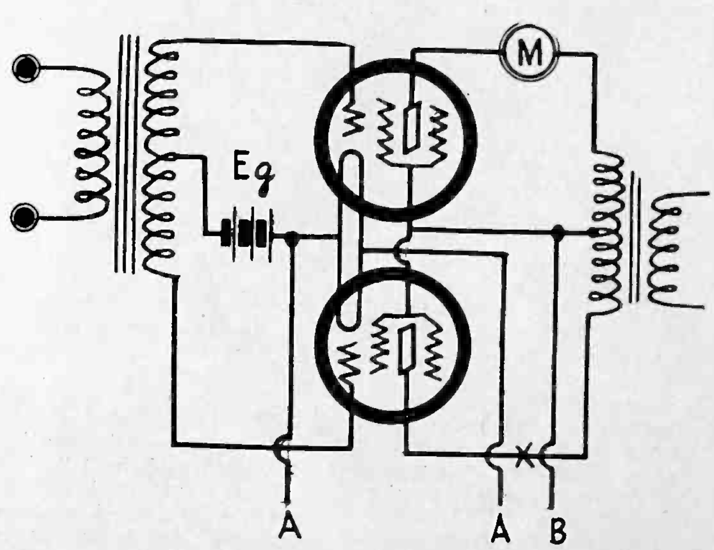


FIG. 4

The power tube in the last stage can also be used for measuring output provided that the bias is raised so that the tube is a detector. In a push-pull stage the indicating meter can be put in either plate circuit.

Inductive Mixer Coupling

Popular Coil System for Wide Range

By Jack Tully

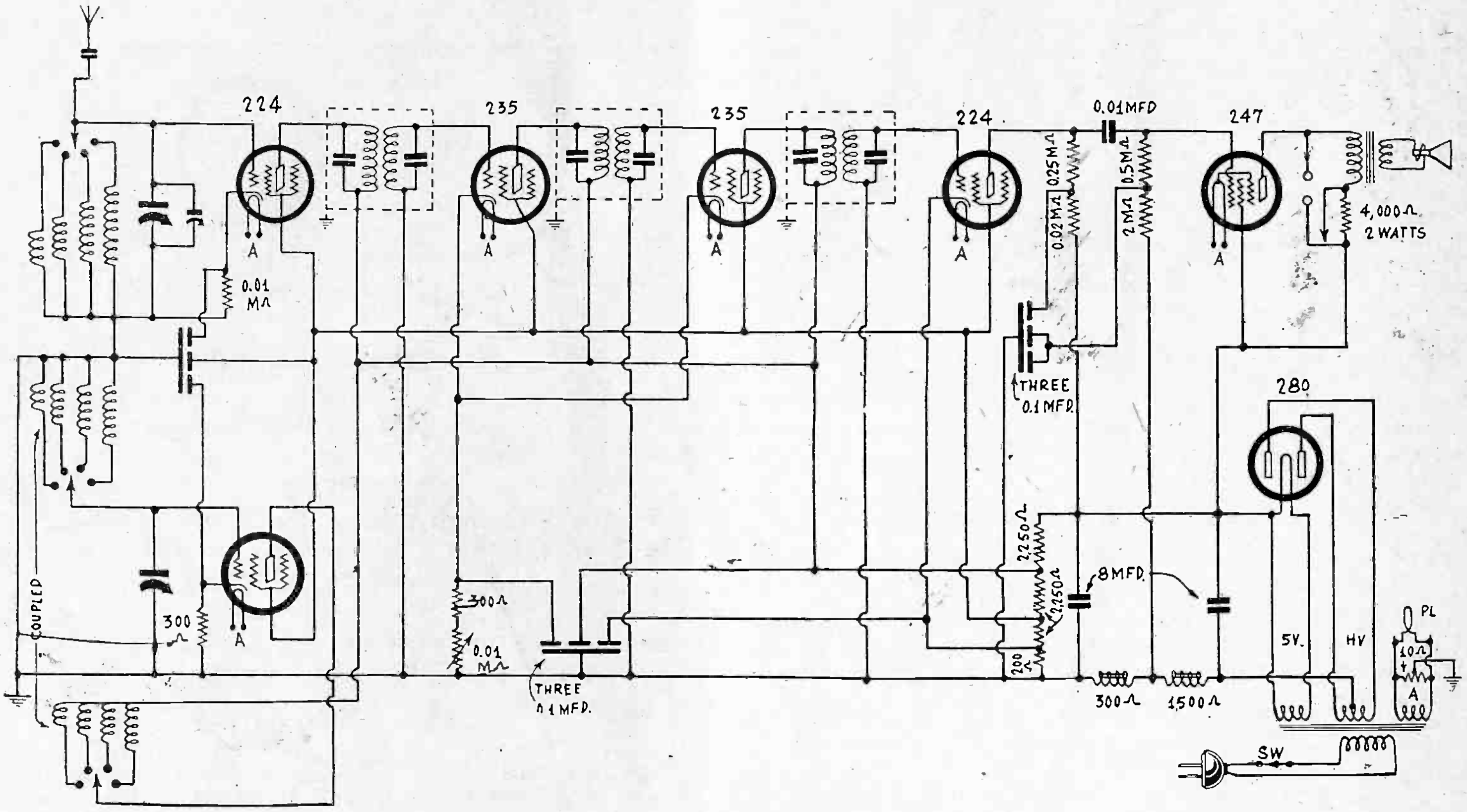


FIG. 1

THE construction of an all-wave superheterodyne or a short-wave superheterodyne may be predicated on the diagram, Fig. 1. Whether the coverage will be from 15 to 200 meters or from 15 to 550 meters will depend on the values used for the oscillator and modulator tuning condensers, and the inductance of the coil systems. If broadcast coverage is to be included, the set should be built as a broadcast set, and later the short-wave feature included, the short-wave results being whatever they are, usually good. If short waves are to be tuned in exclusively, then the set should be built for the longest wave band of short waves, and you will have a good short-wave set, of medium volume.

For all-wave coverage the intermediate frequency should be relatively low, say, 175 kc, whereupon the oscillator may be padded, with series condenser, etc., for the broadcast band, but if it is deemed tolerable to have a manual trimmer across the modulator (e.g., 50 mmfd.), then if the oscillator inductance is about 20 per cent. less than the modulator inductance, there would be 10 per cent. fewer turns.

The largest modulator winding (impedance coil) would have the familiar number of turns for the capacity across it. Say the capacity is 0.00035 mfd. Then, if the diameter is 1 inch the number of turns of No. 31 wire or thereabouts would be 127, whereas the oscillator companion tuned circuit would have 114 turns. These would be wound on the same tubing. Since there is a plate winding, too, the modulator coil could be wound at one end, the plate winding, of 40 turns, next, spaced 1 inch away, and the oscillator grid winding at the other extreme, spaced ⅛ inch from the plate coil. In this way the 1 inch separation effectuates plate coupling to the modulator coil to a small extent and grid coupling of oscillator to modulator to a far greater extent (despite the wider physical separation), since there is much more voltage in the grid circuit.

For each of the succeeding coils add ½ inch to the prescribed separation between the modulator grid winding and the oscillator plate winding, until finally the distance will be nearly 2.5 inches. The turns, on the basis of 0.00035 mfd., will be in the proportion of 1-to-3, so the first short wave band will have tuned windings of 45 turns, and now oscillator and modulator grid coils may have the same number of turns, because the intermediate frequency is a much smaller percentage of the carrier frequencies to be tuned in. The ratio should contract for the next two coils to 2.5-to-1, so the second pair of grid windings would have 18 turns and 7.5 turns, respectively. The tickler winding for the 45 turn coil should be 20 turns, and for the two other coils should be one-half the number of grid turns.

So when the coils are finished there are four tubings, with modulator and oscillator windings on each of the tubings, the coupling between modulator and oscillator being inductive.

The coils may be selected by a switch of the three-deck four-point insulated type.

If the service is to be short-wave exclusively, then of course the coil data would be the same, except with one pair of coils omitted, were the same capacity condenser to be used. However, a set built strictly for short waves is almost certain to give better short-wave results than a set of this type that is to cover the broadcast band as well. The tuning condenser capacity should be smaller. A popular capacity is 0.00015 mfd., and due to being less than half the capacity of the condenser previously considered, four different coils will be required to cover just the short-wave band.

The ratio that may be followed throughout is 1-to-2, so that each grid winding will have half as many turns as its predecessor. If we start at the "bottom" with 8 turns, we find that the succeeding windings are 16, 32 and 64 turns. This will give adequate overlap, as would the coils if made as per directions for the 15-550 meter bands. The tickler for the largest coil may consist of 30 turns, and for the rest, one-half the number of grid turns.

It will be noticed that the intermediate frequency is 175 kc, but if a much higher frequency is used, then the coil data would have to be changed very considerably. No matter how high the intermediate frequency, it will not be higher than 1,600 kc for a super, and so for the two smallest coils, the same data apply no matter what the intermediate frequency, since it will be 1,600 kc or lower, and the frequencies of modulation and oscillation are then so high that 1,600 kc is not a high percentage thereof.

The antenna series condenser may be 100 mmfd. or a little more.

The output is arranged for television terminals, the neon lamp being connected to the two ringed posts. The switch at this position may be used to short out the 4,000 ohm resistor when the lamp is not used. The television signals will be audible even when the lamp is being worked, but the volume will not be so high, because of the division of the load with the 4,000 ohm resistor.

Extreme care should be taken with the intermediate frequency amplifier, for if the coils are placed side by side there will be oscillation, and it will be virtually uncontrollable. The tubes may be placed between respective intermediate frequency coils, and both coils and tubes shielded, shields being grounded, as always.

Data on High Mu 841

Operating Conditions for Classes A, B and C

By Franklin Ellis

IN the preceding issue, dated January 16th, an article was published about the new voltage amplifier tube, 841, which stated that it could be used as a Class B amplifier in push-pull circuits. This class of service is comparatively new and most fans are unfamiliar with it. The only difference between this kind of service and the ordinary Class A lies in the operating grid bias of the tubes in the push-pull circuit. In Class B service it is so high that the plate current is very nearly zero at the operating point. The tubes take turns doing the work of the stage. This they do in the ordinary push-pull stage, too, but not to the same extent.

In Fig. 1 is a diagram illustrating the use of the tubes in Class B service. Physically the circuit is just like any other push-pull stage but the bias is higher. The part of the figure above the line AB pertains to one of the tubes and the part below the line to the other tube. The line BF represents the zero bias axis for the curve for one tube and AB represents the corresponding axis for the other tube. CD represents the operating bias for both tubes. E1 represents the operating bias for the first tube and E2 that for the second. These two are identical, not merely equal.

Operation of Tubes

The sinusoidal curve drawn with CD as its axis represents the signal, or exciting voltage that is impressed on the amplifier. In this case its amplitude is made equal to the operating bias. Let the right side of CD be positive and the left negative. Then as the signal voltage increases from zero the plate current in the first tube increases from I1 to F. Then as the signal voltage decreases to zero the current decreases from F to I1. This is half a cycle and during this half only the first tube delivers power to the load. Near zero, or for low values of the signal voltage, the current does not increase linearly, due to the curvature. But this is partly compensated for by the contribution of the second tube, for near zero there is some current in the second tube plate current, and this current decreases as the current in the other tube increases. Due to the connection of the load transformer the effect in the secondary of this transformer is to straighten out the effective output.

When the signal voltage swings negative, the second tube takes up the load and the process is exactly the same as in the first tube. The second tube now delivers power to the load.

In the secondary of the push-pull output transformer there will be an alternating current which is relatively free from distortion. This method of operating tubes is applicable not only to the new 841 but to any power amplifier. It has been applied to 238 pentodes and even to smaller tubes to advantage.

Output of 841

When the 841 tube is operated in this manner with a plate voltage of 450 volts, the operating bias should be 8 volts. If the amplitude of the signal voltage is equal to the bias under these conditions the output from each tube is 16 watts. Therefore a push-pull amplifier with two of these tubes would deliver a power of 32 watts. The 841 tube is used under these conditions in the preliminary audio frequency stages of transmitters. For reception it would hardly be practical to use the tubes since more than adequate volume can be obtained with much smaller tubes.

In case it is desired to try Class B service in existing push-pull stages, the only change necessary is to increase the grid bias on the two tubes. The tubes should be operated with approximately the same bias as when a tube of the same type is used as a power detector. For example, the bias on 227 tubes with 180 volts in the plate circuit should be about 20 volts. It is best to increase the bias by means of a battery for if by bias resistance the bias resistance would have to be increased. The plate current will be about 0.4 milliampere for the two tubes so that the bias resistance would have to be 50,000 ohms. Across this resistance there should be a by-pass condenser not smaller than one microfarad. In a true push-pull amplifier it is not necessary to by-pass the bias resistance because the resistance is small in the first place and because there is no signal current in the second place. In this case the resistance is 50 times larger and there is always a large signal current. The larger the by-pass condenser the better.

Class C Service

Class C service differs from Class B service mainly in the bias, just as Class B differs from Class A. In Class C service the bias is so high that no plate current flows at the operating point. As will be seen from the table of characteristics for this class of service, the bias is 30 volts when the plate voltage is 450 volts.

It will be noticed in the tables for Classes B and C that the maximum allowable r-f grid current is 5 amperes. This current is measured in the grid lead and is that which flows due to the capacity between the elements of the tube. At high frequencies this current may be very high and it is one of the limiting factors in operating a tube at high frequencies.

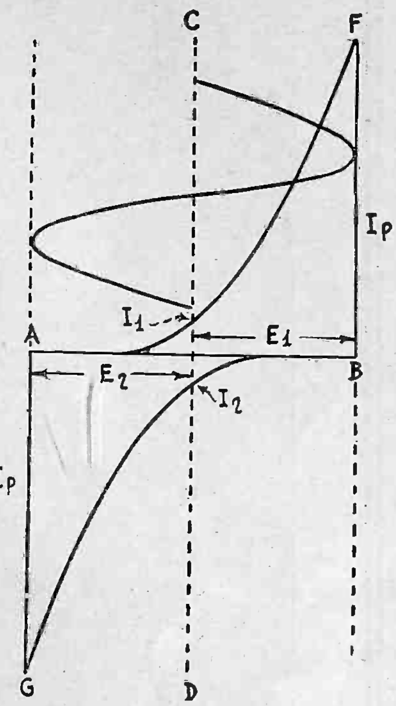


FIG. 1
This illustrates how two equal tubes, although biased for power detection, can be used in a push-pull amplifier to give high power output of good quality.

GENERAL DATA

Filament voltage (a-c or d-c)	7.5 volts
Filament current	1.25 amperes
Amplification factor	30
Plate to grid capacity	8 mmfd.
Grid to filament capacity	5 mmfd.
Plate to filament capacity	3 mmfd.
Maximum length	5 5/8 inches
Maximum diameter	2 3/16 inches
Bulb	S-17
Base	Medium 4-pin bayonet

CLASS A SERVICE

Maximum operating plate voltage		425 volts
Maximum plate dissipation		12 watts
Filament voltage (d-c)		7.5 volts
Plate supply voltage	425	1,000 volts
Grid voltage	—5.8	—9.2 volts
Load resistance	250,000	250,000 ohms
Plate resistance	63,000	40,000 ohms
Mutual conductance	450	750 micromhos
Plate current	0.7	2.2 milliamperes
Peak grid swing	5.8	9.2 volts
Output voltage (5% harmonic)	126	225 volts
Gain (small signal)	24	26
Gain (5% harmonic)	21.7	24.4

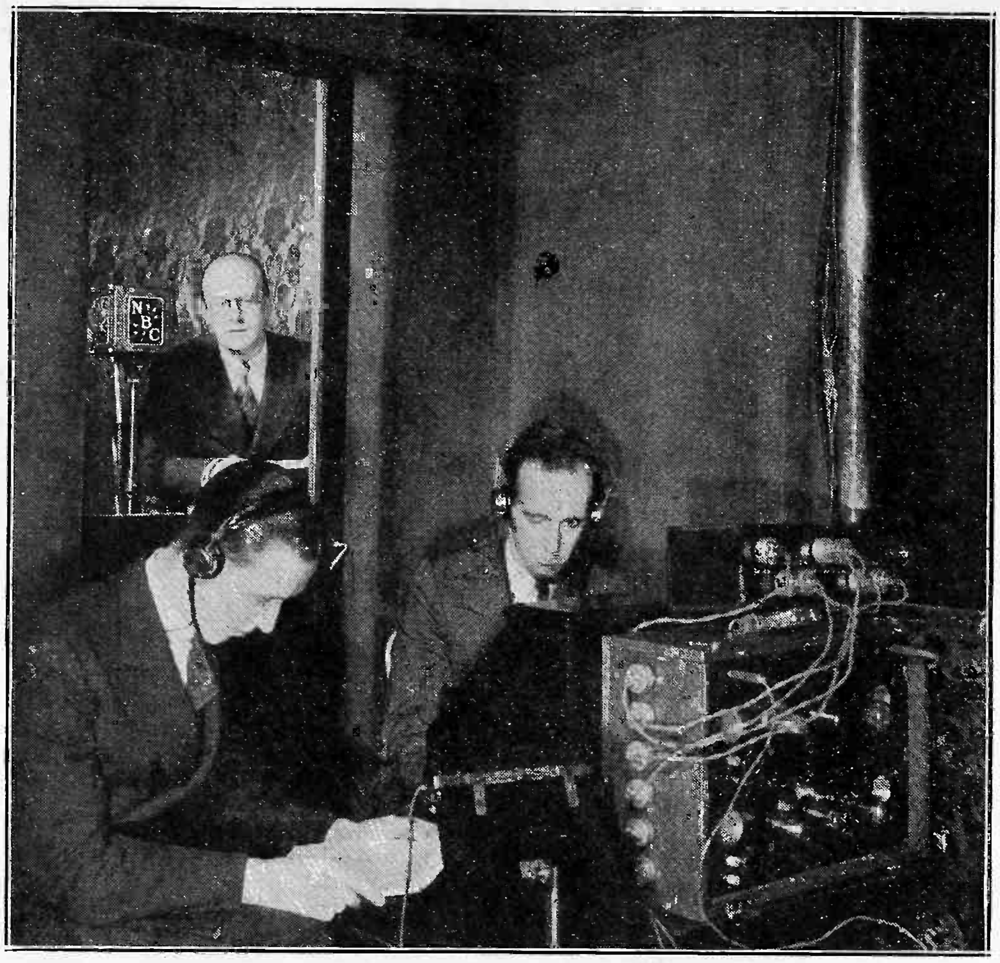
CLASS B SERVICE

Maximum operating plate voltage		450 volts
Maximum d-c plate current (unmodulated)		50 milliamperes
Maximum plate dissipation		15 watts
Maximum r-f grid current		5 amperes
Filament voltage (d-c)	7.5	7.5 volts
Plate voltage	350	450 volts
Grid voltage (approximate)	—5	—8 volts
D-C plate current (unmodulated)	43	36 milliamperes
Peak power output	12	16 watts
Carrier output, modulation factor 1.0	3	4 watts

CLASS C SERVICE

Maximum operating plate voltage Modulated (d-c)			350 volts
Unmodulated (d-c)			450 volts
A-C (R.M.S.)			450 volts
Maximum d-c plate current			60 milliamperes
Maximum plate dissipation			15 watts
Maximum d-c grid current			20 milliamperes
Maximum r-f grid current			5 amperes
Filament voltage (d-c)	7.5	7.5	7.5 volts
Plate voltage	250	350	450 volts
Grid voltage (approx.)	—20	—25	—30
Power output	6	10	13 watts.

HOW OPERA IS AIRED



A view of the National Broadcasting Company's box in the Metropolitan Opera House in New York from where the broadcasts of the operas are controlled, and the action of the various performances described by Deems Taylor, noted musical critic and composer. At right is C. C. Grey, field engineer, at left, W. C. Resides, production man for the broadcasts. In the background, in the especially constructed sound-proof booth, is Taylor.

Pantomime Code Used at Opera

The Metropolitan opera went on the air for the first time recently. A two-year contract has been signed for broadcasting from the Metropolitan, the programs to be carried to a world-wide audience.

A weekly series of Saturday afternoon broadcasts from the Metropolitan now make portions of scheduled performances regularly available to music lovers here and abroad.

All the broadcasts are relayed by short wave to Europe for expected rebroadcast there.

During all of the broadcasts of the present season, Deems Taylor, well-known composer, acts as narrator. Seated behind a sound-proof glass partition in the opera house, Taylor serves as the "eyes" of the radio audience, relating the story of the opera, describing the scenery and filling in wherever it is felt that words will heighten the dramatic value of the broadcast.

Taylor, whose own compositions have been performed on the Metropolitan stage, works from the anteroom of a box in the northeast corner of the Grand Tier after a glass door, permitting a full view of the stage, has been placed between the anteroom and the box proper.

From this same box an engineer and musical director coordinate the visual and audible control of the broadcast. For this purpose the latest type amplifiers and mixing panels have been installed.

Except for the two figures behind the inconspicuous mixing panel in the box, there is nothing to indicate to the audience that the performance is being broadcast. Microphones are distributed in the footlights and wings in such a way that they are not visible. All wiring is carefully hidden.

Adapting the Metropolitan Opera House in New York to broadcasting presented many problems to National Broadcasting Company engineers, and one of them called for some quick thinking by Gerard Chatfield, technical art director.

At all musical broadcasts it is customary to have two men at the microphone con-

Senate A
Divisi

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Third Tim

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With best wishes for your success, and

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proves
n Transfer

Washington.
State of Washington, for transfer of the ce to the Federal Radio Commission, has he House. The Senate action was taken However, what the fate of the bill will ce there is some opposition there to the New York, has introduced a bill in the of Radio. This measure proposes the ap- rtment of Commerce and for the creation en from decisions of the Director. The om each zone. The present Commission

Has Passed

ision, this is the third time it has been it has been killed in the House, the rea- e move. President Hoover formerly was ion then was under his immediate juris- ork of the Division under that arrange- his mind, or is at least willing to permit osal was not mentioned at all in his re-

lliam D. Terrell has been Radio Chief of r since.

tabs on the transmission frequencies of licenses. At present the broadcasting les, but under a new rule of the Com- n will be restricted to 50 cycles. Then more important than it has been in the ring station in full operation at Grand al monitoring work from the respective broadcasting stations can be made each not been possible, due in part to lack of

pparatus

has a larger range than any other such sured the frequencies of stations all over vers and accompanying apparatus are of eneral two types of receivers, one for the for the shorter than broadcast waves. erhead transmission lines, and also loops

UM

t Noted

as there has been a great improvement in at the critics of RADIO WORLD are standing nething about writing, printing and publish- Messrs. Anderson and Bernard undoubtedly

g to see more constructional articles.

F. G. GAMBLE,
Fort Shafter, Honolulu, T. H.

olume of sound as it is picked up by the t the controls to assist in maintaining a man, with a copy of the score being er by warning him of any impending

nversations in normal tones, are situated ropolitan, however, there was no room engineer and production man were as- ox in one of the tiers.

e one pointed out that the control men's ance to opera goers in boxes nearby. which worked so well during the first manent.

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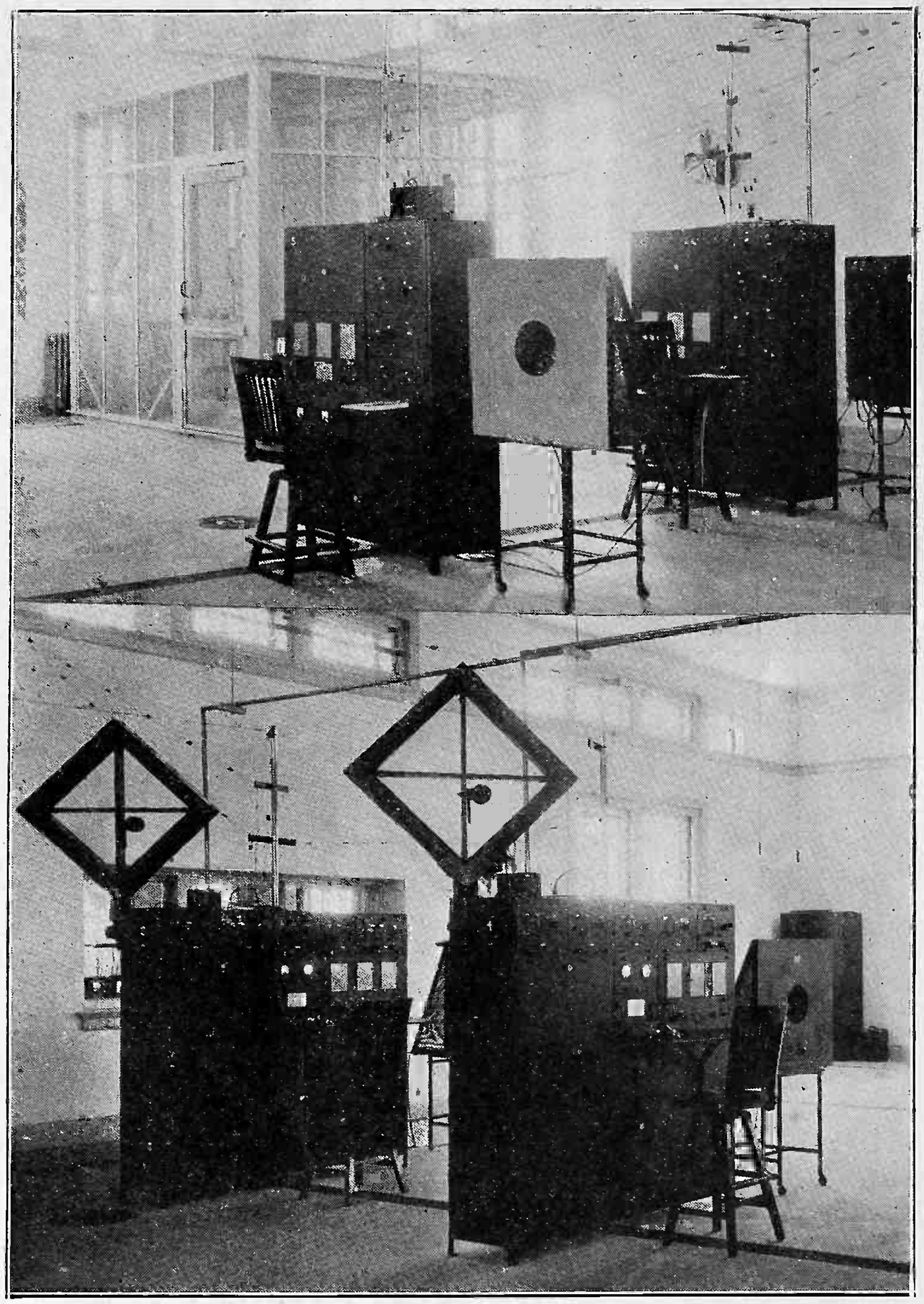
ncreasing in pressure until it terminates cendo ending in a crash. Four taps on but four bars away. Three taps mean nd so on.

U. S. AIR POLICE STATION



Two views of the main instrument room of the frequency monitoring central station of the Department of Commerce's Radio Division, at Grand Island, Nebr. The north end (top) shows the screened booth in background, and high frequency receivers, with speaker, in foreground. The south end (bottom) shows low frequency receivers, loops and speaker. Both views reveal also overhead transmission lines.

Stations to Teach If Schools Close

Chicago.

As a result of the threatened closing of Chicago's public schools due to municipal financial difficulties, plans are being formulated for the instruction of 490,000 pupils by radio. Two of the leading Chicago broadcast stations, WMAQ, owned by "The Chicago Daily News," and WGN, owned by "The Chicago Tribune," have announced that they will extend their present educational service if it becomes necessary to close the schools.

WMAQ has carried regular class-room broadcasts from the Board of Education.

The 239 in An Auto Super

Circuit for Positive Grounding of Battery

By Einar Andrews

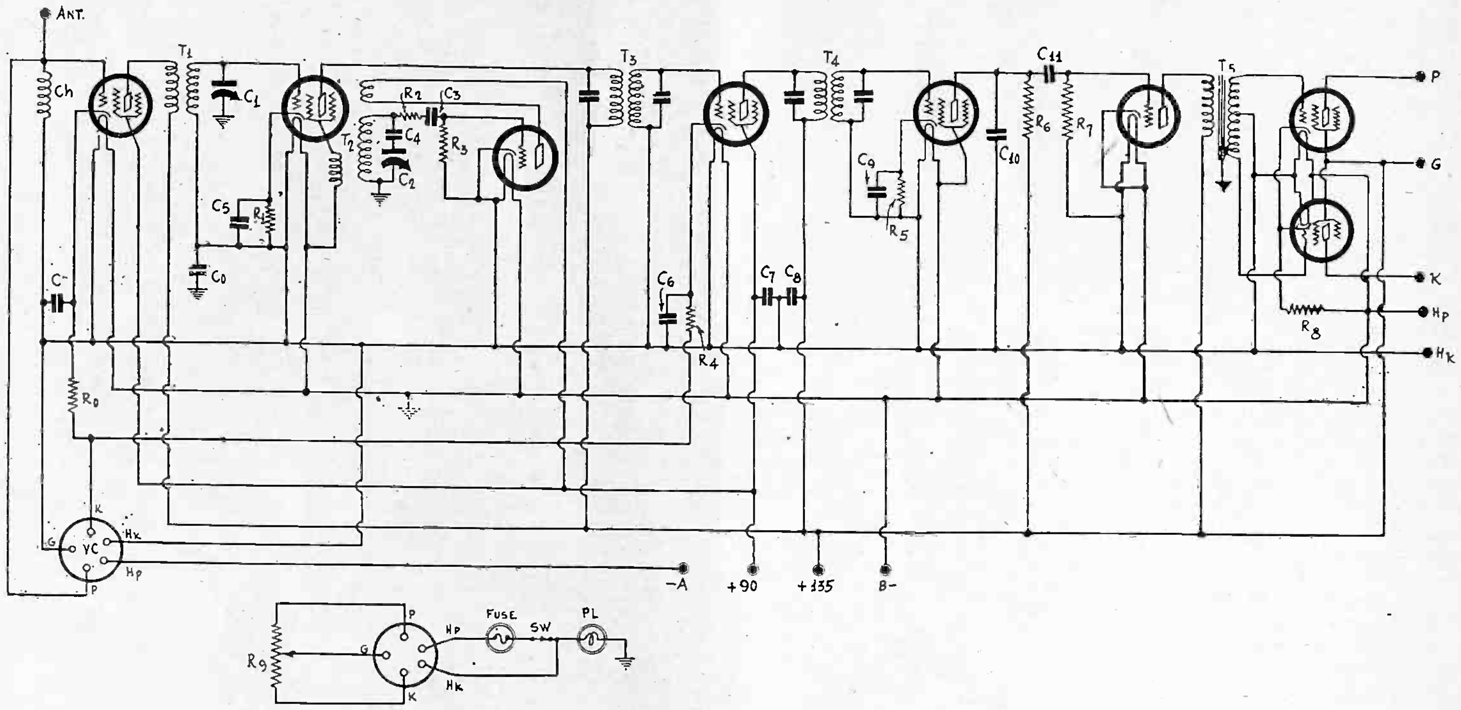


FIG. 1

The circuit diagram of the 8-tube automobile superheterodyne published last week but arranged for the use of 239 r-f pentode tubes in the first and the fourth sockets and also for cases in which the positive side of the car battery is grounded.

IN the previous issue we described an 8-tube superheterodyne for automobile use. In this circuit the radio frequency and the intermediate frequency amplifiers were of the 236 type, the first screen grid tube of the automotive series to come out. Very good results may be obtained with these tubes, but now there is a still better tube that may be substituted, the R 239, which is a radio frequency pentode, variable mu tube.

Since the first and the fourth tubes in the circuit are used exclusively as amplifiers, we should use the best available amplifier for the purpose. The 239 is the best now available. Also, since both these tubes are put on the volume control in such a manner that the bias is varied, it is important that there should be minimum of wave form of distortion as the bias is increased so that there will be no cross modulation. The fact that the 239 is of the variable mu tube makes this tube especially suitable for the purpose.

Changes to Be Made

Fortunately, the characteristics of the 239 in so far as the operating voltages are concerned are so nearly like those of the 236 that the 239 tubes may be substituted in the sockets of the first and fourth tubes without making any changes in the circuit without sacrificing any of the advantages of the 239 tube. The 239 requires a grid bias of 3 volts. So does the 236 tube. The plate and screen currents in the 239 add up to 5.6 milliamperes. Therefore the grid bias resistance for each tube should be 535 ohms. In the 8-tube circuit the bias resistors were specified at 600 ohms. There is not enough difference to warrant any change. Moreover, if the screen voltage on the tube is kept at 67.5 volts, the current will be slightly less so that the higher resistance is advisable.

However, the specifications call for 90 volts on the screens of the 239 tubes. With this voltage the amplification will be somewhat greater than if 67.5 volts are used. Hence when the tubes are changed, it is advisable to change the voltage on the screens. This change does not entail any changes in the wiring, for all that is necessary is to move the screen return lead in the battery cable from the 67.5 volt tap to the 90 volt tap. There is a certain advantage in this in respect to life of the batteries. The 90 volt section will draw more current than the remaining 45 volt section. After the battery has been used for some time the 45 volt section should be shifted so as to be included in the 90 volt section. Of course, this does not equalize the power taken from the three 45 volt blocks unless after another period of use they are shifted around again so that the 45 volt section which has not yet been in the least vulnerable position will be put there. In the event the batteries are kept in the same position until the 90 volt section is exhausted, there is still a whole block which can be used further, and not half a block as would be the case one if one block were tapped in the center, as is required when 67.5 volts are used on the screens.

Voltage on Oscillator

When the voltage on the screens of the 239 tubes is raised to 90 volts the plate voltage on the oscillator is also raised to this value. But this does not matter in the least for the 237 tube will oscillate just as well on 90 volts as it will on 67.5 volts. Indeed, it will oscillate a little more vigorously. A slightly greater sensitivity should be expected by this change alone.

Due to the fact that the 239 is a variable mu tube, the amplification decreases slowly as the bias resistance in the volume control, which is common to the two, increases. Therefore it is advisable to increase the resistance of the potentiometer used as volume control. The resistance ordinarily used is 5,000 ohms, but the controls can also be obtained in 10,000 ohms, and even higher. However, since the control is such as to ground the antenna at the same time it increases the bias a high resistance is not essential.

Omitting Condenser

In the diagram of the eight tube circuit published last week there is a condenser Co betwen the chassis and the negative of the heater circuit. This condenser may be omitted when the car battery is grounded on the negative side, for then the condenser would be short-circuited anyway. It is necessary, however, to use it when the positive side of the car battery is grounded, for then it forms a part of the tuned circuit formed by the secondary of T1 and condenser C1. The specified value of the condenser, that is, Co, is 0.25 mfd. This size will detune the r-f circuit by only 385 cycles at most, and this is entirely negligible. Of course, there is nothing against using a still larger condenser.

In the circuit diagram above the wiring has been made for cases in which the positive of the car battery is grounded. The Hp side of the circuit is connected to the receiver chassis and the Hk side is connected to Hk on the socket for the remote control. The Hp on this socket is connected to the battery lead in the battery cable and this lead is connected to the negative, or "hot," side of the car battery.

SERVICE SHEET NO. 1—TUBES

DETECTORS, AMPLIFIERS

Tube	Filament or Heater Rating: Volts	Amperes	Supply	D-C Voltage Maxima: Plate	Screen	Applied Plate Volts	Negative Grid Bias Volts	Ohms Resistance For Bias Single Tube	Screen Volts	Plate Current Milliamp.	Remarks
WD-11	1.1	0.25	D C	135	..	90	4.5	...	..	2.5	For leak det., Ep. 45 v., grid return to
						135	10.5			3.0	fil. X.
WX-12	1.1	0.25	D C	135	..	90	4.5	...	..	2.5	For leak det., Ep. 45 v., grid return to
						135	10.5			3.0	fil. X.
112-A	5.0	0.25	D C	180	..	90	4.5	900	..	5.2	For leak det., Ep. 45 v., grid return to
						135	9.0	1,500	..	6.2	fil. X.
UV-199	3.3	0.063	D C	90	..	90	4.5	...	..	2.5	For leak det., Ep. 45 v., grid return to
											fil. X.
UX-199	3.3	0.06	D C	90	..	90	4.5	...	..	2.5	For leak det., Ep. 45 v., grid return to
											fil. X.
200-A	5.0	0.25	D C	45	..	90	G. Ret.	...	..	1.5	Det. only. No grid leak. grid return
							(0) Fil.				to F—.
201-A	5.0	0.25	D C	135	..	90	4.5	...	..	2.5	For leak det., Ep. 45 v., grid return to
						135	9.0	...	..	3.0	fil. X.
222*	3.3	0.132	D C	135	67.5	135	1.5	...	45	1.5	R-f. amplifier. Don't use as detector.
						135	1.5	...	67.5	3.3	
222*	3.3	0.132	D C	135	67.5	180	1.5	...	22.5	0.3	A-f. amp. plate resistor 0.25 meg.
			A C			180	1.5	400	75	4.0	
224*	2.5	1.75	or	275	90	180	3.0	800	90	4.0	
			D C			250	3.0	800	90	4.0	
			A C	275	90	275	5	50,000	20 to	0.1	Power det. Plate resistor 0.25 meg.
224*	2.5	1.75	or				approx.		45	ma.	Ip. = 0.1 mt. @ no signal.
			D C								
			A C	275	90	250	1.0	2,000	25	0.5	A-f. amplifier. Plate resistor 0.2 mtg.
224*	2.5	1.75	or								For grid leak det., Ep. 45 v. grid
			D C								return to cathode.
			A C			90	5.0	650		3.8	Add 1 volt to bias if A-c on filament.
226	1.5	1.05	or	180	..	135	8.0	1,300	..	6.3	Ohms for a-c.
			D C			180	12.5	9,000		7.4	
			A C			90	6.0	2,500		2.7	For leak det., Ep. 45 v., grid return
227	2.5	1.75	or	275	..	135	9.0	2,000	..	4.5	to cathode.
			D C			180	13.5	2,700		5.0	
						250	21.0	4,000		5.2	
			A C	275	..	275	30.0	150,000	..	0.2 ma.	Power det. Plate resistor 0.05 meg.
227	2.5	1.75	or				approx.			0.2 ma.	Ip. = 0.1 mt. @ no signal.
			D C								
230	2.0	0.06	D C	90	..	90	4.5	...	..	1.8	For grid leak det. Ep. 45 v. grid
											return to F X.
232*	2.0	0.06	D C	150	67.5	135	3.0	...	67.5	1.4	R-f amplifier.
232*	2.0	0.06	D C	150	67.5	174	6	...	67.5	0.2 ma.	Power det. Plate resistor 0.1 meg.
							approx.			0.2 ma.	Ip. = 0.1 mt. @ no signal.
232*	2.0	0.06	D C	150	67.5	180	1.0	...	22.5	0.25	A-f. amplifier. Plate resistor 0.25 meg.
			A C	275	90	180	1.5	850	75	5.8	Much higher bias O. K.
235	2.5	1.75	or			250	3.0	500	90	6.5	
			D C								
						90	1.5	900	55	1.8	A-c on heater O. K. up to 7.5 v.
236*	6.3	0.3	D C	180	90	135	1.5	600	67.5	2.8	Don't use as detector.
						180	2.5	750	90	3.5	
237	6.3	0.3	D C			90	6	2,500		2.6	A-c. on heater O. K. up to 7.5 v.
				180	..	135	9	2,200	..	4.3	Leak det., Ep. 45 v., grid return to
						180	13.5	2,900		4.7	cathode.
239*	6.3	0.3	D C	180	90	135	3	700 or +	90	4.4	A-c. on heater O. K. up to 7.5 v.
						90		variable	90	4.4	Bias may be much higher.
240	5.0	0.25	D C			180			90	4.5	Plate resistor 0.25 meg.
				180	..	135	1.5	...	..	0.2	
						180	3.0			0.2	

*Screen current of screen grid detector and amplifier tubes equals approximately one-third of plate current.

POWER AMPLIFIERS

Tube	Rating Filament or Heater			D-C Voltage Maxima		Applied Plate Volts	Negative Grid Bias Volts: D-C.	A-C.	Ohms Resistance for Bias Single Tube, A-C.	Screen Vlolts	Plate Current Milliamp.	Power Output, Watts	Remarks
			A C	180	...	135	9.0	11.5	1,900	...	6.2	.115	....
112-A	5.0	0.25	or			180	13.5	16.0	2,200		7.6	.260	
			D C										
120	3.3	0.132	D C	135	...	90	16.5	...	....	...	3.0	.045	....
						135	22.5	...			6.5	.11	
			A C			90	16.5	19.0	1,600		12.0	.125	1 watt bias resistor.
171-A	5.0	0.25	or	180	...	135	27.0	29.5	950	...	17.5	.37	
			D C			180	40.5	43.0	2,150		20.0	.70	
			A C			250	18.0	22.0	2,200		10.0	.4	1 watt bias resistor.
210	7.5	1.25	or	425	...	350	27.0	31.0	1,950	...	16.0	.9	
			D C			425	25.0	39.0	2,200		18.0	1.6	
231	2.0	0.130	D C	135	...	135	22.5	...	....	...	6.8	1.5	....
233	2.0	0.26	D C	135	135	135	13.5	...	....	135	14.5	6.5	Screen current 3.5 ma.
238	6.3	0.3	D C	135	135	135	13.5	...	1,200	135	9.0	5.25	Screen current 2.5 ma. Can use a-c on heater up to 7.5 v.
			A C			180	33.0	34.5	1,300		27.0	.78	2 watt bias resistor.
245	2.5	1.5	or	275	...	250	48.5	50.0	1,500	...	34.0	1.6	
			D C			275	54.5	56.0	1,600		36.0	2.	
			A C	250	250	250	15.0	16.5	420	250	32.0	2.5	Screen current 7.5 ma.
247	2.5	1.75	or										
			D C										
			A C			250	41.0	45.0	1,600		28.0	1.	5 watt bias resistor.
250	7.5	1.25	or			350	59.0	63.0	1,400		45.0	2.4	
			D C	450	...	400	66.0	70.0	1,300	...	55.0	3.4	
						450	80.0	84.0	1,530		55.0	4.6	

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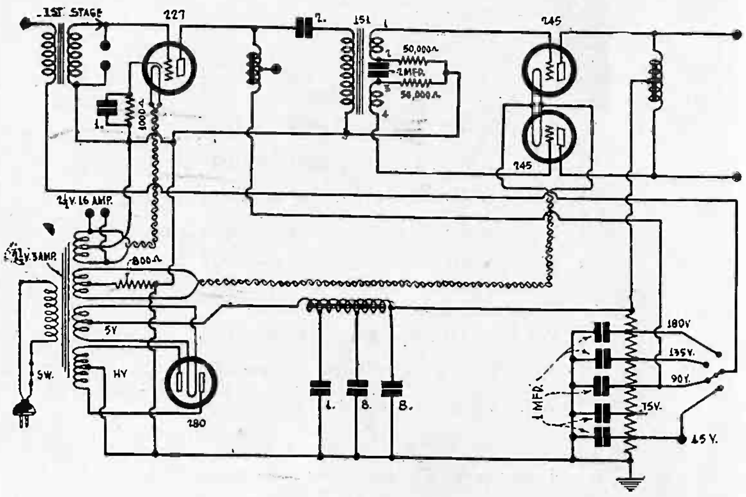

FIG. 983

A power amplifier, with first audio stage a 227 and second audio stage two 245's in push-pull. A full-wave rectifier is included. The voltage for the detector is adjustable, to meet the requirements of either type of detection.

Push-Pull Power Amplifier

AS I have some of the parts for a push-pull power amplifier, please show a diagram for 227 first audio, 245 output, 280 rectifier, with suitable voltage divider values. How can the best voltage for detection be obtained?—K. D. W., Spokane, Wash.

The diagram is printed herewith, Fig. 983. The power amplifier is of general utility, except that the detector tube should not be a screen grid tube, since the primary of an audio transformer is not a suitably high impedance load for such a tube. It is assumed the detector is a 227 and if so it may be of the leak-condenser or power type, as the detector voltage may be 180, 135 or 90 or less. The secondary of the single-sided input transformer to the first stage may have two terminals for phonograph connection. For the first audio plate 90 volts are sufficient, and even then a choke coil may be connected in the plate circuit, say, 30 henries, to keep the direct current out of the primary of the push-pull input transformer, as such current reduces the inductance of the primary. Then a 2 mfd. condenser is connected to the primary, which has low potential grounded. This is known as parallel feed. The secondary of the push-pull transformer, if the construction permits it, may have a resistor-capacity filter circuit as shown, the low ends of each section of the separate windings being connected to one side of individual 50,000 ohm resistors, the other extremes of which go to the ground, while a 2 mfd. condenser is connected between the low coil terminals. If the transformer has a tap for the center of the secondary, then one 50,000 ohm resistor may be used, from tap to ground, with the 2 mfd. across the resistor. The biasing resistor for the first audio tube may be 1,000 ohms, that for the push-pull pair 800 ohms, but no condenser should be put across the 800 ohms. The output may be taken from a center-tapped impedance coil, as shown, or an output transformer may be used, particularly if a speaker is used that has push-pull output transformer built in. The voltage divider may consist of 10,000 ohms or more. Between maximum B voltage and 180 the resistance value should be around 2,000 ohms, the rest of the resistance values being approximately proportional to the voltage drops across them. The choke input type of B supply is shown, the inductance between the rectifier filament and the first condenser being 10 henries, the remaining total 60 henries more. The 2.5 voltage may be taken out for a tuner.

* * *

Calibration of Oscillator

IN calibrating an intermediate frequency oscillator against an oscillator previously calibrated against broadcast stations, I have difficulty in determining what harmonics are being dealt with. Suppose, for example, that I set the intermediate frequency oscillator at the lowest frequency of its range, or with the variable condenser fully meshed, there are very many positions on the broadcast frequency oscillator at which squeals occur. I have been unable to determine just what the frequency of the intermediate oscillator is as there seems to be no consistency in respect to harmonics. Can you suggest a method of procedure for determining the intermediate frequency at any setting of the oscillator?—F. W. C.

Indeed, this is a very confusing problem at times, especially when the fundamentals of the two oscillators are widely different. The best way to proceed is to set the intermediate frequency oscillator at the highest frequency setting, that is, with the tuning condenser wide open, and then start the broadcast oscillator at the lowest frequency. This will insure that the fundamentals are most nearly alike. As you turn the broadcast oscillator condenser there will be several distinct beat positions. Pick out two very strong ones, with no other points between of equal strength. Find the frequencies of the broadcast oscillator at these two points and subtract one from the other. The difference is very likely equal to the frequency of the intermediate oscillator. To check this divide the two broadcast frequencies involved by the difference between them. The quotient should be a whole number, such as 1, 2, 3, 4, and so on. Of course, the quotient will not be exactly a whole number, but very nearly. If the two quotients are whole numbers, then we may assume that the difference between the two broadcast frequencies is equal to the frequency of the intermediate oscillator. As a further test, pick out one of the weaker squeal points and find the corresponding frequency. Divide this frequency by the difference between the two original, that is, by the frequency supposed to be that of the intermediate. The quotient now might be such a number as 3/2, 5/2, 4/3, or the ratio of any two whole numbers. This is an additional check. After the highest intermediate frequency has been found in this manner readjust the intermediate frequency a little downward and find a new squeal point, selecting the strongest. The frequency of the broadcast oscillator may now be two, three, four, or any whole number of times the new intermediate. Select the loudest and then stick to that throughout the calibration until the intermediate oscillator is set at or near the minimum. Suppose, for example, that the broadcast frequency is three times the intermediate at a squeal point. If the intermediate frequency is changed slowly, following up with the broadcast oscillator so as not to loose the point, we know that at every setting of the intermediate the broadcast frequency is three times that of the other. When it is necessary to change to another harmonic, say the fourth this will be made evident by the fact that the squeal point will run off the broadcast oscillator dial and that it is necessary to turn the oscillator back to pick up the next squeal point. Moreover, the intermediate frequency will always decrease as the condenser is closed. No attempt should be made to use very high harmonics, because confusion at the beginning will be great. Suppose the intermediate oscillator covers 150 to 350 kc. Then the second harmonic of 350 will be 700 kc, the third will be 1,050 kc, the fourth will be 1,400 kc, all in the broadcast band. At the low end, where the intermediate frequency is 150 kc, it is necessary to use the fourth harmonic, which is 600 kc. The change-over from the third to the fourth occurs at 183 kc, assuming that the broadcast oscillator goes just to 550 kc.

* * *

Measuring Capacity

IS IT possible to measure capacity of small condensers by means of a universal type current and voltmeter? I have one that as a voltmeter will measure up to 500 volts and as a milliammeter will cover the range from zero to one milliampere. I ask this question because I have a number of condensers the capacity of which I wish to measure and because it is my understanding that Ohm's law applies to condensers as well as to resistors. Please explain how to do it if it is possible.—G. A. E.

It is quite possible provided you have a source of alternating voltage. First measure the voltage with the meter used as a voltmeter. Say that it measures V volts. Then connect this voltage in series with the condenser of unknown capacity and the meter used as a milliammeter. Suppose the current through the condenser is I amperes. If the frequency is 60 cycles the relation between the capacity, voltage, and the current is $I=377VC$, or $C=0.00265xI/V$. Suppose the voltage measures 115 volts and the current is just one milliampere, then the capacity is 0.023 mfd. No larger capacity can be measured in this way unless the sensitivity of the milliammeter can be changed so that a larger current can be read. Great care should be taken to see that the capacity is not so large that the milliammeter will burn out. The meter may be protected by putting a shunt across it at the beginning, increasing the shunt resistance slowly to see that it is safe to remove it entirely. If the needle runs off the scale it is necessary to increase the range of the milliammeter or else to decrease the voltage applied. The voltage can be reduced with a transformer.

* * *

Making Old Super More Selective

WHAT can be done to an old superheterodyne built six years ago to make it more selective and to make the quality better? The set now uses a loop, but I want to put it on a regular outside antenna.—F. W., Fresno, Calif.

The best way to get better selectivity and better tone is to make a new set. You may use as many of the old parts as possible. Since the set was built several years ago, you have undoubtedly two stages of audio amplification, with transformers between the tubes. Considerable improvement in the quality can be effected by eliminating one of these stages or substituting resistance coupling. If a pentode output tube is used in the set there is no reason why the pentode should not be coupled to the detector with the usual resistance and condenser combination. Greater selectivity may be obtained in two ways, first, by getting new intermediate transformers that are peaked more sharply, and second, by putting in another radio frequency tuner. It is not likely that even a superheterodyne made six years ago is not selective enough, for most supers are too selective. This, however, does not mean that there is no interference, due to repeats. To minimize these make the intermediate frequency of the new transformers much higher.

* * *

Connecting Converter to Midget

IN MY receiver, which is a late model 5 tube midget, the volume is controlled with a potentiometer of 10,000 ohms which not only controls the bias on the radio frequency amplifiers, but also the input voltage. I believe this volume control is used in most recent model receivers. Is there a good way of connecting a short-wave converter to such a set? What do you suggest?—W. R. H., Dubuque, Ia.

It depends on the converter. If there is a stage of amplification in the converter the coupling may be effected by using a choke to feed the converter output tube and then connect a condenser of about 0.001 mfd. between the plate of the tube and the antenna post on the set. This is the regular way of connecting. The same connection can be used between the modulator tube of the converter and the set if there is no amplification in the converter, but in this case, of course, the sensitivity will not be nearly as good. It is advisable to use a stage of amplification in the converter when the broadcast set is a 5 tube midget.

* * *

Primaries of Couplers

AT present I am enjoying good reception on a five tube midget, following substantially the diagram of your a-c blueprint No. 627. Now, I would like some information about the sensitivity effect when I increase primary turns, also when I decrease them. I would like to have even amplification, although this requires a special r-f circuit.—K. W. U., Tampa, Fla.

As the primaries are built up the gain is increased and the selectivity decreased, therefore high wavelength stations would come in louder, with better results, but low wavelength stations would come in stronger with much more interference than at present. So a compromise has to be reached. It is not regarded as worthwhile to attain even r-f amplification in such a receiver, because the higher sensitivity at the higher waves would be at the expense of sensitivity on the lower waves.

* * *

Smoke and a Small Flame

IN a short-wave converter that I built I have had some trouble. When I connected converter and set the converter tubes would not light, although in good condition. Then I worked the plug in and out of the wall socket, finally the tubes lit, but then smoke and a small momentary flame emerged from the converter, and I pulled the plug out of the wall. When I examined the converter I found that the secondary of the r-f output transformer was charred, and when I examined the set I found the same condition in the antenna primary. In fact, the set would not play, either, until I put on a new primary. What was the trouble?—D. W. O., Birmingham, Ala.

The primary of the output transformer is in the plate circuit of the output tube, from plate to B plus, and since you mention nothing happened to this coil, presumably it is wired correctly. But the secondary should be connected with one side to ground and the other side to output of the converter. Your mistake was in connecting the secondary return to B plus instead of to ground. Put in a new secondary and connect to ground. The trouble was due to the short across the rectifier. Collodion on the converter coil flamed. The high current burnt out the winding of secondary of the converter r-f transformer and primary of the set antenna coupler.

* * *

Matching Intermediate Transformers

WILL you kindly suggest a circuit by which I can match intermediate frequency transformers quickly? These transformers are to be used between screen grid tubes of the 235 and 224 types, and both windings are tuned. The object of the circuit is to match the transformers so that they will be very nearly tuned properly after they have ben installed so that a minimum adjustment is needed during production of sets. I am equipped to build almost any circuit you suggest—W. A. G., Harmon, N. Y.

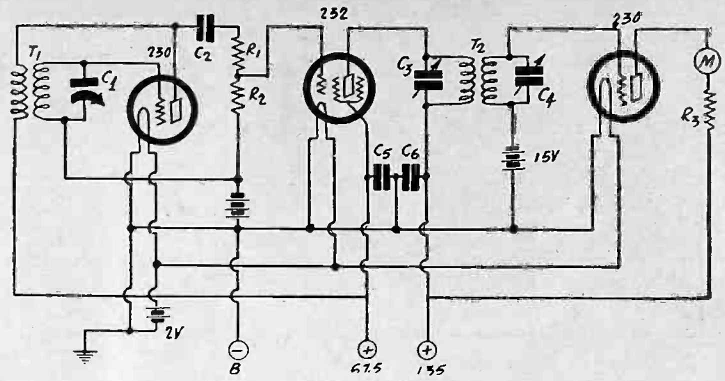

FIG. 984

A three tube test circuit for quickly adjusting intermediate frequency transformers to the desired frequency. The circuit consists of an oscillator, an amplifier, and a grid bias detector.

You will find a suitable circuit in Fig. 984, which was designed for this very purpose. The first tube is an oscillator generating the frequency at which you want to peak the intermediate transformers and the transformer T1 may be made of the same coils as the intermediate to be tested. C1 may be a trimmer of the same kind and capacity as either of the trimmers in the other transformer. C2 may have a capacity of 0.001 mfd. and R1 and R2 may be 100,000 ohm resistance. If the input to the screen grid tube, the second, is too high, reduce the value of R2 in relation to R1 until the voltage impressed on the screen grid tube is right. C5 and C6 may be 0.1 mfd. units. M is a milliammeter of any convenient range, preferably 0.1. R3 is a high resistance of a value which will limit the plate current in the third tube to something less than full scale on M when the grid voltage on that tube is zero. The grid voltage on the third tube should be such that the reading on M is nearly zero when no signal voltage is impressed on the tube, that is, when the secondary of T2 is shorted. Adjust the oscillator frequency to the desired value. Then put the transformer T2 to be tested in the circuit. Adjust the trimmers until the reading on M is maximum. The transformer will then be matched, or tuned, when it is put in a similar setting.

(Continued on next page)

Radio University

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Those not answered in these columns are answered by mail.

Annual subscriptions are accepted at $6 for 52 numbers, with the privilege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

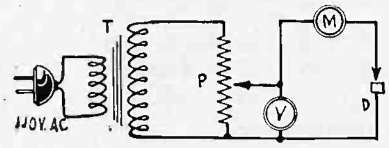

FIG. 985

An output meter of any kind can be calibrated by means of this circuit in which V is a low range a-c voltmeter.

(*Continued from preceding page*)

Calibration with A-C Voltmeter

Please show a simple arrangement by means of which I can calibrate an output meter. I have a low range a-c voltmeter, various resistances. If it is possible to use a thermionic rectifier in conjunction with a d-c milliammeter, I should like to use that.—W. L. J., Lake Placid, N. Y.

Many service men have circuit testers in each of which there is a 0-10 volt a-c voltmeter. This instrument can be used for calibrating an output meter having the same range. Fig. 985 shows one way it may be done. As source of alternating voltage we have the 110 volt line. We need a small transformer T giving a secondary voltage of 10 volts or a little more. A cheap bell ringing transformer will do nicely. Across the secondary of this transformer we connect a potentiometer P of 400 ohms or 20, and between one side of this potentiometer and the slider we connect the 0-10 voltmeter V. By sliding the tap we can get any voltage across the meter from zero to the maximum voltage of the secondary. See Fig. 983. Across the meter we connect also the input terminals of the meter we are to calibrate, in this case represented by M, the indicating instrument, and D the detecting or rectifying instrument. The rectifier may be any one of the circuits shown in Figs. 1, 2, 3, 4 last week. The circuit is about the same as that in Fig. 2, where E is the voltage indicated by the 0-10 voltmeter. The work of calibration simply consists of finding the deflection on M which corresponds to each volt input, starting with zero reading on V and ending with 10 volts, or with the maximum voltage of the transformer winding, whichever is lower. After the circuit has been set up it should take about 10 minutes to complete the calibration. A curve should be plotted of the data taken so that intermediate voltages can be obtained. It may take ten minutes more to draw the curve. In case the rectifier is a three element tube used as a grid bias detector, M is placed in the plate circuit and V in the grid circuit. The slider on the potentiometer should go to the grid. The grid bias voltage should not be in the circuit of V as this would give a wrong calibration.

* * *

Coil Winding Data

Will you kindly give the number of turns required to tune from 200 meters down with a 100 mmfd. condenser, using No. 24 enameled wire and 1.75 inch winding form? Where should the taps be placed?—W. L. W., Austin, Tex.

Use 53 turns of the wire for the lowest frequency range. Place the first tap at 22 turns, the next at 10 turns, and the third at 4 turns.

* * *

Selectivity of Intermediate Transformers

Will the selectivity of an intermediate frequency transformer in which both the primary and the secondary are tuned be too high for good quality? Would you recommend the use of tuned secondary coils only when good quality is of first importance? —G. W., Toledo, O.

The selectivity, in so far as quality is concerned, is likely to be less when both windings are tuned. But in so far as interference from other stations is concerned it is higher. The doubly tuned transformer is a band to pass filter used for the purpose of getting good quality as well as high selectivity. The broadness of the band passed depends on the degree of coupling between the two tuned coils. If they are too closely coupled the band will be very wide and there will be two definite peaks instead of one. Commercial intermediate frequency transformers have been designed so that the coupling is just right to give a 10 kilocycle transmission band. They are greatly to be preferred over coils in which only one winding is tuned.

* * *

Measuring Resistance With Voltmeter

My voltmeter has a sensitivity of 1,000 ohms per volt. This is supposed to give correct readings when measuring voltages in a radio receiver, but I have found that in some instances the indications are erroneous, and that the amount of the error depends on the resistance that is put in series with the meter. It occurred to me that it might be possible to use the voltmeter for measuring resistance by noting the amount of the error. If this is possible and practical will you kindly give a formula by which it may be done?—T. S. R., Montevideo, Uruguay.

This is both possible and practicable, and indeed, is done every time an ohmmeter is used. Suppose we connect the voltmeter in series with a resistance R and a battery of voltage V. We get a certain reading on the voltmeter, considerably less than the voltage of the battery. Let this reading be V1. By Ohm's law we have $V=I1(r+R)$, in which I1 is the current through the meter when the resistance R is in series with the meter and r is the internal resistance of the voltmeter, V and R having the meaning stated above. But rI1 is the voltage drop across the meter and is therefore equal to V1, the reading indicated by the meter when R is in the circuit. Hence $V-V1=I1R$. This may also be written $V-V1=V1R/r$, obtained by multiplying and dividing the second member of the equation by r and again setting V1 for rI1. We can solve the second equation for R, thus $R=(V-V1)r/V1$. The rule then is: Divide the difference between the battery voltage and the indicated voltage by the indicated voltage and multiply by the internal resistance of the meter. The result is the resistance of the external resistor. If the meter has several voltage ranges, the value of r is different for each range. This is rather inconvenient. We can change the formula so that the ohms per volt factor is used each time. Let Vm be the maximum voltage on the range used and ro the resistance per volt. Then $r=roVm$ and the formula becomes $R=(V-V1)roVm/V1$. If the meter has a sensitivity of 1,000 ohms per volt, the formula is $R=1{,}000(V-V1)Vm/V1$. Let us apply this formula. Suppose we use a battery having a voltage of 45 volts and that we use a range of 0.-100 volts. Then V equals 45 and Vm equals 100. Suppose further that when we measure the voltage in series with the unknown resistance we get a reading of 25 volts. This makes V1 equal to 25 volts. Hence we have $R=1{,}000(45-25)100/25$, when the resistance is 80,000 ohms. We can use the same method of measuring the resistance of an old dry cell battery if we assume that the voltage is the same as it was when the battery was new. In this case R becomes the resistance of the battery.

Power Tube Used as Rectifier

(*Continued from page 9*)

pentode is more favorable in this respect for it requires a bias of only 16.5 volts for amplification and a bias of around 33 volts for detection.

Use Grid Battery

When converting a power tube to a rectifier it is not sufficient to add a battery voltage equal to the bias already in the circuit if this bias is obtained with a resistor in the usual way. It is necessary to make the voltage of the battery equal to the bias desired, for the bias resistor has virtually no effect due to the fact that the current is nearly zero when the proper adjustment has been made. For example, suppose that we have an output tube of the 247 type. The required bias for amplification is 16.5 volts and the current through the bias resistance is approximately 40 milliamperes. Hence for amplification we need a bias resistance of about 400 ohms. If the bias is doubled by means of a battery the plate current will be in the neighborhood of one milliampere. Hence the voltage drop in the bias resistance is only 0.4 volt.

Question of Sensitivity

When the indicating device must show very small changes in output a thermo-couple or a hot wire milliammeter is not sensitive enough. Neither is a low mu tube used as rectifier. High mu tubes, screen grid tubes and pentodes should be used in conjunction with a sensitive milliammeter in the plate circuit. Extremely small changes in the output can be detected with a high mu tube and a milliammeter. But it does not require a very sensitive meter to give better results than the ear alone will give.

SENATE TABLES MOVE FOR U.S. AIR MONOPOLY

Washington

A resolution for a survey by the Federal Radio Commission of the uses of radio facilities for commercial advertising and the feasibility of Government ownership of radio facilities has been introduced in the Senate by Senator Couzens, of Michigan. The resolution follows in full:

"Whereas there is growing dissatisfaction with the present use of radio facilities for purposes of commercial advertising: Be it

"Resolved, that the Federal Radio Commission is hereby authorized and instructed to make a survey and to report to the Senate on the following questions:

"1. What information there is available on the feasibility of Government ownership and operation of broadcasting facilities.

"2. To what extent the facilities of a representative group of broadcasting stations are used for commercial advertising purposes.

"3. To what extent the use of radio facilities for purposes of commercial advertising varies as between stations having power of 100 watts, 500 watts, 1,000 watts, 5,000 watts, and all in excess of 5,000 watts.

"4. What plans might be adopted to reduce, to limit, to control and perhaps to eliminate the use of radio facilities for commercial advertising purposes.

"5. What rules or regulations have been adopted by other countries to control or to eliminate the use of radio facilities for commercial advertising purposes.

"6. Whether it would be practicable and satisfactory to permit only the announcement of sponsorship of programs by persons or corporations.

"7. Any information available concerning the investments and the net income of a number of representative broadcasting companies or stations."

The resolution was ordered to lie on the table.

Examiner Opposes Vision License Grant

Washington

Chief Examiner Ellis A. Yost, of the Federal Radio Commission, has recommended to the Commission that the application of the Radio Vision Company, Pittsburgh, for a television station license, be denied. Mr. Yost's reasons follow:

"1. There is not sufficient showing of past experiments in the visual broadcasting field, or a proposed plan of research and experimentation, to warrant a finding that the granting of this application would result in the advancement or development of the visual broadcasting art.

"2. The applicant has made no showing that equipment has been constructed or that laboratory work has been conducted to a point requiring radio transmission for further development of the proposed system.

"3. The financial resources available to applicant are not sufficient to warrant the granting of this application.

"4. Applicant failed to show that the granting of this application would serve public interest, convenience and (or) necessity."

Secret Multiplex Sender Invented

Amsterdam, Holland

W. P. C. Vanderhorst, one of the Dutch pioneers in the radio field in Batavia, Dutch East Indies, has obtained a patent on an important radio invention which permits the simultaneous transmission of several radio-telephone conversations over one transmitter and one frequency, combining secrecy.

It is claimed that the multiplexing may be done without widening the channel, so that there will be no interference with services on adjacent channels. It is held that the difficult problem of synchronization of television can be simplified by the new invention. Details of the new invention are lacking at this time, but it was stated that photo-electric cells are employed in the system.

Secrecy in radio-telephone conversations already exists and is used in the United States and in other countries. There are several methods in use which usually consist of so distorting the signals that speech is unintelligible to eavesdroppers and can only be restored to intelligibility by special apparatus.

SYNCHRONIZED TEST STUDIED

Washington

To determine the success or failure of synchronized operation of broadcast stations, the Federal Radio Commission held special hearings. The hearings involved WTIC, Hartford, Conn., and WBAL, Baltimore, Md., which have been operating synchronously with WEAF, New York, and WJZ, New York, respectively, during several months.

Engineers of the Commission have kept in touch with the operations of the four stations and have received regular reports on experiments. But the Commission desired the men who have been the actual operators to explain what results have been obtained. If it is brought out that the experiments have been successful, synchronization may be used throughout the country, thus reducing interference and relieving overcrowded channels.

WTIC operates one-half time on 660 kc, WEAF's wave, with 50,000 watts power and WBAL operates one-half time on 760 kc, WJZ's wave, with 10,000 watts. WEAF uses 50 kw and WJZ 30 kw. During the one-half time the stations are not synchronized WBAL and WTIC share the 1,060 kc channel, WEAF and WJZ using the 660 and 760 kc channels, respectively.

Photophone Joined with RCA Victor

The RCA Victor Company, Inc., at Camden, N. J., and RCA Photophone, Inc., have been consolidated.

The unification joins two closely associated lines of radio and electrical development. It will mean a closer association of the two lines of activity.

Both companies are wholly owned subsidiaries of the Radio Corporation of America. The staff of the RCA Photophone Company as well as the operations of that Company are being transferred to the RCA Victor Company at Camden, New Jersey.

ROBINSON OUT AFTER 4 YEARS BOARD SERVICE

Washington

Ira Ellsworth Robinson, of West Virginia, has resumed the practice of law, with offices in his home state and in Washington, D. C., after having served as Federal Radio Commissioner since March, 1928. He served as chairman of the Commission from about the time of his appointment until February, 1930. He represented the Second Zone.

Robinson formerly was a judge in West Virginia. He was an opponent of high power, was opposed to the granting of large license benefits to chains and other extensive organizations, and generally maintained an utter independence of opinion, which in some instances led him to sit among spectators at hearings, rather than with the other Commissioners on the dais.

Robinson's commission would have expired February 23d, but his resignation took effect a week earlier. He sent it to President Hoover, who replied by letter as follows:

"My dear Judge Robinson: I have your letter of Jan. 8 tendering your resignation as a member of the Federal Radio Commission. I must, of course, accept your wish in the matter. You have performed a real public service and I wish to express my personal appreciation, to which I know I may add the appreciation of many thousands of your friends and countrymen. Yours faithfully,

(Signed) "HERBERT HOOVER."

"For four years," said Robinson, "I have served to the best of my ability and leave the Commission with a consciousness of duty done."

Possible successors mentioned were Thad H. Brown, chief counsel of the Commission; Ellis A. Yost, chief examiner of the Commission, and William D. Terrell, chief of the Radio Division of the Department of Commerce.

Mechanical Scanning Under Intense Inquiry

Boston

"To attempt to outline the procedure in research that will occur during 1932 is impossible, since as the first two months work may uncover something that will entirely change the trend of research during the rest of the year," said Hollis Baird, television engineer. "The utmost in mechanical systems will be investigated with better scanning systems, and more compact and better light sources are a certain result. Cathode ray work will be continued.

"In the short wave field the present problem of fading and swinging signals is being investigated and we expect to have some very definite solutions to these problems which will at least remove most of the trouble."

HEARST BUYS WCAE

WCAE, Pittsburgh, Pa., has become an affiliate of the Pittsburgh "Sun-Telegraph," a Hearst publication, of which Harry M. Bitner is publisher. He also is president of WCAE, Inc. The station is associated with an N. B. C. network.

A THOUGHT FOR THE WEEK

GOOD times are bad times if the world goes around with a scowl and bad times are not so bad if it can smile its way through. Hence this: A New York radio dealer returned recently to New York from Florida, where he had an opportunity to see John D. Rockefeller. Taking a long chance, the New Yorker went up to the foundation specialist and said: "Mr. Rockefeller, you don't know me, but you would do me a great favor by telling me how Standard Oil stock will go during the next sixty days." Mr. Rockefeller wasn't at all peeved; in fact, he smiled amiably, went up to the stranger and said in a low tone: "My dear sir, if I tell you confidentially will you promise to keep it a secret?" The promise was made. "Then," said J. D., "I have it on inside authority that it will fluctuate"—and he went on with his golf game.

RADIO WORLD

Title Reg. U. S. Pat. Off.

The First and Only National Radio Weekly

Tenth Year

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Homewood Radio Service, 7238 Mt. Vernon St., Pittsburgh, Pa.
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John C. Bosch 5449½ So. Union, Tacoma, Wash.
James Shannon, 812 Olympic Ave., Nashville, Tenn.
Nicholas Gaushaw, 8458 Manistee, So. Chicago, Ill.

NEXT WEEK'S FEATURE

An adapter for using the power tube of your set with a cheap meter for excellent output meter purposes will be described next week, issue of January 30th.

STATION SPARKS

By Alice Remsen

Whirling Waters

For Willard Robison, WOR

(Every Monday, 8:30 p.m.; Tuesday, 11:03 p.m.; and Wednesday, 8:00 p.m.)

MOON is hidden by a cloud,
Tree tops by the wind are bowed.
Night is cold, the year is old.
Bitter thoughts my senses crowd.
At my feet the river flows,
Moaning lightly as it goes.
How I feel! What I conceal!—
Just the whirling river knows!

Whirling waters! Whirling down to warm Southland.
Whirling waters! Whirling right by where I stand.
Tired and all alone, listening to your moan.
As you whirl along, swirl along to the Southland.
Whirling waters! Won't you listen to my song?
Whirling waters! Won't you soon take me along?
I am weary, world is dreary, life is full of pain.
Whirling waters! Take me back home again!

—*A. R.*

* * *

If You Have Never Heard Willard Robison, the Evangelist of Rhythm, and his Deep River Orchestra, you have missed a great treat. He is one of the outstanding radio personalities. His style is individual, he does not resort to idiotic tricks, but manages to hold the interest of his radio audience by giving them smoothly syncopated rhythm, softly blended harmonies, original melodies and lyrics of peculiar charm, orchestrated in his own particular style and sung by himself in his gentle voice to his own softly modulated accompaniment. Lovers of Southern music should make it a point to tune in Willard Robison.

* * *

After an Absence of Several Weeks, caused by illness and an operation, H. V. Kaltenborn, prominent news commentator, has resumed his very clever and concise analysis of current events over the Columbia networks. He is very welcome. His voice, with its crisply staccato enunciation, emits a stream of newsy words, much as a machine gun distributes bullets, and he makes every word count.

* * *

Charles (Buddy) Rogers makes his radio bow under the NBC banner Friday night, January 22, over WJZ at 8:00 p.m. He will work with Leonard Joy and the latter's string orchestra in the Nestle's show. Rogers plays half a dozen musical instruments in addition to his baritone singing and baton waving, and recently came under the exclusive management of the NBC Artists Service.

* * *

When Joseph Granby, NBC Dramatic Actor, plays his roles before the microphone at the NBC Times Square Studio he feels very much at home, for he appeared there for sixteen weeks with Olga Petrova in "Hurricane," when the studio was known as a theatre some years ago.

* * *

Elsie Baker, NBC Contralto, heard weekly on the program, "Golden Gems," is now in the Virgin Islands, as guest of Governor and Mrs. Paul M. Pearson for three weeks. She will give concerts while there, in St. Thomas, St. Croix and St. John, in the interest of local organizations.

* * *

Joe Sanders, pianist and co-leader of the Coon-Sanders Orchestra, heard from the Hotel New Yorker over the NBC networks, holds a strike-out record in baseball with twenty-seven strike-outs in a nine-inning game. Sanders performed this feat when he was pitching for the Kansas City American Association team.

* * *

Ralph Kirbery, NBC's Dream Singer, tried for months to "crash" radio "big time," and when the chance came, he nearly lost it. Kirbery had passed his third audition and had been told that he would be notified about a booking in a few days. Many days passed and Kirbery heard nothing. He visited the studios to learn that the officials had been searching for him for days. He had neglected to state that his 30th Street address was in Paterson, N. J., and not in New York City.

* * *

And Now Comes a Radio Show of a Different Kind—at the Hollywood Theatre, on Broadway, where is housed the first of a regular Broadway variety show, with a thread of a plot, written around radio and starring such scintillating radio stars as Lowell Thomas, Landt Trio and White, Bonnie Laddies, H. Warden (Hack) Wilson, Colonel Stoopnagle and Bud, Singin' Sam, the Funny Boners and Teddy Black's Orchestra. Phil Cook and Tom Johnstone are responsible for writing the show, which is called "Radio Personalities." Arthur Klein produced it.

* * *

The "Daddy" of Rural Radio Writing, George Frame Brown, may now be heard on WABC and the Columbia networks, as Matt Thompkins in his "Real Folks" sketches, which are now being sponsored by Log Cabin Syrup. Every Sunday, at 5:00 p.m., E. S. T. "Real Folks" has been on the air for three and a half years and is a very popular program.

* * *

James (Jimmy) F. J. Maher, a very popular member of WOR's press department, is past-president of the Veteran Wireless Operators Association, and transmitted, from Savannah, what is believed to be the first remote-control broadcast, a speech in the Guards Armory by Eamon de Valera, Irish Republican leader on a lecture tour of the United States. This was during the year following the World War. It was more or less of a flop; nevertheless, Mr. Maher tried the experiment and did get some of Valera's speech through, whenever that wary orator remembered that he was supposed to be speaking into a microphone.

* * *

COMIC CUTS

Limited words, no more, no less, at WOR. Asked Basil Ruysdael: "How did your boy friend like the cigars you gave him for Christmas?" Answered Marie Cardinale: "They helped him stop smoking at New Year's."

* * *

George Shackley, explaining thumbs down on a soprano in a WOR audition room, said, "The microphone isn't kind to her throat."

* * *

Sidelights

CARVETH WELLS, NBC travel talker, formerly taught civil engineering in London. . . CAPTAIN R. HENDERSON-BLAND, who broadcasts "Mood and Memories" over WEAF, was once a champion swordsman in the British army.

(Continued on next page)

(*Continued from preceding page*)
. . . BASIL FOMEEN, NBC accordion player, was once in the Red Army of Russia . . . NAN DORLAND has an ambition to be a writer . . . JOHN S. YOUNG, N. B. C. announcer, prefers beefsteak to all other foods . . . ED THORGERSEN, N. B. C. announcer, was once a broncho-buster, and also a sailor of the Seven Seas . . . EMIL SEIDEL, pianist for Singin' Sam, wrote "Hello, Evening Star," theme song of the new Bath Club program . . . MARION HARRIS, blonde blues singer, ran away from a convent to begin her professional career . . . TONY WONS has also written a lyric, inspired by his famous "Are You Listenin'?" Music by Victor Young and Ray Sinatra. It will be sung by Morton Downey . . . MARGARET SANTRY was one of the first woman radio editors and columnists in the country . . . CARL FENTON once taught Ben Bernie the fundamentals of orchestra leadership . . . EMIL COTE was born of French parents and speaks their native tongue, but has never set foot in France. In contrast, for instance, ISABEL JEWELL, WABC actress, was born on the Shoshone Indian reservation in Wyoming. . . . TED HUSING always wears the same slouch hat and polo coat to cover every sports event. . . . ARTHUR JARRETT, SR., accompanies his son Arthur to most of his broadcasts. . . . LEONARD HAYTON always plays the piano for Bing Crosby. . . . GEORGE HOUSTON, soloist on the Pertussin program, weighs 185 pounds and is more than six feet tall. . . . THE BOSWELL SISTERS are the latest radio artists to have clubs named for them. . . . THE BLUE RIDGE BOYS, WABC's hill-billy singers, spent their first Christmas in a city this season. . . . BOB HARING is still on that diet. . . . CARL FENTON eats lunch at Lindy's every day except Sunday. It takes him three hours. During each bite he is answering the pleas of song publishers. . . . LARRY MURPHY, tenor soloist, was once a trumpet player. . . . MORTON DOWNEY'S brother was mistaken for a Columbia page-boy recently. He was wearing the uniform of a military cadet. . . . MARION HARRIS, NBC contralto, owns four pets—a German police dog, a French bull, a Pekinese, and an American cat. Sort of animal League of Nations, what! . . . COUNTESS OLGA ALBANI, NBC soprano, was born in Barcelona and educated in the United States. . . . MARIA CARDINALE lost a beautiful garnet bracelet a short time ago. She received a duplicate from an admirer for Christmas. . . . HELEN HANCOCK, red-headed WOR executive, is a swell character singer. . . . EVELYN McGREGOR, of the lovely contralto voice, is now on the staff of Columbia. . . . DELPHINE MARCH admits that her favorite program, and the one she loves to sing with, is the Little Symphony, on WOR.

* * *

Biographical Brevities

About Carol Deis

Carol Deis was born in Dayton, Ohio. Her father and mother had good voices, so she comes naturally by her beautiful soprano voice that won her the Atwater Kent Radio Audition $5,000 Prize in 1930.

Carol went to high school and then a business college. When she finished her course, she obtained a position with a law firm. Part of this money went for singing lessons, but the day when she would be able to sing the difficult Bell Song from "Lakme" seemed far away to the young stenographer. Years before, as a high school girl, she had heard the famous Galli-Curci sing that song, and determined that some day she, too, would sing it.

Ralph Thomas, now conductor of an opera school in Los Angeles, was Carol's first teacher. For four years he trained her in the fundamentals of singing. They were long years, when the taxing exercises had to be sandwiched in between the hours at the office, and her only reward came on Sunday when she sang in the church choir, but the memory of Galli-Curci singing the Bell Song spurred her on.

Twice she shook her head when her teachers suggested that she enter the Atwater Kent auditions. She did not feel that she was ready. With the advent of 1930, however, she agreed the time had come. Then began the long preparation. Eight months before her first local audition she began rehearsals. She worked night and day. She sang over a local station to acquaint herself with radio technique. Then came the eliminations. She won the local contest at Dayton; she won the state contest at Columbus; at Chicago she won the right to represent the Middle-West in the National finals. At last the finals. She would sing the Bell Song. Her teachers demurred, shook their heads. It was too difficult, too dangerous, they told her. The slightest variation from the key would mean sure disaster; but the young singer was firm. She had waited until she felt herself fully prepared to enter this contest; now she was ready and she would sing what she liked.

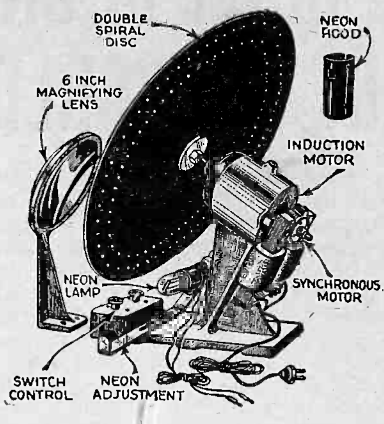
Hands clasped behind her head, in her favorite position, she faced the microphone. Clear and sure the tones came over the air. When it was over there was no doubt about the winner. The young Dayton stenographer was awarded a $5,000 prize and two years scholarship at the Curtis Institute in Philadelphia. She took up her studies immediately, but she was not through winning prizes. The following summer, she and Agnes Davis, another Atwater Kent winner, were selected as two of the three students of all the Curtis classes to take special European training. For four months she studied opera at Munich, Bayreuth, Salzburg and Vienna with her teacher, the celebrated baritone and maestro, Emilio de Gogorza. Then she returned to America for another triumph. In the fall of 1931 she was made a member of the Philadelphia Opera Company. Now she may be heard over the National Broadcasting Company's networks, a real Cinderella of the radio.

* * *

SUNDRY SUGGESTIONS FOR THE WEEK COMMENCING JAN. 24, 1932

Sun.,	Jan. 24	Footlight Echos	WOR	10:30 p.m.
Mon.,	Jan. 25	Piccadilly Circus	WJZ	9:30 p.m.
Tues.,	Jan. 26	The Jarr Family	WOR	7:45 p.m.
Wed.,	Jan. 27	Big Time	WEAF	8:00 p.m.
Thurs.,	Jan. 28	Carl Fenton and Bing Crosby	WABC	7:15 p.m.
Friday,	Jan. 29	Pillsburg Pageant	WABC	9:00 p.m.
Sat.,	Jan. 30	Little Symphony	WOR	8.00 p.m.

Tilted Disc Used in a New Set-up



Detail of the disc, lens, lamp, motor and controls.

The Pioneer Television Scanner has just been put on the market. It scans from the bottom of the disc. This, together with the fact that the disc and lens are tipped at an angle, enables the operator, without straining, to view the image either from a standing or sitting position. The disc is 16 inches in diameter and has a double spiral of 60 holes each. This double spiral facilitates the framing of the image. With this feature it is unnecessary to stop and start the motor properly to frame the image. To frame the picture one simply moves the neon tube by means of movable bracket so that any hole can be used as the top hole. This bracket from the same handle can also be moved sideways for horizontal framing.

Another feature is the method of driving and synchronizing the speed of the scanning disc. The synchronous drive is said to give exactly the same action as the regulation synchronous motor. An induction motor is used to drive the disc up to 1200 R.P.M., when it is cut out of the circuit and the Pioneer Synchronizer then drives the disc at exactly the correct speed. The motor operates for less than a minute in starting. There is only one switch to operate. One turn starts the induction motor and the next turn cuts it out of the circuit and allows the synchronizer to function.

The Pioneer televisior and television receiver were designed by John Fettig.

YALE SPEAKS UP

(Acme)

Members of the Yale University Radio Club have a transmitter and receiver that are in communication with stations in distant countries. The Yale station, WIYU, communicates with stations of other colleges as well as establishing the usual amateur DX contacts. Lt. F. R. Furth, U.S.N., of Kew Gardens, L. I., and H. D. Bergener are communicating with Annapolis from the New Haven, (Conn.) University.

FROST CONTEST OF OLYMPIC ON AIR TO WORLD

Sport enthusiasts in many countries will be able to listen in by radio and enjoy the main features of the Third Olympic Winter Games to be held at Lake Placid between February 4th and 13th. Extensive hook-ups are planned by the big broadcasting companies so that listeners-in abroad as well as in this country can follow the progress made by their athletic representatives.

A group of expert sport announcers will describe the jumps and races over the Adirondack ice and snow. It will be the first broadcast of this sort ever made of the Olympic Winter Games.

More than twenty nations will be represented by the several hundred athletes who will take part in the contests at Lake Placid. These contests will be confined to five major winter sports: skiing, speed-skating, figure skating, hockey and bobsled racing.

$500,000 Invested

The committee in charge of the Olympic events has invested more than $500,000 in constructing special facilities for the games at Lake Placid. These include a large outdoor stadium, a magnificent arena of brick and concrete, and a one and one-half mile bobsled run down the precipitous slope of Mt. Van Hovenberg—the first route of this kind ever constructed in America. Some 250 miles of ski trails have also been cleared in the Adirondack forests.

The arena will be the scene of the figure skating and curling contests, and several of the hockey games which will be staged during the evenings.

The extensive plans for reporting the games by radio to the millions of listeners is not only a task involving the big broadcasting companies, including the National Broadcasting Company and the Columbia Broadcasting System, but also the Bell telephone system, which will furnish the telephone circuits and facilities connecting the radio equipment at the scene of each contest to the distant broadcasting stations.

Special Phone Circuits

Also thousands of miles of telephone circuits are required to link these various radio stations over the continent, including the short-wave ones which will make it possible for many in Europe and other lands to listen in.

For weeks prior to the event the telephone men have been kept busy constructing special lines from the established telephone routes of the scene of the games. The bobsled run, which is about seven miles from Lake Placid, and the ski jump, which is about three miles out of the town, are among the points which will be connected by special lines. The telephone men will also assemble special amplifying equipment for the radio broadcasts and make frequent tests before the actual broadcasting occurs.

A particularly interesting event scheduled by the National Broadcasting Company is one in which the announcer will describe the bobsled ride. With his special transmitting equipment aboard the sled he will speed down the mountainside and around curves at the rate of a mile a minute.

A telephone wire along the run will serve as an aerial, harnessing the report by short wave from the sled. Thus the message, possibly including a few gasps for breath from the announcer as the big bob rounds the banked curves almost on its beam-ends, will be transmitted afar. Also by means of special telephone circuits along the route the regular reports of the races will be given.

Both the Northern New York Telephone Company, and the Bell System, with which it connects, are cooperating in providing the telephone facilities which will play a vital part not only as an aid to radio broadcasting, but also in supplying adequate means of communication for the thousands of winter sport devotees who will witness the games.

Wherever the spectators assemble for a contest there will be installed loud speaking telephones, whereby all the important announcements concerning the event will be heard clearly by everyone. Additional coin-box telephones will also be installed at many points, including the arena, the stadium and elsewhere, for the convenience of the public.

Mouse Halts Program, Dies

Boston.

A report comes from the WBZ-WBZA transmitter at Millis that the recent interruption of service during the midst of a popular program was caused by an inquisitive mouse. The ambitious little animal was inspecting the transmitter without the knowledge or permision of the two transmitter engineers in charge, John L. Ingram and Fred Osgood. Not being conversant with high voltages and the dire consequences of carelessness, the mouse got itself electrocuted. The two engineers saw a brilliant flash as 3,000 volts made an arc where such display of electrics was unexpected. Fuses blew promptly and the stations went off the air, leaving the listeners to wonder and fret without even the usual explanation of "unforeseen circumstances."

It took the engineers ten minutes to locate the cause of the trouble, but when they finally found it the mouse was beyond assistance. It had already gone to join the illustrious company of moths which previously had been used to explain interruptions in broadcast service. More fortunate was the flock of black birds which detuned the WOR antenna a short time ago, but then the birds only caused an impairment of service.

Costa Rica, 7½ Watts, Heard in South India

O. A. F. Spindler, of Oorgaum, Mysore State, South India, an amateur, heard Senor Amando Cespedes Marin, TI-4NRH, Heredia, Costa Rica. Marin's station, 7½ watts, has been heard in the five continents and is heard daily by listeners in and around New York City. Spindler is the first in India to receive this station.

Radio-Television Directory

"Official Radio & Television Digest" is the name of a loose-leaf pocket size book published by National Radio Trade Directory. It contains data covering 1932 models of every radio set, television equipment, coin operated phonographs 16 mm. talkie devices, etc.

The booklet contains prices, models, tubes required, cabinet dimensions, frequency coverage and a wealth of information in compact form. It contains over 100 pages and its price is $2.

WAVE PROBLEM A SERIOUS ONE IN TELEVISION

The progress of television depends on the practical solution of problems which unexpectedly arise at every turn. Not all of these are strictly television problems but some are general radio problems. That is, they have to do with the transmission and reception of the waves which carry the television images, and they are nearly as troublesome when they carry broadcast programs and code.

Earth and Sky Waves

One of the problems to be solved, especially when waves of the order of ten meters are used, is the elimination of ghosts. Waves in the short wave band, from 200 to about 5 meters, travel to their destination by two routes, one following the surface of the earth and called the earth wave, and the other traveling up to the Heaviside-Kennelly layer and then back to earth at a distance point. This is called the sky wave. The earth wave arrives at the destination a fraction of a second ahead of the sky wave, for it travels a shorter distance, and the result is a double image, one appearing as the ghost of the other. One attempt to eliminate this has been done by the Bureau of Standards, and consists of placing a metal screen over the transmitting antenna, which prevents the sky wave from getting out. Obviously, this offers many practical difficulties, especially when the transmitting antenna is on top of a high tower.

Restricted Distance

However, the waves which require that the antenna be placed at an altitude do not travel by the sky route but only directly in a straight line to the receiving station. Indeed, this is one reason why the ultra short waves are being tried.

The fact that the quasi-optical waves travel only as far as the horizon is an advantage in that there may be stations in many different cities all operating on the same wave without any interference.

So far television is strictly in the experimental stage and no one should expect immediate results comparable to movies. The most encouraging thing about it is that intense work is being done everywhere by organizations and individuals having the necessary technical knowledge and financial resources.

Some Executives Optimistic

Non-technical executives associated with the development of television are disposed to be optimistic about the immediate future. Some say that television is here, others that it is just around the corner. Perhaps the silence of the engineers who are working on the various problems is more significant in regards to the immediate prospect of television for the public.

New Incorporations

Stanley Ruth Co., New York, N. Y., electrical contractors—Attys. Cohen & Haas, 302 Broadway, New York, N. Y.

Miles Reproducer Co., New York, N. Y., radio appliances—Atty., M. Parodneck, 1790 Broadway, New York, N. Y.

Allied Electric Clock Corp., New York, N. Y.—Atty., H. Cahitovitz, 309 West 40th St., New York, N. Y.

Quality Radio Service, Inc., Orange, N. J., radio equipment—Atty., J. Harry Hull, New York City.

S. O. S. Sales Co., Inc., Paterson, N. J., electrical machinery—Atty., J. M. May, Paterson, N. J.

Cremonim-Wood Corp., New York, N. Y., radio apparatus—Atty., S. Rabinowitz, 26 Court St., Brooklyn, N. Y.

Atlas Radio and Refrigerator Corp., Asbury Park, N. J.—Atty., E. Capibianco, Asbury Park, N. J.