The Short-Wave Diamond, using 2-volt tubes. See pages 14 and 15.
The Five Continents on Five Tubes!

HZ sensitivity of the AW-5 All-Wave Polo Receiver, is so high that in laboratory tests it was easy to tune in stations from all five continents—Europe, Asia, Africa, Australia and America—without the exercise of any unusual skill.

The AW-5 is a completely wired, tube-equipped receiver, with electro-dynamic speaker, all housed in a beautiful Gothic cabinet, with single tuning control accomplished by use of the modernistic dial.

It gives you the advantages of:

- Two Receivers in One (Both Short Waves and Broadcast Waves)
- Complete AC Operation (with High-Powered Rectifier and Finest Quality B Supply Filtration, Assuring Absence of Hum)
- Easy of Tuning and of Band-switching (a Front Panel Switch Changes From Band to Band)
- Distance Reception, Day or Night

Buy a Set that Gives You ALL The Service You Demand!
Order Cat. AW-5 (wired model) complete with tubes @ $55.00
Kit supplied (including picture diagram, cabinet, all parts, less tubes), order Cat. AW-5K @ $45.00

Read This Amazing Record of Five-Continent Performance!

The reception record of the AW-5, the sensational five-tube receiver, as obtained in our laboratory, is such as to prove the outstanding excellence and dependability of this all-wave midget receiver. The dial is like a magic gust that sweeps the entire earth—for it came stations from all five continents—with clearness and volume, on short waves. And the broadcast band is well handled by this receiver, too.

The wavelength range is from 15 to 545 meters, and besides the broadcast band's usual entertainment value, the short-wave band enables you to tune in foreign and domestic program transmissions, domestic police calls, trans-oceanic conversations, including ships at sea using voice-modulation, television stations, messages from and to airplanes in flight, broadcast relay transmissions originating on short waves, and scientific time signals.

The benefit of two good receivers, for at a price less than the cost of a single merely fair receiver!

Distance galore! Volume aplenty!
Wrap yourself around the world—become a radio world-traveller—with the AW-5, the set that in our laboratory, tuned in such stations as:

- GBU, Rugby, England, on 16.1 and 30.15 meters—5GSW, at Chelmsford, Eng., on 25.53 meters—PCJ, Eindhoven, Holland, on 31.28 meters—LSX, the Argentine, on 28.99 meters—XDA, Mexico City, Mexico, on 20.5 meters—W99CL, Winnipeg, Canada, on 48.5 meters—VQ7LO, Nairobi, British East Africa, 31.2 meters—VUS, Calcutta, India, 25.27 meters—JIAA, Japan, on 37 meters—SS Leviathan (off coast of Europe), call WSBN, on 72.9 meters—SS Olympic (mid-ocean), call GLSQ, on 22.5 meters—VK3UZ, Melbourne, Australia, 34 meters, and many, many more!

DX-4 Short-Wave Converter!

The DX-4 is a Short-Wave Converter to be connected to your broadcast set to enable you to bring in short waves on the loud-speaker. The wave-length range is 15 to 200 meters, with the additional facility of broadcast waves through the converter (200 to 600 meters), so that you can convert any set into a superhetodyne, both for short-wave and broadcast-band reception. The tubes used are two 235 (variable mu), one 224 and one 227. Single tuning control. Precision air-wound plug-in coils are used.

Wired model, with complete set of coils (less tubes, less cabinet), order Cat. DX-4-W @ $30.00
Kit of parts, complete with coils and picture diagram (less tubes, less cabinet), order Cat. DX-4-K @ $25.00
Walnut finish modernistic wood cabinet, order Cat. CBT @ $50.00

(The DX-4 is an AC-operated converter with built-in power supply and 16 mfd. of filter capacity, for 50-60 cycles. Models for other alternating currents and voltages obtainable. Write for prices.)

POLO ENGINEERING LABORATORIES
125 WEST 45TH STREET
Our Entire Line on Exhibition at Our Office

NEW YORK, N. Y.
Telephone BRYANT 9-6516
Short-Wave Coil Winding

New Formula for Determining Number of Turns

Br Brunsten Brunn

Fig. 1

A curve showing the relationship between factor $K$ in the inductance formula and the shape factor $D/b$. 

Here is much call for short-wave coil winding data. A simple method of determining the turns required is sought, a method that can be applied without the use of tables or complex calculation. And such a method is easily worked out for any particular shape factor of the coils.

Theoretically the best shape factor of a coil is one in which the diameter of the coil is 2.46 times as great as the length of the winding. But this theoretical factor does not take into account the distributed capacity. If this is taken into account the length of the coil should be a little greater than that called for by the theoretical optimum. The Bureau of Standards in Circular No. 74 suggests that the shape factor should be 2.3. But even a little longer coil, relatively, may be used.

In the following we shall assume a shape factor of 2.25, that is, we assume that the diameter of the coil is 2.25 greater than the axial length of the winding. This results in a very simple formula for the inductance of the coil.

If $L$ is the inductance in microhenries, $a$ the radius of the coil, and $n$ the number of turns, and if the radius is measured in inches, then $L = 0.05625n^2$. This is true only if the shape factor is 2.25. Whatever diameter and wire are used the spacing of the turns should be such that the ratio of the diameter to the length has this value. If the diameter is too small or the wire too thick to permit this shape factor, either the diameter should be made larger or the wire should be made smaller.

Example of Finding Turns

Let us illustrate the use of the formula. Suppose we wish to wind an inductance of 100 microhenries and we have at our disposal a form the diameter of which is 2.5 inches. How many turns are required? Substituting in the formula and solving for $n$ we obtain $n = 38.7$ turns. This will give the desired inductance only if the shape factor is 2.25. Since the diameter of the form is 2.5 inches the length of the winding must be 1.111 inches. In this space we must put 38.7 turns, or there must be 34.8 turns to the inch. In the No. 22 single covered wire winds 36 to the inch. It is easy to determine with any wire at hand whether it is possible to wind 34.8 turns to the inch. If it is not possible a finer wire must be used or else the diameter of the form must be increased.

A good way of determining the number of turns per inch of any wire is to wind a coil one inch long, or a half inch, or a quarter inch, depending on the size of the wire, and counting the number of turns in the fraction of an inch used. This test winding can be done on any convenient form such as a lead pencil or a quarter inch metal rod.

Determining Turns Without Inductance

In many instances it is not necessary to determine the inductance in order to determine the required number of turns to make a coil that will tune to a certain frequency with a given tuning condenser. If we use the above formula for inductance in the well-known formula for frequency, $F = 1/(2\pi\sqrt{LC})$, we obtain $n = (F/\omega)^2/(CD)^{1/2}$, that is, the product of the frequency and the number of turns is equal to 920 divided by the square root of the product of the capacity of the condenser and the diameter of the coil, $F$ being in cycles per second, $C$ in farads, and $D$ in inches.

This formula is useful in determining the number of turns for different coils in a short-wave set of coils. The capacity in this case is the maximum capacity of the tuning condenser, which is the same for all coils in the set, and $D$ is the diameter of any one of the coils, which should also be the same for all the coils in the set. We see from this formula that the product of the turns and the frequency is a constant, provided only that we retain the same shape factor for all the coils.

Illustrating the Formula

Let us illustrate the use of this convenient formula. Suppose a maximum capacity of the tuning condenser is 200 mmfd. and that the diameter of the coil is 1 inch. Then if we express the frequency in megacycles per second and the capacity in mmfd. we obtain the formula $n = 60$. Remember that $F$ is measured in megacycles, that $C$ is 200 mmfd., and that the shape factor is to be 2.25.

Now let us assume that the first coil is to tune down to 1.5 megacycles per second, that is, to the upper limit of the broadcast band. Then $F = 60/1.5$, or 40 turns. If 40 turns must occupy a space of 5/9 inch on the form, or the wire should wind 72 turns to the inch.

Now let us suppose that the minimum capacity in the circuit is 20 mmfd., which is the remaining capacity when the condenser
A DISCUSSION of short waves, as to their classification and behavior, as well as to their educational possibilities, is contained in a booklet, Information Series, No. 5, of the National Advisory Council on Radio. The topic of the report is "Present and Impending Applications to Education of Radio and Allied Arts." The council's committee on engineering developments prepared the report.

Television's status is discussed in another chapter of the report. No great educational value is expected from short-wave work, except for emergency and a limited area reception, too, like television's use in education, being cited as a possibility, not an accomplished fact.


The Director of the Council is Levering Tyson, and the address is 22 East 42nd Street, New York, N. Y.

The chapters on television and short waves follow, in full:

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VI

TELEVISION

Television broadcasting is the transmission by radio of pictures in motion, e.g., to theatres, homes or schools. These pictures may have as their object the achievement of certain educational purposes. The transmission of the pictures, or reproductions of the pictures on a motion-picture film, utilized at the transmitting station. Otherwise stated, the observer in the receiving station will see a reproduction in motion of the persons and objects of an outstanding event, or will see a reproduction of a motion-picture film, in either case transmitted directly by radio.

The facilities required for television broadcasting differ markedly from those required for present-day broadcasting. Entirely different methods of transmission are required. No wide band of frequencies is necessary; elaborate pick-up or scanning equipment is necessary in the studio; special miking equipment must be provided, and the transmission and reception ratios are more advanced and elaborate in design than is required for telephone broadcasting. The receiving apparatus is similarly of a more advanced and elaborate character than that for telephone broadcasting. A different receiver, is necessary (for wave-lengths outside the present broadcasting band); appropriate scanning, and producing the picture is required, and a special synchronizing equipment, to hold the picture-production at the receiving end in step with the picture-scanning at the transmitting station, is also necessary.

Advanced Experimentation

Television broadcasting is in an advanced experimental condition. It should also be pointed out that it has not been possible to establish transmitting stations capable of giving reliable television service over a considerable area, nor to provide on a commercial scale receivers which give a clear, bright picture of an acceptable color, adequate detail, satisfactory size, freedom from flicker, of sufficiently wide angle of view, and of the requisite steadiness of pictures for the transmission to be under active observation, and there is a likelihood that within the next few years equipment of this sort will be commercially available and that for a large number of television broadcasting stations capable of supplying program material to those having suitable receiving equipment will be in operation.

Producing a network syndication of television programs is a less advanced condition. If a program for a television transmission is recorded on motion-picture film, methods analogous to the electrical transmission described above would doubtless become suitable for syndication. It is also possible that wire line facilities capable of carrying television programs will be developed, although these do not exist even experimentally at the present time. The Federal Radio Commission has made no provisions for television beyond assigning a limited number of fairly rare frequencies in the short-wave region for experimental use. These bands are already fully occupied and indeed over-crowded, with resulting interference between the various experimenters in the use.

More recently the Commission has also opened some ultrashort wave bands to experimental use by its Product's Indecision. It should also be pointed out that television transmission is peculiarly subject to certain objectionable transmission effects known as distortion, fading, multiple images, and like. These are evidenced by blurred or distorted images or a multiplicity of images of the same object, and of course render the transmission practically useless unless they are eliminated. It is hoped through proper use of technics that these objectionable factors in transmission will be largely avoided to avoid these objectionable factors within a reasonable service range, but at present they constitute an obstacle to the practical educational application of television.

One of the easily promised possibilities in this connection is the use of the ultra-short waves, to which the reports were previously made. These wave lengths appear to be free from objectionable fading phenomena, and have a limited range, and furthermore are capable of modulation to an extent which may permit the transmission of a television picture carrying far greater detail than appears possible on the lower frequencies (longer waves). However, problems of interference from sources of electrical disturbances (for example, automobiles, ignition systems, or household equipment), shadowy effects, standing wave effects, and certain other variations in transmission will require considerable further investigation. Engineers are devoting their attention to the study and development of the standing of these waves. Studies which report his television broadcasts will contain an account of the results of international investigations in this field. Although these short waves can theoretically carry, through their modulation, television pictures of great detail, yet the necessary terminal apparatus for that control of the transmitter and the realization of such detail at the receiving station has not passed out of the research and development stage.

Standards Lacking

It is difficult to present a clear description of what television can do at the present time and point out the usefulness because there are no accepted standards and partly because of the rapid development which is taking place. It may be said that television is already capable of carrying a larger number of pictures than those which have been transmitted over limited distances, and that more distant views ("long shots") of simple events are also capable of transmission.

The value of television for educational purposes will be largely dependent upon the amount of detail which the picture can carry. If the rapid development of television continues during the present decade, it is anticipated that television will be capable of carrying pictures of such detail that lecture-room demonstrations can be readily and clearly reproduced, and if some impression of the personal presence of the lecturer can be gained by the observer, and if the range of transmission and reception is such that large groups of people can successfully receive lectures and demonstrations, it is anticipated that television will be of educational value and wide application. If, however, the amount of detail is limited to that now obtainable, it is questionable whether the educators view the results, and the educators are also required the opportunity of using television, even as a partial substitute for the view of the instructor, or of an actual demonstration.

The equipment, available for the home or in the school-room is capable at this time of producing an image limited to several tens of square inches in size (for direct viewing without lens magnification). Far more elaborate and expensive equipment has been made, but the amount of power required for its operation, the degree of skill necessary for its attendance, and the initial and maintenance costs place it outside the range of ordinary school use, and they have not presented any additional useful detail, and are capable only of being viewed by a greater audience located at a greater distance.

Wide Channel Width

Television from the viewpoint of governmental regulation presents one of the most serious problems. Whereas ultra-shortwave broadcasting requires channels approximately 10-kilocycles wide, television broadcasting of adequate quality and detail requires channels at least ten times as wide. The former is a 100-kilocycles wide or even several hundred kilocycles wide (unless some radical and unforeseen development occurs). The width of television channels is engrossing the serious attention of all the engineers and of the regulatory authorities, and as to this time it has not been successfully worked out. There are several directions which offer some promise, but the entire progress of successful direct television is still dependent on the site wavebands is still in a state of flux. The formulation of definite plans for television for educational purposes can not therefore be advised at the present time.

It should be pointed out that much confusion exists among the public as to the exact meaning of the term "television." Comparatively blurred, dim, flickering and unsteady images, carrying little detail and simultaneously visible to only one or two persons at a given receiver (and then only in a darkened room), is claimed by the proponents of television. Equipment capable of yielding such limited results is on the
es Assayed for Educational Value

market to a slight extent, but is obviously of no significance to educators. From the viewpoint of the educator a picture of an entirely different and greatly superior character, somewhat as specified in a preceding paragraph, is strictly necessary. Any educational project based upon pictures which do not meet reasonably high specifications will find the application of television a handicap rather than an assistance, inasmuch as a poor picture is rather a distraction than an instructional agency.

Tend to accent in a still greater degree of mode of transmission and its romantic interest attracts a major portion of the attention of the observer. In consequence it is parallel equipment comprising the radio transmitters, that in general a certain degree of intelligibility or quasi-optical band.

The frequencies depend upon the transmission frequency, transmitters are used which are highly directional and which tend to the radiated energy in a relatively narrow beam. Directional receiving aerials are used. These are connected to receiving sets which have so-called automatic volume controls. An automatic volume control is planned to maintain the output signals at a fairly constant value, regardless of changes (within certain limits) in the strength of the incoming signal. In a still further attempt to reduce the effects of fading an automatic switching mechanism, such as five, or more, may be used, each connected to its individual antenna set. It is found that the fading is eliminated to some extent on the several individual antennas, that is, the receiving signals may be a maximum in one of these antennas and a minimum on the other two, providing the space separation of the antennas is suitable, and the rate of change of the signal is not excessively rapid. By combining the output of the three receivers in question, with a suitable automatic switching mechanism, a more nearly steady signal of improved quality (as a ratio of signal to interference is concerned) is obtained. It will be noted that such an installation is elaborate in that considerable land and financial requirements for the antenna field, the receiving equipment, such as can not readily be handled except by skilled personnel, is necessary.

Broadcast listeners are acquainted with the fading phenomena which occur at night on the signals from broadcasting stations located at certain distances from the listeners' homes. These fading phenomena in general are not unduly severe, but in certain other instances the adverse effects the broadcast listener can get an idea of fading phenomena on short-wave by imagining them to be multiplied severalfold, in both intensity of swing, in rapidity, and in resulting distortion of tone quality.

Limited Application

Despite these irregularities and largely because of the complex apparatus used, the present status of point-to-point international short-wave communication is reasonably satisfactory. It is now frequently possible to carry programs originating in most portions of Europe, and in certain parts of other continents, directly to the United States with moderately acceptable quality, and to transmit programs from the United States to these countries with equal success. It is to be noted that the radio facilities employed for the purpose above stated, elaborate and especially adapted to the circuits in question.

Broadcasting on short-waves to listeners located at great distances has a limited application at present, but industries have utilized such short-wave broadcasting for the transmission of programs to their citizens located in their colonies. For example, stations in Holland transmit programs on short waves to colonists in Java, and British stations transmit programs on short waves to the various Dominions. A number of short-wave broadcasting stations in the United States are heard by listeners in Central and South America, and even by a limited group of listeners in other countries. Relative to this service, however, it is believed that the major interest of the listener is in the international nature of the subject matter, as received is on the average poor. Yet, to a colonist situated at a distance from his country of origin a quality of broadcast service which would otherwise be acceptable may nevertheless satisfy him for a considerable period of time. It is believed that short-wave broadcasts of this sort will continue to hold a justified though limited vogue.

The attempts to utilize short-wave broadcasting for local or national transmission have been less successful. The listener is necessarily restricted to comparatively simple antenna systems of limited dimensions and to a receiving set of limited complexity. Further, the average broadcast listener cannot be expected to be especially trained in the technique of short-wave reception. Not his location, particularly in urban areas, ordinarily free from serious man-made electrical disturbances on these short waves. These disturbances may be minimized by the careful selection of a site. But broadcasting to the general public is not generally and conveniently received in the homes of the listeners whenever these may be located.

As a result, the practice of short-wave national broadcasting has been so slight that the Federal Radio Commission has been unwilling to recognize it as a part of the American broadcasting structure.

The Ultra-Short Waves

The ultra-short waves, when the experimental development of equipment for their use has been completed, may prove suitable for certain types of local distribution of music, or of television, or both. The characteristics of these ultra-short waves are peculiar, and vary somewhat within the frequency band, which has been termed "the ultra-short band." Because of their peculiar characteristics, they may prove to have definite value for educational broadcasting over limited areas.

Certain frequencies are best adapted for each of these services at particular times. In the following paragraphs these three categories of service are considered, and the application of the various frequencies to each of these is indicated.

In the case of international short-wave telephone circuits, elaborate equipment is employed to minimize the effects of fading. In addition to the careful selection of the most desirable transmission frequency, transmitters are used which are highly directional and which tend to the radiated energy in a relatively narrow beam. Directional receiving aerials are used. These are connected to receiving sets which have so-called automatic volume controls. An automatic volume control is planned to maintain the output signals at a fairly constant value, regardless of changes (within certain limits) in the strength of the incoming signal. In a still further attempt to reduce the effects of fading an automatic switching mechanism, such as five, or more, may be used, each connected to its individual antenna set. It is found that the fading is eliminated to some extent on the several individual antennas, that is, the receiving signals may be a maximum in one of these antennas and a minimum on the other two, providing the space separation of the antennas is suitable, and the rate of change of the signal is not excessively rapid. By combining the output of the three receivers in question, with a suitable automatic switching mechanism, a more nearly steady signal of improved quality (as a ratio of signal to interference is concerned) is obtained. It will be noted that such an installation is elaborate in that considerable land and financial requirements for the antenna field, the receiving equipment, such as can not readily be handled except by skilled personnel, is necessary.

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Despite these irregularities and largely because of the complex apparatus used, the present status of point-to-point international short-wave communication is reasonably satisfactory. It is now frequently possible to carry programs originating in most portions of Europe, and in certain parts of other continents, directly to the United States with moderately acceptable quality, and to transmit programs from the United States to these countries with equal success. It is to be noted that the radio facilities employed for the purpose above stated, elaborate and especially adapted to the circuits in question.

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A possibility

It is possible to modulate successfully a short-wave carrier with wide and far wider bands than can be produced at the lower frequencies (longer waves). As a result, it may become possible, upon the completion of the necessary developments, to use short-wave equipment, to send television pictures of considerable detail on the short-wave waves.

The obtaining of requisite frequency stability in certain types of receiving sets for ultra-short waves also presents a definite problem. If either the transmitter frequency or the frequency locally generated by the receivers fluctuates, as is sometimes the case in fading signals, will be produced and satisfactory reception will no longer be possible. The number of available channels for simultaneous operation on the ultra-short wave may after more complete development prove to be very great.

As matters stand, however, only a small number of transmitters, the actual usefulness of which at this time can not be definitely estimated, can be located on the ultra-short waves in any given territory.

So far as international point-to-point communication is concerned, this is equally true. Frequency variation limits the transmitting stations of a percentage which would be regarded as tolerable in ordinary broadcasting stations in the extra-short and short-wave bands (500-50,000 kilocycles) becomes progressively greater (in cycles) on these ultra-short waves, with a corresponding increased variation in frequency of the transmitted wave. Transmitting antennas (for ultra-short waves can be made highly directional if desired, with a considerable concentration of energy in the "beam direction.") The size of the transmitting antenna, even for directional purposes, is small. Accordingly, the transmission path seems to be limited by factors similar to those which control the optical light. That is, the transmission of ultra-short waves is quasi-optical. As a result, the powerful reception of ultra-short waves does not extend far beyond the optical horizon as viewed from the location of the transmitting antenna. There is no "sky-wave" caused by reflection from an overhead conducting layer. However, there are certain other factors which require attention. Some of the shortest of these waves particularly seem to be affected by atmospheric conditions (rain, heat, and so on), as in ordinary light in its passage through fog; large conducting obstacles (hills, masses of buildings) cause noticeable limitations; multiple reflection effects in building groups give a diffusion of the signal, somewhat like that produced on ordinary light when passing through a fog; electrical disturbances in the neighborhood of the receiving set (automobiles, airplanes, household equipment) cause severe interference (even at distances of a mile or more).

Frequency-Wavelength

- 30,000 to 10,000 kc, 9.994 to 29.98 meters
- 9,990 to 8,000 kc, 30.01 to 37.48 meters
Making Resistance Work
Wrong Screen Voltage and Excessive Gain
By Herman Bernard

RESISTANCE coupled audio amplifiers have had an uphill fight with experimenters, because they have tried them and in many instances found them extremely troublesome. It is no secret that skilled scientists have found them troublesome, too, but it need not surprise anyone that a resistance coupled audio amplifier can be worked by almost any one. The question is, what method shall be used to get around the trouble.

Good quality, of course, is obtainable from a resistance coupled audio amplifier. However, if the amplifier oscillates then very wretched quality, or no quality at all is obtainable. The oscillation may be at any audible frequency, most commonly present at the frequency of a motorboat engine, hence called motorboating. But the shrill steam whistle effect also is due to the same cause, only the frequency of oscillation is higher. Sometimes the amplifier oscillates at a frequency higher than the audio frequency, which might seem to do no harm, but because the gain underdampes the-tubes, and when such notes are struck, blasting is heard. There are other causes of blasting associated with oscillation in audio amplifiers.

Two Limiting Factors

There is no doubt a limiting factor applicable to the amount of amplification per stage that can be obtained with a given system; there are more than one stage. Usually a three-stage amplifier will give greater trouble than a two-stage one, because the overall amplification is not so high, and usually too great an overall gain for the circuit, and the trouble will be restricted to whatever stage is most heavily loaded. Usually this is not less than 0.5 meg. With the new pentodes, for instance, the general recommendation is to use 0.5 meg., the higher frequencies of the tube no doubt being the reason. It might be assumed that lowering the grid leak value, which lowers the amplification, injures the low-note reproduction. It reduces the frequency at which it would be with higher leak values, but it is difficult to see injury, for the amplification on low notes too intense to start with, hence the motorboating at the engine frequency. Overemphasis of low notes is just as distorting as preponderance of sensitivity in any other frequency region. Suppose, that the lows are cut a little more than the highs by the low-leak method is advantageous, for the fault in the amplifier is remedied more effectively when the correction is needed, but the reduction is less where not needed. So the cure is attractive.

Two Connections Suggested

Two circuit aids are usually offered. One is that of reducing the voltage applied to the detector, by inserting a 50,000 ohm resistor from B plus to the end of the plate load, and bypassing this resistor to ground or cathode with a 1.0 mfd. condenser. This is called a resistor-capacity filter. The other is the detector is to screen grid tube, is to put a 100,000 ohm or similar value resistor from screen to the voltage source that otherwise would be applied to the plate load. Sometimes there will be radio frequency in this resistor, there will be a severe damper on the detector circuit unless this resistor is bypassed. Almost any value of condenser can be used for radio frequency purposes, from 0.005 mfd. up. Values of 1.0 mfd. and more begin to be effective on middle audio component as well, but if audio bypassing is in mind 4.0 mfd. would represent a better starting value.

Sometimes the oscillation in the audio amplifier is due to radio frequency oscillation acting as a trigger, and as soon as the radio amplifier is stopped from oscillating, the audio amplifier behaves also, although it remains unstable. Usually the radio frequency trigger action would set off the audio amplifier so readily proves the presence of audio instability. Therefore first be sure the r-f end is not osculating and motorboating being noticed on only the lower waves of the broadcast band.

The question of what circuit to use depends a good deal on the radio frequency amplifier. For one stage of radio frequency amplification and a detector (with or without regeneration) no results in satisfactory volume will be achieved unless there are three stages of audio amplification, or one intermediate stage with push-pull transformer coupled output, or other combinations to bring the volume to the intimate level, that is, a gain of around 500, anytime.

Detector Bypass Condenser

For two stages of r-f, leak-condenser detector, with screen grid detector tube, particularly if a-c operated at highest recommended voltages, two stages will be enough, if the first audio tube is a

![FIG. 1]

The hookup for a 224 or 236 detector as screen grid tube and for a screen grid first audio tube. Power detection is used. The applied detector screen voltage may be 45 volts. Usually 45 volts applied to the screen is sufficient, 75 volts too high, as it makes the screen's effective voltage higher than the plate's. screen grid tube, and the output tube is a pentode. If the output is not a pentode the volume will not be good enough to satisfy most persons in reception of so-called weak stations.

It will be found in some instances that a small bypass condenser from plate to ground or to cathode, in the detector circuit, has to be admitted, as there is enough capacity inherent in the circuit to provide a low impedance to radio frequencies, thus detouring them, and the usual condenser, if added, cuts the volume severely. If a filter is desired it may be just a radio frequency choke coil of substantial inductance, commercial rating 10 millihenries or more.

Generally for a-c circuits the grid leak for detection of broadcast waves need not be greater than 2 meg., and the grid condenser may be 0.0025 mfd., provided with clip, if a tubular leak is to be used. Since the sensitivity of the detector depends considerably on the value of leak, correction for too high gain throughout, at audio frequencies, may be provided by reducing the detector leak value.

This is because the detector is an audio tube. When this is done to a value of less than 1.0 meg., then the detector's sensitivity is about on a par with that of a generally biased detector.

For negative bias the resistor, from cathode to B minus, for screen grid tubes in a-c circuits, may be 20,000 to 40,000 ohms, where the plate load is a resistor of from 250,000 to 350,000 ohms.

Low Screen Voltage For Detection

The screen voltage for detection should be much lower than many suppose, and since it is difficult to measure the effective value without a vacuum tube voltmeter, it is well to measure the value for the r-f screen grid tubes, where the voltmeter holds good, and put a resistor between detector screen and the screen voltage for the r-f tubes, equal to at least three times the value of the plate load resistance. Preferably return the screen to 45 volts, using 250,000 ohms (Fig. 1). The value is not critical, and the more usual recommendation of 100,000 ohms may be followed. The current is small. The drop in 100,000 ohms may be around 10 volts, while that in 250,000 ohms may be 12 volts, due to the higher resistance cutting down the current, thus causing a voltage drop not proportionate to that where the current was larger.

The usual type of meters can not cope with voltage measurements where the drop is caused by current flowing at 4 microamperes, where the meter draws hundreds of times as much.

Chain of Dynatron Oscillators

The whole voltage question is one worthy of serious study in connection with resistance coupled amplifiers. Who knows what the effective plate voltage is? If a screen grid tube is used it is desired to have the screen voltage certainly less than the plate voltage, but in many instances the difference is in the other direction, and no wonder oscillation occurs. The audio amplifier may be a chain of dynatron oscillators!

Any one with a good voltmeter has the makings of a resistance meter, and every one should have a resistance meter. It consists simply of a current meter, say 0.1 milliammeter or even more

(Continued on next page)
A Small TRS
Author Enjoys Locals with Good

STARTING WORK ON THE SET.

A broadcast set that cost me very little to build, and which is
affording very satisfactory results, is the one shown in
Fig. 1. I am interested only in listening to local stations,
with finest quality, and do not want large volume. I get the
locals, also some distance, and certainly enjoy most excellent
quality of the broadcast.

The tubes are of the new automotive series. The 236 screen
grid tube is used as radio frequency amplifiers, detector, first
and second detector. The 237 pentode is used as output tube
and the 237 general purpose tube as rectifier. The heater supply
is a 20-watt filament transformer, two tubes being in series
across the secondary, in three instances, accounting for the
six tubes used, and actually affering 7.5 volts, due to the load
of 0.9 amperes.

The parts cost me around $30, not including tubes, and it is
the exact $20 worth I have obtained in radio so far. By my
way of thinking, especially when toldal results are compared
to those of similarly priced sets that are flooding the market.

"No Aerial or Ground".

The way I run the set I "use no aerial and no ground," to
repeat the popular erroneous phrase. What is meant by, is that
I do not have to connect any aerial or ground wire to the set, for
the alternating current lighting line provides both aerial
and ground.

As is well known, one side of the line usually is grounded by the
lighting company. The other side is called the "high" side. These
distinctions refer particularly to radio frequency. The
grounded side may be at a zero radio frequency voltage, dead
for pickup purposes. However, for 60 cycles the grounded side
is just as good as the high side.

The distance between the point where the ground connection
is made by the lighting company, and the convenient outlet used
by you may be so long that there is an effective antenna, and
you can pick up radio waves no matter in which of the two
directions you insert the plug in the wall socket. This is actually
so, and the points in which I have made a test are (two or
better results are obtained, usually, if the grounded side is picked
up for low radio frequency potential purposes. You can easily
tell the difference, either by voltage increase in volume, or the better
stability that results when the preferred method of connection
is used. Sometimes an otherwise stable set will squeal if the
wrong side is picked up.

SHORTING DANGER AVOIDED.

A condenser is connected between the intended high side of
the line and the beginning of the antenna winding of the first
radio coil. Thus shortening danger is avoided. The grounded
connection takes care of itself, due to the connection of one side
of the line to the chassis, used as B minus, which chassis is
presumed to be metal. I used aluminum.

The diagram shows where an outdoor aerial, or a cold water
pipe, or ground, or both may be connected, without shorting danger,
in case one is desired. Of course the pickup will be greater, but
the apparent selectivity will be less. No condition is normally to
be expected whereby an insufficient pickup will be provided without
the external connections.

On all stations local that I tune in, except two, the volume
control has to be retarded for comfortable. The two referred
to are small ones in the low power in outlying parts of the
New York metropolitan area, and their waves suffer some
phenomenal attenuation, possibly due to tall-building obstruction
since the buildings are of steel. The same two stations always
have been feebly received on all sets I ever had, and don't
interest me much, anyway.

Values of constants are impronted on the diagram, except as
to a few points. C1, C2 and C3 constitute the three-gang con-
denser, which, if 0005 mfd. will require 80-turn secondaries on
1.25 inch diameter, whereas if 00005 mfd. is used, 92 turns would
be wound. The wire is No. 32 enamel. The primaries are 20
turns, one-eighth inch from the secondaries, on same form. These

LIST OF PARTS. Three shield radio frequency transfor-
mers, C.R.S secondary, wound for the capacity of the
output condenser to be used. See text.

One 30-hartley B supply choke coil.
One 20-volt fila-
ment transformer.
One 12 volt filament transformer.
00005 mfd. or similar tuning con-
denser.
Two equalizing condensers, 20 - 193 mfd.
One block of three 0.1 mfd. bypass condensers.
Two 1 mfd. bypass condensers.
Two 0.1 mfd. mica condensers.
Two 00015 mfd. mica condensers.
One 600/200 grid condenser with clips.
One 200 ohm flexible biasing resistor.
One 100 mfd. 30 volt condenser, R2, and two limiting resistors.
See text.
One #4 mig. pig-
tail resistor (16,000 ohms).
Three 0.050 mfd. pig-
tail condensers (5000 ohms).
One 0.01 mfd. pig
-tail condenser (20,000 ohms).
One tubular grid
leak, up to 5 meg.
(250 ohm, grid-
tail resistors (5000 ohms).
Two 1,200 ohm wire
wound resistor, or One 600 ohm wire
Two 1,200 ohm in parallel.
Four binding posts.
One vernier dial.
One 0.01 mfd.
Six UY sockets.

PROBLEMS OF RESISTANCE.

(Continued from preceding page)
sensitive instrument, with a resistor and a battery in series, the
tube for binding post is grounded, the secondary is connected.
For 1.5 volts in the battery the resistor is 1,500 ohms, also
this combination is a 0.1-0.15 volts millimeter. However, for practical
purposes you should use a larger resistance value and a larger bat-
tery voltage, as then you can get some idea of the resistance values
up to around 500,000 ohms. The phrase "some idea" comes
to mind because of the extreme difficulty in obtaining scale legibility
at very high resistance values, that must be read near the zero end of the voltage or current scale.

Assuming you can measure a resistor's value, even approximately,
due to difficulty of reading the scale, you can measure the current in
your circuit with a resistor placed thereon, and knowing the value
of the resistor can determine the voltage drop and subtract that
from the meter-measurable applied voltage. You then have the
effective voltage, say, of 0.01 volt, and knowing that this voltage
must be subtracted also, because we desire the voltage from cathode
to screen or cathode to plate.

You must be careful not keeping the screen voltage low, and not
depend on even large values of resistance dropping much voltage
in the screen and plate circuits, where about 0.3 and 0.1 milliamperes
prevail, respectively, then you will get much nearer to the fine
result as you select with resistance value.

It is important, in a-c circuits, to have the B supply particularly
well filtered, using a total of 16 mfd. or more, and a large induct-
ance choke, and not overload any, as that drops its inductance, otherwise there will be hum present.

The fact that such precautions must be taken against hum is com-
monly known, for it proves that the extremely low frequency
120 cycles principally, and 60 cycles incidentally, are amplified well,
as they are in any good audio amplifier.

You do not need a particular scale registered on your meter.
Suppose you have 0.1 millimeter. Then if you use
9,000 ohms and a 6 volt battery source, e.g., dry cells, you can
take the scale readings as found for current, and convert them
et That Cost $20

Quality and Medium Volume

reference point is the cathode, and one side of the potentiometer to ground would allow permit, at that extreme setting, a return to a point negative in respect to cathode by the amount of the negative bias on the tube.

The only resistor that carries any current to speak of is the one marked 300 ohms. A wire-wound resistor is preferable here. Even two 1,200 ohm wire-wound resistors may be used in parallel. That is how I got around the tubular type wire-wound resistor, now that there were of the grid leak pigtail type (except the tubular 5 meg.), or were of the flexible wire-wound type for smaller currents. Two such flexible types of 1,200 ohm will suit nicely, as they will stand 3 watts, and nothing like that is required. Less than 1 watt is used.

The circuit can be used by those having direct current electricity supply in their homes by ignoring the rectifier, and series connecting all tube heaters (five of them) in series again with an extra resistor, the total across the 110 volt a-c supply. The resistor should be of 260 ohms and for 220 volts (as obtained in some direct current districts) it should be 470 ohms. But these resistors cannot carry large currents, 300 milliamperes, so their wattage ratings (actual) are, for the 260 ohms, 22.53, and for the 470 ohms, 54.45 watts. So in the first instance a commercial rating of 50 watts will be all right, and in the second a commercial rating of 75 or 100 watts.

The direct current set will work only if the plug is in the socket in a particular direction, for the polarities are vital. One way gives a negative plate voltage.

Even in the case of direct current it is important to provide a good filter, and the same one would be recommended. The hum can be so low that you can not hear it even with no program on, only the set's rushing sound being audible. Now, since the circuit will produce a hum unless a filter of proportions approximately as stated is used. A 1 or 2 md. condenser next to the rectifier, all right in other filters, will not do here because this is a single-wave rectifier and also there is a relatively high voltage between all cathodes and heaters. Whether single-wave or full-wave rectification is used makes no difference, provided the filter is of sufficient electrical proportions to reduce the hum to the allowable amount or less. The tolerable limit is 5 per cent. ripple voltage.

The resistor may be 225 and is not critical, since the current is only 0.3 ampere (300 milliamperes), and the voltage to be dropped in the resistor equals the total line voltage less the voltage for the six tubes. The computation is as follows: Assuming root square values, which most a-c meters read, take the number of tubes and multiply by the voltage desired for each. Say you desire 8 volts. Then you want 8 times 5. The six tubes. The line voltage, say, is 110 volts. Differences is 82 volts, but for simplifying the arithmetic call it 63 volts. Therefore the resistance should be 63 volts divided by 0.3 ampere, or 200 ohms, to give 8 volts to each tube, but we will use less.

Omitting Transformer

No less a resistance than 200 ohms should be used for this circuit, while 225 ohms may be included, or any value somewhat that neighborhood, the result then being that each tube will get less than 8 volts. The 225 ohm value will afford about 7.5 volts.

The simple resistor for directcurrent drop may be used no less for alternating current, hence transformer omitted.

The resistor carries 0.3 ampere, remember. The wattage therefore is the resistance times the current squared. The resistance, 200 ohms, times 0.9 ampere, equals 18 watts. As in practice, the commercial rating should be about twice the actual wattage (because of manufacturers’ optimism), 36 watts commercial rating is desired. This is not a standard value, so 50 watts would be selected, if possible, otherwise 25 watts would be used. The 25-watt type would get somewhat hot, but hardly any.

The wattage also may be computed by multiplying the current and the voltage, or 0.3 ampere times (using the approximation) 60 volts, equals 18 watts.

The current, 0.3 ampere, applies to the heater circuit and the series resistor, and of course has nothing to do with the B voltage or current, for that current, flowing through the B supply choke coil, will not exceed 40 milliamperes.

It will be apparent that if enough tubes are used, no series resistor will be necessary. At 110 volts a.c., fifteen tubes could be hooked up with heaters on series and connected across the line.

The heater current would be the same. However, the B current would be large, say 80 milliamperes, which, however, is large only in respect to the expectations for the automotive type tubes. In high-powered radio sets we are not at all accustomed to 80 and 100 milliamperes of current flow. The only requirement is that the choke shall have sufficient inductance to be a real choke at such current value.

I do not know what kind of a circuit to suggest using fifteen tubes, and I do not suggest using fifteen tubes, but merely mention the point as being of interest.

A man who had luncheon with me the other day said something about a fifteen-tube set, as follows.

The set would be a superheterodyne, of course. There would be two stages of tuned radio frequency amplification, modulator and oscillator, accounting for four tubes. There would be three intermediate amplifier stages and a detector, accounting now for a total of eight tubes. The audio channel would consist of one resistance-coupled stage and one push-pull stage, three more tubes, except that I prefer the push-pull stage to have two tubes in each section in parallel, because of the relatively low plate voltage, say, 400 volts d-c. Thus we arrive at thirteen tubes. Do not forget to include a rectifier, which is fourteen tubes, while if I had my way I’d include an automatic volume control tube, and there are your fifteen tubes. Good afternoon!!
How to Determine Voltages Effective Potentials Due to Casual Currents

By J. E. A.

The voltage of an unknown source and a resistance of unknown value may be measured with two voltmeters of different known sensitivities. The meters are connected across A and B in succession.

SERVICE men and radio experimenters often place too much reliance on voltmeters. For example, they will plug into a certain socket to measure the plate voltage, or the screen voltage, and find a certain reading. They assume that the reading they get is the correct voltage on the element in question. Sometimes they find an exceptionally low value they assume that something is wrong with the set. They may be right, but the applied voltage is 180 volts and they may or may not get more than 30 volts effective, or even less. Such a discrepancy is not too large enough to question, but it is not enough to justify the assumption that something is wrong with the circuit. Very likely it is just the voltage reading that should be expected when everything is as it should be.

Another point which has worried some experimenters and service men is the discrepancy between the readings obtained by two different voltmeters at the same points when the readouts are taken by the two meters successively. One meter may read 70 volts while another may not read more than 30 volts. Now that is a queer situation and certainly one of the meters is wrong! At least that is the conclusion that is often drawn from the data obtained. This happens so frequently that it may be worth while to discuss the matter in detail. One reason why the second situation does not occur more frequently is that service men seldom measure the voltage at the same points with two different voltmeters. They place too much reliance on the accuracy of the first and only reading, as stated.

An Example Out of Practice

An example of this type came to the writer's attention quite recently. He was present when a service man tested a circuit. A test set was plugged into a certain socket for the purpose of measuring the screen voltage on one of the tubes. The instrument read 50 volts. This reading was about correct because the plate voltage was 135 volts. Yet the writer made the assertion that the screen voltage was too high and it was for that reason that the circuit did not function properly. The service man retorted strongly on the accuracy of the voltmeter reading. He insisted that the voltage was no higher than 50 volts and he was correct while the meter was in the circuit, but the point is that the voltage was much higher when the meter was disconnected, that is, under actual operating conditions of the circuit.

As a demonstration of the unreliability of voltmeters under certain conditions the voltage between the screen and the cathode was measured with two different voltmeters, one having a sensitivity of 1,000 ohms per volt and another having a sensitivity of 66,667 ohms per volt. One meter, the more sensitive, gave a reading of 70 volts while the other gave a reading of 32 volts. Now which of the two meters gave the correct voltage? Certainly both meters were not correct. And why did the two meters give different readings? When they were tested on a battery they gave the same reading, both when they were connected across the battery successively and simultaneously. Both meters were all right. Then why did they give different readings?

The Reason Why

There are two reasons why they gave different readings. First, they had different sensitivities, and second, there was a resistance in the circuit through which the current required by the voltmeters had to flow. The drop in this resistance was different in the two cases and this difference showed up on the meters.

Let us explain more fully how the difference arises and also how the correct voltage and the value of the resistance in series may be determined from the known factors. Consider the left drawing in Fig. 1. Let A and B represent the two points across which the two voltmeters are connected, first one and then the other. The box S contains a source of voltage, say a battery, and in addition a resistance in series with the battery. Both the voltage of the battery and the value of the resistance in series with it are unknown. But when we connect the two different voltmeters, one after the other, we get two different readings. The battery voltage does not change; neither does the resistance. But the voltage across the terminals A and B changes with the meter used.

If we know the ohms per volt of the two voltmeters and the two different voltage readings we have sufficient data to determine both the voltage of the battery and the value of the resistance. At right in Fig. 1 we have placed the box showing the circuit inside. The circuit may not actually be as simple as that but effectively it is, and when we get the E and R we get effective values. If the circuit is just as indicated we get the actual values of E and R.

When we connect meter S1 we have a current I through the circuit, which is the current required by the meter to cause the deflection. This deflection is indicated on the meter scale as a voltage V1. Now we can apply Ohm's law to the simple circuit. It is E=R1I1. That is, the voltage reading on the meter is the battery voltage diminished by the voltage drop in R1. Now let us connect the other meter S2 across A and B. This will give an indicated voltage V2 across A and B. In this case the current in the circuit is I2, which is required by S2 to cause a deflection V2. As before, by Ohm's law we have E=R2I2. E and R are the same in these two equations and we know V1 and V2 by the readings on the two meters. We can therefore

List Prices of Tubes

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

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*This table comparable to the 235.

RADIO WORLD

ADVERTISING RATES

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Advertising Department

Radio World, 145 West 45th St., New York, N. Y.
Meters Don’t Read Accurately in Loads Often Baffle Experimenters

Anderson

determine both E and R, provided only we can obtain the values of 11 and 12.

Getting the Currents

If we know the sensitivity of the two meters in ohms per volt we can easily get the two currents. In the first place the ohms controlled and the current at any reading is proportional to the reading. Thus we have the current at any reading as soon as we have the ohms per volt and the maximum reading of the meter. Let us first solve the two equations in E and R in terms of V1, V2, I1, and I2. The equations are:

\[ E = R I_1 - V_1 \]  \hspace{1cm} (1)  
\[ E = R I_2 - V_2 \]  \hspace{1cm} (2)

Subtract the lower one from the upper one to eliminate E. Then we get

\[ R(I_2-I_1) = V_2 - V_1 \]  \hspace{1cm} (3)

To get E we can substitute this value of R in either of equations (1) or (2) to obtain it in the first. We obtain

\[ E = V_1 I_1 - V_2 I_2 \]  \hspace{1cm} (4)

Thus we have expressions for both E and R in terms of known or easily ascertainable values.

Now let us find expressions for I1 and I2 in terms of known values. Let M1 be the maximum voltage on the scale of meter S1 and let M2 be the maximum voltage on meter S2. We can apply Ohm’s law to obtain the current, if we do not care to obtain it by simple proportion. The voltage across the meter S1 is V1, and the total resistance in the meter is M1r1, in which r1 is the ohms per volt of the meter. Thus we get

\[ I_1 = V_1/M_1 r_1 \]

Standard Frequency Schedule

Once a week the Bureau of Standards sends out highly accurate signals in both vacuum tube and crystal oscillators. The signals should be receivable in most parts of the country provided a suitable short wave receiver is used for their interception.

6000-Kilocycle Transmissions

2 to 4 p.m. and 10 p.m. to 12 midnight, Eastern Standard Time

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Multifrequency Transmissions

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Design of Converter Coils

When there are two tuners in a short wave converter, the oscillator and the r-f tuner, there seems to be no relation whatever between them, especially when the intermediate frequency is high. One reason is that any signal may be received at two settings of the oscillator, and these two require entirely different settings of the r-f tuner, usually requiring a change of coils.

The circuit with filaments of the 2 volt tubes in series, across a 6 volt storage battery.

FIG. 13

When current is drawn in addition to the current drawn by the meter, as in this case, the resistance is obtained correctly but the value of E is the effective, and desired, voltage, for the current in the first meter. Similarly we get I2=V2/M2r2 for the current in the second meter.

To solve the problem we first obtain the currents I1 and I2 from these formulas and then substitute the values of R and V2, for R and E.

An application of the formulas to a specific case will help to clear up the process. Let meter S1 have a sensitivity of 1,000 ohms per volt and a scale of 0.100 volts. Then R1=1,000 and M1=100. When this meter was connected across the terminals A and B the reading was 70 volts. That is, V1=70 volts. The other meter S2 had a sensitivity of 66.67 ohms and a scale of 0.150 volts. Thus R2=66.67 and M2=150. This meter gave a reading of 32 volts when connected across terminals A and B. Hence V2=32.

Using these values we obtain I1=70/1000x1000 and I2=32/150 x 66.67 amperes, or I1=0.07 and I2=1.2 milliamperes.

Now we can substitute these values, together with V1 and V2, in equations (2) and (3) to get R and E. From (4) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (5) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (3) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (2) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (1) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (1) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (1) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (1) we get E=70/32/2=0.7 ohms, or 70,000 ohms. From (1) we get E=70/32/2=0.7 ohms, or 70,000 ohms.

Thus we have obtained the actual voltage E of the battery and the unknown resistance R in series with the battery by measuring the voltage across the terminals A and B and solving two different voltmeters of known characteristics. It will be observed that both meters gave the wrong voltage and that the more sensitive meter gave a result much less in error than the other meter.

When Method Is in Error

Even this method is not applicable in all cases. Suppose that the screen voltage on a tube is measured and there is a resistance in the screen lead. The tube itself requires some screen current and this flows through the resistance as well as the current required by the tubes. The method then gives the value of the resistance correctly but the voltage is in error by a small amount. The voltage obtained in this instance is not the voltage of the battery but the voltage that is applied to the screen, and that really is what is desired. Hence the method is directly applicable to the measuring of the effective voltage on the screen, or on the plate, although the voltage of the source is not obtained when the current through R other than the current required by the meter.

The method is extremely useful and it should be kept in mind always and applied whenever the circuit is such that the effective voltage is different from the applied voltage, that is, whenever the voltage is applied through a resistance. The test for the necessity for using the method is the existence of a discrepancy of the readings of two meters of different sensitivities.

The only other method of measuring accurately the effective voltage is by use of a voltmeter that draws no current, such as a vacuum tube voltmeter. The two meter method is usually more convenient than a vacuum tube voltmeter.

Fig 2 shows a case where the method may be used for measuring effective voltages. For the effective screen voltage the two points for connection of the voltmeters are A and B, and for the effective plate voltage the two points are A and B’. E and B’ are the unknown resistances in the circuit. In both of these cases extra current is drawn and the value of E obtained is the effective value, which is the desired value.
A Short-Wave Set
2-Volt Tubes Used with 6-Volt Storage
By J. E. Anderson and...

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Members of the Answer Department are selected by the staff.
Questions and answers are mailed to University Members.

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Annual subscriptions are accepted for regular numbers, with the privilege of answering radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

A-30
circuit of a three tube short-wave converter in which the frequency ranges are selected by means of tuning switches. There is an intermediate amplifier and a battery supply built in.

I AM looking for an all-wave converter, but one that is especially suited for the reception of short-wave bands. Would it be possible to use a broadcast receiver that is not very sensitive, so that I should like to have at least one stage of radio frequency amplification after the detector tube in the converter. Will you kindly publish such a circuit if it is convenient to do so?—H. R., N.

In Fig. 940 is a diagram of such a converter. It contains an oscillator, a detector, and one stage of intermediate amplification with two tuned circuits in the intermediate level. It also contains the rectifier and filter required to supply the necessary plate and screen voltages.

Squawking Short-Wave Converter

I HAVE built a short-wave converter in which there is one tuner for the radio frequency and one for the oscillator. All I can get in is a lot of squawks, which seem to appear on certain combinations of the two condensers. What do you think of the trouble?—R. B. R.

The squawking is undoubtedly heard when the two tuned circuits are set at the same frequency and it is due to a type of overloading. Reduce the coupling between the oscillator and the condensers. Possi- bly you are using a too low an intermediate frequency, so that the two tuned circuits have to be set too near the same frequency in order to generate the desired intermediate frequency, and then the circuits jump together.

Inductance of Straight Wires

DOES a straight wire have inductance or is it necessary to coil it up to get inductance? If a straight wire has inductance is there enough to take into account in short-wave receivers?—G. W. J.

Yes, a straight wire has inductance as well as a coiled wire. Any conductor, no matter what shape, has inductance when a current flows in it. However, there are certain forms of coils that have very low inductance. For example, two straight wires of equal length joined together at one end and placed very close to each other have a very small inductance. So-called non-inductive resistances are wound this way. While the inductance of a straight wire, such as a connecting lead in a circuit, has a very low inductance, it is not negligible in short-wave circuits where the lumped inductance, that is, the coil inductance, is small. In some instances the inductance of a short length of straight wire is the only inductance required. A short piece of straight wire also has capacity.

Measuring Short-Wave Current

I F a thermo-couple milliammeter is calibrated on alternating current frequencies in the short-wave region, for example, 30,000 kc. to 250,000 kc., will it measure accurately current frequencies in the short-wave region, for example, 30,000 kc. to 250,000 kc.?—W. H.

If the thermo-couple has been constructed for radio frequency measurements it can be used on very high frequencies after it has been calibrated on low frequencies. The two leads carrying the current to the thermo-junction must be short so that they have negligible self-inductance and distributed capacity. The thermo-couple is about the only reasonably accurate current meter that we have for use in high frequencies.

Impedance of Small Choke

WHAT is the impedance of a choke coil of 20 microhysteres at 30,000 kc.? Is it high enough to be of any use as a choke in plate and screen leads?—T. R.

It is about 370 ohms. It is high enough to be of some good in the leads, but it would be better to increase the inductance if this is done without increasing the distributed capacity. It requires only 1.4 mmfd. to tune the 20 microhysteres coil to the frequency in question.

Hertz Antenna

WHAT is a Hertz antenna? What distinguishes it from an ordinary antenna?—E. R. T.

A Hertz antenna consists of two equal conductors running in opposite directions from the point where it is excited by the oscillator. The wires are usually horizontal. The ordinary antenna might be called the Marconi antenna. It is vertical and one end is grounded, the excitation being at or near the ground end. The horizontal portion of a Marconi antenna serves only to insure that the current in the vertical portion is everywhere approximately the same. In the Hertz antenna large balls or other large conducting bodies are often placed at the ends to insure that the current everywhere between is approximately the same. Without these arrange- ments the current at the extremities would be zero.

Resonant Shunt Against Interference

I HAVE a high frequency amplifier which amplifies one frequency which I don't want. Can you suggest a way of getting rid of this without killing the amplifier at other frequencies?—S. T.

One way of suppressing an interfering signal is to put in a parallel resonant circuit in series with the line somewhere and tuning this to the interfering frequency. The more selective this circuit is the more effective it will be in suppressing the interference and the less it will affect other frequencies. Another way is to put in a series tuned circuit across the line and tuning this to the interfering frequency. This will act as a short circuit to this frequency. The more selective this circuit is the more effective it will be against the interference and the less effect it will have on other frequencies. In extreme cases the series parallel tuned circuit and the shunt series tuned circuit may be combined for a practically complete suppression of the interference. The series parallel tuned circuit has an extremely high inductance to the interference so that...
signal cannot get through. The shunt series tuned circuit has a practically zero impedance so that the coupling becomes zero.

Discrepancy Between Two Voltmeters

I HAVE two different voltmeters both of which are supposed to be accurate and they do read the same when I connect them across a battery. But when I attempt to measure the plate voltage on a tube I get entirely different readings. What is the cause of the discrepancy?—A. B. L.

The causes of the discrepancy are a resistance in series with the meters and the fact that the meters have different sensitivities or ohms per volt. The meter which requires the more current reads the lower voltage. In one instance the reading of a 1,000 ohms per volt was 70 volts and that of another having a sensitivity of about 667 ohms per volt was 32 volts. In case there was a resistance of nominally of 20,000 ohms which caused the difference. Apparently, the fixed resistance was nearer 15,000 ohms than 20,000.

Principle of Short-Wave Converters

WILL you kindly give a brief explanation of the principle of the short-wave converter? I have built several of them and they all work, but I believe I really understand the principle that I could make them work better.—F. R. T.

The principle is quite simple and is exactly the same as that of the superheterodyne receiver. The signal desired has a certain frequency. Let us call it F1. The oscillator in the converter generates another frequency. Let us call this F2. Both are impressed on the modulator tube, or the detector in the converter. A difference frequency, either F1-F2 or F2-F1. This is the intermediate frequency and is tuned in the same manner that it is the intermediate frequency amplifier. In the converter it is fixed by the setting of the broadcast receiver, and may be any value between 50 and 1,200 kc desired. Whatever intermediate frequency is selected by the setting of the broadcast receiver tuner, the oscillator is changed, that is r2 is changed, until the difference frequency, either F1-F2 or F2-F1, is equal to the frequency to which the broadcast receiver is tuned. Then the desired signal F1 comes through. As F2 is changed by turning the condenser on the oscillator different signal frequencies F1 come through. In nearly all cases the change in F2 results in a change in F1 in the same direction and in commercial superheterodyne it is the F2-F1 frequency that is tuned to. That is, the oscillator frequency is higher than the signal frequency by the amount of the intermediate frequency. There is a radio frequency amplifier in the converter, it is tuned to F1, the oscillator is tuned to F2, and the broadcast receiver is tuned to F2-F1.

A Buffer Tube

WHAT is a buffer tube in a radio frequency amplifier and what is its purpose?—B. H. R.

It is an amplifier which is strictly unidirectional, that is, such that the signal frequency can pass from the grid to the plate but not in the reverse direction. There must be no regeneration in it. Its purpose sometimes is to prevent oscillations from backing up through the receiver and sometimes it is to amplify the signal strength from backing up to a piezo crystal or other master oscillator as an aid in stabilizing the frequency.

Coupling in Short-Wave Converters

WILL you kindly suggest different methods of coupling the oscillator and the modulator, methods that may be tried in an experimental way, to find which method is best?—L. C.

If you have a radio frequency tuning condenser in the grid circuit of the modulator, one method is to connect a loop of wire between this coil and the oscillator coil. Take a turn or two around the oscillator coil, run the wire over to the radio frequency coil and take a turn or two around that and then join the two ends by close twisting or soldering. Vary the turns on both or either. Possibly you will get a great deal of coupling by taking half a turn around each coil making a simple loop. You can also connect a grid leak between the grids of the two tubes, varying the value of the leak. Similarly you can connect a small condenser between the two grids, varying the capacity. You can also wind a few turns around the oscillator coil and connect these turns in the grid return, or grid lead, of the modulator, or the cathode lead, or the screen lead, or in the plate lead. Another way is to place the two coils side by side and vary the distance between them until the degree of coupling is right. About six inches may be found to be about right.

Natural Frequency of Small Choke

I HAVE a small diameter choke supposed to have an inductance of 100 microhenries and a distributed capacity of 2 mmfd. What is the frequency of this choke and what is its impedance at the natural frequency?—S. V.

The natural frequency of the coil is 11,24 megacycles per second and its impedance at this frequency is 5/R megohms, where R is the resistance of the coil. If R should happen to be 5 ohms the impedance is one megohm, and it is a pure resistance.

Short-circuiting Unused Turns

I UNDERSTAND that when the inductance in an all-wave receiver tuner is changed so as to cover different frequencies it is better to short-circuit the unused turns than to leave them open. I am planning to build such a receiver with direct tuned im-


A THOUGHT FOR THE WEEK

SOMEBODY asks us if we consider it extraordinary that Radio World is 59 years old. In 1932 we bought more stock for subscriptions during a recent ten-week period of 1933 than we had taken in for the previous period of 1930. Our published statement in these columns. We replied: "Why extraordinary? We have been trying to produce a paper which will interest as many actual listeners to our many thousands of readers. Then instead of listening to the calamity howlers, we started on a subscription campaign that netted fine results. Others in the radio field have done the same thing once they were sure they had something worth while. Isn't it the usual story? And we're not going to stop working along the same lines, either, no matter what happens in Europe or Wall Street—and there you are!

RADIO WORLD

The First and Only National Radio Weekly

Tenth Year

Owned and published by Hennessee Radio Publications Company, 100 East 42d Street, New York City. Robert Burke Hennessee, president, and treasurer; John W. Black, vice-president; 145 West 45th Street, New York, N. Y., and 365 West 44th Street, New York, N. Y. Published semi-weekly. Robert Burke Hennessee, editor; Herman Bernard, managing editor; Alfred W. Tobin, advertising manager.

Our Side

READERS have been telling their trank opinion in uncensored letters published in this forum, a regular department of Radio World, saying that insufficient details are given about many circuits, while others complain that sometimes whole articles are aped in diagrams.

Since comment on any diagram or text necessarily is published in a subsequent issue, the original subject matter makes an unmoled appearance, and it is only fair that the comments should be published without lack in the same issue in which such has been the case in every instance. Whatever the reader had to say was said, and is printed, for that issue. However, there is no harm, we hope, in now pursuing the discussion on the basis of readers' comments printed in previous issues.

As for the lack of constructional details concerning many diagrams, that is due to the nature of the article that they illustrate. There are, in general, two types of technical articles printed; one is theoretical and the other is constructional. Any technical article not primarily intended actually to expound the construction of the device under discussion should be classed as theoretical, and any article intended to detail the actual construction or what the author's handiwork will be duplicated, is constructional, even though some theory usually attends the constructional article. It should go without saying that both types of articles have their merit and value.

Unfortunately, the word theoretical calls to mind for many persons a freak circuit, something untied and untested, a scientific paper, but in these days the sense theo trial simply means founded on theory, and theory is a formulated code based on an experimental basis. In other words, for instance, that the resistance present, when the potential difference is 2.16 volts and the current 1.062 amperes, equals 2 ohms, not because the statement is fallacious or absurd (for it is true), but because the writer has never actually reduced to practice and measured a circuit in which there were that potential differ-

ence and that current. Yet Ohm's law is invoked, and Ohm's law is based on experience, it has been proven wrong in a single instance.

So, assuming that there is nothing in the word theoretical about the shunt, let us consider that nearly all radio knowledge is obtained from theoretical treatises and nearly all of an individual's radio knowledge is obtained from theoretical textbooks. Who could ever hope to build even a small fraction of all the radio circuits ever published, to provide for a code receiver which a clear, bright picture of an acceptable color, adequate detail, satisfactory results are obtained from an artificially wide angle of view, and of the requisite steadiness of position. The problems involved are under active investigation, but there is reason to believe that the next few years equipment of this sort will be commercially available.

And it so happens that in the discussion of wave lengths these are in no way the possibilities in the future, with no great enthusiasm for program broadcasting on short waves under present conditions.

But the report bears the same truth, and listens to him as not fitted to get the best results from short-wave receivers because of the same truth, and listens to him as not fitted to get the best results from short-wave receivers.

The Master Stroke

THE greatest tribute to the importance of radio is Radio City, now in course of construction in New York City, where it will constitute an immense and beautiful monument to the age, as well as a cultural center with a greenwood and the usual sadder human,

Imagine a building especially intended for short-wave listening, estimated at $280,000,000! Imagine 5,000,000 people, daily active on the site, three months work, or, more, for persons who sorely need it, with other hands. And it is incidental to supplying the materials and fixtures! Sifting industry, commercial bravery, inspired planning, boundless confidence! These, too, the endeavor types, besides the lasting monument that will rise to the

Behind it all is the steady hand of John D. Rockefeller, Jr., for it was he who furnished the financial money that made Radio City possible. It is his greatest stroke, and one that reaffirms the strength of his moral and executive fibre. Born to a fortune, Rockefeller might as well have been born to poverty, for he had the makings of success, and easily might have been content. But he was one of America's model citizens.

Not only the 25,000 who profit directly by Radio City, but the 25,000,000 who profit indirectly. The character of this land in which we will recognize anew the demonstration of his genius, but the world and the appreciation of the country will recognize anew the high praise he deserves for his undertaking. His is a business enterprise, not to be confused with individual interest, but a part of the world that is carefully shrewd about the world. The project is to be self-supporting. Neverthe-

less, there is in it every evidence of the high purpose, the intellectual supremacy, and the fine sense of recognition and proportion that mark his many philanthropies. The master touch is there, so are the deft vision and the high resolve.
**Forum**

Good Advice From Texas

LAST evening I purchased a copy of *RADIO WORLD* from a local news-stand. It was dated July 18th and is the first copy I have purchased or read since 1923.

I've never been a regular reader of your magazine but after a while I dis-continued reading it on account of the great amount of advertising matter preva- lent in the magazine, as well as the dec-

Consideration.

Some of the articles contained technical articles written by authorities in a clear and understandable fashion, remembering that all readers are not college educated.

Of course, we want the math, but give examples as to how you arrive at the figures.

Now, about the magazine I bought yester-

day evening. There was a noticeable improve-

ment over what I was familiar with. I read the magazine from cover to cover, but most readily absorbed the contents from page 3 (the first text column) to page 15. The last two pages of the magazine held little interest for me.

In regard to the Forum page, I heartily con-vinced Mr. Karl Remsen. But Mr. W. B. Kenyon, Mr. Verne Scheffler, Mr. F. C. Rotger, also Mr. E. L. Sievers, in the comments they made, I see their greatest mistake any magazine could make is the omission of values, the publication of incomplete diagrams and lack of detail.

For example, this in the July 18th issue I refer you to Fig. 2, page 8. There is no B minus connection in this diagram.

In Fig. 9, p. 15, I think I would strongly try connecting it to A plus or A minus, but we would feel sure were it printed on the diagram.

And I refer to Fig. 9C, page 15. This circuit is conspicuous for its lack of values. Not only that, but there are a couple of details that might be added or explained to make the circuit diagram more understandable.

Again, the article by J. E. Anderson and Herman Bernard, entitled "Short Wave Circuits," was good in every way except that there is an entire lack of information as to how to design the coil shown in Fig. 10. This looks as if it might be something good, but there is no comments as to how to design it, how it works, etc. The coil really should be shown in a complete circuit with adequate coil dimensions.

A thorough comment should be made in the text regarding each figure or diagram submitted, and each diagram could be complete in every detail, with values stated, inductance couplings indicated, gain stated, shielding, and what not. I believe a good idea to show inductances in the relative positions they occupy on the form and by all means the number of turns. This is a question regarding the coil shown in Fig. 10. This looks as if it might be something good, but there is no comments as to how to design it, how it works, etc. The coil really should be shown in a complete circuit with adequate coil dimensions.

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Beards grown on notables in vision debut

In preparation for the advent of television on a commercial basis, the Columbia Broadcast- ing Company, through its subsidiary, W2XAB, has on the air, a regular program from New York City that is designed to make the public familiar with the possibilities and problems of television and to gain such technical knowledge of the difficulties and problems, so that proper solution may be applied. Thus Columbia follows its rival, NBC, in preparing the way for the succeeding stations through the exhibition of the Columbia television system.

Moustache and Beards

The opening of Columbia’s service was marked by the appearance of screen, stage and political notables, including Mayor James J. Walker, Guy Lombardo, the orchestra leader, Walter Walker, Columbia’s “television girl,” and KDKA, New York City’s first television station.

Lightning Plays Havoc

A thunderstorm, with attendant static, marked the first transmission. Such conditions work havoc with television fidelity, and to them are ascribed the freak results of bearded lady and ill-tempered gentles. However, still pictures of these and other principals before the microphone, for audible component on WABC’s broadcast wave, and before the photo-electric cells for television, for short-wave transmission, confirm the fact that the beards and moustache were the work of diabolic nature, and not mortal man or woman. Also the Mayor’s no political significance, since it was truly accidental.

Besides, the station holds all three persons in high esteem. Nor, it was the storm. Magnetic disturbances, due to sunspot activity even when the sun is down, or to storms developing over long distances, are stock reasons for such irregularities. It is not a contest to determine how funny a face the control engineer can con- fer on a station’s bowed guests.

Rapid Progress Expected

E. Cohen, W2XAB’s technical director, aside from mustache and beards, said that television today is to be compared to the phonograph. The moving pictures of 1905 and radio itself in 1920. He propounded that television will advance with at least equal speed. That outdoor scenery of a grand scale will be reproducible in the home, finally in colors. He said 1932 holds great promise for television.

W2XAB uses 500 watts, on 2,750 to 2,850 kc (109 to 105.2 meters), 60 lines per frame.

Cells Blamed for Whiskers

The beard-growing tendency of television transmission has been experienced from the start, and experiments are being conducted to devise a remedy for this defect. Not only beards, but freckles and other splatters have been improvised by the tricky television system.

One explanation given of this phenomenon is that the photo-electric cells used are of the potassium type, sensitive particularly to the high end of the color spectrum, and not sensitive to red. Hence a bluish shadow, offset by red, reproduces as an "ornament."

The result of this characteristic of the potassium cell, it is said, has been dark splatters and a tendency to fasten a beard on the subject.

Caesium cells are very sensitive to red and somewhat sensitive to blue, so schemes are being worked out to use the two types in combination, with a proper proportion of the number of cells, to establish relative equality of sensitivity.

Service Men’s Institute Near

Following several local attempts by others to found and perpetuate organizations of radio service men in the United States, Columbia’s “television service,” the Institute of Radio Service Men, has been organized, with headquarters in the Columbia’s studios and technical plant, Chicago, patterned after the Institute of Radio Engineers.

The service man’s institute has the in- dorsement of several large manufacturers of radio, sets, who recognize the advantage of a national body, so that high standards of reliability may be maintained in servicing radio receivers. Service work is of great importance to the manufacturers, who at present are largely authorized servicing bureaus, although there are many independent service men in this country.

The center for the station is intended to serve as a clearing house for the problems of the service man, so that both information and questions may be sent in. It is intended to pub-lish a periodical, similar to "Proceedings" of the Institute of Radio Engineers, but with the prime intention of dealing with service problems, rather than design factors.

Diagrams of commercial receivers are to be printed, also expositions of the most com-mon troubles found in particular receivers, and methods of remedying these. Papers will be read at meetings, and these papers are to constitute, to some extent, the con-tents of the periodical, although papers not delivered as talks also will be printed, as is the case with "Proceedings."

The official beginning of the Institute of Radio Service Men will be staged in con-junction with the Radio-Electrical World’s Fair, at Madison Square Garden, New York City, September 21st to 26th, inclusive. At the public show in Chicago, in October, the activities will be further promulgated, and somewhat later it is planned to hold a con-vention, when details will be discussed re-garding the estabishing of chapters in vari-ous cities.

Leeds makes amateur bid

Leeds, 45 Vesey Street, makes a show-ing with photo-amateurs who tuned in their short-wave transmission and reception. The company has a listening monitor, a dust-plotted crystal holder, a 50 watt socket, a short-wave receiver and copper coils of very thick wire diameter.

Work started on radio city; jobs for many

Radio City, the largest building project in the world’s history, is now in the process of construction. The work is so large that gaining really means destruction, as the first work is digging, and there will be plenty of it. Eight steam shovels are made their way in some measure of over 200,000 cubic yards, at a cost of $1.50 per cubic yard. A work force of 30,000 men, using 200,000 cubic yards of material in the filling of the large excavation, will be needed to fill the base of the Radio City auditorium, which will be the largest in the world, with an area of 10 acres.

Work for 25,000

John D. Rockefeller, Jr., through cor-porations he controls, is planning the project, which, it is expected, will give work to 5,000 men when in full swing, their activity centered on the site, and to 20,000 other persons because of the labor involved in furnishing the steel, bricks, woodwork, metalwork and other materials and fixtures. Contracts for the work between Fifteenth and Fifty-first Streets, and between Forty-ninth and Fifty-fourth Streets, on the west, the skyscraper will raise its 2,220 square feet of beautiful bulk.

Radio Activities

The National Broadcasting Company and the Radio Corporation of America will occupy the first twelve floors of this immense structure. The broadcasting company’s executive offices, studios and technical plant, will be there, including elaborate television transmission facilities, as the company expects that next year television will be ready for the public. The broadcasting, television and photophone work will be done in a wing of this building.

Todd, Robertson, Todd Engineering Cor-poration and Todd & Brown, Inc., have charge of the work, while the architects are Reinhardt & Hoffmeister, also Corbett, Har-rison & MacMurray, and Hodd & Poulinson.

Baldwin in Person

Is Making Earphones

Nathaniel Baldwin personally has taken over the equipment heretofore used by Nathaniel Baldwin, Inc., manufacturer of head-phones, and also unasssembled parts and unused materials. The increasing demand for the head-phones, and particularly for instruments giving faithful sound reproduction, promise con-tinued growth of this business in a substantial way. "I say," he says, "there is a difference between the head-set and the earphone, which must be made known and popular. Using any instruments free of charge which may be defective in any way in which the manufacturer is responsible."

He is located at 3477 South Twenty-third East, Salt Lake City, Utah.
**BOARD RULE BY**

**“ONE MAN” PUT TO COURT TEST**

WASHINGTON, D.C.—WENR, WLS and WGN, all of Chicago, have appealed to the District of Columbia Court of Appeals from a recent decision of the Federal Radio Commission involving license renewals.

The Commission renewed the licenses of WENR and WLS pending determination of the case of WTMJ, Milwaukee, which has asked permission to operate on 870 kc, which is now used by the two cited Chicago stations. The license of WGN was renewed under similar conditions pending the outcome of the case of WCFL, also of Chicago, which has asked to operate on 720 kc, which is now used by WGN.

The appellant stations contend that the conditions imposed by the Commission would deprive them in advance of any right to operate on their present frequencies after the Commission has rendered its decision in the case. The decision is adverse to the appellants. They also claim that the decision “deprives them of liberty and property” and “takes private property without just compensation,” and complain that no notice or hearing was given or hearing held, and the action is void for want of a quorum, as, in fact, only one Commissioner acted, the others even being out of the city at the time.

Replogle Heads DeForest Engineering Staff

The DeForest Radio Company, of Passaic, N.J., announces the appointment of D. E. Replogle as chief engineer. For the past two years Mr. Replogle has been assistant to the president of Jenkins Television Corporation, and full charge of the engineering and production activities of that organization. Prior to this period he was identified with the Raytheon Manufacturing Corporation, heading its licensee engineering service and much of the research work. He will continue to guide the engineering activities of the Jenkins Television Corporation, whose products are manufactured by the DeForest Radio Company.

**Pilot Universal Set**

Pilot Radio & Tube Corporation, Lawrence, Mass., is stressing its all-wave Universal receiver, which uses cams for inductance changing, and thus avoids plug-in coils. The receiver is of the table model type. A kit of parts may be obtained if preferred.

**JENKINS FOR TELEVISION**

Jenkins Television Corporation, Passaic, N.J., has a television receiver, also obtainable in kit form, and all the necessary television adjuncts, including photo-electric cells, neon lamps, scanning discs, magnifiers, etc.

**INSULINE’S SET**

Insuline Corporation of America, 80 Cortlandt Street, New York City, has a short-wave receiver, also a television kit.

**TELEVISION RECEIVER**

A television receiver kit is marketed by Radiotechnic Laboratories, Inc., 1271 Bedford Avenue, Brooklyn, N. Y.

**RECORDING DETECTIVE” IS DEMONSTRATED**

(Acme Newspictures, Inc.)

Apparatus designed by RCA Photophone and built for it by RCA-Victor, so that broadcasting station programs may be recorded as evidence of the type of program transmitted, is being worked by Dr. C. B. Joffliffe, chief engineer of the Federal Radio Commission. The records will be used as evidence of hearings on license renewals. The station is tuned in with the set (top left) while a microphone picks up the program and delivers it to an audio amplifier (on floor) that feeds the recording heads on the twin turntable.

**TELEVISION PARTS**

Arthur M. Pohl, 3541 Michigan Avenue, Detroit, Mich., announces television discs at very moderate prices. These discs are obtainable for reception of all the types of television transmission on the air. There are two main types, flexible cardboard and aluminum. If preferred, the discs are obtainable undrilled. The standard shaft on motors accommodates the discs when a cast aluminum hub is used. Also, neon lamps are supplied.

**CONVERTER FOR SG SETS**

Radio Constructors Company, 357 Twelfth Street, Oakland, Cal., has a short-wave converter for “short waves on any screen grid receiver.” It is of the midget type, in a cabinet, without plug-in coils, and contains its own power supply. The tubes are one 224, two 227 and one 280. The company also has a short-wave receiver.

**16-TUBE SHORT-WAVE SET**

H. M. Kipp Co., Ltd., 447 Yonge Street, Toronto, Ontario, Canada, has an all-wave set, 9 to 190 meters on short waves, 190 to 5,000 meters, for broadcast and code reception. There are four stages of r-f and two stages of a-f, the total number of tubes being ten. Plug-in coils are used.

**DELF IN SHORT WAVES**

Delf, 524 Fairbanks Avenue, Oakland, Calif., features a coil-winding kit, an all-electric short-wave receiver kit, a short-wave portable receiver kit, a short-wave wavemeter, and a short-wave transmitter, besides short-wave coils.

**BAIRD RECEIVERS**

Baird Television receivers are made by the Short Wave and Television Corporation 70 Brookline Avenue, Boston, Mass. A kit is obtainable if preferred. Plug-in coils also are made by this company.

**WE’RE DELIGHTED—AND ENCOURAGED!**

A recent survey of Radio World’s subscription orders for ten weeks from May 2nd to July 3rd, 1931, proved that the amount paid by new and old subscribers during those ten weeks was 15.9% more than was paid during the corresponding period of 1930.

We’re going to try and increase this percentage for the whole year—and know full well that this can be accomplished only by turning out a paper that gives the service expected by a particular and ever-growing radio public.

THE PUBLISHERS.
Thrift Box in New Improved Form

Improved in appearance and operation, with coils available making the wave coverage from 9 to 850 meters, the National Thrift Box is a truly variable midget receiver which offers better performance than ever. This circuit was a sensation when it was first introduced to the public, more than a year ago. Amateur airplane companies, home set-builders and short-wave fans generally recognized it as one of the outstanding short-wave devices. Its record of foreign reception is exceptional.

Clearest reception is provided in Summer on short waves, as a rule, than on broadcast waves and since large chains are sending out their programs on short waves there is the added advantage of having a set reserved for regular feature program reception.

Single tuning control is employed, the spread of frequency for each band covered by the particular coil used, while the audio channel is a fine one, with push-pull output.

The AC model provides utterly humless operation, and is obtainable in two types, either 227 push-pull or, in a special model for extra volume, with 245 push-pull.

"Handbook of Short-Wave Radio," published by the Hammarlund Company, of Sherman Street, Malden, Mass. (50c.), tells a great deal about the constructional side of short waves, not only with the Thrill Box, but with many other and different circuits, as well as treating of the phenomena of short-wave reception.

Hammamulund Offers Short-Wave Condensers

Hammamulund Mfg. Co., 424 West Thirty-third Street, New York City, has added the junior midline condenser to its list of parts for sale through jobbing channels. Formerly this item was sold only to manufacturers. Because of its extremely small size it is in high vogue right now, besides, the workmanship is of Hammamulund's well-recognized type. The total plate swing is inside a 2-inch diameter. The condenser comes in various capacities, from extremely small up to 0.0002 mfd. Short-wave converters and other devices use this condenser.

Besides, Hammamulund has radio frequency chokes and air-wound plug-in coils for short waves.

Soon, it is hoped, details will be announced of the latest addition to the Hammamulund products, an all-wave superhet.

One of the first manufacturers to come out with an improved midget set is Polo Engineering Laboratories, of 125 West Forty-fifth Street, New York City. The set is sold complete with five tubes, all ready to operate. The tubes are one 235 variable mu, one 224 screen grid, one 227, one 247 pentode and one 280 rectifier.

The speaker is housed in the Gothic cabinet, along with the chassis. The parts used are of expert manufacture, and include a National modernistic dial. The wave band selection is made by means of a rotary switch on the front panel. This switch is of the four-point double throw type, activating two tuned circuits at once. A trimming condenser, manually operated, and a volume control with AC switch attached, account for the others.

Repeated tests of this midget, known as the AW-5, have proved that it is a dependable and practical circuit, giving excellent broadcast reception, as well as short-wave coverage from 15 to 200 meters. There is enough frequency overlap between respective settings of the switch to insure full coverage. "There is no missout," stated Gus Eklund, chief of the Laboratories, "for I took exceptional pains to see that the full coverage feature was included."

Audio sensitivity and general tone are accomplished by using a select audio channel and a dynamic speaker. The field coil of this speaker is used as the B supply choke. The filter capacities exceed 18 mfd.

The circuit has been carefully engineered. The test was run in Ranzano Wompa's laboratory and found excellent. The ease of control was particularly gratifying, in view of the sensitivity developed.

Polo also is featuring its improved short-wave converter, the new DX-4, using two variable mu tubes (235), one 224 and one 227. This is connected to a broadcast set, brings in short waves. The use of plug-in coils is retained in this model short-wave converter. There are a new modernistic cabinet and a new layout of parts, with improved performance, in the DX-4.

Intermediate Coils for Short Waves

Intermediate frequency transformers, peaked at 450 kc, and highly suitable for intermediate amplifiers to be used with short-wave superhet and midget receivers, is manufactured by Supertone Products Corporation, which has just moved into two buildings that previously were occupied at 215 Hooper Street, Brooklyn, N. Y. These transformers are in aluminum shields, with screw cap, and may be mounted either perpendicularly or horizontally, with the two condensers for frequency matching easily accessible. High inductance honeycomb choke coils are used for primary and secondary tuned, as the transformers are intended to work out of screen grid tubes, fitted into any type of short-wave detector. The transformers afford high gain with as high a selectivity as total considerations permit. The high inductive reactance accounts largely for the extra gain.

In the same type shield Supertone manufactures intermediate transformers peaked at 125 kc, which may be used by home constructors, or by service men for replacement of transformers in factory-made sets. These are obtainable on application. Address Supertone Products Corporation, 27 to 35 Hooper Street, Brooklyn, and ask for Table W. Mention Radio World.

Low Loss Coils

A short-wave coil is manufactured by Transcontinental Coil, Inc., 59 Church Street, New York City. Low loss and mechanical strength are claimed. There are coils for the following bands: 10 meters, 20 meters, 40 meters, 80 meters, 160 meters and broadcast. The capacity to use is 0001 mfd. However, if 0005 mfd. is used with the 160 meter coil, the broadcast band will be covered. Otherwise with 0001 mfd, the broadcast band is then split between two coils.

INTERNATIONAL DUO

The International Radio Corporation, Fourth and William Streets, Ann Arbor, Mich., has brought out the International Duo, a midget all-wave receiver. The company debated the manufacture of a converter or a receiver and decided on the receiver. There are two dials on the front panel, one to be used for short waves, the other for the broadcast band. A front panel switch takes care of band changing.

HY-7 SHORT-WAVE SET

Haty & Young, 119 Ann Street, Hartford, Conn., noted individually as amateurs, and now radio trade personalities and manufacturers, has assembled but unwired kit, to constitute a short-wave receiver. National parts are used for the tuning adjust and in some other places.

COLORED PLUG-IN COILS

Four coils of the tube base plug-in type, with different colored bakelite to distinguish them, are sold by Radio Trading Company, 2911 2nd Avenue, which sold a similar, but simpler, type, with colored dial, to cover from 15 to 210 meters. The receptacle is a UX socket.

"EXPLORER" CONVERTER

"The Explorer" is the name of the plugless short-wave converter manufactured by Radio Mfg. Co., 605 Grand Street, Brooklyn, N. Y. Two tubes are used. Band selection is by front panel knob switch.

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RESISTORS and Mountings

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0.25 meg. (250,000 ohms) Brush resistor, for all except screen grid tubes. Order Cat. BRA-30, at.......

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1.0 meg. Brush resistor for grid leak. Order Cat. BRA-30, at......0.30 ea. 
2.0 meg. Brush resistor for grid leak. Order Cat. BRA-40, at......0.65 ea. 
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0.025 meg. (25,000 ohms) Amosco resistor. Order Cat. AMS-25, at......0.40 ea. 

[The above resistors are of the tubular type and require a mounting Lynch moulded bakelite mountings, Cat. LYM, at......12c]

Filament Circuits
1-ohm Brush resistor, to afford 5 volts for 34 amps. at source in 6 volts. Supplied with mounted capacity 2 amps. Order Cat. BRA-1, at......0.25 ea. 
2-ohm Brush resistor, to afford 5 volts when two 34 amp. tubes are supplied from a 6-volt source. Mounted capacity 4 amps. Order Cat. BRA-2, at......0.30 ea. 
34-ohm Brush resistor. To drop 3 volts on 32 amp. tubes; use two of the resistors in parallel. Order Cat. BRA-30 (mounting supplied), at......0.35 ea. 

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