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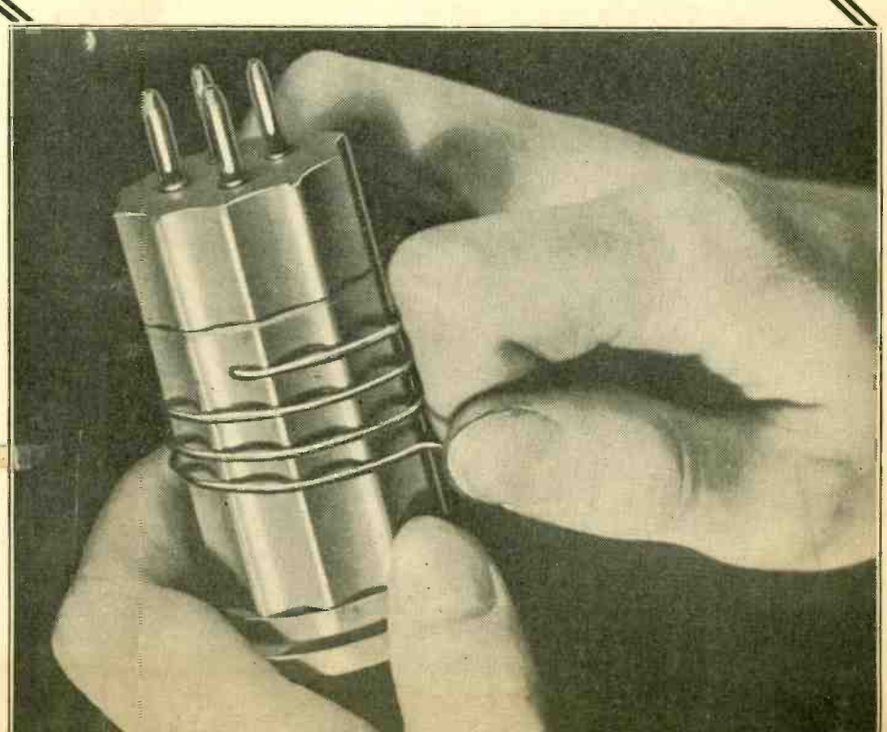

WINDING SHORT WAVE COILS FOR .00014 MFD.

—By Lewis Winner, See Page 5.

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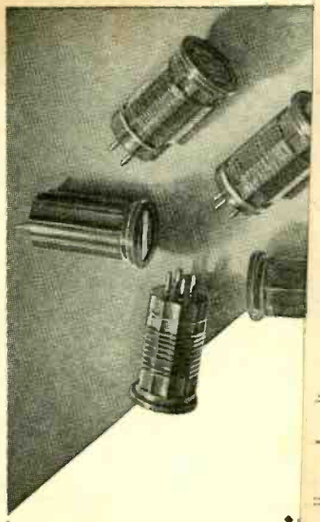

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The First National Radio Weekly

THIRTEENTH YEAR

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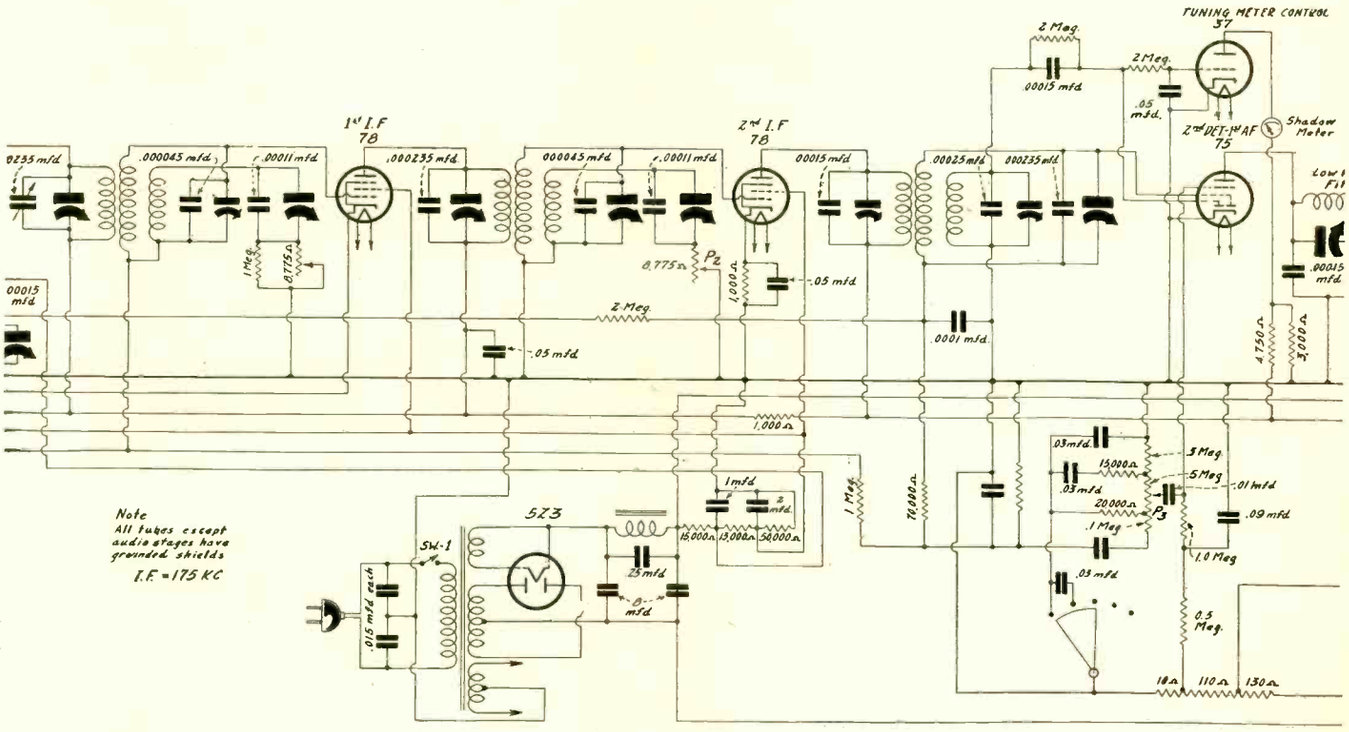
Varying the I-F Band Width

Two Methods are Popular to Achieve High Fidelity

By James Kelter



HIGH fidelity requirements involve the transmission of a band of audio frequencies much greater than heretofore transmitted through the average receiver. For absolute fidelity it is desirable that all audio frequencies up to about 16,000 cycles be equally amplified. With the present allocation scheme of stations in the broadcast band where they are separated by only 10,000 cycles, which is tantamount to permitting 5,000 cycles modulation, such ability in a receiver is not at all desirable, since it defeats the selectivity requirement of the receiver, though the aims of fidelity are preserved. To offset such a difficulty it might be desirable to increase the frequency separation between stations so that interference between adjacent stations will not result.

However, such measures will be strongly antagonized by the broadcast interests since it means a reduction in the number of stations and a consequent loss in investment. Another alternative might be the development of broadcast transmitters that send their programs out on one sideband only. This will space the stations by 10,000 cycles instead of the actual 5,000 cycle separation of today.

The manner in which the band width of an intermediate transformer is controlled by means of a variable resistance in a trap circuit.

Making the Set Do It

To hope for such a change in a short time would be little short of a dream since it involves several changes in the equipment used at present at broadcast stations for which a willingness will not be readily evident. So, this remedy is not of great practicability either.

Because these changes at the transmitter are not readily put into practice, it has been the custom of the radio receiver manufacturers engaged in high fidelity work to make the changes at the receiver.

The theory behind the treatment of the receiver limits its fidelity when two adjacent-channel stations are receivable. In such a case, since the two stations are actually only 5,000 cycles apart, it is imperative that the fidelity band be stopped at 5,000 cycles or two stations will be heard at once. In other instances, when the desired station and undesired stations are separated by more than one channel, it is permissible to allow a wider band to go through. Thus the receiver's selectivity and fidelity should be made variable.

I-F Channel Controlled

In the superheterodyne type of set this is most conveniently accomplished in the

(*Continued on next page*)

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Winding Plug-in Coils

On New XP-53 Form for 0.00014 Mfd.

By Lewis Winner

Hammarlund Manufacturing Co.

IN short wave radio a member of the important family of parts is the plug-in coil. Any experimenter knows what a difference in volume, selectivity and sensitivity exists when contrasted coils are used.

For years Hammarlund has been producing excellent plug-in coils which were, however, just above the popular price range. Tests were made and a new material discovered—XP-53. Though inexpensive, it possessed the characteristics of the most expensive dielectrics.

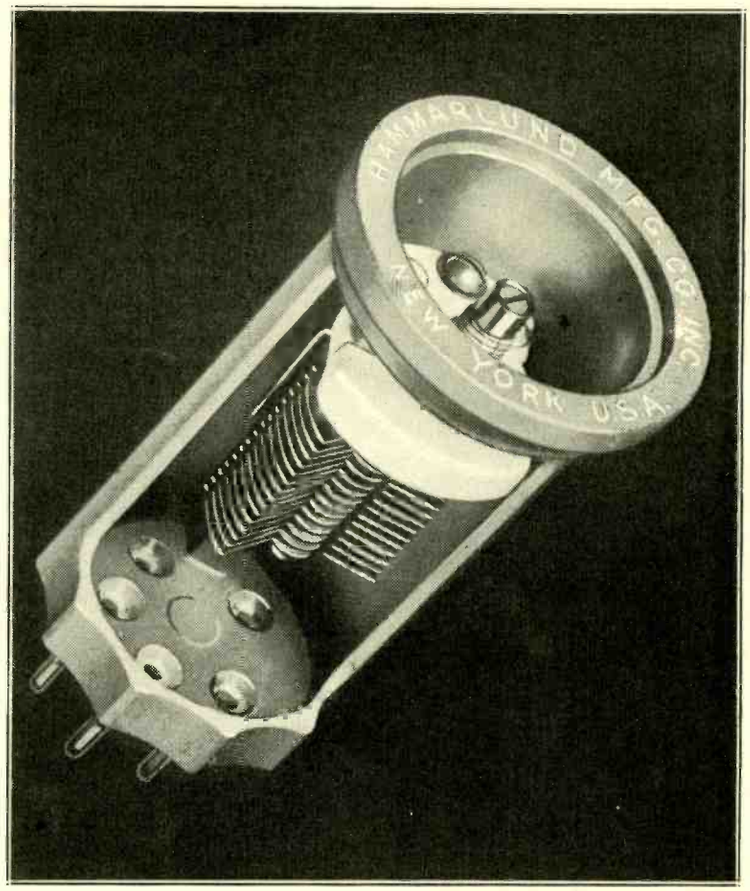
So that you will be enabled to duplicate the final coils as wound by Hammarlund engineers, the coil data are presented with the reasons for the choice of the windings.

The first problem the engineers had to solve was the most practical frequency range for each coil. They had to determine not how much of the short wave band could be covered with each coil, but the required range for each coil in relationship to the important short wave stations. It is quite well known that the greatest short wave tuning efficiency is obtained when the inductance is large compared to the tuning capacity. The problem therefore was to allocate the ranges so that as many as possible of the important frequency bands could be tuned at relatively low capacity values. The bands aimed at primarily were the 19, 25, 31 and 49 meter broadcast bands and the 20, 40, 80 and 160 meter amateur bands. Provision also had to be made for ample overlap between ranges of the coils. The following ranges were chosen, using a 140 mmfd. Hammarlund midget condenser: 17 to 41; 33 to 75; 66 to 150; 135 to 270, and 250 to 560 meters.

Other Problems Solved

Having determined the ranges for the coils, there were other considerations, such as the most practical shape factor, the best wire sizes and turns spacing, the best positions for the coils on the forms and the spacing between the windings. Since most of these vary with the frequency, each individual coil represented a separate problem. The groove-ribbed shaped form was decided upon, since this minimized the contact area between the winding and the form.

Dielectric losses increase very rapidly with frequency and for this reason minimum dielectric must be used. For minimum losses successive turns must be properly spaced to help reduce the distributed capacity.



For bandspread, the air dielectric padding condenser may be inserted right inside the coil form.

After the coils were wound in accordance with the design, they were checked under actual operating conditions with the coil plugged into a typical bandspread (parallel condenser) receiver, and the antenna connected. The ranges were found to be conservative, because the test receiver was completely shielded, and the proximity of the shield walls would naturally tend to reduce the ranges. So the builder of a receiver can depend upon these coils covering the ranges given.

Here is another important point found. A recent study of various type coils available on the open market showed them to have an average of approximately 100 at 15 megacycles. As Q represents the efficiency of a coil in a tuned circuit, the higher it is, the better the coil is. With the Hammarlund coils, wound on the XP-53 material, it was found that the Q at 15 megacycles exceeded 150.

Even the use of artificial coloring, so prevalent in coils, and the cause of losses, has been avoided, thus leaving the material a natural light tan. For convenience too, the coil forms are molded with an

(*Continued on next page*)

(*Continued from preceding page*)

intermediate frequency stages and so we find the market beginning to show introductions of new types of variable intermediate frequency transformers.

Because of its simplicity, the electrical method will first be described. This type of intermediate transformer has been adopted by a leading manufacturer and consists of three coils instead of the conventional two. As is evident from the diagram, the third coil is essentially a trap circuit, which is tuned to the exact center of the intermediate frequency band. Since the trap is tuned to the same frequency as the secondary and the primary and is closely coupled to them, it will absorb energy from these circuits and thus introduce intermediate frequency resistance. By varying the amount of d-c resistance in this trap circuit, it is possible to vary the trapping (hence i-f resistance or loading) to control the width of the frequency band. Accordingly, when the d-c resistance in the i-f trap circuit, as shown in the diagram, is cut out of the circuit, the band width of the intermediate frequency transformer will be increased.

Inductive Coupling Change

As the d-c resistance is increased, the band width is decreased accordingly as the trap is virtually removed. By a suitable ganging arrangement of these resistors in all the i-f stages and tying this control to a knob on the panel, it is possible readily to vary the selectivity-fidelity control of a set.

Another arrangement that is mechanical in nature utilizes the loose coupler idea. Here one of the two coils of the regulation intermediate frequency transformer is rendered movable so that the coupling between the two coils is variable. This is accomplished by means of a threaded rod which engages with a suitable threaded sleeve on the movable coil support. By rotating this rod, the coil is caused to move to and from the stationary coil so that variable coupling is available to decrease or increase the width of the band allowed to enter the receiver. It is possible to mechanically connect this rod to a control on the panel so that this function may be adjusted as the occasion requires from the front panel where all the other controls are placed.

It is believed that newer sets will all boast high fidelity and will utilize some means of controlling the selectivity and fidelity.

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The Three Views of Inductance

Effect of L on Any Circuit Analyzed

By Morris N. Beitman

Supreme Resistor Company

ALL electrical circuits possess a magnetic property associated with the flow of current and called inductance. Inductance may be defined in three different ways. It may be considered as the flux associated with the circuit, or the inductance may be looked upon as the back electro-motive force opposing any change of current, or inductance may be associated with the work done in establishing the magnetic flux. Mathematically each of these three definitions may be expressed by formulae 1 to 3, respectively, below:

$$\Phi = Li \quad (1)$$

$$e = -L\frac{di}{dt} \quad (2)$$

$$W = -Li\frac{di}{dt} \quad (3)$$

These equations may be obtained from one another by suitable substitution of well known electrical formulas. L is a constant and is the measure of inductance. The practical unit of inductance is the henry and conforms to the other practical electrical units.

Assume no capacity present in the circuits analyzed. Suppose a circuit containing a choke coil of inductance L and resistance R is connected to a source of direct current of voltage E, as shown in Fig. 1, with the switch in No. 1 position. Due to the nature of the inductance L, a back e.m.f. equal to $L\frac{di}{dt}$, will be developed and will tend to reduce the available voltage E. A period of time, therefore, will pass before the current will approach its maximum constant value.

Resistance multiplied by the instantaneous current (iR) is always equal to the instantaneous voltage. The voltage at any instance will be the battery voltage E, reduced by the back e.m.f. or:

$$iR = E - L\frac{di}{dt} \quad (4)$$

this may be written as:

$$i\frac{R}{L}dt + di = \frac{E}{L}dt \quad (5)$$

by dividing by L, multiplying by dt, and transposing, we obtain a linear differential equation of the first order, which may be solved by introducing the factor $1\frac{R}{L}t$, where e is the base of natural logarithms, 2.71828. The solution gives:

$$i1\frac{R}{L}t = \frac{E}{R}1\frac{R}{L}t + C \quad (6)$$

since the circuit is considered at time t = O, i.e., before the circuit is closed, i = O, and the constant $C = \frac{E}{R}$. On substituting this value for c in (6), we have:

$$ie\frac{R}{L}t = \frac{E}{R}1\frac{R}{L}t - \frac{E}{R} \quad (7)$$

and with further simplification

$$ie\frac{R}{L}t = \frac{E}{R}(1\frac{R}{L}t - 1) \quad (8)$$

and

$$i = \frac{E}{R}(1 - e - \frac{R}{L}t) \quad (9)$$

From (9) we see that as t becomes large, i.e. after some time passes, the current i approaches E/R value, or follows Ohm's law. The inductance does not have any appreciable effect if the rate of change of current is negligible, or with direct current a short time after the circuit is completed.

At a time when t = L/R, the current has a value of about 63% of its final maximum value. From this it is evident that the ratio L/R determines the time needed for the current (i) to reach a certain fraction of its maximum value. Because of this L/R is called the time constant. Thus the time constant does not depend on either the value of L or R, but rather on the ratio of the two.

The source of potential E may be removed and the circuit short-circuited, by throwing the switch to point 2 in Fig. 1. The current will not decrease immediately to zero, as in the case where pure resistance only is involved, but will decrease in a curve reversed to that of the rise.

If the direct current generator of Fig. 1 is replaced with a source of a.c., the voltage E of equation (4) must be replaced by E sin wt. Upon solving this new equation for i, the instantaneous current, we obtain:

$$i = \frac{E}{\sqrt{R^2 + w^2L^2}}\sin(wt - \Theta) + Ce - \frac{L}{} \quad (10)$$

The term $Ce - \frac{Rt}{L}$ may be neglected after the current has flown for a short time, for as t increases this term diminishes in value. Θ is the phase angle whose tangent is $\frac{wL}{R}$. And, of course, w is the well known $2\pi f$.

The quantity $\sqrt{R^2 + w^2L^2}$ has taken the place of resistance and is known as the impedance of the circuit, usually written as Z. The peak value of the current is:

$$I_M = \frac{E_M}{Z} \quad (11)$$

In effective values this may be written,

$$I = \frac{E}{Z} \quad (12)$$

and this is the commonly used formula for computations.

WLW INTERFERENCE TEST

WLW in Cincinnati, Ohio, is the first high powered radio station in the United States. As a result of its high power, it is having its troubles. This trouble manifests itself as a powerful interfering signal in the Niagara-Lockport, N. Y. area. Special experimental authorization to WLW from the Federal Communications Commission permits use of 500 watts from local sunset to 6 a.m., with directional antennas, to reduce the signal in the area involved.

Table for Winding Short Wave Coils

(*Continued from preceding page*)

inside threaded shoulder, which permits the mounting of the new Hammarlund tvpe APC air padding condenser within the form for special bandspread, or fixed tuning purposes. A generous outside flange is also provided at the top of the form for gripping. A removable wavelength index card is also supplied. This fits into the top of the coil form, and the range of the coil can be written thereon. These blank index cards are orange.

The prongs of the forms have been made especially long and sturdy with large openings at the tips for soldered connections. The prongs are so gripped into the form that they cannot shift or sway, further guaranteeing constant contact.

The blank coil forms are available in four and six prong types as are wound coils.

Coil	Range (Meters)	Primary Turns	Tickler Turns	Secondary Turns With Turns Per Inch	A
A	17-41	5.8	3.8	8.7—No. 16 enameled; 7 to inch	
B	33-75	11.8	5.8	17.7—No. 16 enameled; 12 to inch	
C	66-150	24.8	10.8	37.7—No. 24 enameled; 24 to inch	
D	135-270	47.8	16.8	81.7—No. 28 enameled; 44 to inch	
*E	250-560	87.8	33.8	157.7	

Primaries are wound with No. 34 dsc. wire. Ticklers are wound with No. 32 dsc wire. Four prong coils are identical to six prongs, except that primary winding is omitted. Primary windings are interwound with secondary windings starting at ground end, and have the same number of turns per inch as the secondaries. All coils are wound in the same direction.

*The primary turns for E are 95 to inch, using No. 34 dsc wire. The secondary turns are 88 to inch, using No. 30 enameled and the total length of winding is 1.8". Tickler is wound with No. 34 dcs wire, with 95 turns to inch. Length of winding is .35" All windings are close wound with primary wound directly over secondary, starting at ground end. Windings are in the same direction in all instances.

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Electrolytes for Condensers

Solutions of Ammonium and Other Alkali Salts Popular

By Paul McKnight Deeley

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BY experimental determination it has been found that, in general, the electrolytes most suitable for condensers are solutions of ammonium or other alkali salts of the weak acids such as, borates, tartrates, citrates, molybdates, and oxalates. Sulphuric acid solutions have also found a wide range of application in present commercial usage. Although the almost exclusive use of ammonium and sodium borates have become present commercial practice, it is interesting to note that anodic films can also be formed in such electrolytes as solutions of sodium sulphate, potassium permanganate, ammonium chromate, potassium cyanide, ammonium phosphate, ammonium citrate, citric acid, malic acid, ammonium bicarbonate, sodium silicate and many of the salts of the organic acids as well as the weaker organic acids themselves.

At the present stage of development in the art of electrolytic capacitors only two types of electrolytes are in general use for the formation of anodic films. These are: first, an aqueous solution of ammonium or sodium borate and boric acid, and second, an aqueous solution of sulphuric acid. In many instances, Processes are in use which involve the utilization of both of these types of electrolytes in a multiple step procedure. That is, an initial anodic formation takes place first in one type of electrolyte and is then completed in another type of electrolyte.

Sulphuric Acid Electrolyte

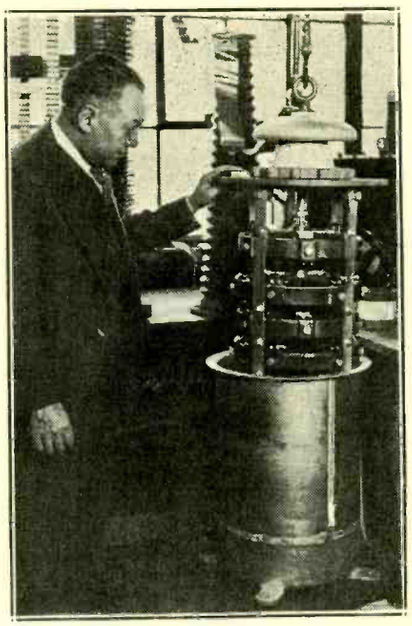
The use of sulphuric acid solutions in the formation of anodic films is limited in commercial practice, in that, anodic films formed in such solutions will stand only comparatively low voltages. There are, however, many advantages to be encountered in the use of such a process and not least among these is the excellent cleaning action which takes place on the surface of the aluminum by virtue of the fact that the sulphuric acid tends to digest any oil or grease film existing upon the anode material. Also very rapid forming of the anodic film, up to certain voltages, takes place due to the high current densities which can be used.

The formation of the anodic film in a sulphuric acid electrolyte can take place on either alternating or direct current, but due to the fact that relatively large currents at relatively low voltages are required it becomes most practical to use alternating current.

Due to the fact that anodic films formed in sulphuric acid electrolytes are limited in voltage such a process is generally used as a preliminary formation if the anodic material is to be used in capacitors rated at higher voltages.

Ammonium Borate-Boric Acid

If there is no specific reason to the contrary it is immaterial what actual voltage is used for this type of formation. The factors which control the anodic film formation are current density, solution concentration, temperataure and time. Naturally, for a given current density a certain solution concentration and voltage is necessary. To maintain a given current density with a weaker solution concentration a higher voltage will be necessary and vice versa. Voltages up to 150 volts have been used without difficulty.



William Dubilier, vice-president of the Cornell-Dubilier Corp., inspects the largest mica dielectric condenser ever made. This unit, 3 feet high and rated at 15,000 volts, 150 amperes, is one of several made under Mr. Dubilier's direction for a chain of high-powered radio transmitting stations.

This type of electrolyte produces an excellent anodic film and has been used extensively in the commercial production of electrolytic capacitors. This type of electrolyte can be used, without varation in concentration, to produce anodic films for capacitors rated from six volts to four hundred and fifty volts. The anodic film produced in this type electrolyte is much thicker than the films produced in most other types of electrolytes and is a dull grey color for that reason. Also the amount of anode surface required to give a certain capacity at a certain voltage is slightly greater on account of the reason that such films are thicker.

The specific resistivity of this type electrolyte is relatively low and for that reason current densities are high.

This type of electrolyte may be used to form anodic films without the use of any other operation or it may be used as the means of a second formation after the anodic material has been "performed" in a sulphuric acid electrolyte as has been previously described.

The ammonium borate-boric acid electrolyte is best suited in connection with the use of direct current but can be used in either the "still formation" or "continuous formation" processes.

In the formation of anodic films in this type electrolyte in connection with the use of the still formation process the applied voltage is built up until the desired voltage is reached then maintained at this point until the current density has dropped to the desired minimum value. At this point the anodic material is removed, washed in distilled water and carefully dried.

The continuous formation method has practically replaced the still formation on account of economical reasons and the addition fact that with such a process any voltage formation can be instantly obtained by the mere adjustment of applied voltage.

The continuous formation process also is very flexible in application and lends itself to multiple step formations. In this respect an extremely satisfactory anodic film formation can be produced by combining the use of the sulphuric acid electrolyte with the ammonium borate-boric acid process. This is accomplished by allowing the anodic material first to pass through the sulphuric acid electrolyte then successively through wash tanks and then through the ammonium borate-boric acid electrolyte. This multiple step process is not limited to the continuous formation method, however, because a series of still formation processes can also be successively carried out. Such a procedure would obviously necessitate an unnecessary amount of handling and be therefore less economical.

Sodium Borate-Boric Acid

This type of electroylte posseses a number of distinct advantages over the ammonium borate-boric acid electrolyte already mentioned. Among these advantages is the ability of this electrolyte to stand considerably higher voltages and its stability in regard to the loss of the alkali content. It is quite obvious that the ammonium borate-boric acid electrolyte will constantly lose its ammonia content with operation at advanced temperatures. The anodic film produced with the use of the sodium borate-boric acid electrolyte is considerably thinner as evidenced by the appearance of interference colors on the surface of the anode material and the fact that a higher capacity is obtained for a given surface area at a given voltage.

By varying the sodium borate content a wide range of variation can be obtained in different voltage formations for specific applications and for these reasons the sodium borate-boric acid electrolyte has come into almost universal use.

The specific resistivity of this electrolyte varies with the sodium borate content but is considerably higher, voltage for voltage than the ammonium borate-boric acid electrolyte. This is another advantage on account of the fact that lower current sources are necessary in actual practice.

The sodium borate-boric acid electrolyte

(*Continued on next page*)

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Better Televising Detail

Mechanical Scanning Achieves It with Higher Aspect Ratio

By J. Francis Dusek

[*A debate on electrical and mechanical scanning was published in the February 23 issue. The author of the following article augments the discussion he carried on at that time.*—EDITOR.]

THE question naturally arises, in comparing electrical and mechanical television scanning methods, if 180 lines are required for satisfactory definition of a picture of a certain size by the cathode ray method, why not utilize 360 lines and obtain the same result as we would with a mechanical system of 180 lines?

There are several reasons why this expediency is not practical, not only from an efficiency viewpoint but also for other practical reasons. Every time we double the number of lines we increase our electrical and optical difficulties four-fold, both in transmission and reception.

Let us analyze our transmission problem, using 180 line scanning. Either the standard 35 mm motion picture film or direct pickup would be used. Using film, we find that each picture is approximately $1 \times .75$ inch. To scan this area with 180 lines each scanning spot would have to be $1/180 \times 1$ inch high and 1/180 of .75 inch wide.

Detail May Be Increased

The aspect ratio of our scanning spot can be changed at will so long as we adhere to a mechanical scanning system. As we decrease the width of our spot our detail will increase in proportion to this reduction, a feature not possible with cathode ray scanning.

Due to the aspect ratio of the picture, which in actual practice is about 5 to 6, we scan more of the detail in the horizontal direction if we should make the ratio such that the width will be one half of the height. We would then scan this area horizontally in more than 360 lines. But as we decrease our spot in size we decrease the amount of light and must compensate for this loss either optically or electrically.

As we proceed in this direction we finally arrive at a point where we start to amplify the electronic emission of our first amplifying tube to such an extent as to suffer the consequences of the shot effect. This is the rushing sound due to the uneven emission of electrons, the disparities reaching an audible quantity when the amplification is high.

Optical Expertness Needed

The limit of practical amplification is reached when the output of a photocell is less than 1 microvolt, since lower values require so much amplification that the noise overrides the signal. Although picture values, rather than sound, are under consideration, the limitation is the same for both, as what causes interference due to high amplification simply manifests itself in one instance aurally and in the other instance optically.

It is at this point that the optical expert's services are imperative. He must devise a system that will collect a greater angle of light, and optically reduce this to such a small spot so that, despite losses suffered in passing through the film, the output will be more than 1 microvolt.

A problem of this kind requires patient calculation and many trials before a satisfactory solution is reached. The same difficulties in reverse are encountered in the receiving apparatus.

The foregoing constitutes just one aspect of the optical problem. In connection with the electrical problem, the wide frequency band required to delineate a scene constitutes a tremendous difficulty.

Band Becomes Enormous

Once again taking our 180 line picture as a basis we find $180 \times 180 \times 24$ (frames per second) $= 388{,}800$ cycles per second, the required band width. If we decrease our spot in width as previously explained we have, for example, $180 \times 200 \times 24/2 = 422{,}000$ cycles per second. This means that radio transmitter, the receiving equipment and the light source must respond over a band from the lowest frequency of 24 to the highest of 422,000 cycles, and do so equally well over this wide band.

We all know how long it took the radio engineers to give us the now popular high fidelity transmission and reception for an acoustical range of only 30 to 17,000 c.p.s.

Now, if with cathode ray tubes we must go to 360 lines to do the same work as with a mechanical system using 180 lines, on the new basis our frequency band would be $360 \times 360 \times 24/2 = 1{,}555{,}200$ c.p.s. This would necessitate a transmission band in our now much crowded radio spectrum equal to the bands of four 180 line transmitting stations employing a mechanical scanning device.

No Gas Cell

The photoelectric cell previously mentioned must be of the vacuum type because the so-called gas cell, while seven to ten times as sensitive for its usual requirements, such as sound reproduction, burglar alarms and the like, discriminates against the higher modulation frequencies, and it is well known this discrimination cannot be tolerated in a high quality television scanning device.

The amplifying equipment, as well as the light modulation, must depend on the photo cell. Tubes of the neon or other gaseous types cannot be used successfully for a light source at the receiver for the same reasons as given in the case of the gas type photo cells.

The scanning subject has been treated principally from the motion picture film aspect because it is believed that such material will constitute the principal source of program material. The standard 35 mm motion picture film offers the finest possibilities for television programs, as it incorporates the picture, the story and the sound, all executed in the most thorough manner and with skillful technique, offering exceptional entertaiment at low cost to the transmitting station.

The spontaneous telecasting of equivalent subjects would be abnormally expensive, necessitating the hiring of talent, scenery, music, directors, technicians, as well as calling for plant investment for lighting and studio, an enormous investment for a schedule of 4 hours of program a day.

However, there will be occasions when simultaneous telecasting will be imperative, such as a President of the United States giving a fireside talk, when a direct pickup television camera would be employed. The event would be transmitted as and when it takes place. However, the same event would be recorded on movie film, so that the program could be repeated for the benefit of those who were unable to see and hear it on the previous occasion.

(*Continued from preceding page*)

is an aqueous solution of boric acid and sodium borate.

This type electrolyte may be used to form anodic films without the use of any other operation or it may be used as the means of a second formation after the anodic material has been "pre-formed" in a sulphuric acid electrolyte as has been previously described.

The sodium borate-boric acid electrolyte is best suited to direct current formations but can be used in connection with both still formations and continuous formations.

In connection with the sodium borate-boric acid electrolyte extremely satisfactory results have been obtained with a multiple procedure which consists of first forming the anodic material at a lower voltage than that finally desired, using a solution containing a heavier sodium borate content, then forming to the desired higher voltage in a solution containing a smaller sodium borate content. By this method it has been found possible to form anodic films as high as 1000 volts.

One distanct advantage of the multiple step formation process is that in the higher concentrated solutions used in the initial formations considerable power is saved in the reduction of the IR drop in the electrolyte.

In the use of the sodium borate-boric acid electrolyte the ratio of boric acid to sodium borate and the concentration of the solution changes with the amount of anodic material formed. Aluminum tends to plate out into solution and thus causing a certain amount of suspension of the sodium borate content. Boric acid is continuously lost by evaporation and the deposition of boron upon and the occlusion into the anodic material. Alkalinity increases with use.

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A-C Line Synchronization

for Television Over Enormous Area

By J. Lawrence Cassell

THE synchronizing of television receivers in various parts of the country with the local transmitter has been simplified in the past few years by the plan to broadcast all pictures on ultra-short waves. It is well known that the useful area of these transmitters is within 25 or 30 miles so that the local power company furnishing energy to the transmitter is also supplying the locking pulse that keeps our scanning discs in step. This locking pulse is the well known 60-cycle alternating current that we have in our homes.

The Motion Picture Speed

Because the motion picture industry will contribute the bulk of our television programs, a statement that can be very easily substantiated, we have one great problem when using 60 cycle current, that motion pictures are run at a speed of 24 pictures per second. This means that the scanning disc must make 24 revolutions per second, or 60 times that or 1440 revolutions per minute. Our text books and motor manufacturers tell us that a two-pole motor runs at 3600 r.p.m. on 60-cycle current, that a four-pole machine runs at 1800 r.p.m. and that a six-pole machine revolves at the speed of 1200 r.p.m. This latter speed (1200) was adopted as a standard for television in the unfortunate and premature start from the laboratories several years ago. This gave us pictures at the rate of 20 per second.

In authenticating the statement that the motion picture industry will supply the bulk of the television programs, a trip through one of the large studios in Hollywood is taken, or if we are that fortunate the actual making of a movie from start to finish is witnessed. We find that each stage or set has been constructed long before the actual picture is taken and that every last detail is checked and rechecked before any photography is started. We find many, many technicians with flood lamps, spot lamps, cameras, mikes and amplifiers, well trained men who follow an ever present script and who perform with clock-like precision at the commands of the director. At the end of each day the pictures are previewed and a corps of experts makes notes on this scene and that. Some of these scenes are taken over several times to bring out some small part of the story that the director and his board of censors want. Some small lighting effect. The inflection of an actor's voice. Minute things to you and me but the actual reason why Hollywood produces the finest pictures in the world.

What Preparation Is Needed

When we stop to think of the length of time it takes to produce a feature, because of all these takes and retakes, it is not very hard to see the plight of the program director of the future television program. Each picture in television of a "live program" must be 100 percent. At the time it is being broadcast. The lighting must be perfect, the script must be followed to the letter by every member from the sound man to the engineer on the direct pick-up camera. The cost of such a program would be very high. This would mean many costly rehearsals with a final winding up of a short program to make the entire program commercial. It is quite evident that Hollywood with its enormous plants and laboratories can produce pictures far cheaper than we can in direct pick-up television for some time to come, so that the problem that now faces a company that wants to be in on the big rush in television will be the design of a motion picture television scanner. As stated before, this means that it is necessary to have a speed of 24 pictures per second, or 1440 r.p.m.

Advances Expected

Most engineers say that this is impossible, because each north pole must have a south pole but William Hoyt Peck, president of the Peck Television Corporation of New York, realized that a motor must be built to run at 1440 r.p.m. so that the public could see standard motion pictures via television be allowed himself to tread the paths that most engineers fear, with the result that after the last few years of painstaking effort Mr. Peck has invented and produced a motor thoroughly tested and proved, giving the public the first mean of synchronizing its television discs with the wealth of programs made in Hollywood that will be broadcast from local television stations.

With the tremendous developments that will follow the start of a real television service in America we will be sure to find advances in transmitter and receivers, and what now looks like limitation of range to only 25 or 30 miles for each station will soon begin to look like 100 or 500 miles and with this thought in mind the Peck Television Corporation has compiled a map showing the distribution of generating station in the eastern part of the country that is typical of the rest of our country.

Generating plants at Buffalo and Niagara Falls are connected in step with New York City 24 hours a day. This is done so that surplus power can be used at a great saving to everybody. All important points in New England are connected to this network for the same purpose. Even in Canada, Winsted, just across the border from Detroit; Toronto, Ottawa, Montreal and even Quebec are connected to this network.

The Tie-in Line

A special line has been constructed to tie in New Jersey, Pennsylvania and Maryland.

When we stop to think of the simplicity of a small motor in performing this necessary synchronizing control for mechanical scanning systems one must be startled by the fact that it requires as many as eight tubes to synchronize a cathode ray tube.

It is true that the motor does not perform any other function than to synchronize the picture but the total current of the motor does not begin to tell on the customer's pocket book as compared to eight tubes, some of which are power tubes.

The ease with which large generating stations are tied together and the service free from interruptions certainly makes an almost ideal synchronizing system. It is not too much to hope that with the advent of the beam antenna similar to the one just installed at WOR, and with companion reception antenna, such large energy will be transferred that even 300 mile reception of the micro waves will be a nightly occurrence. The value of the tremendous job of connecting these power systems together will only then be felt in radio circles.

"Match Box" Velocity Microphone Announced

About the size of a match box, with an output equal to a large velocity microphone, constant with any position of the speaker's head, the new 7 point Junior Microphone announced by Amperite will be unusually welcome for the unusual job. By letting it hang like a monocle, the microphone is maintained by the speaker always at the right distance from the microphone. The enthusiastic sport broadcaster can jump around, turn his head in any direction—but his audience will always be right with him. Walking after dinner speakers will find it impossible to get away from the 7 point junior—that includes the women. And the detective might find it a useful little gadget to place at some particular spot especially since the reproduction is so real, without peaks, or background noises.

Including the transformer, which is concealed inside the microphone case, the total weight is only 8 ounces, hence hand microphone use is included. Optional output impedance is 50 or 200 ohms. It has a frequency response from 60 to 7500 cycles and an output of minus 68 db on open line. The microphone cable can be any length up to 2,000 feet. Its directional quality makes it easy to eliminate acoustic feedback and audience noises. It is a microphone that can be used where a microphone should not be seen.

Amperite New Pickup Delivers Large Output

A new Amperite phonograph pickup that requires only one stage of audio amplification is announced. The output of the Amperite Pickup is +10 db, while the old magnetic is —15 db.

The Amperite pickup consists of an oxide crystal with an average resistance of approximately 100,000 ohms.

The construction of this pickup is also a radical departure from the magnetic pickup. Dampening makes it possible to eliminate resonant peaks. Contrary to the magnetic pickup, the response does not fall at the lower frequencies but rises.

Since the pickup is not a self-generating device, it requires a d.c. potential across it. This potential may be any value between 25 and 200 volts as the voltage is not critical. The pickup obtains the required voltage from the set itself. No outside battery or voltage is required. When it is connected between the plate, cathode or ground of the tube preceding the output tube the pickup is automatically biased, getting its potential through the plate coupling resistor. The current drain of the pickup is less than 1 milliampere.

When the tube preceding the output tube requires a load impedance of 250,000 ohms or more, the SPDT switch is not necessary as both the tube and pickup can be constantly left in the circuit for either radio or phonograph.

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Ingenious Ph

Smoke Alarms, Door Lighting

By Sam

[Here are six more experiments with photo cells. The practices outlined have been tested and work satisfactorily. Other experiments were published in the February 23, March 2 and March 9 issues.—EDITOR.]

EXPERIMENT 26

How to Make a Photo-Electrically Operated Smoke Alarm

In some processes it is necessary to heat high inflammable fluids or oils that might ignite from extreme temperature. As a rule the evolution of dense smoke is the first warning of the danger and the AM cell permits the arrangement of an alarm system that would warn instantly of such a condition or be made to operate devices to check the spread of flame.

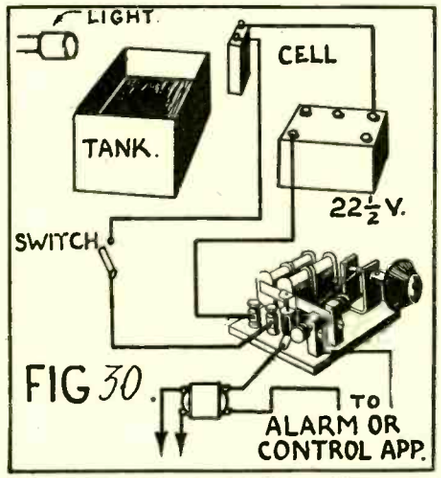

FIG 30.

In Fig. 30 an arrangement is shown to take care of such conditions. It will be seen that a source of light is mounted in a reflector on one side of the tank or vat and a cell enclosed in a hood on the other side. The cell is connected to a battery and relay. The relay contacts are so connected to the alarm system that no alarm is given while the relay holds up.

With this system, the light from the lamp at the tank falls on the cell and the relay armature is held against the front contact. Should smoke come from the tank or vat, it cuts the light off from the cell and the relay armature falls back, closing the circuit to the alarm bells or other apparatus to check the fire.

EXPERIMENT 27

How to Make a Photo Cell Smoking Chimney Alarm

In power plants it is important that the chimneys be prevented from smoking because it is a sure sign of improper combustion and low efficiency. It is desirable therefore to have some form of alarm that will warn the fireman should the chimney start to smoke, in order that proper adjustments may be made to correct such conditions.

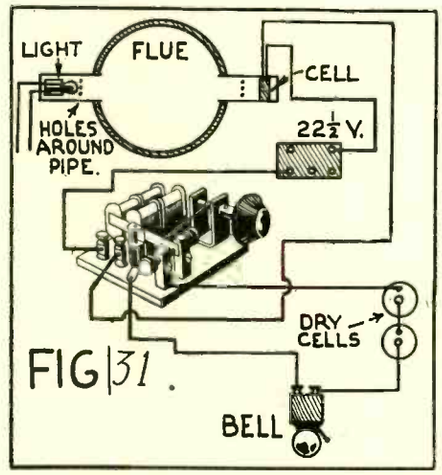

FIG 31.

To accomplish this, a hole is cut in each side of the flue or smoke duct leading to the chimney. In one hole is fitted a lamp and reflector that throws a beam of light across the flue and out the other hole. In the other hole a tube is fitted to support AM cell. This arrangement is shown in Fig. 31, where it will be noted that the tubes holding the cell and light have small holes drilled around them. These holes admit small streams of air that sweep soot away from the cell and light.

The cell is connected to a back-connected relay, as in the case of the smoke alarm and a bell or indicator light serve as a warning signal to the fireman.

When no smoke is passing through the flue the cell will be illuminated and the relay will hold up keeping the alarm system open. Should smoke pass up the flue it will cut off the light, permit the relay to drop back and actuate the alarm.

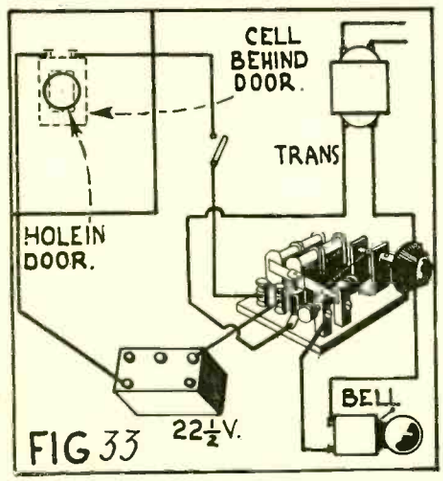

FIG 33

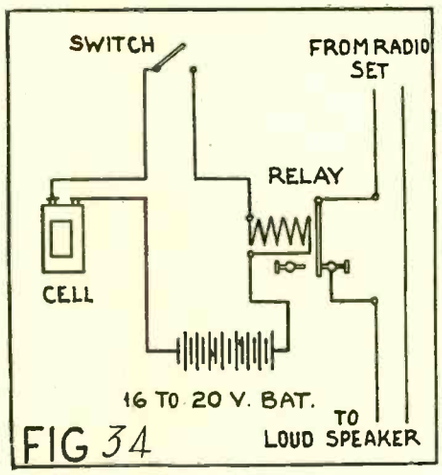

FIG 34

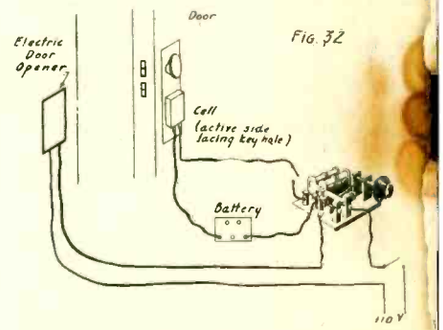

FIG 32

EXPERIMENT 28

Unlocking a Door with a Flashlight

This is a unique stunt and should amaze anyone seeing it done for the first time. The apparatus can be readily connected to a door already fitted with an electric door opener unless one wants to go to the expense of installing an electric door opener.

The apparatus is connected as previously shown in Fig. 32. The cell is mounted over the larger keyhole in the door with the face of the cell towards the door. In this way a light directed through the keyhole will fall on the cell. The junior model may be mounted in any convenient place and leads run to the cell and door opener.

After mounting the cell and unit, the relay is adjusted so it remains open normally, but on holding a flashlight close to the keyhole the relay will close and operate the door opener.

The apparatus may also be so connected as to ring a bell instead of operating the door opener as shown in Fig. 33.

EXPERIMENT 29

Causing a Door to Open Automatically

By following these instructions carefully it is possible to easily arrange a door so that on walking up to it the door will swing open automatically and close again after one passes through.

A door at the end of a corridor is easier to fit up for the purpose but with a little ingenuity any other door can be so fitted without difficulty. In addition to the cell, battery and relay there will be required a small battery motor, some heavy twine and a few pieces of board and two regular dry cells to operate the motor.

The apparatus can be most conveniently located on a narrow board nailed to the top of the door frame. The motor is first fitted with a wooden spool that will hold about four feet of heavy cord. The motor is then mounted on the board at a slight angle so the cord which passes over a pulley located where the edge of the door touches the wall when the door is swung open will run straight on to the pulley. The end of the cord is fastened to the door by means of a small screw eye. Another cord is tied to the screw eye and passes over another small pulley and has

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oto Cell Uses

Openers and Parking Explained

el Wein

a small weight attached to its end sufficient to close the door against the drag of the motor.

The above assembly should be tested after oiling the hinges of the door. With the door closed the two dry cells are connected to the motor terminals and the motor should start winding up the cord and thus opening the door. On disconnecting the batteries the weight should then pull the door closed again. All moving parts should be carefully oiled to assure easy operation.

It may be necessary to add an additional battery or use a motor with a reduction gearing to obtain sufficient power to open the door, depending upon the door's weight and stiffness. Too large a winding drum will also make it difficult for the motor to pull the door open or too heavy a counterbalance. These points should also be checked.

With the door working properly the control apparatus may then be added. The cell is mounted on the wall about 5 feet from the door and four feet from the floor. Directly across from the cell a light is mounted to illuminate the cell. The light may be a floor lamp with a reflector to throw the light on the cell. The cell batteries and relay are placed on the shelf and the whole wired as shown in the wiring diagram. Note that the operation of the door here depends upon the interruption of the light beam.

With the apparatus wired (Fig. 33), it may be adjusted and for convenience a buzzer or small lamp may be connected in place of the motor to indicate when current would be on the motor. With the light shining on the cell the relay will be held closed and the circuit to the motor open. Now increase the tension on the relay armature by turning the adjusting screw to the right until the relay opens and the motor circuit is closed as will be indicated by the light or buzzer. Turn the screw slowly to the left until the motor circuit opens, that is, the buzzer stops. Standing in front of the cell and thus cutting off the light should start the buzzer again, stepping away should stop it.

Now connects the motor into the circuit with the door closed. Walk towards the door and hesitate slightly when between the light and the cell. The cutting off of the light from the cell will cause the motor to start and wind up the cord, thus opening the door. When the door is two-thirds open step through it and the light again falling on the cell will pull up the relay and stop the motor, the weight acting to close the door again.

This is a very startling effect and much amusement is had from the surprised actions of one seeing the apparatus work.

EXPERIMENT 30
Radio Silencer

Advertising makes radio programs possible, but too much advertising does not add to the enjoyment of the program. For that reason, an interesting and amusing adjunct to a radio set is an effortless method of cutting out the announcer when he becomes annoying. This can be accomplished easily with the AM cell and any of the relays described. This effective experiment is startling to your friends, when they are first shown the device in operation.

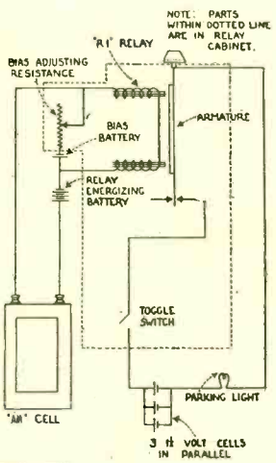

FIG 35

SCHEMATIC WIRING DIAGRAM

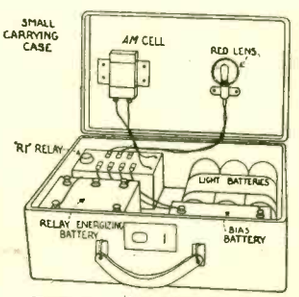

FIG 36 ARRANGEMENT OF PARTS IN CARRYING CASE

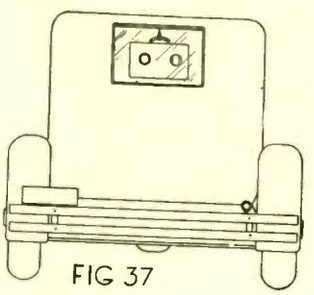

FIG 37

For this purpose the AM cell and relay are connected as shown in Fig. 34. Those who are well acquainted with radio construction may tap into the radio set. A small switch should be included in the circuit to switch off the control, when not in use.

The back contact of the relay is used in this case as will be noted, the contacts being connected in the "voice circuit" to the loudspeaker of the radio set.

A little care is necessary in selecting the wire to be cut to connect in the relay contacts. When a dynamic speaker is employed there are two sets of wires to the speaker, one set furnishing current for the field coil. These wires should not be touched. The other pair of wires carry the "speech currents" and one of these wires is to be cut and connected to the relay contacts. Most radio sets have the latter wires marked "speaker" on the chassis of the set and can be traced from that point. It is only necessary to cut one of the two wires and connect the two ends to the terminals on the relay.

Sets using magnetic type speakers have but one pair of wires to the speaker and either one of these wires can be cut and connected to the relay.

Mount the cell somewhere on the front of the radio cabinet where it will not be too conspicuous, with the switch in a concealed position. With a program tuned in on the radio set, and the switch on the control mechanism closed, now sit in the chair you usually occupy when listening to the radio and throw a beam of light from the light source onto the cell. This should cause the relay to act and open the circuit to the loud speaker which will cut off the music till the light beam is removed from the cell. A little adjustment of the relay may be needed.

Now imagine the amazement of your friends when they see you reclining comfortably in an easy chair and when the announcer takes too much of the program, simply turn on a flashlight and silence him at your wish.

EXPERIMENT 31
How to Make an Automatic Parking Light Control for Automobiles

The purpose of the automobile parking light control is to provide a mean of switching "on" a parking light at sunset, if the car happens to be left unattended at that particular time.

The entire mechanism for performing this useful operation may be built into a very small, inexpensive leatherette-covered carrying case or hand bag. The one illustrated in Fig. 35 has the following overall dimensions—14" x 9¾" x 5 ". This bag will hold all necessary equipment, so that it is entirely self-contained and portable. It may be stored out of the way, in a corner of the car, when not in use, or if the cell and relay are to be used for other purposes also, the bag serves as a convenient container for transporting the equipment from the car to the place where it is to be used.

The above apparatus is fitted into the carrying case and connected as shown in Fig. 35. All parts should be fastened securely, so that they will remain in position regardless of where the carrying case is placed.

In preparing the case for mounting the parts, the first step is to drill two holes in the cover. These should each be about 1½" in diameter. One hole is used to permit the sunlight to enter the case and strike the active area of the AM Cell. The other hole permits the light from the miniature lamp to be seen, when this is illuminated. The AM cell is fastened against the hole at the left by means of a brass bracket as shown in Fig. 35. The red lens is fastened in the other hole, with the miniature socket and pilot light secured in back of it.

The relay cabinet should be fastened to the bottom of the carrying case by means of small right-angle rackets. The batteries are secured by means of brass straps about ½" wide, which are fastened to the inside of the case by small wood screws.

After the parts are all fastened in place, the wiring is performed exactly as shown in Fig. 35.

The next step is to adjust the relay. This should be cone with the cover facing the sun. Exact directions for making this adjustment accompany each relay.

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Locating Trouble in Servicing

All Methods Have Own Advantages, No One Way is All-Inclusive

By Morris N. Beitman

Supreme Resistor Company

THE repair of radios or allied apparatus falls into two steps, (1) the location of the trouble, and (2) the repair or replacement of parts or circuit. In practice the greatest difficulty is encountered with the location of the trouble. To aid in this direction complex and elaborate testing equipment are utilized. The repairing or replacing a bad part is quite simple by comparison, requiring only mechanical procedure. So is also lining-up and adjusting if a good oscillator and output meter are used.

There was a time when the radio serviceman was simply the electrician with a side line. Upon being called, the pioneer repair man would arrive plus a few mechanical tools and a soldering iron. Then would begin the gentle tapping of tubes, tickling the detector grid-leak, and other such manoeuvres. Noises would be carefully analyzed. Was that a buzz or a sharp click? And in this manner the trouble would be located and the set repaired.

Time for Hunt Lessened

With the passing time new developments came to aid in servicing receivers. A flashlight bulb and battery found their application for testing shorts; and then a meter to see if the secondary of that transformer was "good." Complete testing outfits, analyzers, oscillators followed in their turn. Now the serviceman can obtain efficient and complete testing apparatus to help him find the baffling troubles in the minimum amount of time.

There is a number of specialized methods of service approach, as for example the resistance method. Servicing, however, is not a game to see how complex a job could be made or how much experimentation could be performed. The object behind every service job is to place the set in perfect condition in the minimum amount of time. In this respect the greater the variety of your testing equipment and the greater your ability to apply the different methods that may suit the particular case, the sooner will the trouble be located. Therefore, if possible use all the different methods, applying the proper ones to each particular trouble.

By the resistance method is meant the testing of circuits and circuit components. Condensers, of course, will read open-circuit and how resistance coils will read short-circuit and this is where the greatest drawback lies. But if a set is entirely out of order, this method will be the best to apply. This method also proves its excellency where resistors have changed their values and influence the set not to function properly.

Oscillators Most Helpful

The voltage method gives the voltages that are applied to the different elements of the vacuum tubes. This is an excellent method if the tubes light, but requires quite a lot of time to locate the poorly functioning or out of order circuit.

To immediately locate from what part of the set the trouble is coming, an oscillator is by far the best bet. Beginning with the loudspeaker an audio tone can be placed through. If it is heard, the speaker may be considered to be functioning satisfactory. The audio signal may be next applied to the grid input circuit of the power tube. If the signal is heard in the loudspeaker with the oscillator attenuation reduced, the power tube circuit is working all right. In this manner by applying also modulated radio frequencies (intermediate if a super) the bad circuit may be quickly and easily located. Then with either the voltage or the resistance method the trouble itself may be located.

Of course, the tubes should always be suspected of bad operation and be the first to be checked when trouble is present. Of the three characteristics of vacuum tubes, amplification factor, plate resistance, and mutual conductance, only the latter one gives a fair indication of the tube performance. All the better tube testers work on this principle of giving the mutual conductance reading. Some meters are "English reading," that is, they are marked off into "good" and "bad" portions and the variations of different tubes is compensated in the circuit.

"Analyzing" Proves Boon

Occasionally, however, repair cases come up where the usual approach fails to locate the trouble. In such cases with good testing apparatus the trouble will be located in a comparatively short time. Many a serviceman relates stories of a ten hour job, when in reality if he used his equipment and his head an hour would do. The case where the trimming condenser was shorted and the coil across it was open, the repair man floundering with the resistance method, is well known. Surely even ten hours would not clear up the trouble, but a radio frequency oscillator would point right to the source in no time.

Electrical Stethoscope Segregates Sounds

A small device which enables a physician to magnify the sound of the human heart 100 times and to "tune in" on heart sounds he wishes to hear has been placed in experimental use.

The device is an electrical stethoscope based on the telephone principle with a heart instead of a voice doing the "talking." The two vacuum tubes used are each but the size of a peanut.

It was originally developed by the Western Electric Company for a medical student whose poor hearing prevented him from using the ordinary stethoscope. Its success in aiding this student aroused interest among physicians having the same handicap and also among those who make examinations in noisy places. In addition, it was found that the tuning device assists in difficult diagnoses by emphasizing faint heart sounds which may be especially significant.

The entire stethoscope weighs less than a full brief case and is about half the size. A pick-up device, which works magnetically like the ear piece of a telephone in reverse, is laid against the chest and picks up the vibrations of the chest wall caused by the action of the heart. Most heart tones are relatively low in the scale of sound and the pick-up device is designed to transmit these low tones most efficiently.

These sounds are electrically transmitted over a short telephone cord to a tiny amplifier weighing 4 ounces and about one-fourth as large as those used in the best radio receiving sets. The amplifier contains the two "peanut" tubes, 1½ inches high and ½ inch in diameter, and two miniature transformers with cores of permalloy, a special metal alloy which produces high magnetism from extremely small electrical voltages. This amplifier multiplies the original power 100 times, employing only 4 flashlight cells for the filaments of the two tubes and 2 of the smallest size dry batteries for their plates.

This current is delivered to a telephone receiver which reproduces the heart action in the form of greatly magnified sound. A physician may hold the receiver directly to his ear or he may attach to it the tube of his own stethoscope and thus listen in the usual manner.

"Tuning in" on certain heart sounds is done through an electrical filter. The thumping of the heart is its loudest sound and also its deepest, the tones lying mostly below 100 cycles in the sound scale. The "blowing" and "whistling" of the heart, which in certain ailments may be the more significant, are much fainter and are also higher in pitch, being from 200 to 1200 cycles. By throwing a switch the physician causes the filter to cut down on the low thumping tones and thus tunes in clearly on the heart's higher notes.

A single switch turns the stethoscope on and off and another controls its volume. By plugging in extra receivers, as many as three persons can listen at the same time. The portable stethoscope is a miniature companion to the large hospital type of electrical stethoscope which has been in use for some time and to which a crowd may listen.

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50-40,000 Ohmmeter at $1.87

Splendid Results from Breadboard Continuity-Resistance Tester

By Jack Tully

BY the expenditure of $1.87 and a very little work a resistance meter was built that serves an excellent purpose. Also of course it is a continuity tester.

Ordinarily when one hears of a simple little resistance meter he is told that the maximum resistance readable is 10,000 ohms, but in this instance the maximum is 40,000 ohms, and the minimum is 50 ohms, a ratio of 800 to 1.

The meter used was the Readrite Model No. 805, which has a range of 0-5 milliamperes, and is calibrated in bars 0.25 milliampere apart (250 microamperes). The magnet wire with which the meter coil is wound has a resistance of 2,160 ohms and this is high enough to permit use of the meter without any external limiting resistor. For instance, 10.5 volts could be applied and not quite full scale deflection would result, or about 4.9 milliamperes. It would be practical even to use 12 volts, which on short of the "unknown" terminals would cause 0.5 milliampere excess current, not necessarily dangerous to this meter, but avoided nevertheless, and 10.5 volts used. Three dry batteries of 3 volts each were connected in series and one cell of 1.5 volts also in series, constituting the 10.5 volts, the meter the rest of the series.

On this basis the resistance values may be computed for the unknown in terms of current. The *total* resistance equals the voltage in volts divided by the current in amperes, the answer being in ohms, and this being a form of Ohm's law. Included in that total resistance is the meter resistance of 2,160 ohms, which must be deducted.

Table of Resistance Values

Let us take one example. Suppose the meter reads 1 milliampere when an unknown resistance is placed across the open terminals to close the circuit. What is the resistance of the unknown? It is 10.5/0.001 or 10,500 ohms, less the meter resistance of 2,160 ohms, or 8,340 ohms, set down on the following table as 8,350 ohms, as it is not possible to read as closely as a 10 ohm difference.

The unknown resistance is Rx in the table and the meter current is MA. The resistance is given in ohms and the current in milliamperes:

MA	*Rx*	*MA*	*Rx*
.25	40,000	2.75	1,650
.5	19,000	3.	1,350
.75	12,000	3.25	1,070
1.	8,350	3.5	840
1.25	6,050	3.75	640
1.5	4,850	4.	460
1.75	3,850	4.25	300
2.	3,100	4.5	170
2.25	2,500	4.75	50
2.5	2.050	5.	0

Directions for Use

As for specific details for use of the instrument, a reading very close to 5 milliamperes denotes either a short circuit or a resistance too low to cause readable indication. There will be enough movement when the unknown is the secondary of a radio frequency transformer for stand ard broadcast coverage to tell whether the coil is continuous, and not shorted. If the coil is open there will be no reading. Primaries usually read as short circuits would, though not shorted. If what should be a resistor gives no reading the resistor is open, unless the resistance is, say, above 100,000 ohms. Some small deflection for 100,000 ohms is noticeable but not distinguishable for resistance calibration.

Condensers will read "open" because they do not pass d.c. and the "open" reading applies also to electrolytics in this instance, because the voltage is so low that the leakage through the condenser, if any, would not cause the meter to move.

There is no way to increase the sensitivity of a meter itself without rebuilding it, although there are methods of reducing the sensitivity, as by shunting. No such reduction is required for any present purpose, however.

Check Against Open Resistor

Hence a resistance may be determined to be of around 100,000 ohms or higher, if there is scarcely any, yet some, deflection. The resistor might be either open or very high and cause no visible deflection. The check for this more voltage may be used in series, just to make sure the resistor is not open.

If the current is just barely less than 0.25 milliampere the resistance is 50,000 ohms, approximately, while if the reading is just 0.25 milliampere the resistance is 40,000 ohms. The next bar on the meter represents 0.5 milliampere, equivalent to 19,000 ohms, and there is more than a 50 per cent. difference between the higher and lower resistance values. Suppose the reading is half way between 40,000 and 19,000, what is the resistance of the unknown? The correct answer happens to be 28,000 ohms. The difference between 40,000 and 19,000 is 21,000. Half the difference is 10,500 ohms. Add this to the 19,000, or subtract it from the 40,000, and the result if 29,500 ohms, about 5 per cent. off, which is good for an estimate.

If a table is pasted on the board on which the tester is built, one may consult the table after reading the meter current and obtain the value of the unknown resistance.

No Switching Needed

When no resistance or conductor is across the terminals the circuit is open, so no switching is necessary, but precautions should be taken not to leave a resistor or conductor across the "unknown" terminals when the tester is not in intentional use.

It is practical to measure higher resistances than 40,000 ohms with this meter only by increasing the voltage. Extra series resistance, for limiting current purposes, would be necessary, so that more than the maximum allowable current would not flow through the meter when the "unknown" terminals are purposely shorted. If a battery of 45 volts is used instead of 10.5 volts, there should be a limiting resistor cut in for this service of about 7,000 ohms, and the unknowns then will be 4.3 times the values given in the table. It is not intended, however, that the present instrument be a two-range affair, but that it be confined to the single range use because that way it is so simple and serves a splendid purpose even so.

[*Illustration and diagram next week.*—EDITOR.]

Women Are Executives of New Radio Guild

A newly-organized company serving the radio broadcasting industry has leased extensive offices in the Radio City section of Rockefeller Center.

The new quarters, on the 36th floor of the RCA Building, will be occupied in two weeks by the Radio Guild of America, Inc.

The corporation will produce radio programs, originate radio advertising ideas and scripts, and conduct an artist's bureau for radio entertainers. Miss Agnes Grant, formerly assistant to the program director of the American Woman's Association, is director of the artist's bureau.

The personnel of the company numbers about fifteen. Mary Olds, first woman manager of radio KFIC, San Francisco, and producer of nearly fifty of the larger programs on the air, is president of the Guild. Eleanor Eayrs is first vice president and treasurer, Mrs. William Woodhouse Peake is third vice president and secretary and Albert Chanson is legal counsel.

Women Regard Radio As Home "Essential"

Next to the electric iron, a radio set is the most essential of all household electrical appliances, according to a survey among 1,017 housewives in New Jersey in McCall's Magazine. Asked to vote on the "most essential" household electrical equipment, the New Jersey housewives voted as follows: Irons, 68.9%; radio, 64.4%; vacuum cleaners, 63.3%; refrigerators, 38%; washing machines, 36.3%.

The thousand-odd New Jersey women were found to own 8,882 electrical appliances with homes equipped as follows: Irons, 96.5%; radio, 95.6%; vacuum cleaners, 76%; toasters, 73%; clocks, 53.5%; waffle irons, 51%; refrigerators, 44.2%, and washing machines, 41%.

Of the 8,882 electrical appliances owned by these families, only 222, or 2.5%, were not in use for various reasons, ranked in order as follows: Heater, percolator, waffle iron, fan, vacuum cleaner, clothes washer, toaster, radio and clock.

The report suggests prospective business servicing these "disusers."

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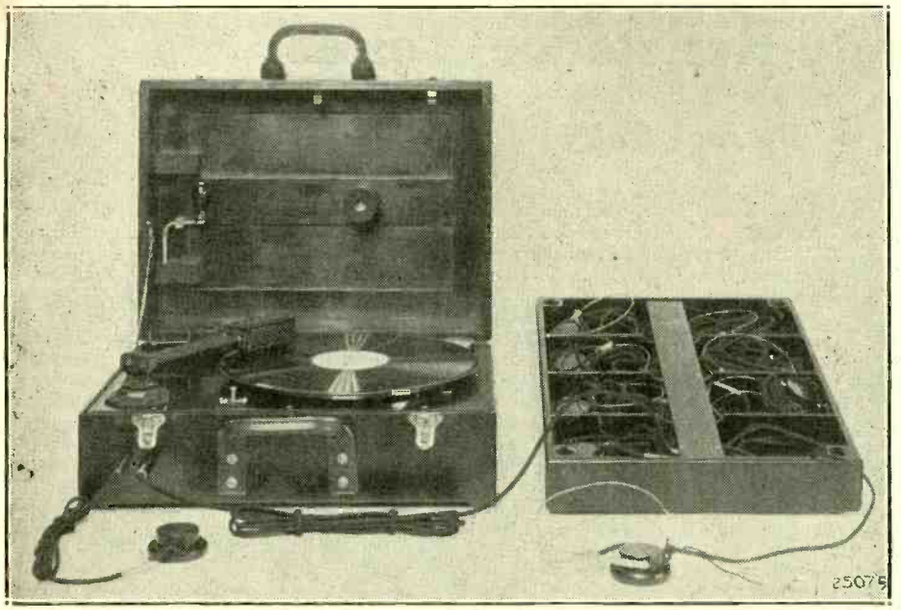
How 4-A Audiometer of Western Electric Works



Pupils who lag behind others in classroom work have long been a problem to their teachers. The causes for the lagging naturally differ. It is only in recent years that the increasing interest in physical examinations and their use has proved that the lagging often results from physical defects and variations. Subnormality in acuity of hearing in many cases accounts for apparent inattentiveness and lack of ability to understand instruction.

With the realization of this condition and the use of physical examinations to discover those with defective hearing, a need has grown for an instrument that will measure acuity of hearing, accurately and quickly, and also use the same standard of measurement for all examined. In addition it was obviously desirable to avoid the errors possible when a hasty whisper or watch tick test is given for this purpose.

The Western Electric No. 4-A Audiometer is essentially a phonograph to which has been added telephonic apparatus so that the sounds produced in the phonograph are transmitted to the ears of those under examination.

Uniform Transmission

With the Audiometer it is possible to transmit sounds to the listener's ears with a great degree of uniformity. Tests made with one person or a group of persons will be exact duplicates of tests made with other persons or groups of persons whether it be on the same day or at some future time.

The Audiometer affords a faithful reproduction of conversational speech embodying a wide pitch range.

The Audiometer test also minimizes to a great extent the effects of room noise and eliminates the reverberation from the walls of the room. It further insures uniform intensity to all pupils being tested because it is independent of the distance between the original source of sound and the pupil.

The Audiometer permits the detection of children who are deaf only in one ear, but who by special concentration of attention might pass other tests unnoticed.

The use of telephone headsets in making tests with the Audiometer arouses the interest of the children.

It provides a means for making quick and accurate tests of acuity of hearing. As many as 500 pupils can be accurately tested in a school day.

It avoids the variations that creep into whisper and watch tick tests.

With it, either ear can be tested separately.

The sounds used to make the tests are always the same at any given point in the test even if the instrument repeats its test many times.

The pupil by writing down the numbers heard indicates definitely where in the range of sound the ear recognizes sounds, and is able to interpret them correctly.

The Audiometer consists of a spring motor phonograph using a magnetic reproducer instead of the usual acoustic reproducer. The magnetic reproducer picks up the vibrations originated by the record and transforms them into electrical vibrations. These in turn are conveyed to the telephone head set, by this transformed into sound waves, and delivered to the ear of the person or persons under examination who hear as if by telephone. All the necessary electrical energy is developed in the magnetic reproducer. No batteries or other outside sources of electrical energy are required.

Tests to 40 Persons

Tests of up to and including forty persons simultaneously are possible by using multiple telephone head sets. The telephone head sets are provided in No. 4-A Receiver Holders. Each Receiver Holder is an eight compartment tray, in which each compartment holds a telephone headset for one person. The eight telephone headsets in each Receiver Holder are connected by a single cord which is plugged into the Audiometer. Five of these Receiver Holders can be connected to the Audiometer at a time, thus accommodating the maximum number of persons.

The records employed with the No. 4-A Audiometer are double faced and are made especially for use with this instrument. They are so arranged that the intensity of the sounds (numbers) transmitted to the listener's ear decreases in small steps to a minimum, returns abruptly to the maximum, and then decreases again. This process occurs four times in the playing of each side of the record. The first two series of numbers on each face are spoken in a woman's voice and the second two in a man's. Each decreasing series is composed of different numbers, since repetition would introduce the memory factor into the test. The same rate of intensity attenuation is, however, maintained in all eight series. Each ear of the patient can, therefore, be tested four times at each intensity. The determination of hearing loss can thus be made with considerable accuracy.

Sheets Supplied

For the use of those being examined, special recording data sheets have been designed. They contain all the instructions necessary for their use. The listener writes on these special forms the numbers heard, thus indicating the sound intensity at which intelligibility ceases. This intensity determines the person's acuity of hearing.

With every package of data sheets for use with the No. 4-A Audiometer, a master sheet is packed. By placing this master sheet by the side of the data sheet so that the horizontal lines coincide, the examiner can immediately discover what figures have been recorded incorrectly, and can thus determine the listener's hearing loss.

How to Use Larger Oscillator Condensers

[*Note on last week's beat note oscillator.*]

If low radio frequencies are used it is not practical to have suitable inductances for the condenser required, unless coils are put in series, as around a couple of hundred millihenries would be required for the variable condenser of 80 mmfd. that affords the 2.25 capacity ratio needed to attain the 1.5 to 1 frequency ratio in the example of 20 to 30 kc variable span with fixed frequency at 20 kc. In either instance of fixed frequency higher or lower than the variable, the frequency ratio would have to be the same for the same general radio frequency region, that is, 1.5 to 1, for span of 20 to 30 kc for example.

The suitable inductance could be built up, using several separate honeycombs, joined in series for secondaries, and smaller windings for ticklers, but a set of two such coils is needed, and the layout becomes bulky as well as the coils expensive.

A way of reducing this trouble is to use a standard single condenser of the normal maximum, 350 to 500 mmfd., and then put a parallel condenser across it, to reduce the frequency ratio from 3 to 1 or more, down to 1.5 to 1. For 350 mmfd. the fixed capacity should be 230 mmfd., for 400 it should be 290 and for 500 should be 340 mmfd. Then the inductances are more readily obtainable and the usual condensers are converted into practically straight frequency line affairs, provided they were originally midline. The secondary inductances for the three examples, in ascending order of original capacities, would be 110 millihenries, 90 millihenries and 75 millihenries. These are not unsubstantial inductances, either.

ROTARY GAP SIMULATED

The old days when the singing of a rotary spark gap rent the ether is not completely gone, although Federal edict has banned the spark "ton of bricks." A similar effect, though not nearly as broad in nature, can be produced by keying an audio oscillator before the microphone of a phone transmitter. The tone of this oscillator can be made to simulate the rising and falling pitch of the rotary "sink" of old due to variation of oscillator frequency.

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75 Watt Key Transmitter for Planes Weighs 15 Lbs.

A new long distance telegraph transmitter weighing only 15 pounds and delivering a nominal 75 watts of continuous wave radio frequency power to the antenna, is announced by the radio division of Westinghouse Electric & Manufacturing Company, Chicopee Falls, Mass. The new CH transmitter represents 5 watts for each pound of transmitter unit, and operates on frequencies ranging from 333 kilocycles up to 10,000 kilocycles by means of plug-in coil assemblies. This provides for operation with marine stations including ships at sea as well as operation on the aviation communication bands.

The set operates from the 12 volt battery system of the plane through dynamotor. The relatively low plate supply voltage of 500 utilized for a transmitter of this power, as compared with 1000 volts usually employed, is a decided advantage for reliable operation under various climatic conditions.

The dynamotor is purposely designed for aircraft service. It is unusually light in weight although ruggedness has not been sacrificed. The use of magnesium alloy castings combined with careful design has resulted in a machine of 13½ pounds weight capable of delivering 150 watts of 500-volt pawer to the transmitter. This represents a factor of 11 watts per pound of dynamotor.

In brief, specifications of the new transmitter are:

Power Output—75 Watts Norminal

Type of Signals—Continuous Wave Telegraph.

Coil Systems:

2700-3450 kc	5890-7410 kc
34-4420 kc	7410-8620 kc
4420-5890 kc	8620-9700 kc

500 kc with external antenna coil

333 kc with external antenna coil

Power Supply: 12 to 14 volts d.c. through a 500-volt dynamotor.

Tube Complement: One 210 as master oscillator, four 210's as power amplifier.

Weights: Transmitter unit with one set of coils and shock absorbing base 15 lbs.

Operator's Control Unit—1 lb.

Dynamotor—13½ lbs.

Flameproof Telegraph Key—1 lb.

The equipment is of splash-proof construction. Provision for ventilation and cooling of the transmitter is made by means of louvres in the sides, small openings in the bottom, and suitable drip-proof ventilators at the top. The dynamotor unit is totally enclosed.

A normal output of 60 to 75 watts in the frequency band of 2,700 to 10,000 kilocycles may be obtained with a sixteen ohm antenna. The equipment is so designed that neither tubes nor transmitter are damaged if the antenna should become grounded or open-circuited.

Horizontal Construction

The horizontal type of construction, employing chassis and sub-base, is used, with most wiring, resistors, and bypass capacitors located beneath the chassis base. The cover for the transmitter upper compartment is screwed to the chassis and has a hinged lid for access to plug-in coils and tubes. The bottom of the chassis is covered with a protection plate, designed also to accommodate a shockproof mounting. Wing nuts and studs attached to the base plate hold the transmitter assembly in place on shockproof base, thus allowing quick change-over of transmitters when such is desired.

Long distance, light weight telegraph transmitter for airplanes

The shockproof unit for the transmitter consists of four molded rubber cylinders contained in removable aluminum cans, these units being attached to the under side of transmitter sub-base plate. The shockproof unit is designed to screw or bolt securely to the mounting board in the plane. A plug-in power connector block is utilized to bring all input power and control circuits to the transmitter.

Felicitations Conveyed by David Sarnoff

Your publication's long association with the radio industry and its service in interpreting radio's progress, its problems, and its hopes for the future, enable the workers in the industry to felicitate you upon your Thirteenth Annual Number as one of "the family."

In the years since it was founded, RADIO WORLD has recorded much radio history—the rapid development of the new art, its meeting since 1929 of an economic situation that put many older industries to a severe test of endurance, its emergence with its stride still youthful and strong. The radio industry, supported by the unremitting research for new products and services that has characterized it from its beginning, looks forward confidently. In reporting the advances which all of us are sure lie ahead, I hope that your publication will enjoy many more anniversaries.

Very truly yours,

DAVID SARNOFF.

G. E. LAMP CORD

A newly designed type of all-rubber parallel lamp cord has been announced by General Electric. Both copper conductors are insulated simulataneously with at least a 1/32-inch wall of rubber, which affords good insulation and abrasion characteristics and, in addition, permits easy separation of the individual conductor for assembly purposes. It is available in four standard colors—brown, ivory, black and olive.

Application of Resistors and Rating Wattage

When a flow of electrical current occurs there is a certain loss of energy that is converted to non-useful forms. This loss may result in evolution of heat or radiation of energy. In ordinary electrical and radio applications the loss of energy in the form of heat is by far of greater magnitude in comparison to radiation losses. Resistance is that property of conducting systems that causes this loss to occur.

In an ordinary direct current circuit the resistance will be equal to the voltage divided by the current, i.e., Ohm's Law.

$$R = \frac{V}{I}$$

Power lost as heat is given by a well known physical law discovered and named for Joule:

$$P = I^2R$$

This simply means that power lost is proportional to the product of the resistance and the square of the current.

Special Losses on A.C.

In alternating current application other losses besides the one defined by Ohm's Law occur and must be considered. Electromagnetic energy is radiated into space and is absorbed by related circuits by means of induction. Eddy currents and hysteresis occur due to the presence of metals and magnetic materials respectively. Skin effect must be considered when frequencies encountered are of a high order. All these effects will increase the energy loss over that given by Ohm's Law.

Division of Application

Radio receiving application of resistors, both carbon composition and wire-wound types, may be divided into several groups according to the function of the resistor unit in the circuit. These are enumerated below together with the common range of resistance and wattage values.

In these applications other factors outside of Ohm's Law may be neglected.

Effect of Temperature

The resistance of a conductor is a function of the material and dimensions of the material. Temperature also has an effect on the resistance. In carbon composition types this may be either positive or negative, that is, resistance may either increase or decrease with rise in temperature. In wire-wound resistors the temperature coefficient is positive and is quite small.

CLASSIFICATION OF RESISTORS FOR SERVICING

Use	Ohms	Watts
Voltage Divider	1,000 to 100,000	10 to 50
Bias, amplifier	250 to 10,000	Up to 20
Bias, detector	About 100,000	1 or 2
Grid resistor	100,000 to 1 meg.	1 watt or less
Plate coupling	100,000 to ½ meg.	2 to 10 watts
Oscillation suppressors	100,000 to 10,000	Up to 10
Filter resistors	1,000 to 25,000	5 or 10
Voltage drop	Fractions to 400	10 to 50
Decoupling	10,000 to 100,000	Up to 10

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Acoustic Load Matching

Must Be Observed for High Fidelity

By D. M. Linth

WHEN our red-hot radio enthusiast starts thinking about designing a new piece of radio equipment for his layout, he concerns himself most meticulously in the detail and ramifications of the electric aspects of the problem. If he is also interested in the appearance of the proposed job, he will also heed to the aesthetic principles involved. That is the full extent to which his head is bothered about the question. And that is enough of a problem to worry about. Yet for real results, especially if high fidelity plays an important part in the equipment's performance, he should also consider the acoustic aspects of the problem.

When two electrical circuits are to be connected together, they should be so paired that the impedances of the two have a definite relation to each other. Our constructor knows that to increase the efficiency of a receiver it is essential that the acoustic load be increased to a point where the load resistance (acoustic) is fairly large in comparison with the amount available for dissipation. That is the part that is played by the horn on some loudspeakers. The horn is not amplifying sound as some would have you think, but rather it is an impedance matching device to connect the diaphragm of high impedance to an atmosphere of low impedance. That it is not an amplifying device is clearly indicated by the fact that the horn could not function without an auxiliary source of power. In order that this device perform this function as efficiently as possible it has to be so shaped as to produce a network that is unsymmetrical and composed of distributed constants that are gradually changing.

The Exponential Horn

Various calculations have shown that this desire is achieved by an exponential horn which acts as a high-pass filter that transmits no sounds below a certain frequency. In many respects, the theory involved in this endeavor is similar to that involved in the design of a transmission line, except that the line concerns itself with constant circuit constants with increasing length of line.

In the design of such a horn two factors enter the propagation constant along the horn, and the reflection at the ends. In connection with the filter effect referred to above, it might be borne in mind that the less the rate of taper of the horn, the lower will be the limit of frequencies transmitted. It is thus obvious that to include the extremely low audio frequencies, as is necessary in a high fidelity receiver, that this horn be quite long, of the order of fifteen and more feet. Because such a length is impossible in the home installation, these horns are bent around and around themselves so that the entire unit takes up a small space not unlike the coils of a tube.

The Cone Requirements

In the earlier days of radio, the exponential type of horn was quite the thing. But today we realize that the dynamic type of loudspeaker can approach the ideal with greater ease. The dynamic speaker makes use of a piston action effect which accomplishes the necessary movement of a suitable column of air. In this device it is desirable that the cone material be stiff and light with its edge suspended by a soft material to reduce resonance effects and so that the cone as a whole can move in and out.

Thus, the cone takes the place of the long and cumbersome horn of the exponential type of speaker. The cone also replaces the diaphragm of the horn unit and thus performs a dual function.

It is enabled to perform this diaphragm function since a small coil of wire through which the audio currents flow is mounted on the small end of the cone and in turn is so positioned that it lies in the field of a strong electromagnet. This small voice coil is usually free to move only in a direction along the axis of the cone so that if the coil does have any motion it will cause the cone to move in and out in synchronism with the audio current that is flowing through the voice coil. Sound generated by the cone is capable of being heard either front or back of the cone.

Reason for Large Bubble

These front and rear sound waves will tend to interfere with each other if allowed to occupy the same space and since it is politic to provide a dynamic speaker with a baffle arrangement that will not allow the front and rear waves to mix. The baffle is necessary to prevent eddy currents of air from circulation in the cone area between the front and the back. If this baffle were absent, a sound compression produced in the front of the cone, in moving forward, would cause air to rush around the edges to relieve the rarefaction in the rear which of course is not conducive to fidelity reproduction. Thus, a baffle should be made as large as is conveniently possible and here again, just as with the exponential speaker horn, the lowest frequency limit is dependant upon this area.

If the radius of the cone is a quarter wave length or more of the sound wave, the compression wave in front, in attempting to circulate the baffle, would find the cone moving backward by the time it reached the rear of the cone. The lowest frequency that is thus efficiently emitted by a dynamic speaker cone is lowered by increasing the size of this baffle. It can be seen then that in order that a baffle installation claim a low frequency response that is on the order of 30 cycles per second, it should have a diameter of about 19 feet or more. This great dimension when compared with that seen in most any installation will give a picture of the extent to which such installations reproduce the low frequencies.

Therefore, the next time you construct a radio outfit that hopes to boast of the high fidelity that is supposed to possess, pay heed to the acoustic aspects of the problem and you will find that the results will compensate the effort made to provide a decent product.

National Union Adds Tube Tester to Dealer Plan

Confidence Master Tube Testers in both counter and portable models have been added to the list of radio service shop equipment made available by the National Union Radio Corporation of N. Y. These Testers, manufactured by Apparatus Design Company of Little Rock, Ark., test more than 147 types of tubes in only four sockets, without the use of adapters. All parts of dual purpose tubes can be tested separately, both plates of full wave rectifiers can be tested independently and in addition to regular receiving type tubes, certain amateur transmitting and sound equipment tubes can also be tested. These testers are available to service dealers on one of National Union's regular tube purchasing agreements.

The two other publications deal with laboratory experiments on electron-tube theory and on electron-tube applications respectively. One is intended as an experimental supplement to McArthur's book, while the other is a laboratory manual covering a number of fundamental electron-tube applications.

Government Short Wave Book Mailing Is Imminent

The following letter was received by RADIO WORLD from the U. S. Department of Commerce:

It is regretted that the issuance of the new edition of the publication World Short-Wave Radiophone Transmitters has been delayed by the developments of a new demand for services of this organization.

The work is now being completed, and copies will be mailed on all orders of record in a short time. I trust the delay has not proved too inconvenient.

If we may be of further service at any time, please do not hesitate to call on us here in Washington or at our District Office located 734 Customhouse, New York City.

Very truly yours,
ANDREW W. CRUSE,
Chief, Electrical Division.

Stevens Wins Award for Good Announcing

Carlyle Stevens, a young announcer of the Columbia Broadcasting System, has been chosen for the first annual "BBDO award for Good Announcing," it was announced by Roy S. Durstine, vice-president and general manager of the advertising firm of Batten, Barton, Durstine & Osborn, Inc.

The award is a substantial check. With it goes an engraved stopwatch.

Catalogues

Three 1935 catalogs are announced by the Cornell-Dubilier Corporation, condenser manufacturers, of 4377 Bronx Boulevard, Bronx, N. Y. City.

Catalog 128, of 16 pages, is for use by radio parts distributors, dealers, service men and amateurs. Catalog 129 lists standard types of replacement condensers, both paper and electrolytic. For manufacturers and engineers, catalogue 127 contains information on the use of condensers in power factor correction, motor starting, high voltage circuits, etc.

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Radio University

Questions answered weekly. From the great number of questions submitted by many readers only those deemed of wide interest are published in these columns, with answers. Readers desiring individual question and answer service by mail may obtain it by subscribing for RADIO WORLD *for one year (52 issues) @ $6.00 and obtaining a Radio University membership card. No other premium with this offer.*

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

Interelectrode Capacity

WHAT IS the significance of interelectrode capacity as it applies to vacuum tubes?—K. L.

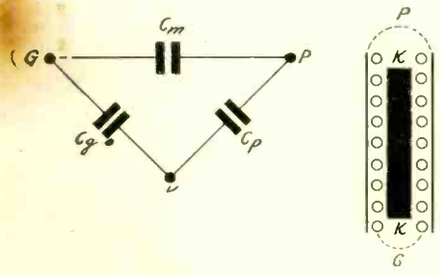
The sketch shows the elements of a three electrode vacuum tube, the cathode as K, the grid as G, and the plate as P. These elements are concentrically mounted and thus are related to each other physically. Since the area of these wires and plates are very small and also since the distances between elements, though physically quite small, are electrically quite large, these elements form a small condenser. When very high frequencies flow through the tube, this small condenser offers an appreciably low impedance path for radio frequency currents and so have to be reckoned with in the calculations that are necessary in radio design. The input capacitance thus produced between the grid and cathode is customarily abbreviated C_E and in the ultra high frequency bands usually forms the sole capacitance (neglecting wiring capacity) that exists in the circuit. At these high frequencies, the output capacity, C_P, likewise has an appreciable effect upon the circuit constants. The capacity, C_m, that exists between grid and plate is a disturbing regenerative influence at times and at other times is a valuable device, as in the tune plate-tuned grid circuits. These capacities quite naturally depend upon the size of the elements and their respective spacing. The character of the gas or vacuum in the bulb also affects the capacity to a lesser degree.

* * *

Two-Tube Receiver

I WOULD LIKE to construct a simple workable two-tube battery receiver suitable for all bands. Please publish a suitable hook-up.—H.H.V.

A very sensitive and effective receiver is indicated in a diagram on this page. It will be noted that the 32 and 19 type tubes are utilized. For the achievement of all bands, it is necessary to use plug in coils or switching of fixed coils. The various other parts are indicated. When used with a well designed antenna and ground system, this receiver should be capable of reception of signals from all parts of the world.



The small capacity that exists between the elements of a vacuum tube becomes quite important at the ultra high frequencies and this sketch shows manner in which these capacities occur.

Bureau's Researches

PLEASE ADVISE REGARDING the researches of the Bureau of Standards that concern radio, infra red, ultra violet, X-rays, and cosmic waves.—K. C. Z.

These findings are published monthly by the Bureau of Standards in its journal. It is suggested that you inquire of the Superintendent of Documents, Government Printing Office, Washington, D. C., for full information on governmental publications.

* * *

Car Set

IS IT POSSIBLE to attach an ac-dc set to my car battery and utilize this set for radio reception in an automobile?—R.B.C.

The use of a vibrator in conjunction with a transformer and your car battery might well serve to operate an ac-dc receiver provided a good antenna system is installed, since these sets are not as sensitive as those specially designed for automobile use.

* * *

Recording Method

IS IT FEASIBLE to connect a 500 ohm recording head to a 500 ohm output transformer that is connected to a 15 watt amplifier for the purpose of recording sound?—K. N.

It is permissible to match these two units as you indicate but you should take care that the recording unit does not become overloaded from the large output available from your amplifier.

* * *

Needs Personal Service

I WOULD LIKE to install a set of loudspeakers and microphones at both ends of my shop, a distance of 500 feet. Since I know nothing about radio, I would appreciate information from the elementary point of view.—E. J. F.

If your knowledge of radio is nil, you will probably find it more economic to enlist the services of a reputable service man skilled in this work.

* * *

Winding Data

IN YOUR ISSUE of December 22, 1934, there appears an article upon a 4 tube universal t-r-f set. Please give the number of turns of No. 28 enameled wire on a 1-inch form of the r-f and detector coils. I should also like to know the value of the variable condensers.—J. J.

Both condensers are part of a 365 mmfd. two ganged condenser and in order to couple these condensers with appropriate coils for the broadcast band on a 1-inch form, it is necessary that the secondaries of these coils be wound with 12 turns of No. 28 enamel wire. Primaries should be wound alongside the secondary and spaced about ¼ inch therefrom with about 40 turns of wire of the same gauge. The third coil indicated in the diagram with the loose end is merely a few turns of wire that is experimentally determined for the purpose of varying the coupling in the initial adjustment process of the receiver. The question is answered because asked, but the coil will be bad because far too long for the diameter. A form about 5 inches long would be needed for winding and mechanical reasons. Use of 127 turns of No. 32 enamel for secondary is far preferable, primary, 20 turns, over secondary rear ground end.

* * *

Buzzer in B Supply

CAN A HIGH FREQUENCY buzzer be used to operate in the vibrator B supply described in RADIO WORLD on Jan. 19, 1935?—A. de la Z.

It is hardly likely that a high frequency buzzer would be capable of carrying the necessary amount of current and so it is not believed that a buzzer can be used for this purpose. It is advised that you obtain a replacement vibrator that is obtainable from most radio stores for about $2.50.

* * *

Turns for Oscillator

I WOULD LIKE to know the number of turns and size of wire for primary and secondary winding on a ⅞" diameter form for oscillator coil for a 175 kc i-f to cover the broadcast band 550 to 1600 kc.—C.H.F.

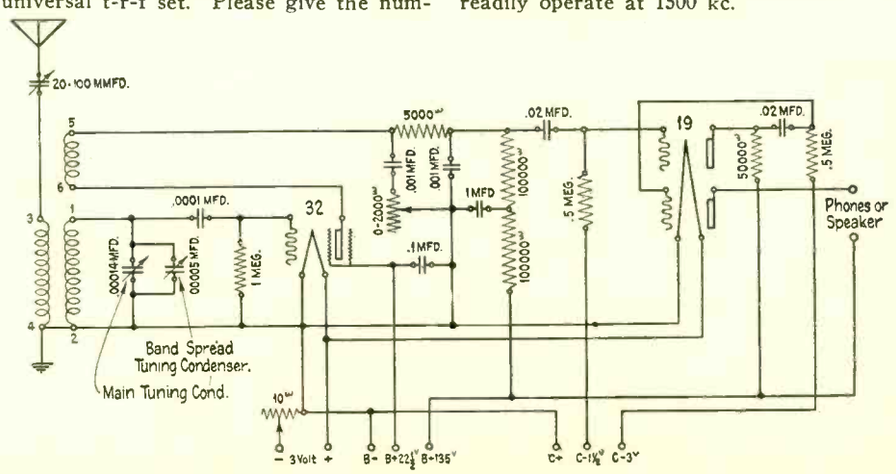
Assuming general run of tuning condenser, the oscillator coil for 175 kc i.f. should have 110 turns of No. 32 enamel for ⅞" diameter. A padding condenser, 1350-1800 mmfd., is used also.

* * *

Coil for Phonograph Device

WHAT CONDENSER VALUE is required to tune the Phonograph Oscillator described in RADIO WORLD for Feb. 2, 1935 to 1500 kc?—C.G.

Since neither the coil nor the condenser is specified in the article, it is necessary to give the constants of both these items. With a 140 mmfd. condenser shunted across the coil, an inductance of about 80 microhenries is necessary. Such a coil can be built on a 2" form of 37 turns of No. 24 enam. wire. If a padding type of condenser is used, this arrangement will readily operate at 1500 kc.



A two tube battery receiver that renders three tube service.

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GENTLE LUCILLE AND OTHERS

IT PLEASES ME VERY MUCH to announce that gentle Lucille Manners, popular young NBC soprano, has been chosen to fill the place of Jessica Dragonette on the Cities Service program during the latter's vacation. Miss Manners, who has been heard on many NBC programs, will give four recitals with Rosario Bourdon's Orchestra and the Cities Service Quartet. . . . For those who have wondered what had become of Dale Wimbrow: he is now to be heard on a new series over an NBC-WJZ network each Monday and Friday at 6:35 p.m.; and on each Wednesday over WEAF at the same time. Dale, who is known as the Mississippi Minstrel, is sponsored by Soap Products, Ltd. He is a veritable one-man show, playing stringed instruments, whistling, singing, reciting original poetry and telling stories. . . . Another new program now being heard over WJZ each Friday at 10:50 a.m. is Maurice, "The Voice of Romance," sponsored by S. Gumpert, Inc. This series also combines short dramatic playlets, dealing with scenes from everyday life. Maurice offers popular songs and ballads of the romantic type. . . . Jack Benny is continuing on the air for Jello. Each Sunday, as usual, at 7:00 p.m. over an NBC-WJZ networks. He has just signed a new contract which takes in the spring and early summer. Co-signed with Jack are his associates, Mary Livingston, Frank Parker and the two "Dons" Wilson and Bestor. . . . Audrey Mason is a newcomer to the air-waves. She was heard on a recent Airbreaks program. You're all right, Audrey, and deserve a place in radio!

CANDID CAMERAGRAPH

GRACE MOORE sweeps majestically into the NBC studios in Hollywood for her Tuesday night broadcast . . . flanked on one side by her dark and handsome husband, Valentin Perrera, on the other by her accompanist and her voice teacher. . . .

A few casual brushes of her blonde locks and she steps to the microphone to begin a last rehearsal . . . Maestra Harry Jackson stands on the conductor's dais . . . his tux coat flung over a nearby table as he directs rehearsals in his shirt sleeves . . . swinging his arms in great sweeps without benefit of baton. . . . He's polite but firm with his men . . . seems to know what he wants. . . .

A brief conference with Miss Moore and the orchestra swings into tempo and the Vicks star begins singing . . . one hand cupped to an ear, the other beating a rhythm. . . . She wears the latest in evening gowns, topped by a beautiful white fur cape. . . .

A few minutes before 9:00 p.m., E.S.T., and while the musicians scurry out for four cigarette puffs, Miss Moore talks over her songs with Jackson and her teacher . . . Gayne Whiteman, famed movie commentator, who announces the program, goes over his lines . . . and the program is on. . . .

Miss Moore is one of the few radio singers who reads her own lines . . . which she does in a rich, mellow, sincere voice. . . . As she sings she occasionally raises her eyes to the glass-windowed audience room above, where Dr. Maria Marifoti, her voice teacher, formerly of the Metropolitan, New York, waves an encouraging hand. . . .

SOCONY CELEBRATES

Celebrating its seventh consecutive year on the air—and entering its eighth—Soconyland Sketches, veteran of the air waves, observed its birthday with another amusing "Snow Village" episode, "The Clock in the Steeple," which was broadcast over the WABC-Columbia network on Saturday, March 2, from 7:00 to 7:30 P.M., E.S.T.

Three personalities, Arthur Allen, famous in his role as Uncle Dan'l Dickey, and the authors, William Ford Manley and Henry Fisk Carlton, have been intimately associated with the series since the beginning.

"Our first show," recalls Dan'l Dickey (otherwise Arthur Allen), "was broadcast on February 29, 1928. That's a long time ago—a very long time ago in the radio business. It's long enough to give our show the record for the longest unbroken stretch of dramatic performances."

Today the authors of these famous Sketches looked back over their long list of scripts and reminisced a bit:

"Our first idea was to do only history stories," said Manley. "We did Miles Standish, Old Ironsides, and The Cherry Valley Massacre. But we found, after the first year, that Parker Fennelly teamed so well with Arthur Allen that we conceived of two homespun rural characters built around these two actors. I guess the character of David Harum, from Edward N. Westcott's famous novel, really suggested the development of our Snow Village sketches, and the first of these, 'The Auctioneer,' was broadcast on November 26, 1929."

Station Sparks

By Alice Remsen

TWO GOOD ONES RENEWED

Captain Dobbsie's Ship of Joy has launched a new cruise, this time over the Columbia network. Each Tuesday and Thursday at 10:30 p.m. Sponsored by the Stewart-Warner Corporation, makers of Alemite automobile lubricant. Hugh Barrett Dobbs, known to millions of listeners as "Captain Dobbsie," pilots "The Ship of Joy," which has as its crew one of the country's foremost musical organizations, Horace Heidt and His Californians. Among the featured vocalists are Lisbeth Hughes, contralto and harpist; Bob McCoy, bass; and Art Thorsen, who triples as bass player, vocalist and chief arranger . . . "Bill and Ginger" have been awarded a contract renewal by the C. F. Mueller Co., makers of macaroni and spaghetti—(good eats, I always use their brand—Adv.)—and will continue their broadcasts for another year with the script still written by that lovable rogue, Arthur Q. Bryan. Mondays through Fridays, 10:15 a.m. WABC and Columbia network. . . . WOR, through the Mutual Broadcasting System, has added a number of Chicago dance bands to its nightly schedule. You may now hear those aces of bandom, Ted Weems, Jan Garber and Wayne King, Saturdays at 11:30 p.m. until 12:30 a.m. . . . Prudence Penny has returned to the air waves via WOR with her unique program, "The Romance of Food," each Friday at 8:45 a.m. . . . Jack Filman, well-known sports commentator, is being presented nightly at 7:00 p.m. over WOR. Mr. Filman temporarily replaces Mr. Stan Lomax, who has left for his annual trip through the South to visit baseball training camps. . . . WOR has its new transmitter, 50,000 watts, at Carteret, N. J. A special ceremony of dedication and a day of congratulatory programs marked the event. . . .

STUDIO NOTES

Lanny Ross has taken up bowling. . . . Dorothy Page tried to impress a traffic cop by singing to him—but it didn't work. . . . Jimmie Fidler was the youngest commissioned officer in the U. S. Marine Corps during the World War. He was just nineteen when he received his gold bars. . . . If Gus Haenschen hadn't turned to music for a career he could have been a photographer, a designer in iron, or an expert cabinet maker. . . . Don Hall is teaching Vee Lawnhurst radio code. . . . Andre Kostelanetz says that opera singers are not temperamental. . . . Ray Heatherton has made a successful movie test, so don't be surprised if the youthful baritone flits to Hollywood. . . . Sam Hearn, NBC comedian, is a violin virtuoso by avocation. . . . Connie Gates is a pianist who turned out to be a singer. . . . And Verna Burke is a dancer who did the same thing.

A THOUGHT FOR THE WEEK

BEATRICE LILLIE IS GOING TO BE FAIRLY BUSY ON THE AIR UNTIL NEXT JUNE. Lady Peel, if you insist on being punctiliously exact, has of course proved pretty conclusively that she knows how to get the last breath of comedy out of each microphone contact. Her whimsically cheerful English comedy has made her services in demand by these sponsors who are willing to pay big prices for choice radio goods. Bee Lillie—to get back again to things not associated with Burke's Peerage—has also shown that women are going to be—in fact are—important figures before the 1935 *mike.*

Others who are demonstrating that women need no longer take back seats in the studios and who have won high places as entertainers away from the airways are Geraldine Farrar, Elsie Janis, Grace Moore—and of course those others who share with their husbands the salaries and fame that come through the sponsors who gladly pay out ready money for the things they believe their public wants—should we say demands?

Dale Wimbrow on Air for Shaving Soap Product

The Professional Model Latherizer, used in sanitary barber shops throughout the United States, and Latherizer Liquid Shaving Cream, manufactured by Soap Products, Ltd., are being introduced to the public via radio and newspaper advertising. WJZ is used Monday and Friday from 6:35 to 6:45 p.m. and WEAF 6:35 to 6:45 on Wednesdays. These programs follow the Press Radio News.

The radio program informs the public that the shaving brush is as insanitary as a public toothbrush and no barber ship which uses the brush can be a sanitary barber shop.

The artist on the radio program is Dale Wimbrow, the Mississippi Minstrel. He is unique and has an entirely new method of delivery in the rendition of his entertainment. The advertising account is handled by Kelly, Nason & Roosevelt, Inc., 30 Rockefeller Plaza, N. Y. City.

Below 60 Cycles

From 60 cycles to zero, a very small dial space on a calibrated audio frequency oscillator, is neglected. That is one reason why such calibrations do not go below 6 cycles, the other being that the mechanical system does not permit calibration to such fine difference as represented by 60, 50, 40 and 30 cycles, etc., with the same condenser. However, if a tiny parallel or series condenser is used for this auxiliary low frequency service the calibration may be made on the basis of a stroboscope.

The result is communicated to plotting paper and a curve drawn. Then those able to do so by protraction can prepare a dial scale for use on a device that now will be direct reading.

Lee Tracy Gets Ticket

Lee Tracy, the movie actor, has just been issued a ship license for radio equipment aboard the Adore with the call letters WIFW. The power of the transmitter is listed as 100 watts using the regular marine frequencies between 2000 and 17,000 kc.

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3 F.
Amplifier
4 Watt
3 tube A. C. Kit

Including Full Construction Details 5.95

Black Crackle Chassis and Transformer Cover.
Dynamic Speaker, $2.50 extra.
Tubes, $1.75.

MAIL ORDERS FILLED PROMPTLY

Our Latest Broacast Sensation
TYPE 8B PATHFINDER
Broadcast Superheterodyne
WITH A.V.C. AND NOISE SUPPRESSION

Automatic Tone Control. Complete Kit of Parts.. 17.95

Send for a free diagram of this super circuit.
8" Dynamic Speaker, $3.45

THOR RADIO CORP.
167 GREENWICH STREET, NEW YORK CITY

RGH 5
A 5 tube self-powered All Wave A.C. Receiver. Complete kit of parts, including 8 short wave coils as described in this issue. $12.95

Kits shipped ready mounted, with complete Construction Data.
Dynamic Speaker $2.50
4 Broadcast Coils $1.80

SEND FOR FREE DATA

1934 Biggest Year For Radio Exports

All records for export of radio apparatus from the U. S. were broken during 1934, with sales abroad of $24,856,898, according to the recent report of the Department of Commerce, Electrical Equipment Division. The 1934 exports were $1,723,083 above the former record exports of 1930, according to Andrew W. Cruse, Chief of the Electrical Equipment Division, and all classes of radio apparatus shared in an export increase over 1933.

Recovery in foreign markets from adverse conditions affecting American radio sales abroad in 1932 and 1933 were evidenced, according to Mr. Cruse. All-wave sets were credited with increasing the unit value of receiving sets sold abroad in 1934 to $35, as compared with $18 in 1933. Spain, United Kingdom, Mexico and Brazil were again the ranking foreign markets for American radio.

Brazilian Trade Treaty Gives 25 p.c. Reductions

Twenty-five per cent. reduction on radio receiving sets and tubes exported to Brazil is a substantial benefit proposed for the American radio industry under the tentative reciprocal treaty negotiated by the State Department with Brazil.

The trade agreement with Brazil has been approved by the U. S. and Brazilian official representatives. It will not become effective, however, until approved by the Brazilian Congress and will come into force thirty days after ratification by the Government of Brazil and the approval of President Roosevelt.

Light radio apparatus and tubes of American manufacture would be given the twenty-five per cent. customs reduction under the Brazil trade agreement. Also heavy radio, telephone and telegraph equipment, motion picture films, mechanical refrigerators, agricultural and other machinery would be continued at the present tariff rates. The present favorable Brazilian customs treatment for these heavy commodities would be "bound for the life of the agreement."

NEW ANTI-RADIO BILL

From the forty-four State Legislatures now meeting, the first bill aimed at automobile radio has come from the Connecticut Legislature, where a bill has been introduced to fine anyone $50 for having a radio in his automobile, police cars exempted.

Factory Employment Continues to Be Good

Sustained production and sales in the radio industry during the closing months of 1934 were reflected in recent labor reports for November and December, 1934, of the U. S. Department of Labor, Bureau of Labor Statistics.

During December, 1934, fifty-six radio and phonograph establishments reported employment of 37,822 employees as compared with employment of 38,306 employees reported by fifty-eight establishments during November. No wage increases were reported in either month.

Per capita weekly earnings during last December in radio factories were $19.86 as against $19.22 in November, an increase of 3.6 per cent, but 8.7 per cent over December, 1933.

Average hours worked per week during December, 1934, were 35.2 per cent as compared with 34.2 per cent in November, an increase of 2.9 per cent, but 11.9 per cent above December, 1933.

Average hourly earnings of radio factory employees during December, 1934, were 56.5 cents and in November, 56.3 cents. The December earnings were 9.6 per cent above those of December, 1933.

As compared with the average for 1923-25, radio employment last December was increased 107.9 per cent, while December payrolls were 32 per cent above the three-year average.

Opportunity to Export Auto Sets to France

Several firms in France are interested in obtaining American automotive radio which may be laid down in France for approximately $45, according to the U. S. Bureau of Foreign & Domestic Commerce. The average retail prices in France of automobile sets now range between 1,200 and 1,500 francs, or about $80 to $100. If possible to land automotive sets in France, duty paid, at approximately $45, it is believed that a considerable market for American automotive radio would develop. Manufacturers interested should correspond with Andrew W. Cruse, Chief of the Electrical Division of the U. S. Bureau of Foreign and Domestic Commerce, Washington, D. C.

JANUARY EXCISE TAXES

A slight decrease during January in U. S. Internal Revenue Bureau collections of the five per cent excise tax on radio and phonograph apparatus is reported.

Tabulation of All Interference Planned

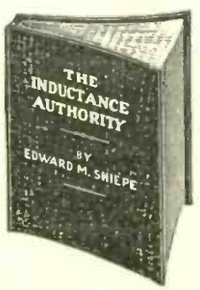
The increasing acceptance by the public of short-wave broadcast reception and the advent of the new high-fidelity receivers have brought man-made electrical interference particularly to the attention of the public. The gradually approaching use of ultra-short waves, for facsimile and television broadcasting, similarly require that all reasonable steps be taken to reduce electrical interference so as not to impede the growth of these developments.

The Committee on Interference of the Radio Manufacturers Association plans to assemble information on all known sources of radio interference. Methods of measuring the susceptibility of radio receivers to interference, both by incoming waves and over the power lines, will be considered. In addition, methods of measuring electrical noise, the development of standard portable equipment for the purpose, and conveniently available methods for measuring the field strength of radio signals in the neighborhod of the receiving stations, will have attention.

TUBES TO FRANCE

The Radio Manufacturers Association Tube Division adopted a resolution to cooperate with the French Government agency in allocation of tube import quotas to France. Chairman S. W. Muldowny of New York presided. The tube manufacturers voted to respond to the recent request from the French Government for cooperation in administering the French quotas of tube imports.

R-F COIL WINDING MADE EASY



Sent prepaid anywhere on earth on receipt of $2.00.

ALL you need are any standard wire and coil form and you can wind a radio-frequency solenoid to any requirement from information contained in "The Inductance Authority." No calculation is needed. Quick consultation of simple charts gives the answer in number of turns and gives it with high accuracy. This is the indispensable book for those who wind their own coils.

RADIO WORLD, 145 W. 45th St., N. Y. City

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MIDAS

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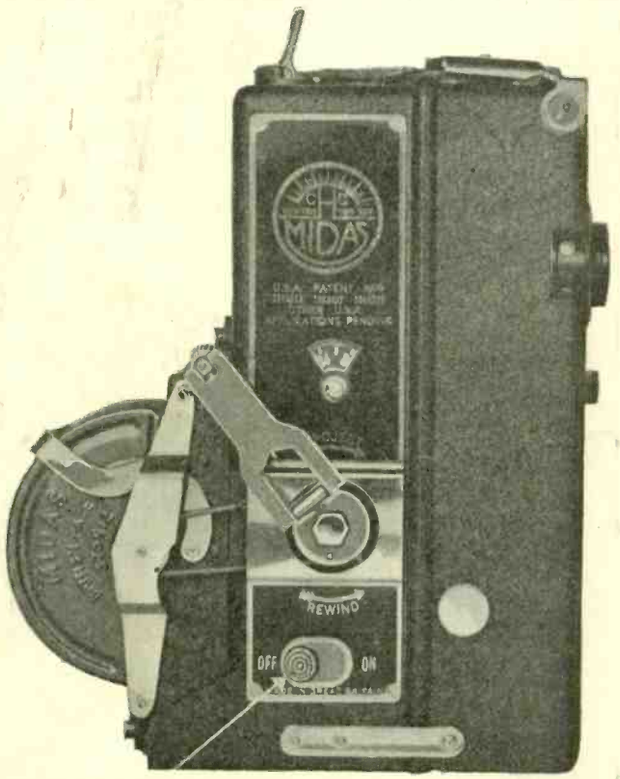
THE MOVIE MIRACLE

A.	Camera-Projector . . .	$36.75
B.	Case	5.50
C.	Screen	1.75
D.	Unexposed film	1.75
E.	Demonstration film . . .	1.00

Complete unit consisting of items a, b, c, d, e.

Price includes development and return by mail.

$41.75



Takes moving pictures and projects them, in the same instrument.

Needs no house current, as it operates by a self-contained electrical unit. Uses a 9½ MM. film and projects a picture 18" x 24".

The only instrument that can project a picture on a boat, in a tent, or any place where no electrical power is available.

This Camera-Projector, complete, with genuine cowhide leather case, screen, demonstration film, and unexposed film, $41.75.

Films for this camera cost $1.75, which cost includes developing and return. This is not a toy, but a real combined Camera and Projector.

Sign the attached coupon, and mail in to us, and we will be glad to send you further information.

Without obligation on my part kindly advise me how I may obtain a MIDAS CAMERA-PROJECTOR on a weekly payment plan.

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Dept. M-15.

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