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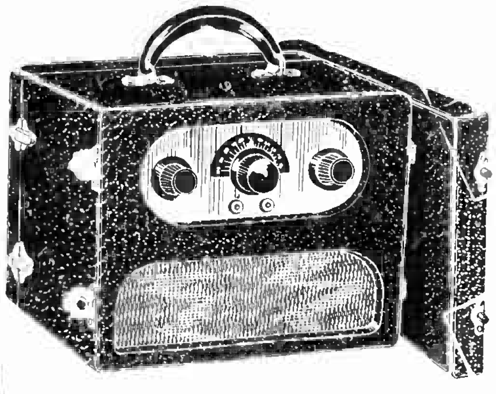

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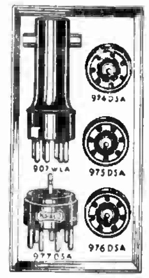

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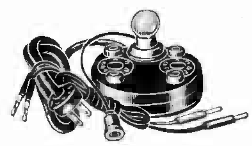

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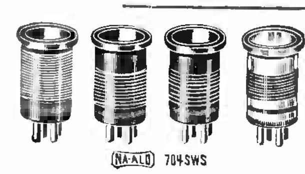

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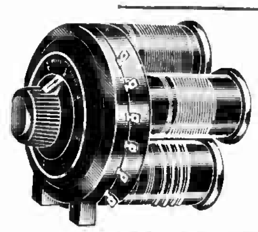

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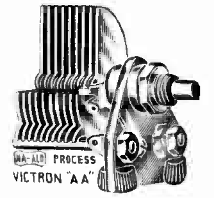

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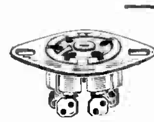

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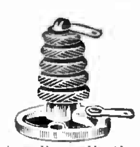

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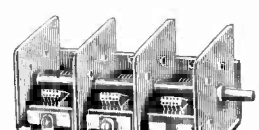

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REG. U. S. PAT. OFF.
The First National Radio Weekly
THIRTEENTH YEAR

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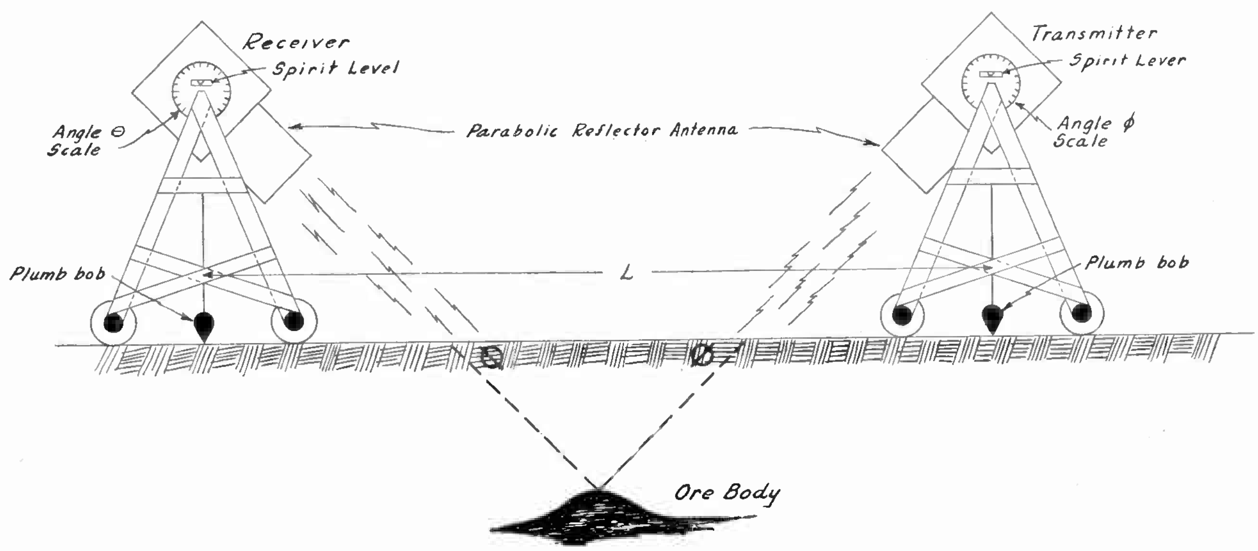
Hunting Treasure by Radio

System Based on Conductivity and Mutual Inductance is Most Reliable

By M. K. Kunins



By means of a portable transmitter and receiver, both of which utilize parabolic reflectors, a comprehensive treasure survey is possible.

ONE of the foremost and most necessary industries in any country is the mining of minerals from the earth, since the raw materials that are utilized in manufacturing processes are thus obtained.

The more spectacular type of mining operation concerns itself with the rarer metals that occur in various ores. These ores are generally from minerals that are mined from the earth. The metals then are extracted. Such metals rarely occur in the pure state but are combined with other elements and as such are named minerals. Thus, silver is found combined with sulphur, and sometimes with arsenic; copper is found as oxides, sulphides, and carbonates; lead as sulphate and carbonates; and iron as oxides, sulphides and carbonates. In many instances, metals occur together.

Ores occur in various kinds of deposits. For radio prospecting the type of deposit that is most favorable is that which occurs in seams or fissures in rock and form veins or ore sheets. Such deposits occur in a variety of shapes and may be found as a crust, as a film or as a sheet on the fissure walls.

As was intimated, ores usually are found in combination with other substances, and to this mixtures the name **gangues** is applied. These other substances may be poor conductors of electricity, such as quartz, dolomite, calcite, siderite, barite, etc., and handicap the process to be described.

Various Methods Used

Through the years, mineral prospecting was practiced in various ways. Sometimes it was the good old gravitational method, or perhaps it was done magnetically. Yet another way might have utilized seismic devices, and, more recently, electricity was applied.

A comparison of the many methods clearly indicates the superiority of electrical methods and accordingly most prospecting devices today utilize such principles. These apparatuses may be founded on the natural circulation of currents in the earth, or perhaps upon the circulation of applied currents in the earth by means of buried electrodes, or the principle may be concerned with electromagnetic induction.

The inductive method is, by far, the most practicable, since the natural earth current method is not controllable and the applied current method is rather cumbersome.

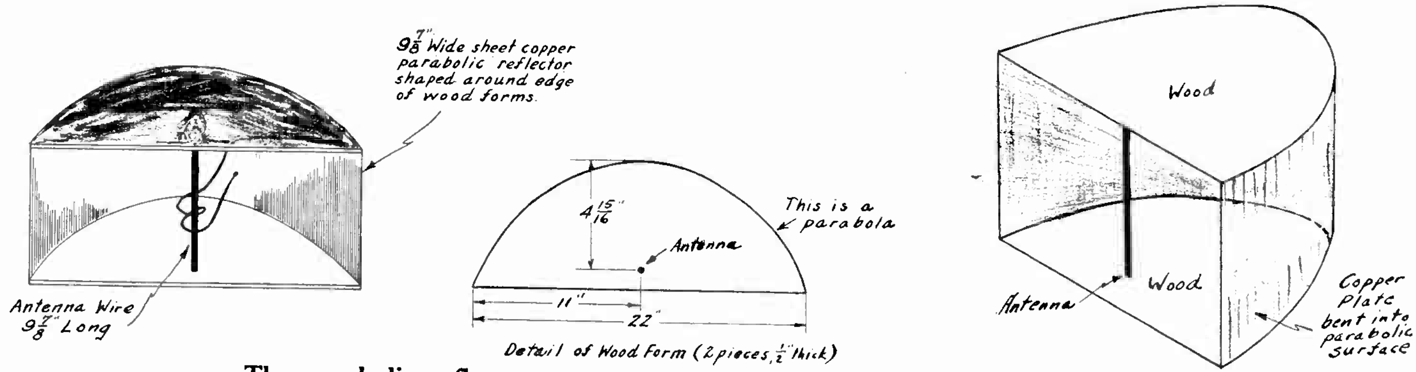
Since greater inductive currents are generated by the higher frequencies, the applicability of radio waves is clearly evident. And so it is that radio equipment finds another important application in the field of treasure-hunting.

Conductivity Varies

Since radio prospecting depends upon the effects produced in the flow of an electric current, the matter of conductivity is of major importance. The greater flow of current will occur at the point of greatest conductivity.

Accordingly, those ores conductive to electric currents will be more suitable for radio prospecting methods. Of course, conductivity is a relative attribute—some

(Continued on next page)



The parabolic reflector antenna consists of a copper sheet bent into the form of a parabolic surface (vertical shading). The parabola is held by two wood forms, the lower one of which supports the antenna wire at the focal point. The upper wood form is shown crayoned. At right is a perspective guide.

(Continued from preceding page)

ores are more conductive while others are less, there being no absolute non-conductor of electricity. Among the more conductive ores will be found the pyrites, some anthracite coals, graphite, chalcopyrite, arsenopyrite, carboniferous shales, pyrolusite, galena, magnetite, the metals in the pure state, etc.

A multiplicity of ores occurs in nature, so that relatively non-conducting types will be found combined with the better conductors. The non-conductors occur as carbonates, silicates and some sulphides. Since such ores are not effective for radio prospecting purposes, the present methods are necessarily limited. It should be understood that the application of radio to the field of prospecting has its limitations and should not be classified as a perfect divining rod.

Directional Antenna Used

It is an accepted fact that metals or other conductors will have a voltage induced in them when in an electromagnetic field. This voltage will be directly proportional to the product of the exciting current, frequency and the mutual inductance between the exciting apparatus and the ore deposit. This voltage will, of course, have an associated current which will emanate a radiation of its own that may be detected by suitable radio receiving equipment. Therefore, to accomplish these objects, a generator (hereafter alluded to as the transmitter) and a detector (hereafter alluded to as the receiver) of radio frequency currents are necessary. By means of a directional antenna, the energy of the transmitter may be concentrated toward the earth while another directional antenna will be utilized to receive the reflected wave, the intensity of which will depend upon the parameters mentioned above (frequency and current of oscillator together with mutual inductance between the ore and the apparatus). Transmitter frequency and current are controllable in obvious manners, whereas the mutual inductive relation will depend upon the depth and conductivity of the deposit.

Since the frequency and current of the transmitter are maintained at a constant value, the only variable involved in the process of radio prospecting will be the mutual inductance between the ore deposit and the apparatus. By constant use of the apparatus the operator becomes adept and develops a sixth sense which will render him quite capable at an approximate judgment of the character of a hidden ore deposit—its depth below the surface and the degree of its extent.

Procedure for Triangulation

Accurate depth measurements can be accomplished by providing the receiving and transmitting instruments with rotatability through 180 degrees in a vertical plane, with plumb bobs, with 180 degree angle scales and with spirit levels. By the inclusion of these devices, triangulation methods may be adapted to these instruments and exact locations of ore deposits computed (subject to slight inaccuracies due to refraction).

The procedure to follow in this triangulation survey would be as follows. The transmitter is wheeled to any spot in the survey area and is adjusted to direct its energy ray into the earth. The angle at which this adjustment is set is readable directly from the angle scale. This scale comprises a rotatable circular disc with angular calibrations on its periphery. With this disc is a spirit level that serves to indicate when the scale has been adjusted to the horizon. The angle is then read directly from the index. Both the transmitter and the receiver are equipped with this arrangement. Thus the angle of either the transmitter rays or the receiver rays is ascertainable.

When the transmitter has been suitably located and placed into operation, the receiver is moved about in the proximity of the transmitter with receiver antenna pointing toward the earth in the direction of the transmitter, until maximum response is obtained.

Ore in Them Thar Hills

Should no response be audible in the receiver, the absence of ore is indicated. Accordingly, a new location for the transmitter should be found, and the receiver procedure repeated. When responses result, the presence of ore is shown. Angle readings should then be taken at maximum response and plotted on a chart. Intersection of the two bearings will locate the ore on the chart from which suitable interpolations can be made. The performance of this procedure for the entire area to be surveyed will serve to give a vivid and trustworthy picture of ore conditions beneath the earth's surface.

Radio prospecting, as heretofore practiced, operated on comparatively low radio frequencies and the directivity of the energy could thus not be rendered very acute. However, recent developments in the ultra-high frequencies have served to show the value of these lower waves.

This portion of the electromagnetic wave spectrum is rapidly losing its former aspect of little value. One of the most important attributes of these waves is the ease with which an efficient reflector antenna system may be constructed whereby the energy from a single oscillator tube may be concentrated to such an extent that its effectiveness is tremendously increased.

Use of Acorn Tube

Utilizing the new 955 acorn tube on a wavelength of 50 centimeters the oscillator's energy may be directed into the earth by means of a parabolic reflector system, the wires of which are only about 9 inches long.

And think of the small size of the entire equipment itself when comprised of these small tubes! Such an arrangement would truly be a portable treasure seeker and would probably achieve better results than the larger variety due to the concentration of energy by the reflecting antenna. Verily, this is tantamount to employing a super-searchlight in the search for treasure. This is a real virgin field for the dyed in the wool experimenter and may be the beginning of some experimenter's journey to the proverbial pot of gold at the end of the rainbow.

Parabola Construction

To construct the parabolic antenna, proceed as follows. Secure a sheet of wrapping paper about two feet square. Fasten it down to some smooth surface and draw vertical and horizontal lines equally spaced, similar to cross section graph paper, about one inch apart. Then draw a parabolic curve on this paper by tracing through a series of dots plotted from the formula for a parabola, $y^2 = a\ x$, where a is the focal length of the parabola. For the 50 centimeter band, this focal length should be 12½ centimeters, or 4 15-16 inches, as shown in the sketch.

When this curve has been drawn, it should be cut out and then used as a template from which two pieces of ½ inch wood are cut, also shown in the sketch. These two pieces of wood will then constitute the top and bottom of the reflector. A sheet of copper, 9⅞ inches wide and about 30 inches long, should then be wrapped around the edge of these two wood forms and fastened to it so that the troughlike arrangement sketched in the diagram results. A wire about 9⅞ inches long for the antenna, is then placed at the focal point of the parabolic surface. Two insulated bushings might be included through the copper sheet, off center, so that the antenna may be fed from the transmitter or so that it may feed the receiver, according to its use.

It has been mentioned that the new acorn tube, type 955, can be utilized for the transmitter and receiver. Two circuits are shown that might be adapted for this purpose. One is a push pull arrangement utilizing two tubes. Tuning is accomplished by means of a wire that slides over and shorts two parallel wires in the plate and grid circuits of the tubes. These wires are spaced about one inch apart and will vary in length according to the operating frequency. The other one tube arrangement accomplishes tuning by means of a copper plate that slides over the edge of two copper bars in the plate and grid circuit of the tube, the plate being insulated from the bars.

[Circuit diagram on opposite page]

Latest Changes in Official List of Broadcasters

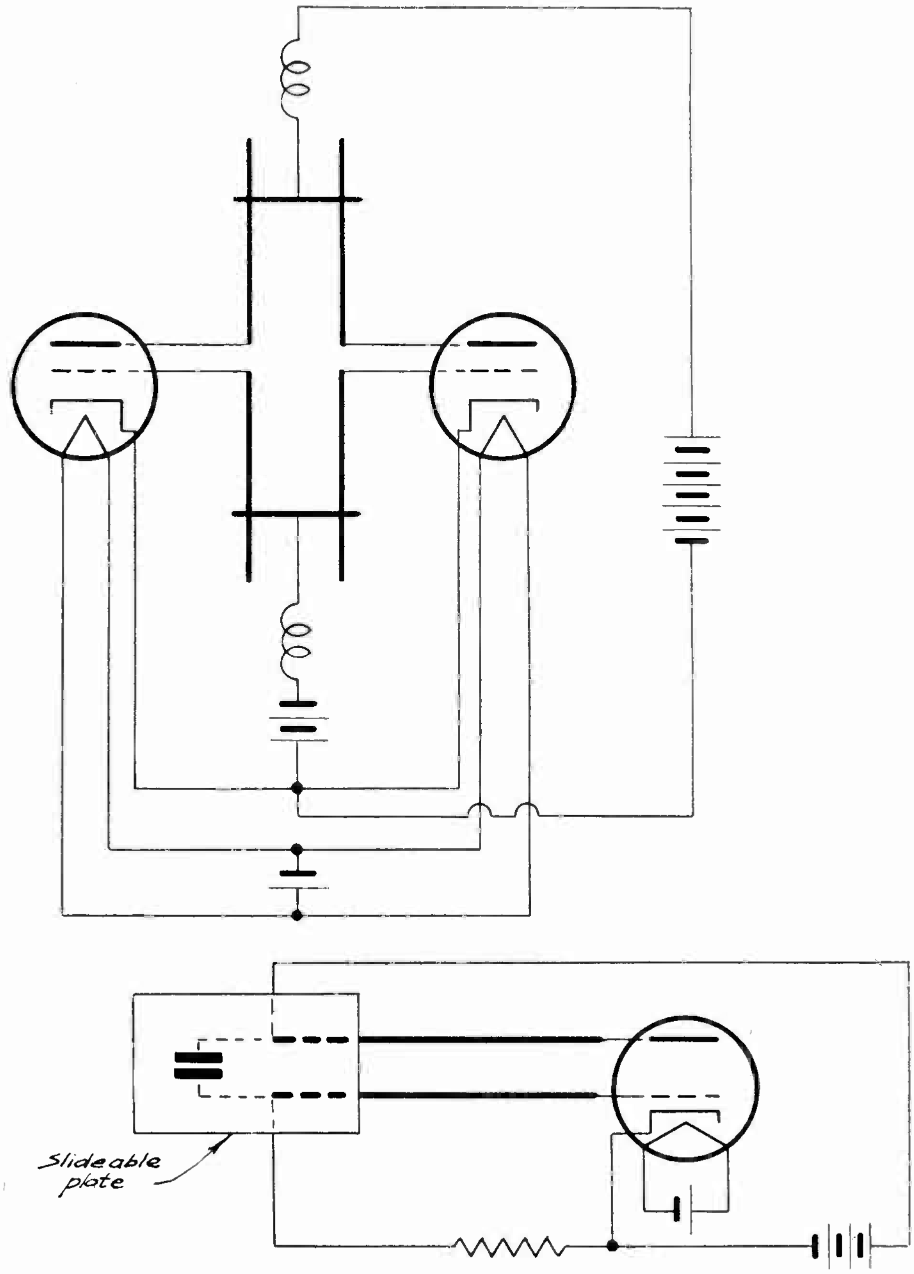
Alterations and corrections to the edition dated January 1st, 1934, of 'Radio Broadcast Stations in the United States," are announced by the Federal Communications Commission for the month of October as follows:

Call Letters — *Studio Location* — *Alterations and Corrections*

Call Letters — *Studio Location* — *Alterations and Corrections*

KABR, Aberdeen, South Dakota. C.P., permittee, Aberdeen Broadcast Co., Frequency 1420kc, power 100w. D—no quota charge.
KFAB, Lincoln, Nebraska. M.S.A, Exp. U-Syn. WBBM—night.
KFJM, Grand Forks, North Dakota. S.A., Exp., power, 250w LS.
KFRO, Longview, Texas. C.P., permittee, Voice of Longview, Frequency 1370 kc, power 100w D—no quota charge.
KFXJ, Grand Junction, Colorado. C.P., 250w—LS.
KGBX, Springfield, Missouri. S.A. Exp., move T near Springfield, Frequency 1230kc, power 500w.
KGBZ, York, Nebraska. Power 1kw, 2½kw-LS.
KGIR, Butte, Montana. C.P., 2½kw-LS.
KGNF, North Platte, Nebraska. Power 1kw.
KGRS, Amarillo, Texas. C.P., 2½kw-LS.
KICK, Carter Lake, Iowa. Licensee, The Palmer School of Chiropractic, C.P. move T and Studio Davenport, Frequency 1370kc.
KIT, Yakima, Washington. Power 250w-LS.
KMED, Medford, Oregon. Power 250w-LS.
KOOS, Marshfield, Oregon. C.P., 250w-LS, S.H. night.
KPAC, Brownsville, Texas. T and Studio changed to Port Arthur.
KSLM, Salem, Oregon. C.P. covered by license.
KSO, Des Moines, Iowa. S.A. Exp., power 500w, 1kw-LS.
KWK, St. Louis, Missouri. Power 2½kw-LS.
KWCR, Cedar Rapids, Iowa. Frequency 1430kc, power 250w. 500w-LS.
WALA, Mobile, Alabama. Power 1kw-LS.
WALR, Zanesville, Ohio. Strike out C.P. T and Studio Toledo (Protest).
WATR, Waterbury, Connecticut. Licensee, The WATR Co., Inc.
WBAA, West Lafayette, Indiana. Frequency 890kc, power 1kw-LS.
WBBM, Chicago, Illinois. M.S.A. Exp., U-night Syn. with KFAB.
WBBZ, Ponca City, Oklahoma. C.P. covered by license, Licensee, Estate of C. L. Carroll, Deceased, Rep. Howard Johnson.
WBTM, Danville, Virginia. C.P., 250w-LS.
WCAO, Baltimore, Maryland. Power 1kw-LS.
WCBD, Zion, Illinois. Change Studio to Waukegan.
WCLO, Janesville, Wisconsin. Licensee, Gazette Printing Co., Inc.
WDBJ, Roanoke, Virginia. Power 1kw.
WDBO, Orlando, Florida. S.A., power 1kw-night.
WEED, Rocky Mount, North Carolina. U-D and S-WEHC-night.
WEHC, Charlottesville, Virginia. C.P., Frequency 1420kc, power 100w, 250w-LS, U-D, S-WEED-night.
WFBC, Greenville, South Carolina. Power 1kw.
WFEA, Manchester, New Hampshire. C.P., 1kw-LS.
WGAL, Lancaster, Pennsylvania. Power 250w-LS.
WGLC, Hudson Falls, New York. C.P. move T and Studio to Albany.
WGPC, Albany, Georgia. Unlimited.
WHA, Madison, Wisconsin. Power 2½kw.
WHDL, Tupper Lake, New York. C.P., T and Studio Olean.
WHEF, Koskiusco, Mississippi. C.P. covered by license.
WIBM, Jackson, Michigan. C.P., 250w-LS.
WICC, Bridgeport, Connecticut. C.P., 1kw-LS.
WIND, Gary, Indiana. Power 2½kw-LS.
WIS, Columbia, South Carolina. C.P., Frequency 560kc, power 1kw-2½kw-LS.
WJBK, Detroit, Michigan. C.P., 250w-LS.
WJEM, Tupelo, Mississippi. Strike out all particulars.
WJIM, Lansing, Michigan. C.P. covered by license.
WJR, Detroit, Michigan. T-Wyandotte.
WKBF, Indianapolis, Indiana. Power 1kw-LS-U.
WKBZ, Ludington, Michigan. T and Studio moved to Muskegon.
WKFI, Greenville, Mississippi. Strike out all particulars.
WKJC, Lancaster, Pennsylvania. Power 250w-LS.
WLBZ, Bangor, Maine. C.P., 1kw-LS.
WLNH, Laconia, New Hampshire. C.P. covered by license.
WLVA, Lynchburg, Virginia. C.P., 250w-LS.
WMBG, Richmond, Virginia. C.P., 250w-LS.
WMBH, Joplin, Missouri. Unlimited.
WMFD, Wilmington, North Carolina. C.P., permittee, Richard Austin Dunlea. Frequency 1370kc, power 100w-D, no quota charge.
WMFE, New Britain, Connecticut. C.P., permittee, William J. Sanders, Frequency 1380kc, power 250w-D.
WMFF, Plattsburg, New York. C.P., permittee, Plattsburg, Broadcasting Corp., Frequency 1310kc, power 100w-D. no quota charge.
WMFG, Hibbing, Minnesota. C.P., permittee, Head of the Lakes Broadcasting Co., T-Mountain Iron. Frequency 1210kc. power 100w-U.
WNAD, Norman, Oklahoma. Power 1kw.
WNBX, Springfield, Vermont. C.P., 1kw, D to Erie, Pa. SS.
WNOX, Knoxville, Tennessee. Frequency 1010kc.
WNYC, New York, New York. Power 1kw.
WPAD, Paducah, Kentucky. C.P., 250w-LS.
WPEN, Philadelphia, Pennsylvania. Frequency 920kc. power 250w-500w-LS, S-WRAX.
WRAK, Williamsport, Pennsylvania. C.P., 250w-LS.
WRAX, Philadelphia, Pennsylvania. Frequency 920kc, power 250w-500w-LS, S-WPEN.
WSFA, Montgomery, Alabama. Power 1kw-LS.
WSMK, Dayton, Ohio. Licensee, WSMK, Inc.
WTMJ, Milwaukee, Wisconsin. Power 5kw-LS.
WTOC, Savannah, Georgia. Power 1kw.

[*Above list is official*]



Two circuits for the ultra high frequencies which may be used for either transmitting or receiving for the treasure hunt.

125,000 Rotarians on Two Continents Hear One Program

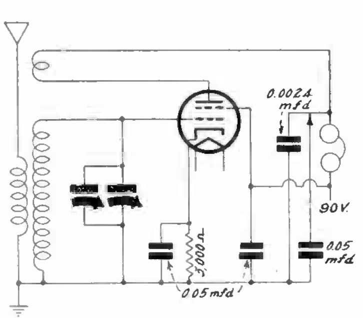
One of the largest audiences ever assembled to hear a two-way pan-American broadcast tuned in on a joint radio meeting of Rotary clubs in Buenos Aires, Argentina, and Schenectady, N. Y.

Notified by Rotary International, every Rotary club in North and South America was invited to hold simultaneous meetings and was asked to prepare for the event by installing two all-wave receivers—one tuned to General Electric's short-wave station W2XAF at Schenectady, N. Y., and the other to Transradio International's station LSX at Buenos Aires. Since both stations have been consistently and clearly heard, during good atmospheric conditions, in every part of the western hemisphere, this plan made it possible for 125,000 Rotarians of some 3,000 clubs in the two Americas to attend the joint Schenectady-Buenos Aires ceremonies via short waves. They found after a short wait that the inter-American program, beginning at 9:00 p. m. in Schenectady, presented a number of notables in Rotary's international organization. President Emeritus Paul P. Harris, of Chicago, founder of Rotary, and Walter W. Head, vice-president of Rotary International, said that the unique inter-club meeting exemplified the sixth object of Rotary—promotion of international fellowship. Official greetings from the United States were extended by Secretary of Commerce Daniel C. Roper, speaking from Washington by remote control. From Buenos Aires, official greetings, in exchange, were sent to North America by Senor Luis Duhau, Argentina's Minister of Agriculture, and an expression of good wishes from the Buenos Aires club was made by President Cebal-los of that unit.

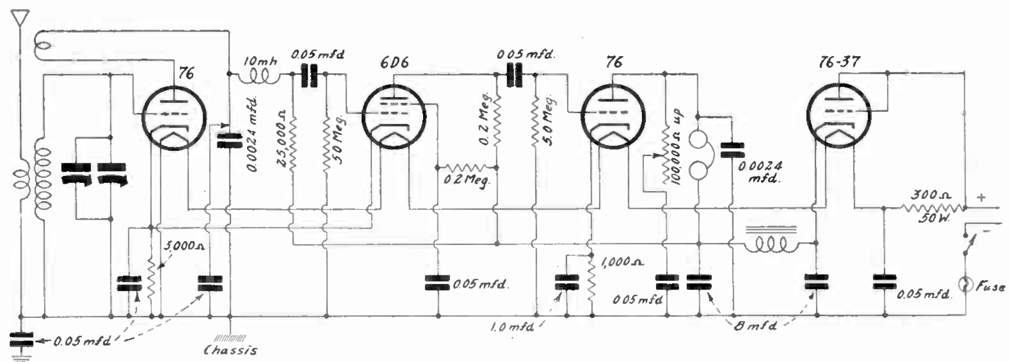
Zero-Beat Reception

"10 kc Selectivity" on a One-Tube Receiver

By Herman Bernard



The one-tube circuit that afforded such excellent selectivity. The zero-beat method of reception was used.



Some audio amplification is advisable, especially to compensate for the drop in the quantity of sound due to the tone-padding circuit. This circuit will work a speaker on locals.

ZERO-BEAT reception has been known for nearly twenty years and has been used to some extent on an experimental basis, and though recognized as the most selective, has been identified with mushy signals.

A preliminary investigation has been made of this method, and it has been found it yields all the selectivity that one could require. For instance, on a one-tube set, WLW was tuned in at New York City, and WOR, the loudest local at the point of reception, completely tuned out. Some ten-tube superheterodynes do not quite accomplish that. The two stations are 10 kc apart.

The reason for the selectivity is not far to seek. An oscillating receiver can zero beat with only one frequency or multiple. Say that 710 kc is the station and the receiver frequency. The effect of a station on 700 kc is to create another beat, not zero this time, but 10,000 cycles. Not much intensity attaches to a 10,000-cycle note in any receiver. All of this sound can be eliminated by a single fixed condenser across the signal line. The same situation obtains for 720 kc compared to 710 kc. Since the nearest channel produces a note outside, or put outside, the audible group, stations on frequencies farther removed yield beats of the super-audible type, hence these may be called non-existent from a practical reception viewpoint.

Jingle-Bell Interference

By this reasoning we find that the reception at zero beat, that is, when there is no difference in frequency between the oscillating receiver and the oscillating wave the station emits, attains the highest selectivity possible from a single tube.

There was one type of interference that could be heard, and that was due to the modulating frequencies of either or both of adjoining-channel stations exceeding 5,000 cycles. Then there is overlapping, with consequent jingle-bell sounds, but as these are in the high audio-frequency region, the shunting condenser across the line will remove them. The jingle bells are heard on all tuning systems that have audio channels that are in any way sensitive to these frequencies, unless the tuner is so selective that it does not pass modulating frequencies much higher than 5,000 cycles. Therefore the jingle bells haven't anything particular to do with a zero-beat receiver but apply to practically all receivers. However, in the zero-beat example the tone padding is such that all such high audio frequencies are cut out.

The principal reason for doing this is that as one tunes the oscillating receiver he hears squeals for every station laying down a carrier of sufficient strength to produce an audible result. These are finite beats and the pitch or audio frequency varies as one tunes.

Not the Most Sensitive

The lower the radio frequencies concerned the easier it is to manipulate the dial and come to rest at zero beat, but as the carrier frequencies become high, for instance, or are higher than the broadcast band, an ordinary tuning system fails. Either the station is skipped over entirely, because of the rapid change of tiny capacity that encompassed the resultant audio range of the squeals, or the station becomes nearly impossible to resolve a finite beat into a zero level. Micro-vernier auxiliary tuning becomes necessary.

Although the most selective, the zero-beat method is not the most sensitive. This follows from the fact that the greatest sensitivity is attained when the tube is just below the point of oscillation. If the receiver is constantly oscillating it is constantly above the point where oscillation stops. But sensitivity can be built up at audio frequencies.

A Resolver Is Needed

It was found that all local broadcasting stations came in without any mushy reception. As the coils were changed to permit tuning in higher frequencies, considerable mushiness was experienced, as had been true with very weak broadcasting stations, presumably distant ones. However, whenever the carrier is so weak, or the carrier frequency is high, the zero-beat system calls for a very small capacity or inductance change to differentiate between zero beat and any audible squeal. It is otherwise too difficult to get in between the finite values. In fact, it is nearly impossible with normal systems.

However, if a very small variable condenser is put in parallel with the main tuning condenser, the resolution may be accomplished. As small a commercial condenser as could be readily put into the set was tried out and some weak broadcasting stations were tuned in for the first time without mushy results. Therefore it may be assumed that the mushiness complained of in the past was due to failure to be able to establish actual zero beat. The failure arises from the relatively great capacity, hence frequency, changes with tiny angular displacements of the dial.

A 15 mmfd. condenser was reduced to whatever capacity resulted when only two plates remained, and still this was too large, so the rotor plate was sheared down to a skinny V, and the results were much better. A commercially-made condenser of a few micro-microfarads, driven by a high reduction ratio dial, not necessarily with any scale attached, would do the trick better, no doubt. Say the capacity of the condenser is from 2 to 4 mmfd., minimum to maximum, a capacity ratio of 2, a frequency ratio of 1.41, by itself, but across some capacity like 250 mmfd., a capacity ratio of about 1.01 or frequency ratio of 1.005, or a change of 5 cycles out of a 1,000. Thus at 1 mgc the change would be 5,000 cycles, at 10 mgc 500,000 cycles. For 10 mgc, therefore, the capacity change would have to be smaller.

This is true despite great reduction ratio of the driving mechanism. Other methods of changing the frequency slightly are given special treatment later on in this article.

Trial on Regenerative Set

A suggested method is to take the smallest variable condenser you have, and put in series with it a condenser of a few micro-microfarads. This might consist of half an inch of twisted pair made up of hookup wire, the two leads forming the condenser plates. Then the larger condenser could be varied. Assuming even a relatively large condenser of 6 to 90 mmfd. range, with 1 mmfd. in series, the change would be from about 6-7 mmfd. to a bit less than 1 mmfd.

Anybody who has a regenerative set

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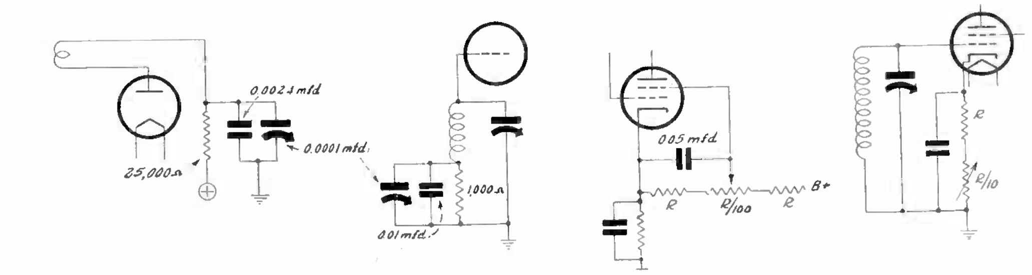
How to Obtain Small Frequency Changes



Four other methods of changing the frequency slightly for zero-beat reception purposes. The one at left uses a relatively small variable condenser across a bypass condenser in the detector plate leg. The next one uses the same system in the grid circuit. The third example is that of screen-voltage variation, while the last changes the negative bias on the tube a little. All four methods apply to the detector tube.

As very small change in inductance or capacity is required so that zero-beat reception may be enjoyed, particularly on frequencies higher than those of the standard broadcast band, some methods other than the direct inclusion of a small parallel condenser in the tuned circuit are shown.

The first method shows a relatively small variable condenser across the bypass condenser in the detector plate circuit. Since the effect of the tube is like that of a series resistance, the bypass capacity across the plate load resistor has a minimized effect on the tuned circuit. The larger the bypass capacity the larger the effective parallel capacity it contributes to the tuned circuit. This has been verified experimentally.

For such capacities as 1.0 mfd., etc., the effect on the tuned circuit is equivalent to that of a condenser of a few microfarads, therefore since the maximum capacity as shown would be 0.0025 mfd., the equivalent parallel capacity across the tuned circuit is even smaller than in the previously-cited instance.

Welcome Difficulty

So, too, 100 mmfd. is relatively small compared to 0.0024 mfd., and it may so happen that the change is even too small. That would be a welcome trouble, as all one would have to do would be to increase the variable or decrease the fixed condenser. And when the capacity changes do not alter the frequency in any manner the ear can determine, then one starts at the easier beginning. When the change is so rapid at first that one glosses over stations otherwise receivable, the remedy is not so ready.

It is perhaps well to keep the resistances out of the tuned circuit, but the second diagram at least reveals a method of slightly altering the frequency. The 1,000-ohm resistor is bypassed by a sizeable capacity, and the variable is only one-one-hundredth the value of the constant.

Also, one may desire to alter the screen voltage slightly. This may be done by using the usual dropping resistor between arm and B plus, represented by R at right in that diagram, and using an equal value resistor on the other side, the potentiometer being between these two resistors, arm to screen.

Resistance Values

It is suggested that the value of the potentiometer be one-one-hundredth the value of teh limiting resistors, or, if the two limiting resistors are unequal, that the potentiometer be one per cent. of the smaller. Depending on what band or general region of frequencies one intends to work in, the potentiometer value may be selected. The values suggested should apply to the broadcast band and intermediate short waves. For higher frequencies, the potentiometer may be made a fraction of 1 per cent. of the smaller of the two limiting resistors, assuming them unequal. At all hazards, when the arm is at any position the screen voltage should be sensibly related to the plate voltage. If the plate voltage is low, say around 100 volts, the screen voltage may be the same, whereupon the right-hand R would be omitted.

Negative-Bias Method

An easy way to change the frequency is to alter the negative grid bias slightly by having a small rheostat in series with the cathode-leg biasing resistor. Whatever value R has for biasing, in the fourth diagram, the rheostat may have one-tenth that value, or, if this proves too much for the intended purpose of the rheostat, shunt the rheostat with a resistance smaller than itself.

The general rule is that the higher the negative bias, the lower the frequency, because the emission utilized is less when the bias is increased.

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can try out the zero-beat method of reception and see how he fares. The small variable capacity has to be put across the main tuning condenser for ease of attainment of results, and when difficulty arises in establishing zero beat, the main condenser has to be turned to the lesser-capacity side while the vernier condenser is at minimum, or the main condenser turned to the higher capacity side of zero beat when the vernier condenser is at maximum. Then the vernier condenser is used for establishing the zero frequency difference.

The regenerative receiver would be worked in a constantly-oscillating condition.

Use on Signal Generators

Any who have signal generators of the type that have modulation removable also may resort to the zero-beat method, by putting condenser-bypassed phones in the generator plate circuit, and establishing antenna input. This input may consist of wrapping a few turns of wire around the coil and connecting one end of the wire to the antenna, grounding the other end, if you like, although this is not necessary.

The oscillating receiver has to be stable, of course, and so must the transmitter, for that matter. A good deal of the transmission, considering "all waves," is unstable, and therefore the reception will move from zero beat to some finite beat. Stabilization of the oscillating receiver may be accomplished to a degree by using a large enough plate load resistor in the detector, the attenuating effect of the resistance on amplitude of oscillation not being serious, because of the low-impedance capacity shunting this resistor. Of course, if the plate resistor load is made too high the circuit will stop oscillating, at least over part of the dial, and therefore the value should be selected on the indicated experimental basis. The specified 25,000 ohms are safe for oscillation to 20 mgc, with only a fair coil system.

There was no trouble on the broadcast band, as the receiver with the 25,000-ohm resistor was amply stable, and of course so were the broadcasting station carriers. Some trouble was experienced in trying to hold a few amateur transmitters. This might have been due to the stations having just gone on the air for the night, the tubes not having warmed up and the circuit generally not having attained its normal temperature.

If a transmitter carrier changes frequency very slowly, that is, drifts, this may be followed through by tuning, but if it changes rapidly, the effect is somewhat like that of fading, accompanied by audible change of frequency more pronounced than in the instance of real fading.

Bringing in C.W.

The zero-beat method of reception may be slightly amended, of course, to enable reception of continuous waves. By this type of transmission is meant the intermittent sending of a continuous-wave carrier, for which true zero-beat reception provides no possibility of audibility. It is necessary not only to have an oscillating receiver, but one oscillating at a frequency slightly different from that of the carrier. The pitch or audio frequency heard in the phones or speaker is equal to the difference between the two frequencies. Hence once may select any tone he desires, and in amateur practice a note is selected to which the acoustical transducer is most sensitive.

We have a switch tone-padding circuit, and therefore we have practically cut off the frequencies higher than 5,000 cycles so that we shall not be annoyed by the squeals as we tune from station to station, or "cross the carriers," as the saying

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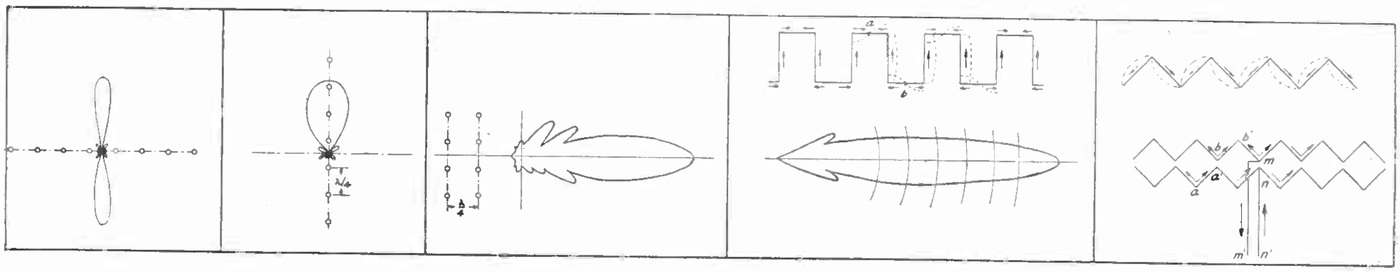
Beams for Much More Power

Antenna Arrays, Other Reflectors, for Sending and Receiving

By Edgar G. Barrows



A number of vertical wires are spaced regularly at a distance from each other that is less than one wavelength with currents in phase. The resulting field is at right angles to the array.

A number of vertical wires are spaced one quarter wavelength from each other with currents in phase quadrature. The resulting field is in line with the array and gains benefit of asymmetry.

This is two arrays of the first type separated by a quarter wavelength. The resulting field becomes asymmetrical rather than symmetrical.

The Grecian key pattern antenna arrangement of Mesny with one side of its symmetrical field pattern. Without the reflector or curtain, another symmetrical lobe will appear.

The zig-zag directive arrangement of Chireis and its practical adaptation. This arrangement is responsive to a wide band of frequencies.

RADIO waves are limited in their usefulness by interference induced in them as they flash through space. To minimize this limitation, the signal-to-noise ratio must be increased, which involves weaker noise or a stronger signal.

Noise may be weakened at the receiver by re-arrangement of the antenna system and by more selective tuning circuits, but this remedy is extremely limited. The signal may be strengthened at the transmitter by an increase in power and by a more efficient arrangement of the transmitting antenna system. The man at the transmitter cannot control the magnitude of the noise at the receiver directly but he can affect the initial strength of the signal at the transmitter, with a consequent effect at the receiver.

The altering of power for this purpose is usually limited by license, or if not, by financial considerations. At any rate, it should be the desire of all transmitter operators to have their equipment performing at maximum efficiency.

Beam Boosts Signal

Aside from efficiency of the transmitter proper, efficiency in the antenna system is a point that is usually overlooked. This is the best tool in many instances whereby a signal may become more effective in overriding noise at a receiver. And the best means in this connection is the endowment of an antenna with the property of directing its energy in a single path so that its strength is concentrated with a consequently great increase in volume at the receiver. Another advantage of the concentration of this energy besides increase in signal strength is the minimizing of interference to other signals.

The advantages of directional transmission and reception have been appreciated since the early days of radio but efficient systems have been possible only since the development of the high frequencies. This is so since a directional antenna system cannot be efficient unless its physical dimensions are compatible with the wavelength of the signal.

For the lower frequencies this results in gigantic dimensions which are impractical due to the great deal of space necessary, and due to the handicap on rotatable action to furnish directivity in all directions.

Ham Band Improvement

On the other hand, the high frequencies, short wavelengths, are readily adaptable to practical sizes and so may utilize the antenna array to full advantage. The radio amateur should avail himself of this fine opportunity to utilize an effective means of increasing the strength of his signal and reducing the great amount of QRM (interference) on the ham bands.

In the construction of a directional antenna array, the ham has the choice of several types. He will decide which to use according to the amount of space available and the extent of his needs. All directional antennas make use of either one or both components of a system of wires comprising what are known as directors and reflectors. The director is the name applied to those wires that are directly fed by the transmitter while the reflector is a wire that is usually spaced one-quarter wavelength away from the director. This wire is not fed directly from the transmitter but has a current induced in it due to its proximity to the director.

The quarter-wave spacing is critical, since it is this spacing between the reflector and director that causes the current that is induced into the reflector to have the correct relation in phase angle so that directivity is built up in one direction only.

The lengths of the director and reflector wires are so chosen that they represent

(*Continued on next page*)

Directions on Coupling Antenna to Receiver

(*Continued from preceding page*)

is. Therefore we have to select a tone not higher than 5,000 cycles, which we do by adjusting the vernier condenser, or other micrometric control, to yield the very tone we desire or prefer.

The nomenclature for the types of transmission is far from perfect, an observation that holds true of radio technical terms to a large extent, and so perhaps a word should be said in explanation of continuous-wave sending, of comparison with other forms.

Cases Distinguished

Take the most familiar example, that of broadcasting stations. They too send out continuous waves. But they introduce modulation, consisting of voice and instrumental frequencies. The modulation changes the frequency of the carrier, and this is classified as an "interruption," so broadcasting stations send out interrupted continuous waves, abbreviated i.c.w.

The Circuit Diagrams

The diagrams of the one tube and a four-tube circuit include the tone-padding, which is an 0.05 mfd. condenser across the 25,000-ohm plate resistor or phones in the detector circuit, and in addition the volume control is really a tone control in the four-tube set so that the "highs" may be further attenuated by any who so desire.

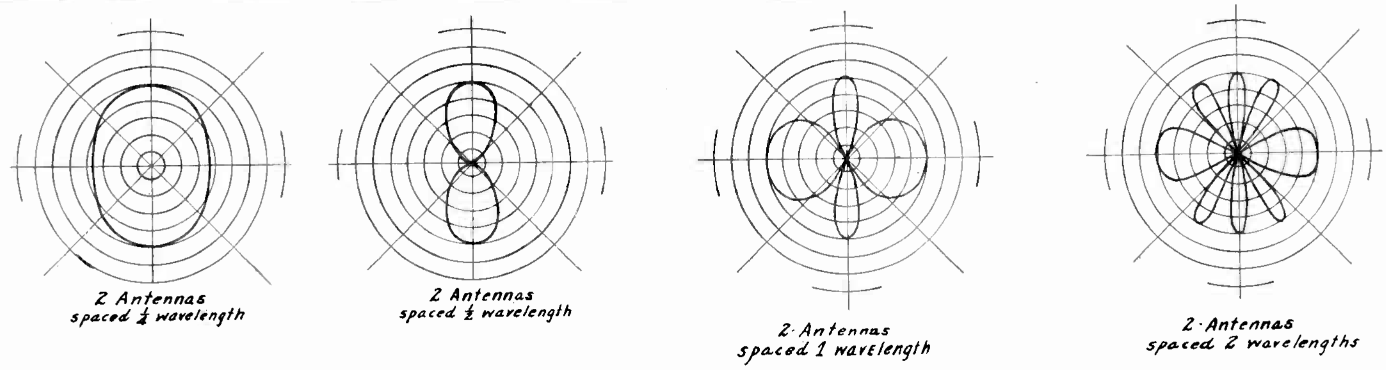
The larger circuit is shown for only earphone operation, because of the lowered amplitude due to the tone padding, but the circuit will operate locals on a speaker. Therefore a small magnetic speaker may be hooked up in place of the 'phones.

The 4-tube circuit is for "universal" use, 90-125 volts a.c. or d.c.

To have the zero-beat receiver working properly it is necessary that the antenna be coupled to the tube input with sufficient looseness that oscillation is present all over the tuning span for any given coil. This does not mean a skinny primary for any frequencies as low as those of the broadcast band, but as the frequencies become higher, particularly much higher, naturally the coupling is made seemingly less. In fact, it may be more, but the far fewer turns make it seem less.

The test for enough coupling is that the stations should be heard well and without interference. That presupposes there is oscillation, for otherwise it would be practically impossible to hear any stations, except very loud ones, and those would come in broadly.

Should the antenna be grossly overcoupled to the tuned circuit there will be cross-modulation, even if oscillation is present.



Two vertical wires to which are fed currents in phase radiate different field patterns dependent upon the spacing between them.

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multiples of half wavelengths of the signal current. When space limitations are present this length necessarily becomes one-half wavelength as a minimum.

The most obvious scheme for obtaining directivity of a radio beam would be an imitation of the reflector behind searchlights. These reflectors are built in the form of a parabola, since it is the property of this curve to reflect in parallel straight lines any rays that are emitted from its focus. Accordingly we find that very good directivity is obtainable by application of this idea to radio. The principle involved is to construct an antenna wire one-half wavelength long, to serve as a director. This director is placed at the focal point of a parobolic surface built around it. This parabolic surface may either be a sheet of copper, copper mesh screen, or a system of wires that are parallel to the director and to each other and describe a parabolic path. Such an antenna is detailed in the article on treasure finding in this issue. This antenna can be so constructed so that it may be rotated in all directions. A compass may be attached to it and thus permits the operator to control the destinations of his signals.

More Wires, Closer Beam

When two directors, fed in phase, are vertically mounted and spaced one-quarter wavelength, some directivity of a symmetrical pattern is obtained as shown in the first sketch. Consecutive variations of this spacing from quarter-wavelength to half-wavelength, to one wavelength and to two wavelengths, are shown in the other sketches. The effect in the field pattern is obvious and it can be seen that the directivity of the array is materially affected by this spacing.

When a great number of half-wave directors is constructed so that the spacing is less than one wavelength, with currents in phase, we have what amounts to a hyperbolic arrangement with a focal point at infinity. Such an antenna is shown in a diagram and possesses a symmetrical figure eight field pattern, the acuity of which increases with increasing number of director wires in the array.

If this arrangement is altered so that the spacing between adjacent wires becomes equal to a quarter wavelength and each alternate wire is made a reflector while the others remain director wires, the field pattern becomes asymmetrical. This is a valuable property since it becomes unidirectional instead of bi-directional. Just as the hyperbolic antenna, consisting of directors only spaced less than one wavelength apart, has the outstanding property of an acute beam, the hyperbolic antenna, with alternate reflectors, has the outstanding property of unidirectional radiation.

Further experiment reveals that the asymetry is obtained by the use of the reflector wire, and that one director and one reflector are sufficient for this purpose. Accordingly, by combining the two types of arrays just described, it is possible to obtain an acute, asymmetrical beam by the arrangement shown in another diagram. Here we have a row of director wires separated from a row of reflector wires by a distance of one-quarter wavelength. By increasing the number of pairs of wires, a very acute beam can be afforded.

For avoiding the delicate adjustments of the antenna arrays described, and to simplify the methods of feeding them, René Mesny, professor of hydrography, French Navy, contrived an ingenious scheme, shown in the next diagram. It will be seen that this antenna resembles a Grecian key pattern formed by a continuous wire. The dimensions of this wire are so chosen that the current distribution on it is one half wavelength from point a to b, the middle points of successive tops and bottoms of the pattern. This will make all sides one-quarter wavelength long.

It will be noted that with this arrangement the currents in the vertical wires are all in the same direction, while the currents in the horizontal portions oppose each other. This Mesny arrangement may be excited in the center or at the ends by separate oscillators. One row of this Mesny curtain will produce a beam that is bi-directional. The advantage of asymmetrical radiation is obtainable from this scheme also by means of another Mesny curtain spaced one-quarter wavelength behind it to act as a reflector. By this means, a unidirectional antenna is easily constructed and readily adjusted.

Wide-Band Method

The next sketch illustrates the Chireix-Mesny antenna (sometimes called the C-M system.) This antenna is an extension of the Mesny scheme of one continuous wire and comprises a zig-zagged wire, each section of which is a half wavelength long, as shown. The next sketch illustrates the practical form of this antenna and constitutes one section of a whole curtain of such pairs. Similarly, for asymmetry, another curtain is spaced one quarter wavelength from the first antenna in back of it, to form a reflector that provides the uni-direction pattern. One advantage of the C-M curtain is that it may be used for transmission or reception on a band of frequencies, 400 kc wide on a wavelength of 20 meters.

There are several more types of elaborate arrangements that have been devised and are being used successfully. However, for amateur purposes they become quite cumbersome. They are accordingly of no interest here. It is believed that the foregoing comprises sufficient data to start the amateur's curiosity working and it is hoped that the disease germ, known as "beamocci," has been planted in fertile soil since the field of directional antennas has been avoided by the amateur too long.

Utilizing the ultra-high frequencies, one may perform many experiments and possibly gain fame by discovering some unknown fact in this field.

Literature Wanted

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

David F. Myrick, c/o Fountain Valley School, Colorado Springs, Colo.
W. A. Stine, Rock Hill, South Carolina.
Paul Weland, Box 139, Arnolds Park, Iowa.
G. F. Dennis, 261 West 8th Street, Marysville, Ohio.
H. R. Darling, 264 Wood Avenue, Hyde Park, Mass.
Ray L. Stanley, Sr., 1416 North Correll, Dallas, Texas.
John Muir, 4239 Drexel Boulevard, Chicago, Ill.
Ben F. Purl, Box 402, Calvert, Texas.
L. Johnson, 608 East 6th Street, Cheyenne, Wyoming.
Melvin I. Shoul, 102 State Street, Newburyport, Mass.
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Arthur L. Tuttle, 32 Wall Street, Wallingford, Conn.
Geo. B. Thompson, M.D., 2400 West Pico Street, Los Angeles, Calif.
L. Bottinelli, 323 E. Mosholu Parkway, New York City.
William Peckett, 202 Morse Street, Camden, New Jersey.
Nick Carlis, 511-9th Avenue, New York City.
D. W. Goodenow, 88 Oxford Street, Somerville, Mass.
Ernest Grigg, 2905 Horner Avenue, Merchantville, New Jersey.
Edward J. Kranter, Box 33, Wickliffe, Ohio.
Fred Koehler, 1609 Dexter Avenue, Cincinnati, Ohio.
King Mar, 150 North Market, Wichita, Kansas.
McDaniel Radio Co., 3518 Fruitvale Avenue, Oakland, Calif.
Joseph Novick, R.F.D. 2 Box 61, Altoona, Pennsylvania.
J. Wallace Rock, Braham, Minnesota.

No Transformer, No Choke

In this Hum-Free Short-Wave Converter

By Henry Burr

WHEN circuits were shown a few years ago without any power transformer even persons other than transformer manufacturers were startled a bit, because the power transformer had been considered standard if there was to be a-c operation. More recently even the filter choke is omitted. What about that? The manufacturer of transformers also manufactures filter chokes, but in the instance of chokes he hasn't so much to worry about, because the use of the resistor to replace the choke is limited to small-current outfits.

One such outfit is the converter diagramed herewith. Looking at the cathode of the 76 rectifier tube, at right-hand side of the diagram, we find that the B plus lead is taken from the cathode as usual, but that at once we encounter a resistor of 0.02 meg. (20,000 ohms). Next to the rectifier is an 8 mfd. condenser. We expect to find another similar capacity where the common B feed is taken by a converter or receiver, but there is none, for none is needed.

Hum Effectively Silenced

There are two factors that operate in favor of the practicality of the scheme shown. One is that the limiting resistors in the plate legs keep down the current, hence the parallel resistance imposed on the rectifier is large compared to the rectifier resistance, and the other is that there are condensers bypassing these limiting resistors, so that hum is prevented from backing into the tubes. And relatively small capacities across substantial resistors are very effective.

The diagram of the converter shows the 6D6 as the modulator and the 76 as a separate oscillator. In the 6D6 plate leg is a 20,000-ohm resistor, which may be higher if preferred, but too high a resistance here makes the sensitivity noticeably low. In the oscillator plate leg the resistor is shown as 0.2 meg., or ten times as high, and this aids in stabilization of the oscillator. True that the amplitude of the oscillation is reduced, but we do not want much amplitude at all, only enough so that about one-eighth of the oscillator's r-f voltage may be applied to the modulator without overloading the modulator. This is done by connecting a wire from a tap on the oscillator coil to the suppressor grid of the modulator. If the coupling proves too tight it may be loosened by putting a resistor between these two points, instead of a conductor. The value of the resistance will depend on the degree of reduced coupling desired, but in general not more than 50,000 ohms would be suitable.

Such a circuit as this is quite hum-free, and one can not notice the difference in hum between this example and that of an expensively-filtered model that omits the plate-leg resistors and has the usual concomitants. However, if anybody wants to put the full voltage on the plates, all he has to do is to omit the limiting resistors in the converter plate legs, insert the choke in place of the 0.02-meg. from cathode toward the plate returns, and include an 8 mfd. condenser at the end of the choke, negative to line. He will have a little more sensitivity, maybe some overloading of the modulator, but no less hum.

Station Siren Included

The modulator is equipped with a neon-tube circuit that serves as a station siren.

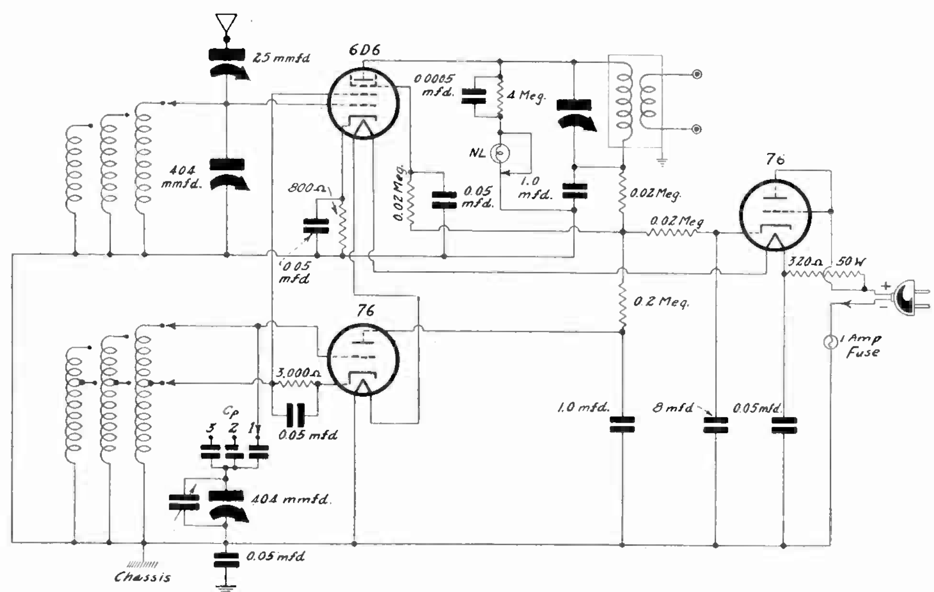


Diagram of a short-wave converter free of hum.

When a station is tuned in the audio tone generated by this relaxation oscillation becomes much more pronounced. Then when the station is located the relaxation oscillator may be shut off. The shorting of the neon lamp by a switch does this.

Output is taken from a broadcast coil used "backwards," that is, usual secondary is tuned to the intermediate (receiver) frequency and is in the plate circuit; primary is used for connection to antenna post of set.

Many persons want to know what is the best intermediate frequency to use. The answer can not be given correctly without a knowledge of the location and also of the receiver. In general, it is well to favor the higher frequencies, and if your receiver will tune above 1,600 kc a bit, you might use that, provided the receiver is fairly stable in that region, or can be made so by attenuator adjustment.

The chief advisability arises in the effect of the high intermediate frequency on image-interference suppression. Considering an i.f. half as high, the suppression may be said to be only half as good. This is true because the trouble arises from a difference, equal to twice the i.f., so if the difference is doubled things are twice as good as they were before. In fact, the higher i.f. has somewhat the same effect as a pre-selector stage. And the extra tuning condenser section and coil system are not required.

A Nice, Quiet Spot

If the circuit is built for a high i.f. it should be used somewhere around the intended frequency, if the tuning condenser is a ganged one. One should be satisfied that there is a so-called dead spot, really a quiet spot, on the receiver dial at the frequency intended to be used, meaning no reception is had here, therefore the frequency is suitable for i.f. use without interference arising from conflict with broadcasting. Otherwise the output of the converter would mix with the broadcasting station's wave at the location and you'd get much of both in the set, which doesn't make for pleasant reception.

Winding Directions for 1,620 kc Converter Coils

The converter described herewith is intended for short-wave use, by switching, and therefore the winding diameter used is 1 inch.

R-F Coils	*Osc. Coils*	*Padding*
26 t. 28 en.	18.5 t. 28 en.	CP1=317.5 mmfd.
8.4 t. 18 en.	7.8 t. 18 en.	CP2= 756 mmfd.
2 t. 18 en.	2 t. 18 en.	CP3=2,100 mmfd. (0.0021 mfd.)

The oscillator coil is center-tapped for the two smaller coils, and the other or lowest frequency coil has tap about one-quarter the total number of turns, measured from the ground end. Close winding is used throughout.

WORTH THINKING OVER

WHETHER CANADA RADIO INTERESTS like it or not, fifteen minutes a day is the period allotted to broadcasting news over the 'cross-border microphones. This decision is the result of long conferences between the Canadian newspaper interests and the Canadian Radio Broadcasting Commission. Ten P. M., EST, is the hour fixed.

When Canada gets down to doing something, whether in art, science or entertainment, it usually makes a clean job of it. The broadcasters of Canada would, naturally enough, like to enjoy the privilege of spending as much or as little time in spreading the news as suits their own convenience or desire, but there's the law as it now stands. Of course, you may be sure—if you know anything about how law is regarded in Canada—that's just the way the matter is to be worked out.

And you can set your watch by that 10 P.M. program, coming and going.

Noise Crusade Under Way

IRE and RMA Engineers Confer; Campaign to Seek Co-operation, No Punishment

By Lee Frawley

THE engineering profession has begun to take a deep interest in the elimination of noise. The campaign is to be waged on the basis of education, not compulsion. When radio remedies were to be applied in the past, laws were sought, and many obtained. However, though this practice is also practically uniform abroad, it is believed that gentle persuasion will be more effective in the long run, especially as the noise-creating agencies are so numerous, that the problem, if tackled on the compulsory basis, might grow to be as cumbersome as was the enforcement of the Volstead act.

A conference was held at Rochester, N. Y., by the Institute of Radio Engineers and Radio Manufacturers Association, Inc., as the first effort to reduce as much as possible man-made static. This is the kind of interference created by automobiles, and rotating devices generally.

Some Remedies Simple

The co-operation of the motor car manufacturers will be asked, no doubt, on the basis that a great deal of the trouble arising from ignition in an automobile can be stopped from emergence into the ether by the use of close shielding in the cars. Offenders of other types, such as operators of flashing signs, X-ray machines, vibrators, motors generally, are numerous, and they, too, could remedy the situation by introducing damping systems that would not interfere with the operation of the device. Sometimes so simple a remedy as the installation of a 1.0-mfd. condenser the commutator will do the trick.

The noises from motors, where these motors act as generators, although it is not intended that they should so act, are usually of a low-radio-frequency origin. That is, the motors generate a carrier. As the wave form is highly damped, the carrier is modulated, and the modulation takes the form of the fiercest grinding static.

Not very much seems to be known by the profession as a whole about the origin and elimination of noise. Naturally, the proposition that the noise should be eliminated at the source is fundamental, but assuming that such elimination may be costly to the perpetrator, and that he is non-co-operative, the engineer is left to devise some system of protecting the receiver from causing too much bother due to noise.

Filter This and That

One of the earliest methods used was to put some kind of a filter in the a-c line circuit. It was thought that the line current carried some of the interference, because the same line served the motor and the set. This was not a bad idea, as a theoretical consideration, but when the audio-type choke-condenser system as used, and did not cure the trouble often enough, radio-frequency filter chokes and condensers were used, and in some instances these did some good, also. However, the mere facts that (a) the remedies were not really remedies in a sufficient number of instances and (b) the experimental nature of using an audio filter or a radio filter system to see which would work, proved well enough that there was more mystery about the solutions, in the minds of the attempted solvers, than they would care to admit in public.

However, anybody who is experimentally inclined can determine for himself a few things about the origin of noise, the frequency of the noise-carrier, and the frequencies of the modulation of this carrier. Also, if any one wants to make a worthwhile study, he can find out whether the motors generate radio-frequency harmonics of the noise-carrier radio frequency that is sent out by the offending motor.

Picture of Situation

The situation may be viewed like this: a motor is revolving, it has associated with it some form of interrupting device, which may be commutator or an armature, the current is unsteady in the motor circuit, even on d-c motors, and there is a kink or group of kinks in the wave form that one would naturally associate with production of harmonics. Therefore no doubt the motor has the following relationship to frequency: (1), it turns at some given frequency; (2), it makes a certain current change in value at some much higher frequency than any frequency of revolution of the motor itself; (3), the current is of such form as to yield harmonics of this rate of change.

It takes some intensity to produce radiation, the fundamental of the noise-carrier gets out, by the second harmonic may be 65 per cent. of that, the third harmonic less than half the fundamental, and thus the harmonics diminish so quickly that it is not to be expected that they appear as radio frequencies to which the receiver will respond.

But the strong fundamental, due to the change in the current by the motor action at some radio frequency, gets out so as to cause disturbance. The frequency of this disturbance may be measured on a frequency-calibrated receiver. It is equal to the difference in frequencies between two adjacent response points for the noise carrier. If that difference is 50 kc then the noise is being sent out on a 50 kc carrier, and most noises of such origin imprinted on a carrier are somewhere around that frequency.

Here's a Valuable Tip

So when the strong 50 kc gets into the first tube, the harmonics are produced in the receiver, hence the noise is tuned in at periods equal on various points of the dial equally spaced in frequency, that spacing being of course the fundamental.

The best, easy method of getting rid of noise of that type is to use a very weak input to the receiver, say, for the broadcast band, introduce a series antenna condenser of 50 mmfd. Of course, this makes the receiver seem less sensitive, although in fact the sensitivity of the set is not affected at all, only the input cut down. And the reason why the series condenser helps so much is that it improves the selectivity by loosening the coupling, it makes the fundamental period of the antenna system much lower than one that would be ratably excited by the noise-carrier, and therefore to attain a given volume of sound from the set the amplification in the set has to be at a substantial level. This means usually that the tuned circuits are put into full play, and it is noticeable that when a station is brought in, even at a position where noise would be present, the stations kill off the noise, hence much of the so-called noise interference is simply encountered when tuning at positions where there are no local stations, for instance. The only known noise that comes in literally all over the dial is natural static, and there's no remedy in sight for that.

The engineers of the two associations are going to study the whole subject closely, and no doubt they will find out some arresting facts, especially if they will observe nature in her real activity, and not carry too much predisposition into conferences. Conferences in which the conferees bring "complete solutions" for the difficulties under discussion usually amount to nothing. If the conferees adopt the attitude they came to learn and and not to teach they may go a long way toward doing something of great importance for radio.

Short-Wave Aspect

The periodic nature of noise should be studied carefully, and the frequencies measured. Many noise carriers are easily measured, for although the noise itself comes under the head of transient, the carrier created, which enables the wide penetration of the interference, is no transient. Only the modulation is transient.

The growing popularity of short waves has accelerated efforts to reduce noise, especially as the sales of receivers is impeded somewhat by the fact that short waves are so noisy. The car ignition trouble is particularly severe in the intermediate short-wave band. This is a form of spark transmission, and indeed if punitive measures were sought, the offenders might be punished under existing law for sending without a license! What they send may not be particularly illuminating, but some folk say they can identify a car by the form of interference it creates. One fellow says: "Here comes a Ford model T," and then all hands rush for the window and lo, and behold! There they see—well, it may be a Ford model T or a Quince model G, but it's a car nevertheless and it causes interference.

Because the knowledge necessary for a full insight into the subject is so wide, and because co-operation is needed from so many quarters, aid is to be sought from the Edison Engineering Institute, the National Electrical Manufacturers' Association, the Society of Automotive Engineers, and even the Federal Communications Commission.

Notables Quoted

Here is what some of the conferees had to say at Rochester:

DR. ALFRED N. GOLDSMITH, consulting engineer, former RCA vice-president, one of the foremost active advocates of betterment in radio:

"We shall strive in a co-operative manner to bring about an electrically silent atmosphere in the United States. We shall pursue purely persuasive methods in an effort to be helpful over a period of years in improving all types of radio reception, which includes television, if, as and when it arrives. No governmental edit will be sought, as has been the case several foreign countries. We shall do the work, not by legislation, but by constructive engineering methods."

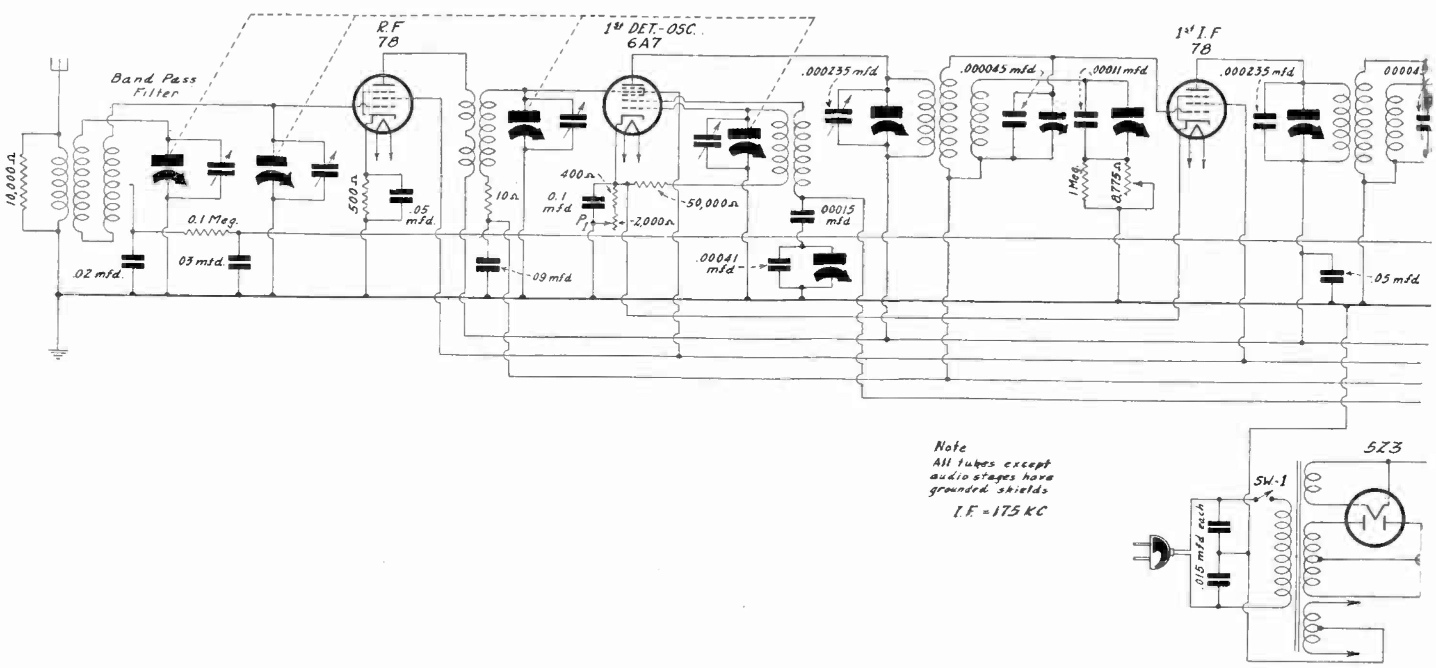
ORESTES H. CALDWELL, formerly Federal Radio Commissioner, now a magazine director:

"The present wide interest in short wave radio has brought new interference factors into the radio picture, due to the short-wave emissions of the ignition systems of automobiles and airplanes. The steady rat-a-tat-tat of the spark distributors on private cars, trucks and mail planes can often be heard for several miles, blotting out faint radio signals from the other side of the world. Proper shielding will largely eliminate such automo-

(*Continued on page 19*)

ANALYSIS OF HIGH-

By Rodma



The circuit diagram of the Philco 2 broadcast channels. The all-wave n the extra c

ON occasion, the hue and cry was raised that modern radio receivers left much to the imagination in regard to faithful reproduction of the high-quality transmissions of most broadcast stations. It was stated that the best radio receivers lacked the frequencies above about 3,000 cycles, hence reception had a booming tone and caused instrumental music to sound unnatural. Such instruments as cymbals, bells, etc., which contain a preponderance of the frequencies between 5,000 and 10,000 cycles would thus be denuded of most of the recognizable characteristics. It therefore is commendable that high-fidelity receivers have come into existence.

The Philco high-fidelity models, 200 for broadcast band, 200X for domestic and foreign, are a ten-tube superheterodyne so designed as to provide a uniform audio response from 30 to 7,500 cycles, which is an improvement over most present broadcast receivers. However, due to the allocation scheme of broadcast stations enforced by the Federal Communications Commission at present, where stations are separated by 10 kilocycle channels, it has been necessary to include in this receiver suitable means for controlling the width of the audio response.

Modulating Frequencies

Stated differently and at the same time to give an example: Suppose your receiver is so located that it can receive two broadcast stations separated by 10 kilocycles more or less equally loud. If the receiver will allow a signal to enter that occupies a band 15 kilocycles in width (7,500 cycles on both sides of the carrier frequency), it will reproduce all audio frequencies above 5,000 cycles from the station adjacent to the one that is tuned in. Thus cross-talk and chatter will mar the performance of an otherwise good receiver. It can be seen then that high-fidelity sets are limited in their audio frequency range by the separation between adjacent stations; and that where selectivity is desired, fidelity has to be sacrificed. On the other hand, the situation may be such that other stations are sufficiently far removed from the carrier of the desired station that no interference would result. In this case, the selectivity can be sacrificed for greater fidelity and better quality can be enjoyed. It can therefore be seen that until new Federal regulations provide greater separation between adjoining channels that might cause interference, a variable selectivity-fidelity control is a necessary adjunct to all high-fidelity receivers, and the degree of fidelity obtainable from a high-fidelity set is determined by the presence or absence of adjacent-channel interference.

Antenna Treatment

Few stations use modulating frequencies of 15 kc, but some experimental ones do so on 1,500 to 1,600 kc, spaced 20 kc. But even on other stations the improved reproduction is marked.

In order to allow the initial acceptance of a sufficiently wide band, the antenna circuit has been designed to furnish sufficient selectivity and yet not to mar the fidelity features. This is accomplished by the shunting of the primary of the antenna coil with a 10,000-ohm resistor which tends to maintain constant band width. This also tends to retain the high inductive transfer of energy from antenna to the first r-f circuit which helps to minimize noise in the first stages that can be highly objectionable in a high-fidelity receiver.

The coupling of the antenna circuit to the first tube is accomplished through a band-pass filter which affords enough selectivity to minimize interference; yet its flat-topped resonance curve prevents sideband cutting and consequent loss of fidelity. It will be noted that throughout the circuit, resistance is introduced in all tuning circuits to provide this flat-topped performance.

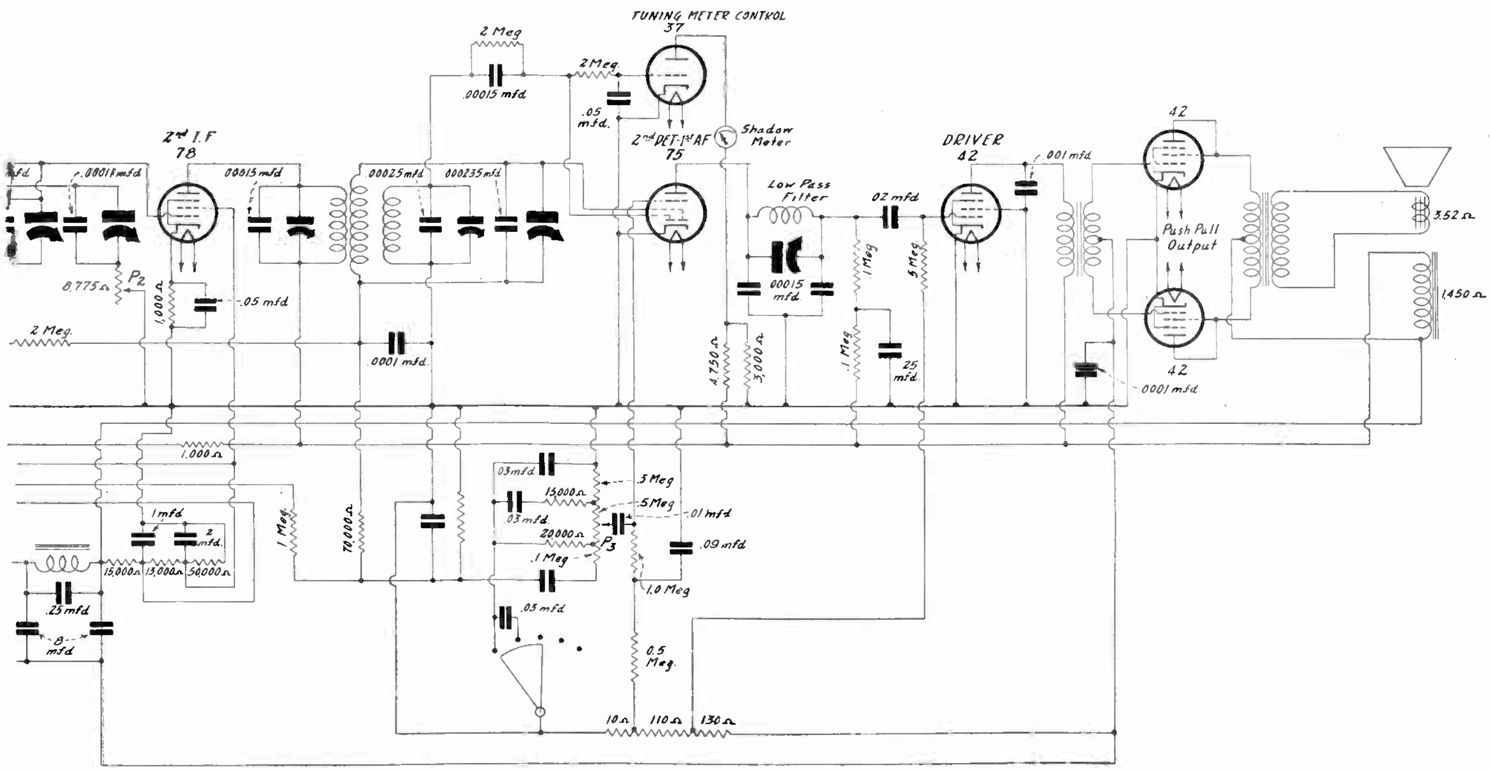
Another interesting feature of this set is the three-coil arrangement on the i-f transformers. The first and second windings will be seen to be standard, while the third winding represents a trap circuit tuned to the center of the intermediate-frequency band. This circuit will tend

VOLTAGE TABLE FOR

Tube	*Heater-Fil.*
78 R.F.	6.3 v.
6A7 Mixer	6.3 v.
78 First I.F.	6.3 v.
78 Second I.F.	6.3 v.
37 Meter Control	6.3 v.
75 Sec. Det.-Amp.	6.3 v.
42 Driver	6.3 v.
42 P.P. Output	6.3 v.
42 P.P. Output	6.3 v.
5Z3 Rect.	5 v.

-FIDELITY METHODS

ı Worcestor



ı00 high-fidelity receiver for standard ıodel, 200-x, is the same, except for ıils and switching.

to broaden the resonance curve of the i-f transformers so that an approximately uniform band, 15 kc. wide, is obtained, at maximum. The width of this band is controllable by varying the resistance of the trap circuit so that the i-f selectivity may be synchronized with the audio fidelity for different conditions of interference.

By these means, the selectivity and fidelity of this receiver are controlled and most effective reproduction of the broadcast programs under varying conditions of interference is possible.

Additional features that are incorporated in this set are automatic volume control, tuning meter circuit, compensated volume control, class A prime output and a low-pass filter to block the passage of all currents above 10,000 cycles.

. PHILCO 200 AND 200-X

Cathode	Screen	Plate
3 v.	80 v.	225 v.
8.v.	76 v.	210 v. (p) 90 v. (grid 2)
8 v.	76 v.	210 v.
8 v.	76 v.	220 v.
0 v.	....	63 v.
0 v.	....	110 v.
0 v.	....	225 v.
0 v.	....	335 v.
0 v.	....	335 v.
..	....	350-350

Technique carrying out the vast experience the manufacturer has had in laboratory, production and sales work has been embodied in the circuit. For instance, there is bass compensation automatically present in the 75 circuit, so that at positions for low volume there will not be an accentuation of the audio highs, otherwise unavoidable, due to the low impedance of the load on the triode's grid. The 20,000-ohm resistor and the 0.03 mfd. condenser provide this compensation, as in combination they attenuate the highs as much as the circuit otherwise would tend to accentuate them, with the volume control near minimum sound level.

Tone Compensation

As there are various settings that will be used, the control is made rotating, so to speak, hence proper compensation will be present no matter what the settings of the control.

The 75 triode is an audio amplifier. The choke and condenser in the series connection of the output is a low-pass filter, with sharp cutoff at 10 kc.

The form of interference resulting from the modulation of a station 10 kc removed from the intended one, causing a jingling rise and fall of sound, resembling jingle bells, is therefore reduced very considerably, and in most instances eliminated. The corection therefore is introduced at the audio level, where it is very convenient to handle it. Nevertheless a sideband width of 10,000 cycles is fully accommodated. This is necessary, if the high-fidelity aspect is to be truly carried out, as indeed it is.

The 42 Tubes

The 42 tube is not used as a pentode, but as a triode, due to the interconnection of elements, accomplished externally at the socket. This tube in the single-sided stage is the driver, and works the push-pull Class A-prime output stage, using the same tubes in the same manner, that is, as triode amplifiers. It is necessary to avoid pentode use in output stages if the high-fidelity goal is to be intact.

Semi-Fixed Power Bias

The negative bias on the high-current tubes is of the semi-fixed type. This is much better than the self-bias method, so far as output capabilities, and is somewhere between fixed bias and self-bias, as to such results. The tubes may be worked at high power levels due to the semi-fixed bias, and the result is that very loud passages will not introdue distortion. The run of receivers will suffer from loud-passage distortion, as when the symphonic orchestra makes a crashing climax, but with audio gaited as in this set, such distortion does not arise.

The table herewith gives the voltage readings, all values for d.c., except the high-voltage feed to the rectifier tube. This particular measurement is a.c. and is rms.

When the voltage readings were taken the line voltage was 115 volts, the tuning dial was set at 55 (and in the 200-X this would simply be 55 in the standard broadcast band), volume control at maximum sensitivity position, fidelity control midway.

Howard Petrie is the tallest of NBC announcers, possessing as well the deepest voice. A native of New England, he graduated to Radio City from WJZ, Boston. In off hours he studies voice and rides horseback. Petrie is married.

The Cathode-Ray Oscilloscope

Its Development and Practical Use in Radio

By M. K. Kunins

W2DPS

Principle of Bifilar Oscillograph.

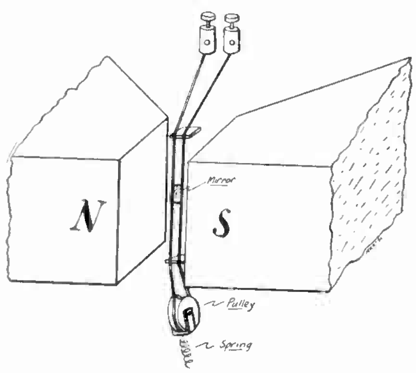


Fig. 1

Ho and Koto Electrostatic Oscillograph.

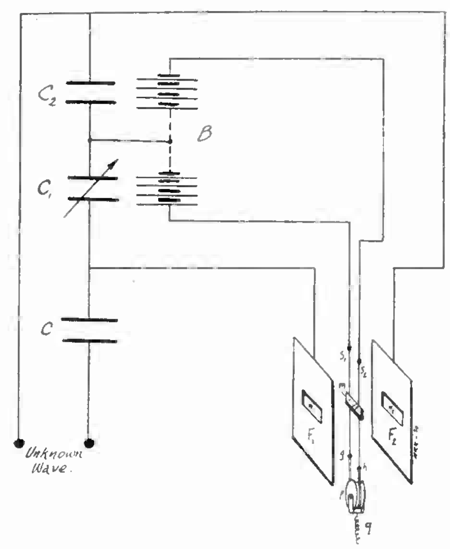


Fig. 2

Piezo Electric Oscillograph.

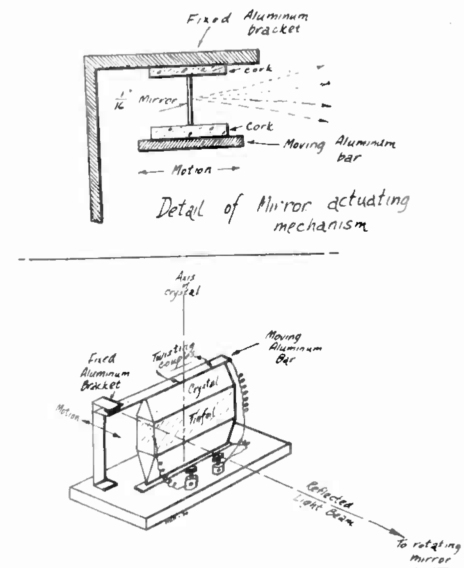


Fig. 3

SINCE the days of Faraday's observations, man's knowledge of the science of electricity has been greatly enhanced. Yet the actual nature of electricity is still a profound secret. What little revelations have been made are in great measure due to the oscillograph. For does not the oscillograph disclose the wave shapes and other properties of electrical forces? It is thus that we appreciate the prodigious possibilities of this instrument and feel that time spent with the oscillograph is of great value.

Just a few of the many uses for an oscillograph for service in simplifying the visualization of various endeavors are included in the following:

Wave form observations
Phase relations
Frequency comparisons
Characteristics of electrical oscillators
Characteristics of radio circuits
Studies of the a-c and d-c arcs
Performance of Tesla and induction coils
Studies of electric sparks
Breaking contact phenomena
Studies of the X-Ray tube
Studies of thermionic vacuum tubes
Corona measurements on power lines
Detection and measurement of atmospheric disturbances, of explosion pressure waves, and other mechanical and electrical transient impulses.
Resonance curves
Permeability and hysteresis of magnetic materials
Measurements of dielectric constants and dielectric strengths
Measurement of power loss in insulators
Capacity and inductance measurements
Electrical manifestations of physiological phenomena
Observation of moving electron properties
Measurement of amplification
Observation of the results of rectification

Although this list is quite long, it is by no means comprehensive, and the researches of every day serve to make it longer.

Refinements Introduced

As is the case with all projects, the oscillograph was evolved from many forms. The first successful type of oscillograph was a natural consequence of the ordinary moving-coil galvanometer. It was inevitable that the galvanometer should be used for oscillographic purposes because of the excellent results obtained with it when used for ordinary measurements. However, due to the rapid movements required of an oscillograph, the ordinary moving-coil galvanometer had to be refined. The different respective refinements in the galvanometer oscillograph introduce us to Blondel, Einthoven and Duddell. The net results of the work of these and other illustrious men is the bifilar oscillograph.

This instrument contains a single loop of light-conducting wire stretched taut between the large poles of a powerful magnet (see Fig. 1). A small mirror is usually mounted on the loop by means of which quantitative readings are obtainable. This type of oscillograph is handicapped because for susceptibility even to such a comparatively low frequency as 10,000 cycles per second, it must be constructed of such delicately light parts as to be impractical for ordinary purposes.

Another form is the electrostatic oscillograph. This instrument is a form of electrometer so designed that it can vibrate very rapidly with proper damping. This high period necessitates a strong controlling force and since electrostatic forces are small at low voltages, this instrument is best adapted for high-voltage work. For such work, it has the advantage of consuming practically no energy. In the instrument devised by Ho and Kato (see Fig. 2), the potential to be measured is applied to the plates F_1 and F_2, either directly or through a condenser multiplier if the voltages are extremely high.

Plate Spacings

These plates serve as "quadrants." They are 15 mm. long 9 mm. wide and spaced 5 mm. apart. Deflections are interpreted quantitatively by the mirror, M, which is viewed through the window w_1. Window w_2 is added merely for symmetry. The condensers, C_1 and C_2 serve to split the potential between the two quadrants. They are nominally of the same capacity: one of them must be adjustable. The condenser multiplier is introduced through the insertion of condenser C. The moving members are formed by two metal strips, S_1 and S_2. As in the moving coil oscillograph, they are stretched by a spring, q, between insulating bridge pieces. They are insulated from each other at their lower ends by the silk thread, gph. The moving members are charged from a 300-volt battery, B. The middle of the battery is connected to the common terminal of C_1 and C_2. This type of oscillograph is handicapped at high frequencies for the same reason as the moving coil bifilar oscillograph. However, it is well suited for low-frequency, high-voltage work.

The piezo-electric effect may also form the basis of an oscillograph. This type has the advantage of being quite inexpensive. However, it is also limited in frequency range. The oscillograph devised by Wynne-Williams of the University College of North Wales in Great Britain is an example of the simplicity that characterizes the piezo-electric oscillograph. This oscillograph employs a Rochelle Salt crystal of suitable form which vibrates sympathetically with the impressed voltages. These vibrations are transferred by suitable mechanisms to a small mirror. The sketch in Fig. 3 explains this type of oscillograph. The only advantage of this instrument is its negligible cost although this is obtained at the expense of accuracy to a certain extent.

Cathode Ray Opens Way

It must have been noted that each of the foregoing types of oscillograph was limited in frequency range. Thus, the frequencies met with in radio were not available for analysis by such oscillog-

(*Continued on next page*)

Braun Tube.

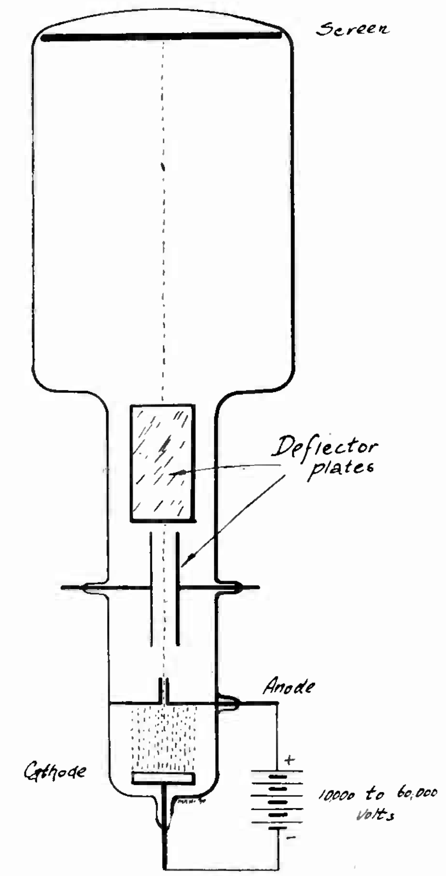


Fig. 4.

Complete Assembly of W.E. 224A Tube.

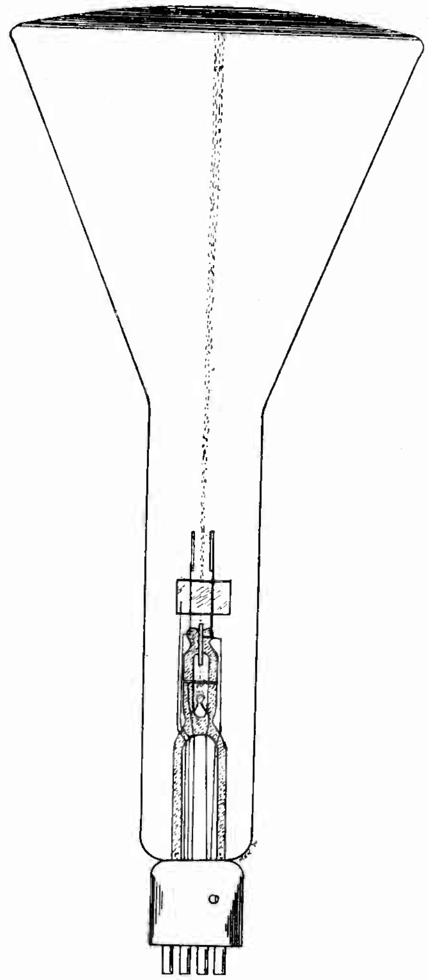


Fig. 5.

Element

Assembly of W.E.224 A Cathode Ray Tube.

Fig. 6.

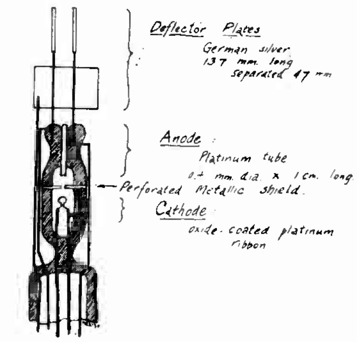
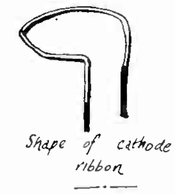


Fig. 7.



(Continued from preceding page)

raphy. Since this incapability was caused by the inertia of the moving parts, radio frequencies could not be analyzed successfully until the inertia was overcome. The solution of this problem was very handsomely obtained by means of the cathode rays that are present in a Crookes tube. The infinitesimal mass of the electrons composing the cathode stream coupled with the fact that the cathode stream is deflected by an electromagnetic or electrostatic field enable this agent to constitute a very flexible oscillograph.

In general, cathode-ray oscillographs are classified into two groups, the cold cathode and the hot cathode. In turn, these two groups are each sub-classified as to the means of electronic stream deflection electrostatic or electromagnetic. Electromagnetic deflection is accomplished in both the cold and hot cathode oscillographs by means of a set of plates that are so situated that the electronic stream passes in between them. Thus the electronic stream is forced to move in sympathy with any potential applied to the plates. Similarly, electromagnetic deflection is obtained by causing the electronic stream to pass in between two co-axially spaced coils.

Braun's Tube Was "Cold"

The cold cathode-ray oscillograph was first developed by Braun, and is sometimes spoken of as the Braun tube. As will be seen in Fig. 4, the Braun tube consists of a bottle-shaped bulb in the narrower extremity of which is the cathode. In going towards the wider part of the bulb we come upon the anode, and the deflecting plates or coils, progressively. Finally, at the broad extremity of the bulb, there is the screen. The action of this tube is dependent on the generation of cathode rays.

As is generally known from the brilliant work of Sir William Crookes, cathode rays are produced in an evacuated vessel between two electrodes when the pressure in the vessel is about 0.001 mm. of mercury and the potential between the electrodes is from 10,000 to 60,000 volts. Herein lies one of the disadvantages of the Braun tube. The high voltages that are required for operation are not only dangerous but also impart the electrons comprising the cathode ray stream with a high velocity that tends to decrease the sensitivity obtainable with this instrument.

In view of these difficulties, a form of the hot cathode ray oscillograph tube was evolved by Johnson of the Western Electric Company. This tube, representing the best results of the researches of many great men, is similar to the cold cathode Braun tube except for the fact that it substitutes a heated Wehnelt cathode for the cold cathode of the Braun tube. As a consequence, this tube requires an anode potential of only 300 to 400 volts, which besides being less dangerous, imparts a much lower velocity to the electronic stream, which accounts for greater sensitivity of the hot cathode tube.

Residual Gas Helps

However, this advantage is not without disadvantage. Due to the comparatively longer time required by the electrons to reach the screen, the forces of mutual electrostatic repulsion operate and cause the electronic stream to spread out. This would be a serious drawback were it not for van der Bijl's suggestion of retaining some residual gas in the bulb. The introduction of argon in the Johnson tube at a pressure of a few thousandths of a millimeter of mercury tends to focus the electronic stream and this drawback is nullified. The sketches of Figs. 5, 6 and 7 show the construction of the Johnson hot-cathode-ray oscillograph tube clearly. The general external appearance of this tube is apparent from Fig. 5.

In Fig. 6 will be found an assembly view of the electrodes which shows the relative position of each element. It might be noted here that the deflection plates are constructed of German silver so as to minimize eddy currents induced from electromagnetic fields.

Fig. 7 illustrates the peculiar shape of the cathode. This form is utilized so as to protect the cathode from the bombardment of the positive ions which pass through the aperture of the shield. For the screen, the Johnson tube uses parts of calcium tungstate and zinc silicate as the active material. Both of these materials are specially prepared for fluorescence and are bound together on the wide end of the bulb with pure water glass. It was found that this procedure gave a generally more useful screen. The pure calcium tungstate gives a deep blue fluorescence which is about thirty times as active on the photographic plate as the yellow green fluorescence of the pure zinc silicate. On the other hand, the silicate gives a light which is many times brighter visually than that of the tungstate. By mixing the two, a screen is produced that is more than half as bright visually as pure zinc silicate and more than half as active photographically as pure calcium tungstate.

It is evident from the foregoing exposition that the Johnson cathode-ray oscillograph is generally more refined than any of its predecessor types of oscillograph. It combines safety and sensitivity, due to the low voltages; flexibility, due to its compactness; frequency range, due to its lack of inertia; and comparatively low cost. However, it is still not the ideal oscillograph. There remains a bad point. This is the fact that as hermetically sealed cathode-ray tube ages, the vacuum becomes harder. As a result of this, the electronic stream spreads out and a large spot appears on the screen instead of a sharply defined point of light. This loss of focusing ability is a serious handicap and is consequently a factor in limiting the life of a Johnson tube. Nevertheless, this tube represents a system by far the best for ordinary work during its normal life and consequently was used in the further development of the author's work, done before the newer group of similar tubes was produced.

The Dufour Method

For the sake of completeness, a few words will be mentioned concerning the

(Continued on next page)

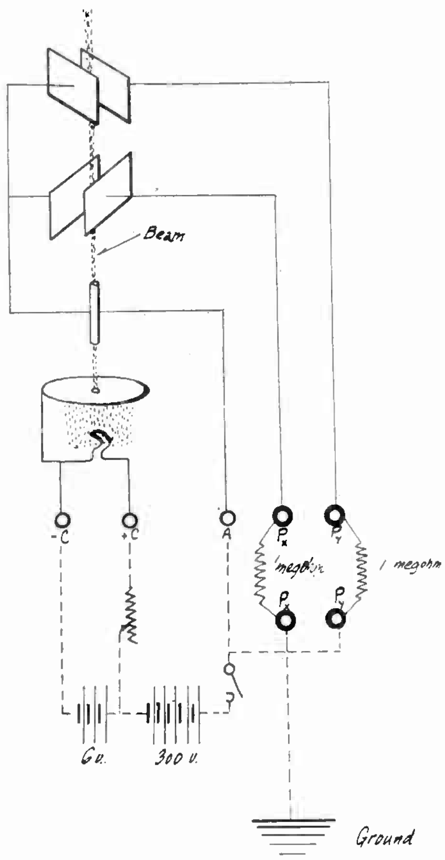


FIG. 8

Internal and external connections of Western Electric 224-A cathode-ray tube.

(Continued from preceding page)

Dufour oscillograph. This instrument is of the cold cathode type. It is so arranged that photographic plates may be placed directly in the electronic stream path, thus permitting the full intensity of the cathode rays to reach the plate. Due to this greater intensity, frequencies as high as 350,000,000 cycles per second have been photographed. Also, this instrument is the best yet devised for recording transient phenomena. One of the luxurious necessities incurred by this instrument is a vacuum pump for re-exhausting the tube for every photographic exposure. Thus, due to its high cost and its special precautions, the Dufour oscillograph is limited to special work only.

Hot-Cathode Oscillograph

As has already been intimated, the best type of oscillograph utilizes cathode rays. In order to generate these rays, certain conditions have to be fulfilled. One of these conditions is that electrons are to be emitted in an atmosphere of low pressure. Of the several ways of producing electrons, the Wehnelt cathode has proven to be the most easily handled. Consequently, this is the means used for obtaining electrons in the Johnson tube.

However, attempts to make a low-voltage cathode-ray oscillograph with a thermionic cathode operating in a high vacuum have met with two great difficulties. These are the charging up of the fluorescent screen and the glass walls of the tube, and the spreading of the electronic beam, due to the greater time during which the mutual repulsion of the electrons acts in a low-voltage tube. If, however, there is a small amount of gas in the path of the electronic stream, the positive ions produced by the passage of the electrons eliminate both these difficulties. The slowly moving positive ions build up a space charge within the beam which effectively neutralizes that of the electrons, so that the beam remains narrow and a sharp spot is produced on the screen.

Accumulated Charges Prevented

The ionized gas also permits the escape of the electrons from the screen back to the anode and prevents the accumulation of disturbing surface charges. On the other hand, when gas is present in the tube, steps have to be taken to guard against arcing and the injurious effects of positive ion bombardment on the cathode. This is achieved by making the volume of gas surrounding the electrodes very small, for which purpose the cathode, shield and anode are enclosed in a glass tube, 3 cm. long and 7 mm. in diameter (see Fig. 6). This tube, containing the electrodes, is mounted within the main tube at the end opposite the screen (see Fig. 5).

The gas in the main tube may be the vapor from a small globule of mercury, although other gases at a pressure of about 0.005 mm. work equally well.

Oxide-Coated Filament

The cathode, from which the electrons are emitted, is a short oxide coated filament. Its life is materially increased by protecting it from the bombardment of the positive ions that leak through the shield. This is accomplished by shaping the cathode strip into a ring (see Fig. 7), the diameter of which is slightly larger than the diameter of the shield's aperture, and mounting it coaxially with the anode. The momentum of the positive ions then carries them past the active part of the cathode, and they strike where little damage can be done. By means of this artifice, the cathode now has an active life of about 200 hours.

In their travel from the cathode, the electrons then strike a perforated shield, where they are transformed from a cloud to a beam. Since the shield is at the same potential as the cathode, it does not affect the velocity of the electrons imparted by the anode.

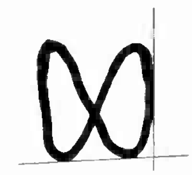
Then, the anode serves to attract the electrons emitted by the cathode through the shield. It is a thin platinum tube, 1 cm. long and 0.4 mm. in diameter. Because of its tubular structure, the anode does not stop all the electrons that it attracts since a small fraction of them pass through the whole length of the tube and form the beam in the main part of the tube.

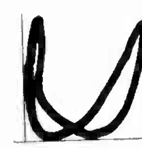
The Deflector Plates

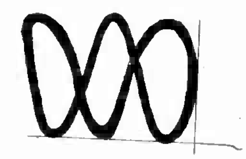
After leaving the anode, on their way to the screen, the electrons pass between two sets of rigid deflector plates. These plates are arranged in parallel pairs at right angles to each other. They are made of German silver, a metal that is non-magnetic and whose high specific resistance diminishes the effect of any induced eddy currents. They are 13.7 mm. long in the direction of the tube axis and are spaced 4.7 mm. (see Fig. 6). One plate of each pair is permanently connected to the anode and is thus at the same potential as the anode. The diagram of connections, shown in Fig. 8, illustrates the electrical hook-up. The electron stream, in passing the first set of plates, is deflected towards the positive plate by an amount depending upon the instantaneous difference of potential existing between these two plates.

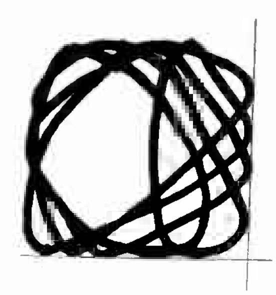
A second deflection, at right angles to the first, will take place when the second pair of plates is reached, if a difference of potential exists between the plates of the second pair. The spot on the screen will then be determined in position by the resultant effects of the simultaneous potential differences existing on both pairs of plates.

LISSAJOUS FIGURES.

2:1  Fig. 9a

2:1  Fig. 9b

3:1  Fig. 9c

4:5  Fig. 9d

The sensitivity of this tube is such that about one millimeter of deflection of the spot on the screen is obtained with one volt between the deflector plates. The electrons, striking the screen, drift back to the anode structure through the ionized gas and most of them are collected by the deflector plates. There is thus a small ionization current flowing to the plates. Consequently, this tube is not strictly an electro-static device. In order that this ionization current should not have a disturbing influence upon the deflection of the beam, it is quite essential that leake resistances of the order of one megohm be shunted across the terminals of both sets of deflector plates (See Fig. 8).

As has been previously explained, the viewing screen is a mixture of calcium tungstate and zinc silicate, bound together by pure water glass. This mixture is a compromise between the desirable and undesirable qualities of either constituent alone. A most generally useful screen is the result.

Practical Application

By utilizing the principles of the foregoing exposition, we place at our disposal a stream of electrons, known as cathode rays. When this stream impinges upon the screen, a greenish fluorescent spot is produced. As such, this instrument is little more than a scientific toy; for, obviously, such a stationary spot is very litited in its application. However, the connection of potentials to the deflector plates and the consequent motion of the spot opens the gate to innumerable valuable applications. Let us investigate the effects on the image of various kinds of potentials applied to the deflector plates.

[Part II, the conclusion of this article, will be printed next week, issue of December 8th.]

The Doctor's Shack Prescription

Burton T. Simpson Takes Own Medicine with Delight

By C. M. Brookings

AN example of a modern shack into which have been built not only transmitters but personality and brains is that of the distinguished amateur operator and professional physician, Dr. Burton T. Simpson (W8CPC), 108 Homer Avenue, Buffalo, N. Y. Dr. Simpson takes amateur radio deeply to heart, not only as a personal hobby but also as a means of development of the brotherhood of man. He devotes considerable time to promoting ham interests and is president of the Atlantic Division Radiofone Association.

Dr. Simpson's shack is shown in the photographic reproduction herewith.

On the left are two transmitters. They are built exactly alike except one uses a 160-meter crystal and the other a 40-meter crystal. The near transmitter is for 40-meter CW and 75-meter fone. The one behind is for 20-meter CW and 20-meter fone. The circuit is: 210 oscillator, 210 doubler, 210 buffer, a pair of 830's push-pull, Class C modulated by a pair of 845's and the linear amplifier consisting of four 852's in push-pull parallel. The input to the final stage on CW is one kilowatt which is cut down to 500 watts on fone, by a non-industive resistor in the grid circuits.

The splendid care and engineering that W8CPC put into the shack equipment produced this enviable result. The ham who did this exceptionally fine job is the distinguished physician, Dr. Burton T. Simpson, director of the State Institute of Malignant Diseases, Buffalo, N. Y.

Size of Transmitter

The transmitters are 66 inches high and 48 inches square. The front panels are aluminum, crackle finished, and the sides and back are perforated steel. The sides may be lifted off for adjustments. The shelves are aluminum and the power pack and modulator system are on the lower shelf. The r-f stages are in the middle shelf and the top shelf accommodates the linear amplifier.

All a-c circuits are in lead cables and the entire transmitter is floating in the cabinet; in other words, the circuits are isolated by insulators. The job is completely home built. The transmitters are on large casters, and can be freely moved when the plug-in circuits and antennas are disconnected.

The antenna leads come into the shack through a plate glass window and are connected to either transmitter by sliding brass tubings. The antenna itself consists of a split Hertz, 33 feet on each side of the center with 45-foot feeders. This antenna works on 20, 40 and 80 meters. On 20 and 80 the feeders are tuned in series, while on 40 the tuning is parallel.

The power supply is self-contained in the transmitters except that to the final amplifier, which is situated in the attic above the radio room. This supply consists of either a motor-generator which can be varied from 800 to 2,500 volts, or a transformer using mercury rectifier tubes. The filter consists of an input choke with a large filter choke having 4 mfd. on either side. A 250,000-ohm bleeder is across the output. Either supply can be utilized by throwing a couple of switches.

What's on the Table

The operating table has on it from left to right an REL frequency meter and an 8-tube home-built superheterodyne receiver. Next is a monitor on top of which is an oscillator to determine the frequency of the crystals. Next is a speech amplifier which consists of one stage utilizing a pair of 112A tubes in push-pull. Next is another monitor. The monitors are one built for 80 meters and one for 20 meters. In front of the speech amplifier is a condenser microphone which has 3 pre-audio stages. Break-in is accomplished by a convenient toggle switch on the edge of the table. Throwing the switch to the right turns on the transmitter and off the receiver; to the left, turns off the transmitter and on the receiver. A switch on the front panel turns on the filaments which are continuously kept lighted. Another switch throws on or off the modulator system by a system of relays.

To change from one transmitter to the other it is only necessary to swing over the antenna and plug in and turn a switch for the power pack and another switch for the amplifier and power packs to the transmitter. This switch is seen at the lower end of the table.

W8CPC has been on the air continuously since February, 1926, and in that time has contacted more than 6,000 stations, having worked all continents and 68 different countries. While 20-meter fone is the band of preference, still W8CPC works considerable 75-meter fone and 20- and 40-meter CW. The shack is situated in a bedroom on the second floor through the courtesy and generosity of the XYL.

Station at Summer Home

Dr. Simpson has a station at his summer home at Springville, N. Y., which is 40 miles south of Buffalo, under the call letters of W8DTA. He has a Class B transmitter there with a 100-watts input. The circuit is a 50 tritet oscillator, a 59 regenerative multiplier and a pair of 46 push-pull buffer, modulating a 203A by a pair of 210's, Class B. On 75 meters he uses a Zepp antenna with 60-foot feeders, on 20 meters a vertical antenna composed of 3-4 inch brass tubing, 33 feet long with 17 feet feeders. While he works at Springville only during July and August, he has made more than 500 contacts from that station, including a fone contact with LA1G, Oslo, Norway.

National Union Offers Rider's Service Manuals

National Union Radio Corporation of N. Y., announced that arrangements have been concluded which will make it possible for every service dealer in the United States to become the owner of a set of the Radio Service Manuals compiled by John F. Rider.

The National Union offer permits service dealers to obtain any of the volumes from one to five or all of them on a special tube-purchasing agreement.

H. A. Hutchins, National Union's Vice-President, stated that on a recent extensive trip, while talking with service dealers in many States, he had become convinced that complete Service Manual data such as contained in the Rider compilations are an absolute essential to modern service work. National Union is making a special offer until December 31st.

Metropolitan 5-Meter Tests Put on Schedule

The low-powered 5-meter transmitter operating in various sections of the 56 to 60 megacycle spectrum is covering the metropolitan area in a remarkable manner. Two-way conversations have been effected between the installation on the 46th floor of the Hotel New Yorker and nearly every town within a radius of 40 miles. Reports are reaching the members of the club which operates the station that the transmitter is being heard over even greater distances. In the past it has been considered possible to carry on such work on the ultra-high frequencies only over distances limited to the range of vision, although exceptions have been noted.

The power in use at this new station (W2DLG) is less than 15 watts and the reported signal strength from all of the outlying districts indicates that this station is putting out the most effective signal in the metropolitan area.

The primary purpose of the new installation is to obtain accurate data on the possibility of using the ultra-high frequency bands for consistent communication purposes, as well as for the broadcasting and television, as soon as television is developed to a point which will enable amateurs to experiment in this increasingly important field.

Seeks Consistent Communication

It is the Club's aim to establish direct and as consistent communication as possible between the headquarters of the American Radio Relay League at West Hartford and amateurs throughout the metropolitan area. Recent work indicates that it will not be long before satisfactory conversations will be a regular thing between these two points. Two stations in Yonkers, N. Y., already have conducted two-way conversations with Hartford, and one station in Montclair, N. J., has done likewise.

To facilitate picking up the West Hartford station, a definite schedule has been arranged between Ross A. Hull, who operates W1AL at West Hartford for the League, and Arthur H. Lynch, who is directing the work at the New York end of this circuit. The schedule includes transmission from W1AL on a special beam antenna directed toward the center of New York City and operating on 59.7 megacycles at the following hours each night, EST: 9:00 to 9:05; 9:30 to 9:35; 10:00 to 10:05 and 11:00 to 11:05 P.M. This schedule is followed by transmission from the New York end to Hartford for the succeeding five minutes of each period.

To make it easier for amateurs in the metropolitan area to pick up the station at West Hartford, the beam antenna on the New Yorker has been adjusted to a wavelength which is within one or two dial degrees on the average 5 meter receiver of the point at which the Hartford station may be picked up.

Tone Telegraphy Used

For about two minutes before the Hartford station goes on, the New York station transmits to all amateurs in the metropolitan area indicating that transmission from Hartford is about to start and enabling the New York amateurs to thus determine where to look on their dials for the Hartford station.

As a general rule, this transmission is made on tone modulated telegraphy rather than voice.

For communication with amateurs in the metropolitan area the station on the hotel generally operates on a frequency which is at the opposite end of the 5-meter band and stations tuned to this frequency would, of course, miss picking up the Hartford station. The correct method of determining the frequency is to tune in the musical telegraphic note sent out by W2DLG just prior to the schedules listed above.

Members of the Garden City (N. Y.) Radio Club will appreciate having reports from amateurs who pickup the New York station, particularly when they are located a considerable distance from the metropolitan headquarters at the Hotel New Yorker.

The results already obtained indicate that a comparatively low-powered station, strategically located in the center of New York City, can cover the metropolitan area on these ultra short waves, which are suitable for television broadcasting.

The Bronx Radio Club

The club room in the cellar of Frank Frimerman's home at 740 Prospect Avenue, New York City, where the Bronx Radio Club has been meeting every Friday without break for more than 12 years, is being repainted and redecorated. Since the members pay no regular dues, the hat was passed around at one meeting and when the noise had abated it was found that almost $40 in American money had been collected. Visitors who haven't been around in a while won't recognize the "jernt" now.

* * *

Fred Parsons, W2EXM, blew the power pack of his big 50-watt three-stage, crystal-controlled transmitter, so he rigged up an emergency outfit using a **single** 2B6 tube in the "Les-Tet" circuit developed by Frank Lester. W2AMJ, who is a past president of the club. Although a few fellows reported him a bit weaker than before, most of the gang noticed no difference in signal strength, and Fred had great difficulty convincing them that the 2B6 was all he was using. At a meeting he spent an hour explaining the circuit, and a lot of those present copied all the dope.

* * *

One of the regular members of the club, who attends practically all meetings, is S. Young White, of the famous Loftin-White team. He usually starts his radio talks with a choice story or two, NOT on a radio subject.

* * *

Many of the boys are having fine luck with low-power rigs. Abe Dolid. W2GLP, is using a solitary 24A (yes, a 24A receiving tube) in an electron-coupled circuit, and has been reported R7 in Baltimore! W2DJJ, with an aerial mostly surrounded by cellar pipes and only 20 feet of it in the open, works 3's, 8's and 9's with a single 210 fed by a power pack from a receiver.

* * *

All meetings of the Bronx Radio Club are open to visitors, and are famous for their informality. The discussions range from politics to psychology, but let anyone mention a new tube or circuit and the meeting really gets down to business. Code practice is held before the meetings open.

Fone Associations Growing Rapidly

There is great activity in the formation of amateur radiofone associations throughout the country. There are at present organized and functioning well, the Atlantic Division Radiofone Association, of which Dr. Burton T. Simpson, of Buffalo, N. Y. (W8CPC) is president; the New England Fone Association, of which Colonel Boyden, W1SL, is president; the Canadian Radiofone Association, of which Milton Cole, VE3II, is president, and the West Gulf Radiofone Association, of which Millard Walker, W5AHK, is president. The total paid-up membership in these associations is nearly 600 and new members are rapidly coming in.

In the very near future perfection of a radiofone association in the Central Division, in the Mid-West Division and in the Delta Division is expected. It is hoped that before long all divisions will have an active radiofone association.

The object of these fone associations is to police the members, to improve radiofone operation, to develop this phase of the art and to be of mutual help through technical committees. Weekly broadcasts are put on the air from key stations, which broadcasts consist of news of interest to fone men. Each association is governed by a board of directors. During the interval of annual meetings, the work of the association is carried on by an executive committee.

However, in the New England Division, where there is a director representing each state, meetings are carried on weekly by radiotelephone, the president acting as presiding officer. The dues of the association are $1.00 per year which just about pays expenses of postage and issuing membership certificates and other incidentals. VE3II, as president of the Canadian Radiofone Association, which was recently organized, says they have already more than 100 members and he feels confident that within six months every fone amateur will be a member of the organization.

Radiophone and Finder for Small Craft Announced

A new type of radio telephone equipment which enables captains of fishing vessels, harbor craft and yachts to have telephone service at sea comparable with that on land is being shown for the first time at the Marine Exhibit, 80 Broad Street, New York City.

When within range of a coastal harbor radio telephone station providing this service, captains are able by means of this equipment to talk to their offices, their homes and in fact to almost any destination as easily as though they were on land. They merely pickup up a telephone, located, for example, in the pilot house, press a button on the instrument and say "Marine Operator." Promptly a voice replies with the familiar "Number Please" and the call goes through as do millions of land calls daily. When the ship itself is called, a selective device rings its bell but not that of any other ship.

The equipment designed by Bell Telephone Laboratories for the Western Electric Company consists of a telephone and a control unit, a cabinet about the size of a trunk which contains a 50-watt transmitter and a superheterodyne receiver, and lastly a power unit.

A radio direction finder newly developed for use with this equipment gives bearings to within one percent accuracy even at distances of several hundred miles. The direction of the incoming beam is registered directly on a scale in the pilot house.

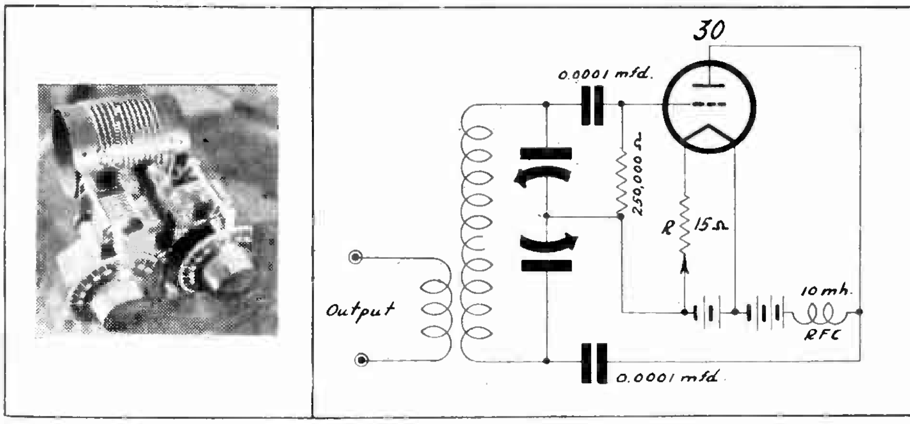
THE AMATEUR ORACLE

Address Questions Concerning Amateur Regulations and Technique to M. K. Kunins (W2DPS), Technical Editor, Radio World, 145 West 45th Street, New York, N. Y.

Colpitts Oscillator

PLEASE INDICATE the circuit diagram for a Colpitts oscillator, showing all constants for the 40-meter band.—N. B.

The accompanying sketch shows the Colpitts oscillator. It will be noted that two variable condensers are utilized to tune one inductance. The oscillation adjustment is therefore obtained by means of the condensers rather than by changing the inductance as in the Hartley Oscillator. For the 40 meter band, these condensers should be of the 21 plate variety across a twelve turn coil. Other constants are shown in the diagram. Incidentally, this circuit has the advantage over the Hartley in that the voltage across the condensers is less and consequently these condensers do not have to be of the high-voltage type.



The Colpitts oscillator consists essentially of two condensers in series across an inductance. Thus, oscillation control is achieved through variations in these capacities.

* * *

Key Clicks

MY EFFORTS to be in the ham game are continually haunted by the neighbors who complain of clicking noises in their receiver when I transmit. Are there any remedies that I can apply so that this awkward situation may be averted?—B. V. C.

Key clicks seem to be your trouble and to remedy this situation it is necessary to experiment with various arrangements that have been devised by other hams who have been similarly troubled. To start out, connect a "bleeder" resistor across the high-voltage power output of your filter system. This should be about 10,000 ohms or so, dependant upon the magnitude of the high voltage. Another remedy consists of connecting a condenser across your key and a series arrangement of choke coil and resistor of low value in series with the key. Experiments with various values of condenser, resistance and inductance will tend to disclose the most effective arrangement. Further efforts might consist of loosening of coupling, relocation of the antenna system and redesign of transmitter voltage distribution.

* * *

Cathode Connection

HOW CAN the position of the cathode on a receiving tube be recognized? Is there any convention for this?—L. J.

The cathode in all receiving tubes is placed in the same location. To recognize this element, hold the tube with the prongs toward you and the two thick prongs, representing the heater prongs, on bottom. Then the cathode prong will be the one next to the right-hand heater prong.

* * *

Twisted Pair Feeders

IN THE construction of feeders for a high-frequency transmitting antennas, past practice warned us to maintain a distance of several inches between feeder lines. Now, I notice that ordinary twisted pair is being used for this purpose at some stations. Aren't the losses in this type of wire for high frequency so great that very poor energy transfer is obtainable?—L. S. A.

Ordinary twisted cord has been tried at a number of amateur stations and reports indicate that the losses in such feeders are negligible when the feeders are correctly designed. The all-important point to remember in this endeavor is that the feeder impedance be matched to the antenna impedance and to the transmitter impedance. A good way to match the antenna impedance is to divide the antenna in two at the middle with an insulator of about two feet in length and separate the twisted pair for an equal distance to form a triangular arrangement. Variation of the lengths of this triangle will determine the dimensions for optimum operation. To match the impedance of the transmitter output circuit, couple the twisted pair feeders to the transmitter by means of a tapped coil with series variable condensers on both sides. Variations of the taps and the condenser settings will serve to create a matched condition here. It might be stated that these twisted pair feeders are in use at a ham station that utilizes an input to the last stage of one kilowatt and it was noticed that the feeder became very hot without the triangular matching arrangement. When the matched condition was installed, however, the heating was no longer present. If it does this for one kilowatt, it certainly must be O. K. for smaller powers.

* * *

What Is a Good Ground?

I'VE BEEN TOLD repeatedly that a cold water pipe makes the best ground. My experience seems to contradict this axiom since I've found that I get better results from a gas pipe. Please explain this discrepancy.—P. M.

In the final analysis, the efficiency of a ground connection depends upon the conductivity of the ground in the earth. That is, the character of the soil, its dampness, mineral content, etc. will determine whether a radio signal will reach zero voltage level more or less easily. Therefore it should not be assumed that because a pipe contains water it is a good ground. Neither should it be said that a pipe is a good ground because of gas in the pipe. A good ground is determined by two elements: the character of the soil where the connection to earth is made and the resistence of the ground lead to the earth. For the best ground, both these elements should have the lowest resistance possible. Therefore, the ground lead should be short and of high conductance and the actual earth connection should occur at a point where the ground is habitually damp and high in mineral content. The axiom regarding the superiority of water pipes has grown out of the belief that most water pipes are not insulated electrically at the joints so that the pipe system itself has low electric resistance and that the ground through which it passes becomes damp from leaks and sweat around the system. Most gas lines do have insulating bushing somewhere along their length and so are not of high electric conductivity, Perhaps it happens that in your case you have struck an exception to the general rule. The standard acceptance of the cold-water pipe ground is certainly all right to follow in general.

CRUSADE AGAINST NOISE

(*Continued from page* 11)

tive-ignition interference, and it is hoped the makers of 1935 cars will thoroughly shield the new models."

W. R. G. BAKER, chairman of the Engineering Division of Radio Manufacturers Association, vice-president and general manager of the RCA Victor Company:

"The indications are that when television and radio picture transmission become publicly available they will use the shorter waves where man-made static is particularly prevalent. When interference is present on standard wavelength sound broadcasting, the program is usually intelligible although imperfect, because the ear is able to compensate for deficiencies. In visual broadcasting, however, as in a television or radio picture service, interference is translated in terms of visual distortion for which the eye is incapable of compensating properly. More immediately, a reduction of interference would materially aid the progress of short-wave reception of foreign programs which is lately gaining wide popularity. There are two ways of coping with electrical interference in radio reception. The first and most important is to eliminate the interference at its source by proper shielding and suppression methods; and the second is to use a scientifically-designed noise-reducing antenna system. But this last method is not always practicable in congested city areas. Automobile manufacturers and makers of electrical appliances have already shown a willingness to co-operate in this public service. It is now necessary to intensify this co-operation to clear the air waves for the new short-wave entertainment and communications services. Among the chief sources of interference are automobile ignition systems, dial telephones, and home electrical appliances which, when inadequately shielded, generate electrical interference that is carried into the home via the power lines."

Radio University

ANSWERS to Questions of General Interest to Readers. Only Selected Questions Are Answered and Only by Publication in These Columns.

Regulation of B Supply

WILL YOU PLEASE state whether the high-resistance field coil used as B choke is the best practice, and if there is any relationship between this resistance and the power output of the last stage of an audio amplifier?—I. K.

The use of the field as the B supply choke, where the field necessarily has a pretty high resistance, is not the best practice, but is generally more convenient, and, as to first cost, more economical. From the efficiency viewpoint the separate-choke system is superior, and the speaker field may be across the line, with field resistance high enough. Thus the field causes bleeder current to flow. The separate choke should have a low resistance, some few hundred ohms, and high inductance. It is well then to use the mercury-vapor rectifier tubes, 82 or 83. The question at issue is one of regulation, and the better the regulation, the larger the power output. It may be asumed that an equivalent resistance of 500 to 1,000 ohms exists for the power supply, in most receivers, and if this is reduced to 200 ohms, the power output of the previous example, taken as 5.7 watts for a given tube, could be raised to 6.4 watts, and by the use of the mercury-vapor rectifier, and low-resistance separate choke and low-resistance transformer high-voltage secondary, the power in the voice coil can be increased to 7 watts.

* * *

The 6A6 and the 53

STATE WHETHER the 6A6 tube may be circuited and used the same as the 53 tube, of which I understand it is a duplicate?—J. W. C.

Yes, the two tubes have the same static and dynamic characteristics, but the 6A6 is a twin-triode for 6.3-volt operation, and notice particularly than the current is 0.8 ampere in the heater. These tubes are intended mainly for Class B service, but can be applied to other purposes, particularly by uniting elements externally, to create a single triode.

* * *

Decimal Type Dials

I REQUEST a brief statement of the idea behind the decimal type airplane dials for signal generators.—I. K. C.

The idea is the same in principle as used on meters, where the ranges are extended, but the same scales used, a multiplication factor being applied to the scale. For instance, the meter may read 0 to 5, for volts, milliamperes, etc. Therefore the same scale could be applied for 0 to 50, and the user mentally multiplies the scale by 10, merely annexing a cipher. So if a scale is calibrated for a direct-frequency-reading dial, two tiers, if the ratio is critically correct, the decimal system may be applied. Thus, one scale reads in frequencies from 54 to 170 and the other from 170 to 540 kc. Moreover, some models also have the wavelength equivalents, besides the frequencies. However, for wavelengths, divide by the factor, 10, instead of multiplying, because the higher the frequency the lower the wavelength. Now suppose the fundamental is 54 to 170 kc. One scale is read directly and used as seen. Suppose the range is 170 to 540 kc fundamentally. Then the other scale is read directly and used as seen. Now notice that if the first scale is multiplied by 10, the frequencies start at 540, where the second one left off, and end at 1,700. So the next scale, multiplied by 10, affords 1,700 to 5,400. The first scale multiplied by 100 yields 5,400 to 17,000, and the second scale multiplied by 100 yields 17,000 to 54,000. Thus the scales are made to repeat themselves decimally. It must be said, however, that the generator will not oscillate at 54,000 kc, but will stop somewhere between 25,000 and 30,000 kc. The advantage of the decimal system is that for all bands the scale is given the widest possible spreadout. Fundamentals are used throughout.

* * *

Tapped Coils

DISCUSS THE RELATIVE merits of using a tapped single coil for all-wave coverage, moving the condenser stator down to the desired tap by switching, or shorting out the unused part, as well as compromising to use a single primary for a band or two, so that secondaries may be disposed on either side of it, and thus save space and expense?—J. W. S.

The object of introducing coils into receivers for tuning purposes is that the tuning be accomplished very satisfactorily. All systems that use other than a separate coil for each band sacrifice a great deal. In fact, some of the compromises, like tapping the coil for use of only a small part of the total inductance, whether the exclusion is by shorting or by leaving the whole winding in circuit and putting the tuning condenser across only a part, are obnoxious, even may not work. One expedient tried by somebody or other was the use of tapped honeycomb coils for all-wave coverage. Now, that's something. Giving a demonstration of such a system must be exasperating for the designer. The recipient of the demonstration likewise will have some uncomfortable moments.

* * *

Air-Dielectric-Tuned I.F.

DOES THE CHANGE in frequency that takes place in a mica-dielectric condenser across intermediate coils have a substantial or a small effect on the resultant r-f tuning?—H. E.

The frequency change has a small effect on the r-f tuning, and the higher the carrier frequency tuned in, the smaller the effect. The use of air-dielectric padding and trimming condensers in the oscillator circuit is of far greater importance than the use of air-dielectric capacity across the intermediate coils, in this regard, because very small capacity changes in the padding and trimming create large frequency differences. However, it is of some advantage naturally to have air-dielectric condensers at the intermediate level.

* * *

Honeycomb Coils

WHAT IS THE STATE of affairs regarding honeycomb coils for frequencies higher than the intermediate ones? Are these coils suitable for the broadcast band? How high in frequency may one go without having to resort to solenoid coils?—L. E. D.

At present the use of honeycomb coils is confined to the lower frequencies, such as intermediates. However, some honeycombs have been tried in the broadcast band and worked well. In a given instance of an experimental antenna coupler, with equal degree of coupling in both instances, happened to provide better results with a honeycomb than with a solenoid. This of course is contrary to expectation and popular opinion, yet it is probably true that little authentic information exists concerning honeycombs and their performance at frequencies higher than those for which they are normally used now.

* * *

Regeneration in Pre-Selector

THE QUESTION is raised whether introduction of regeneration at the pre-selector level of a superheterodyne will develop audible squeals in the speaker output, and if so why.—K. S. C.

Yes, the regenerative action can produce squeals that will be heard in the speaker. The question we assume is posed because the intermediate channel does not pass frequencies that in themselves are in the audible range, and the interrogator assumes perhaps that therefore the squeals are trapped out. This is not so. Take as an example a pre-selector tuned to 5,000 kc and using regenerative action. Assume that a station is sending out a carrier frequency of 5,000 kc. Assume that regeneration action is being used in the pre-selector and that the frequency of regeneration is 5,534 kc. The difference is 466 kc. The intermediate channel will pass 465 kc, and also, let us say, 5 kc on either side, therefore it will pass a frequency differing from the peak by 1 kc. It is obvious 466 kc is 1 kc higher than the i-f peak. Enough voltage of the carrier frequency of 5,000 kc may get into the first detector so that the beat between 5,000 kc and 5,534 kc is rather strong. Therefore the first detector will have an output, due to the local oscillator action, equal to the intermediate frequency, and also an output equal to a frequency 1 kc higher, both oscillating frequencies, therefore beating, and the difference frequency is made audible in the second detector, amplified in the audio channel and heard in the speaker.

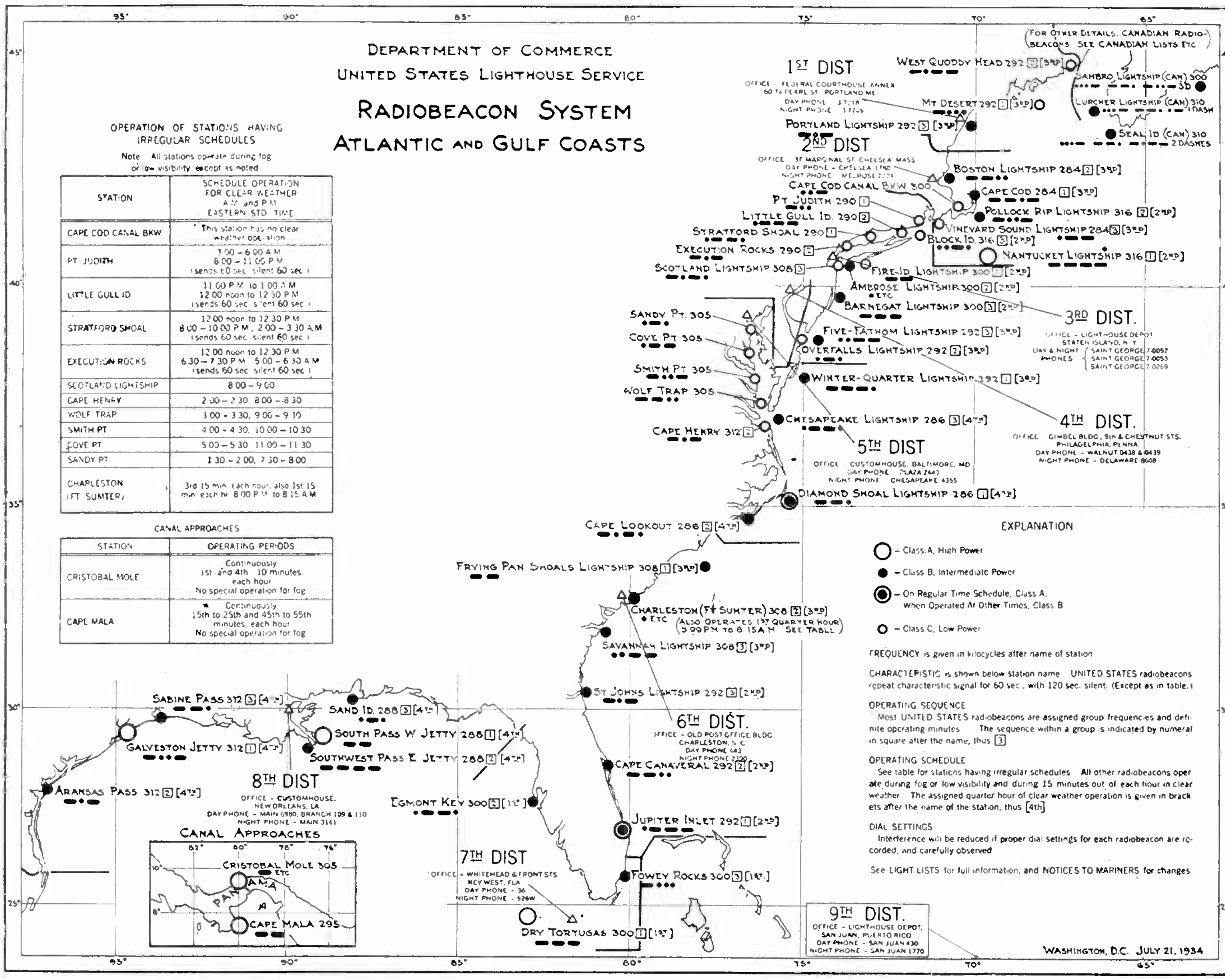
* * *

Station Harmonics

IN AN ALL-WAVE set I have built I have had several experiences that convince me that broadcasting stations send out harmonics, because I pick them up, and if they were not sent out I would not hear them. It was my impression that the Government required the stations to suppress their harmonics from the transmission.—L. O.

Section 144 of the Radio Law provides that broadcasting stations must not deviate from assigned frequency of the carrier by more than 50 cycles above that frequency and 50 cycles below that frequency. The sending of harmonics therefore would be a violation of that provision, punishable finally by loss of license, if persistent warnings are ignored. However, the general assumption, such as you voice, that the broadcasting stations send out harmonics is not consistent with the facts. The idea that unless harmonics are sent, responses in the speaker due to such harmonics having been tuned in, would not be heard is fallacious. The mere fact that the station's fundamental is received by the set and amplified, of itself renders the creation of harmonics possible. Practically all such harmonics of broadcasting station frequencies therefore are created in the receiver. This is particularly noticeable in some superheterodynes. The statement is generally true of all receivers because the tubes themselves are not, and in general can not be, operated on a linear basis. Even accepting the diode detector as linear, the amplifier tubes, in the tuner are not, therefore harmonic trouble always is possible, a fact consistent with the complete innocence of the broadcasting stations from any offense whatever.

Atlantic and Gulf Coast Radiobeacon Map



Map showing names, locations, frequencies and schedules of government radiobeacon service. (Courtesy of United States Lighthouse Service)

Radiobeacon System

WILL YOU PLEASE let me know on what frequencies the direction-finding transmissions for marine use are sent, also whether voice or code is used, and some idea of the identifications?—L. W. C.

The Radiobeacon System is operated by the United States Government, Lighthouse Service, Department of Commerce. The frequencies range from 284 to 316 kc, and there are several transmitters on the same frequencies. However, the coded transmissions are different. The code consists of dots and dashes. For instance, around New York there are the Ambrose Lightship and the Fire Island Lightship. Ambrose sends a dot, Fire Island two dashes. Both operate on 300 kc. The general rule is that the signal is repeated for sixty seconds, followed by 120 seconds of silence. Besides, there are irregular schedules for some other stations. The information is printed on a map published by the Government. The direction-finding use is as follows: A receiver is used that is loop-operated, and the directional properties of the loop are used to determine the direction from which the signal is coming. By noting the signal and consulting the map the actual point of origin is determined. So, with the loop geared to a magnetic, the true direction is obtained, and if directions of two transmitters are obtained the location of a ship may be determined by triangulation. A point worth noting is that a loop works about equally well in two opposite directions. The procedure for finding the particular one of the two directions is called sense finding. Sense finding is therefore operation without 180 degrees of ambiguity. A method used is to ground one side of the loop to prevent the pickup from the second or alternate direction.

* * *

Limit of All-Wave Set

CAN AN ALL-WAVE set be depended on for good performance at frequencies higher than 20 mgc, and if not, what can be done about improving a set so that it will perk properly in this region, so to nearly 30 mgc.—K. C. S.

Probably the general rule concerning all-wave receivers is that they stand up well to about 10 mgc, then lose sensitivity rapidly, and finally are very poor at around 20 mgc, and only in uncommon instances have any gain worth mentioning at frequencies higher than 20 mgc. The reason is that the circuit losses build up so rapidly at these frequencies. It becomes advisable to have circuits specially built for the higher frequencies, if there is any serious intention of reception of such frequencies. A few all-wave receivers do yield results to around 30 mgc, but these practically invariably will have enough tuned-radio-frequency amplification ahead of the modulator to support a high-signal input to the modulator. Otherwise the noise is almost bound to be higher than the signal, tantamount to a statement that reception is practically prohibited.

* * *

Aerial and Noise

FROM TIME TO TIME I have read different statements about whether a long or a short aerial should be used on a sensitive all-wave set, some writers contending that a large-voltage input should be used (long antenna) to reduce noise, others that a small input should be used for the same reason. It seems to me you have printed both comments, that is, your information has been conflicting, and if so, will you state your present opinion?—L. W. C.

We have been very consistent about it, and in printing our present opinion are also printing the same opinion we have expressed several times before. It is this: The input should be small, because the tuned circuits of the receiver greatly favor the signal as against the noise. Large input, from practically untuned systems, which includes all types of antennas used with receivers, are as receptive to noise as to signals, and naturally do not discriminate between them. Tuned circuits do. Try a shorter aerial and notice how the noise does diminish, i.e., ratio of signal to noise increases.

Station Sparks *By Alice Remsen*

OWEN DAVIS'S PROBLEM

THEY are discovering that writing for radio is not so easy; at least Owen Davis, Pulitzer prize-winning playwright, now writing the scripts for "The Gibson Family," admits that he finds is harder than he anticipated. Mr. Davis has turned out such good plays as "The Nervous Wreck," "Spring Is Here," "The Detour," "The Alibi" and many others, and should be able to write the simple dialogue required for "The Gibson Family." He probably also realizes that simplicity is THE hardest thing to acquire in dialogue, particularly when the ear is the only audience. There are no gestures, no bits of business, except by sound—only the dramatic quality of the voice and sound effects, to produce illusion. Go to it, Mr. Davis. Perhaps you may be headed for the turning point in the profession of radio writing! . . . Senora Grever, Spanish song writer, mother of eight children, and grandmother of two, is writing special songs for the voice of Jessica Dragonette, the Cities Service soprano. Miss Dragonette has already broadcast a few of the Senora's compositions. . . . The three-hour dance band program which starts over NBC-WEAF on December 1st consists of Kel Murray's, Xavier Cugat's and Benny Goodman's bands. . . . Irene Wicker, the Singing Lady of NBC network fame, will publish her first volume of children's stories on December 1st. The book will be brought out by the Whitman Publishing Company, of Racine, Wisconsin, under the title of "The Singing Lady's Favorite Stories." . . .

PICKLES AND THINGS

Lois Miller, organist, and Milton Lomask, violinist, have proven so popular on Josephine Gibson's hostess counsel programs that the sponsor, the Heinz Company, has increased the number of programs to five a week, so that Miss Miller and Lomask can have two programs a week practically to themselves. . . . Danny Malone, thme young Irish tenor, who was introduced to American audiences over an NBC network in a series of intimate programs, has made his Broadway debut with the Abbey Players, at the Golden Theatre, New York. Danny is playing the role of Jack Reardon, an unsophisticated country boy, and sings the only musical number in the play, a setting by Maud Valerie-White of Lord Byron's "So We'll Go No More A'Roving." . . . G. W. Johnstone, known to his intimates as "Johnny" Johnstone, has resigned from the Press Department of the NBC after a service of eleven years, to become the Director of Press Relations for WOR. Dave Casem, former head of WOR publicity, left for Florida last week, where he will rest a while and write special material, and I understand that Jim Maher is also resigning from WOR on December 1st, for which I'm more than sorry, as Jim is a fine lad. . . .

CAPITOL FAMILY CELEBRATES.

The Capitol Family recently celebrated its twelfth anniversary on the air over an NBC-WEAF network, with Major Bowes officiating as usual. The program marked the six hundred and twenty-fourth consecutive weekly broadcast for this popular hour's entertainment. . . . A new departure in the technique of producing radio drama has been introduced in the broadcasts by Mary Pickford and Company over NBC networks. It consists of a room-size space set apart from the rest of the stage in NBC's auditorium studio at Radio City, and the microphone at which Miss Pickford and her company perform is set in the centre of this space. The stage is surrounded on three sides by wings and a back group, but it is open to an audience in the front. The orchestra which furnishes the background music for the drama is placed at the side of the stage, but outside the three-sided "room." A second microphone is used to pick up the orchestral effects, thus giving separate control of the musisal and dramatic portions. . . . The U. S. Army Band has shifted to a new time over the WABC-Columbia network. The new schedule brings Captain William Stannard and his men to the microphones each Friday at 11:30 a. m. . . . Tito Guizar is suspending his Midday Serenades over WABC until January 13th. The romantic Mexican tenor is in great demand for personal appearances and out-of-town vaudeville engagements. . . . The rotund Alexander Woollcott, "Town Crier" of the air, has had his contract renewed and will be heard at a new time commencing January 6th over a nationwide WABC-Columbia network; each Sunday evening at 7:00 p. m. By the way, popping into the English Westminster Cinema, on West 49th St., New York, recently, to see the imported film, "Man or Aran," I was agreeably surprised to see (used as a sort of curtain raiser to the more sombre feature) the "Town Crier" himself in a short, called "Mr. W's Little Game." It was very enjoyable, and when I got home I promptly started to play his little game, and incidentally won a pair of gloves, for which, "Mr. W," I thank you! . . . Pat Kennedy and Art Kassel's Orchestra have been extended both in time and network. They are now heard five times weekly and have an additional twenty-two station hook-up. This feature originates in the Columbia studios at WBBM, Chicago.

HE'S THE BUSIEST

Frank Novak, the one-man band, is the busiest musician in the world; he plays more than forty different instruments. Frank is now heard over the new ABS network. . . . Station WABY, in Albany, New York, joins the WMCA-ABS network on December 1st. WABY is owned and operated by Adirondack Broadcasting Company, Inc. . . . Dr. Melchiorre Mauro-Cottone, former Vatican organist, and now director of operatic music on ABS-WMCA network, is marking his eleventh year in radio this week. He began broadcasting in 1923 when he was organist at a leading New York theatre. . . . Grete Stueckgold, Saturday night soloist with Andre Kostalanetz and his orchestra, says in this week's Columbia Quotes: "It always amazes me to hear said of the more popular and melodic music that ti is 'terrible stuff.' To me that is not true at all. I really enjoy singing the music of today with its infectious rhythm and its haunting, yet simple, melodies. Very often music of this sort takes possession of the listener as completely as some great lieder of Brahms or Schubert. Certainly, this popular music is not in the same province as great classic vocal music, but it does compel the listener to attention and affords him great enjoyment." . . .

STUDIO CHATTER

H. V. Kaltenborn was once a tutor in the home of John Jacob Astor. . . . George Hall's Orchestra has been on the air several years but has never broadcast from a studio. . . . Elaine Melchior, the Ardala of "Buck Rogers in the 25th Century," was married to Lean F. Anspacher, New York business man, on November 15th. . . . John McCormack wears tortoise shell glasses when he broadcasts; so do I, John! . . . Amos n' Andy sit cosily at a studio table with a microphone between them, when they broadcast—in their shirt sleeves. . . . Carmen Lombardo, Guy's second-in-command, bosses the boys at rehearsals. . . . When Jimmy Wallington is announcing he always keeps his left hand in his pocket. . . . Sigmund Romberg was an American spy during the World War. . . . Lawrence Tibbett sang "St. Louis Blues" on the Packard program recently and explained to his radio audience that Duke Ellington played the number before an audience of serious music lovers at the Salle Pleyel in Paris and they loved it. . . . Guess that's how folk songs are born!

A THOUGHT FOR THE WEEK

WE'VE HAD LITTLE TO SAY ABOUT MAJOR EDWARD BOWES in these columns. It did not require the "Amateur Hour" on WHN to bring this announcer to the friendly attention of the American public. The Major, somehow, has always given the impression that he doesn't think it a handicap to be considered a gentleman in the best and broadest sense of the term. This man from his first appearance before the microphone has been able to convince his hearers, without any obvious effort, that he was a gentleman just because he couldn't help himself. His manner has been easy, earnest, direct and engaging, and lacking in that which spells cheapness, tawdriness and the desire to be sophisticated at any expense.

Radio has a lot of brains and talent on its roster, but we really believe—and we say so without fear or favor—that Major Edward Bowes is one of those who have won high position without straining either good taste or good will.

MORE OF YOUR ANNOUNCERS

KELVIN KEECH—Romance and adventure constitute Keech's background as one of NBC's ace announcers. Made his radio debut as orchestra conductor for the BBC; is a linguist of ability and will tell you about teaching the Prince of Wales how to play the "uke."

PATRICK J. KELLY—Was a sailor, marine engineer and musical comedy star before becoming a radio announcer. He is supervisor of NBC's staff of announcers, making only occasional microphone appearances.

ALAN KENT—Writes comedy as a hobby, and occasionally produces radio shows between assignments. He came to NBC from the stage as an actor, but was drafted to his present job.

DON LOWE—Eligible young bachelor of 24 summers started his dramatic training as a grammar school boy in Hartford, Conn. Played stock before becoming an announcer at a Boston station.

WILLIAM LUNDELL—Conducted a children's orchestra at the age of twelve; was a newspaper writer at 20; a preacher for a short time, ending up as an NBC announcer in 1931. Interviews are his hobby and his job.

GRAHAM McNAMEE—Is radio's pioneer sports announcer. Made his debut in 1923 at the Greb-Wilson fight. Broadcast his first World Series that same year and has been heard in every series since.

CHARLES O'CONNOR—Won his spurs as an NBC announcer on the Lindbergh kidnaping case. Studied law at Harvard, and is an all-'round athlete, five feet eleven inches tall, weighing 168 pounds. Clothing is his hobby.