July 15, 1925
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RADIO PROGRESS

"Always Abreast of the Times"

IN THIS ISSUE:

YOU WILL UNDERSTAND THIS MAGAZINE--AND WILL LIKE IT

PUBLISHED TWICE A MONTH

The Marvelous 5-Tube Radio Frequency Set

AUTO BALANCED 5-TUBE RADIO FREQUENCY

The combination of "RICO" CELLUWELD Low Loss Coils and Variable Condensers is made mechanically perfect. The Coils are welded firmly to the support of the rotor plates, our own patented principle.

Selective and non-oscillating, the "RICO" "AUTO-BALANCED" TUNED RADIO FREQUENCY SET accomplished by carefully setting the neutralizing angle of the Coils at the factory; remains permanent due to the CELLUWELD process.

The Complete Ricodyne Kit contains everything. The set you can build in 3 hours. Price Complete.......................................$38.75

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An assurance of perfect performance, faithful tone production and $100 radio receiver value, all for

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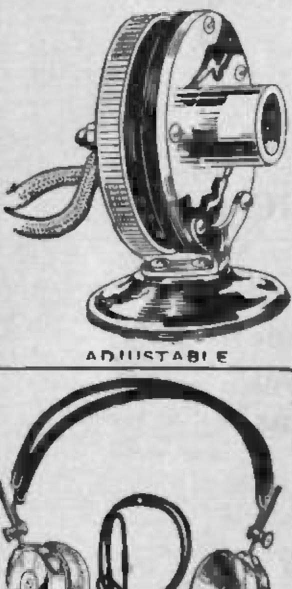

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Adjustable phonograph unit makes your phonograph a perfect loud-speaker

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The Melotone Has All the Qualities of the $10 to $12 Units

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.......RICOFONES, $2.95. ADDRESS ....
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for all Long Wave Circuits

RICO Products on this Page Will Improve Your Radio 100%

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The sensitivity, selectivity and volume obtained in all types of long-wave circuits depends entirely upon the intermediate frequency transformer. TROPAFORMERS have been specifically designed to meet the new scientific requirements of long-wave circuits. The TROPAFORMER combines transformer and condenser. The condenser is shunted across the secondary winding of the transformer, and by its use the transformer may be tuned to any definite wave length between 3,000 and 9,500 meters. Only in TROPAFORMERS will long-wave circuit users find these advantages, and these advantages are patented for TROPAFORMERS exclusively!

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Free Hook-up of the Famous Tropadyne Circuit with Each Tropaformer Ordered.

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You Can with the RICO-DYNE 5-Tube Auto-Balanced Cellu-Weld Tuned Radio Frequency Kit

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Complete Knockdown Set as illustrated with full instructions how to build this marvelous set within a few hours.

Greatest Radio Value in History—This is What You Get:

1—Pair Ricofones. 1—Genuine Bakelite Front Panel, completely drilled and engraved. 1—Genuine laminated Bakelite Sub-Panel—with sockets already mounted. All mounting holes properly drilled. 3—Auto Balanced Tuned Radio Frequency Units—perfectly matched and balanced. 3—Beautiful 4-inch Dials. 1—Variable Grid Leak and .00025 M.F. Condenser. 1—4 to 1 Audio Transformer. 1—2 to 1 Audio Transformer. 1—.002 Fixed Mica Condenser. 1—.006 Fixed Mica Condenser. 2—Single Circuit Jacks. 1—Filament Control Switch. 1—30-ohm Rheostat. 1—10-ohm Rheostat.

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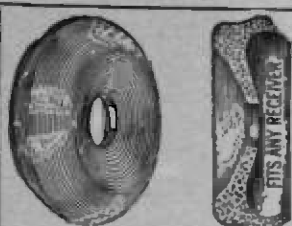
for bliss!



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You'll know what real ear-phone comfort is when you use RICO FONEKUSHIONS. They are made of soft, pure sponge rubber, and fit any make of headphone. They are like soft, downy pillows for your distance-seeking ears.......................... **50c**

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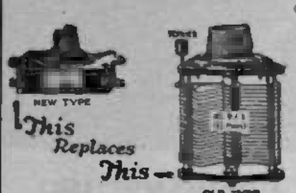

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In the old days, folks used horses. Now they can get as much power out of one auto as from 40 horses. It was all right, too, a few years ago, for folks to use the old-time condensers, but now, since Rico brought forth the RICO STRAIGHT LINE CONDENSER, which occupies two-thirds less space than the ordinary mesh plate type, everyone modernizes his set with the RICO STRAIGHT LINE CONDENSER.

No. 411—.00025 mfd. $1.75
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Inclusive with Dials. Without Dials, $1.50.

Each of these Rico products means added pleasure and value to your Radio Set.

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131 Duane Street, New York City

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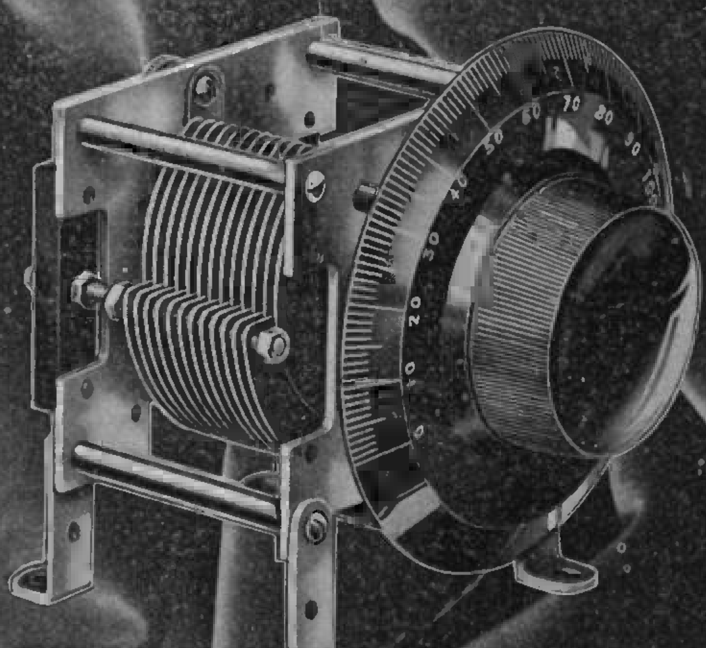

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RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 2 Number 9

Contents for

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If You Don't Have Your Mail Forwarded You Will Miss These In Our Next Issue

You hear a great deal about high speed (low length) waves. Most other magazines, as well as RADIO PROGRESS, have given directions for making a set to pick them up. But when can you find such oscillations? In **"Four Speeds for Schenectady,"** Vance has explained **when** these waves are on the air and why this broadcasting station is using so many different waves.

The spring is house-cleaning time for most homes. But summer is the best occasion for overhauling your radio set. Reasons and directions for doing this are set down at length in **"House Cleaning a Radio Set,"** by Goulden.

Some of the powerful stations can be tuned out easier than those smaller and farther away. This surprising fact is discussed by Taylor in **"Why Some Waves Are Hard to Lose."**

The second and final part of Nickerson's **"Build An Up-to-Date Crystal Set"** takes up the fine points of this hook-up. He also shows how a well-built crystal set may be used ahead of a vacuum tube radio as a wave trap. This cuts down a lot of local interference.

Miss Goldman has been writing some sparkling stories about broadcasting stations. Her **"The Women's Hour at WJZ"** will be read by both men and women with considerable entertainment.

Of course a nearby sending station naturally is much harder to tune out than a distant one, even with the best of receiving sets. But Alexanderson in **"Local Stations That Can't Be Heard"** gives us the results of some experiments by the Radio Corporation which are quite startling. A system of radio has been invented in which a nearby station can hardly be heard on a good set, whereas it is picked up much easier at a distance. Don't miss this one.

Crosley has unearthed a situation which is quite threatening to the life of broadcasting. This startling condition with suggestive remedies is explained in **"Broadcasting is Being Strangled."**

Governor Smith of New York has been experimenting a great deal with radio along the lines of politics. You know what an important part it had in the last election. Read what his experiments show for the future in **"Radio is Making Politics."**

RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

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What Is Inside a Microphone?

This is the Place Where All Broadcasting Starts

By HORACE V. S. TAYLOR

WHO is the biggest eavesdropper in the world? Undoubtedly it is our old friend Mike, for he is constantly listening in on bands, banquets, and business of all kinds and telling the world what he hears.

You may think a microphone is nothing but an older brother to an ordinary telephone transmitter. But this is hardly the case. When talking to a friend over the phone if his voice trails away into nothingness, you naturally yell at him to talk into the mouthpiece. Perhaps his face was only a foot or so away but the result was that you could no longer hear him.

Picking up Fifty Pieces

This would never do for a microphone. One of the ordinary conditions of broadcasting is the reception of a band concert. There may be fifty pieces in the orchestra and they are located all over a good sized stage. If the microphone could pick up only the music coming from a foot or so away we should hear the director waving his baton and that would be all. No, the microphone must be able to hear the music which comes from all over a large room.

Another case is of a speaker of a lecture platform. As he warms up to his subject and begins to get excited, he will often pace up and down the stage. It would never do to have his voice fade out just as he worked himself up to a particularly fine burst of eloquence. Nor would it be practical to follow the lead of one of the big broadcasting stations a while back. The director of this station told the story of a Scotch bagpipe player. He was to broadcast one of his native bagpipe marches. He did his best to stand in front of the transmitting instrument, but he could not get the proper swing to his arm as it clutched the bellows. The trouble was finally solved by the bagpiper marching solemnly up and down the stage while a bell boy paged him continually with a microphone parked on his arm.

Fig. 1. This Curve Shows Why the Microphone Has Such Far Reaching Ears.

Mike Has Very Big Ears

That happened sometime ago before the instrument was well developed. In these days the "ears" of the microphone are so keen that as the saying goes they can hear "a gum drop." It is this need for picking up sounds from far and wide which has forced the development of the microphone.

You will probably think that a very sensitive instrument would be needed for this purpose—much more sensitive than the ordinary phone. Such an idea is all wrong, however. The microphone is not nearly as sensitive as a telephone receiver. This is explained better in Fig. 1. The telephone has a curve of pick-up as revealed at the top of this picture. It has been developed for just one thing—to pick up all the energy it can when given off right at the mouthpiece. Notice how high this curve goes at the receiver and how sharply it falls off on each side. A foot or two away it is not able to hear much of anything.

Not as Sensitive as Phone

The microphone, on the contrary, as has just been discussed, must be able to bring in the sounds from all around. It must *not* emphasize those which occur in its own vicinity, and so it can not have the strong pickup which the phone transmitter possesses. Its curve of response is shown at the bottom of the figure. For a given sound nearby, you will see that it has a response only a small fraction as great as that of the telephone. But when we get a few feet away there is a different story. Instead of falling off sharply as the upper curve does, its response holds nearly constant stretching away on both sides. Of course, there is a slight decrease as we get some distance from the diaphragm. This effect is not wanted, but it can not be prevented to a slight extent. However, the proof that the results of this falling off are very slight is given by the fact that an orchestra sounds so natural when heard over the radio.

You have all seen pictures (if not the thing itself) of the ordinary or garden variety of microphone. This is shown in Fig. 2 except that the thin silk cloth, which is spread over the inside of the holes has been removed, and this allows you to look in. The springs which you can dimly see through these holes are used to support the mechanism in the center in such a way that it will not be damaged by jolts and jars. If the speaker at a National Convention should get vicious and begin to throw things, it would never do to have the microphone pull in its horns because of a bad jolt which it might receive.

How It Looks Under the Skin

Beside the case is seen the internal mechanism. As a matter of fact, there are two of these—one with its face towards us, and the other turned around so that it shows its back. The front view is the one shown at the left. The four hooks around the outside are the ones used to fasten the spiral springs, which hold up the inside as already explained.

The actual springing of the device can be better seen from Fig. 3. This shows the appearance with the cover removed. Notice that there are three wires running through to the mechanism. The ordinary telephone transmitter uses only one, which can be seen coming out from the back. The reason for this difference will be explained in a few minutes. Here again, in Fig. 3, we have two extra mechanisms lying beside the case.

Does Not Mind the Jolts

To understand the operation of this unit, take a look at Fig. 4. This shows the parts cut away to reveal the inside. Right at the top at "A" is the screw to which the wire is connected. "B" is a ring which holds the spindle "C". At the lower end of this spindle is the cup (upside down) "D". Inside it are the carbon disks "E." All the parts mentioned so far are rigidly fastened together and carried by the heavy frame "F," which is the part suspended by the spiral springs. All this mechanism is so massive that it is not affected by the air vibrations of the music coming in and so is relatively fixed in space. We say, "relatively" since as it is mounted on the supporting springs, it will move back and forth in case the whole microphone gets a bad jolt.

The diaphragm "G" which has been cut away to show the details also carries at its center a felt cup "H" which mates with cup "D." The difference between these two is that while "D" is immovable, "H" vibrates back and forth with the diaphragm. Filling these two cups are the carbon granules "J." These are made of specially refined coal dust. They have the property of decreasing their electrical resistance tremendously when they are compressed. When the pressure is removed, the resistance jumps back again to its original value.

Squeezing Them Up Tight

You can now see the action of this device. As a sound wave comes in through the openings in the cover of the case, they strike against the diaphragm and set it into oscillations. Cup "H" vibrates just as the air waves do and so when it rises it compresses the carbon grains into cup "D." This immediately lowers their resistance. An instant later when the diaphragm springs away again, the grains are no longer squeezed tight and so the resistance falls.

The electrical circuit is from contact screw "A," through "B," "C," "D," to the carbon disk "E," then through the granules "J" to the diaghragm "G," and so to the frame. "F." The second wire is taken off this frame. Another series of carbon grains and disk with its containing cup is seen on the other side of the diaphragm at "K." The action here is exactly the same, and the third wire which was seen in Fig. 2 is connected to a contact screw on the back corresponding to screw "A," at the front. Either of these pairs of carbon contacts would work a microphone very well.

The Push-Pull Disk

Notice though, that when the dis-

Fig. 2. How the Eaves-Dropper Looks When He Has Taken Off His Dress Suit. Front View in Middle, Rear View at Right

phragm moves down it compresses the lower carbon and at the same instant removes the pressure from the upper one. On its return this action is reversed. That is we are always tightening one contact while we loosen the other. If the action of the carbon grains were absolutely uniform, this double action would not be so necessary, but there is a slight irregularity which occurs when the grains are squeezed together. By using a double action in which one opposes the other, this irregularity is made to compensate for itself with the result that the combined action of the two sides of the diaphragm gives an electric wave which is undistorted as compared with the sound wave which sets it off.

You may wonder how the current gets through from the carbon grains to the steel diaphragm without burning at the surface, since steel is not a very good conductor of electricity. To get around this difficulty the surface of the steel at the center of the disc is gold plated. Of course, gold will not oxidize, and it has a low resistance ,and so no trouble is ever experienced at that point.

Mike Does Not Like Echos

The entire unit as now described would work pretty well without anything further except for one objection. A steel disc is so springy and elastic that once it has been set into vibration by the sound wave it wants to keep on oscillating, just as a rubber ball keeps bounding for some time when dropped on a hard pavement. Of course, as soon as the voice stops speaking to the mike, it should be quiet and not make an echo on its own account.

Fig. 3. The Spiral Springs You See at Left Hold the Unit from Being Damaged by a Bad Jolt

To get rid of such an echo, it is necessary to damp the diaphragm in such a way that its oscillations die out at the same time that the air waves cease. This is done by drilling a series of holes, "L," through the back plate, "M." These holes can be easily seen in the back view of the mechanism in Fig. 3. Now as the diaphragm works back and forth, it approaches within 1/1000 of an inch of the plate, "M." Of course, the thin film of air between these two parts is compressed and it rushes out through the holes, "L." An instant later, when the disc springs back again, the air is sucked back through the same holes.

It All Depends on Holes

It is this breathing action in and out to the damping holes which takes up the energy of the echo vibrations. By making the size of the holes just right, it is possible to damp out all the extra vibration, with the result that the diaphragm exactly follows the waves of sound. This reproduces them in the electric current, and so gives true music without any distortion.

Notice how the edge of diaphragm, "G," is crimped between the heavy supporting rings. This stretches the metal very tightly and so gives the disc a very high period of vibration. If left to itself without the damping piece, "M," the diaphragm would vibrate naturally at its free period of 6,000 cycles or oscillations per second. The presence of the damping back "M," adds the pressure of the air film to the stiffness of the spring and so brings up the period to 9,000 cycles per second. This corresponds to a note more than five octaves above middle C on the piano. Such a note is never used in ordinary music.

Whistling Into a Bottle

You know when you whistle with a bottle at your lips, that some one note will come out very loud or resonate as you whistle up and down the scale. If you are performing a tune, it would be very bad to have this note come in the music, as it would distort the loudness tremendously. The same thing applies to broadcasting. It is only by having the resonant note way above the scale as just described that distortion from this cause can be prevented.

The result of this construction as already described is to produce a unit which is only about 1/1000 as sensitive to sounds at the mouthpiece as is the ordinary telephone transmitter. However, this sensitiveness does not fall off materially for distances of a good many feet from the instrument. In order to bring it back to a volume like that of the ordinary tone, it is run through a

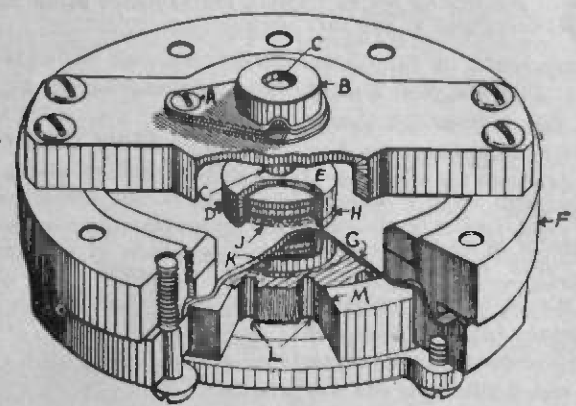


Fig. 4. The Speaking Unit Itself. Notice That Both Sides Are Alive

Continued on Next Page

American Radio Relay League

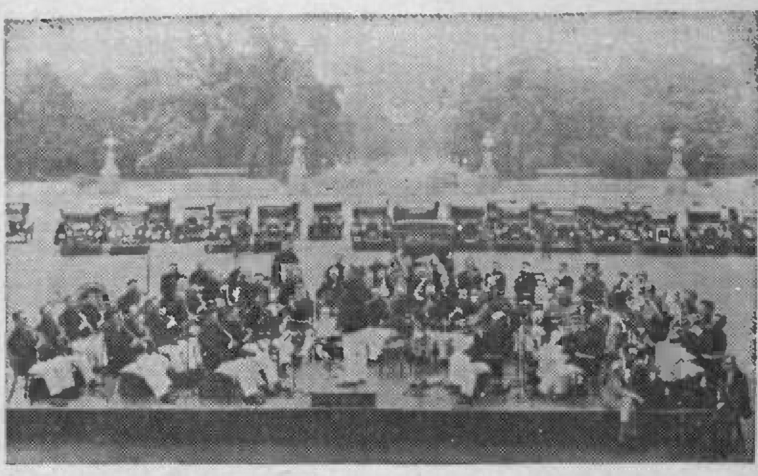
ALL THE WORLD WILL HEAR

High speed (short) wave communication, the method made famous by the experiments of John L. Reinartz, operator for the forthcoming Navy-MacMillan expedition to the Arctic, is to have its first general test on a world-wide basis. Under the leadership of the American Radio Relay League, transmitting amateur radio enthusiasts in the United States, Canada, Australia, New Zealand, England, and the continent of Europe, are planning for their first tests from the middle of July into the first week of August, this summer.

The tests are to be on 60,000, 15,000 and 7,500 kc. (five, twenty and forty meters) and are to be run for forty-eight hour periods in order that each of these wave speeds may demonstrate its efficiency under all night and day working conditions.

The theory of these fast vibrations predicts good transmission and reception at all hours of the day and night with comparatively low power. This theory will be well tested and complete data collected by the American Radio Relay League, so that if all theories are correct there will be a simple schedule on which all transmission work on fast waves may be carried on.

The tests will be made July 18-19, July 25-26 and August 1-2.



The United States Marine Band, Captain William H. Santelmann, leading, playing in weekly concerts, which are broadcast by Station WRC, Washington, and other eastern stations, including Station WJZ, New York; WGY, Schenectady, and WBZ, Springfield.

The band is shown on the special platform erected in front of the steps of the United States Capitol, the audience being seated on the Capitol steps and in the cars parked in the plaza.

AUTO SHOW GOES ON AIR

The value and reliability of amateur radio had a fine demonstration during the recent Maintenance Show and Service Convention of the automobile industries in Detroit, when direct contact with a New York amateur was kept by a local station. Stanley P. McMinn, of "Automotive Merchandising," owner of station 2WC, in New York, sent through a wealth of news material for his publication through the medium of station 8CWK, owned by F. K. Kearney, of Detroit.

Schedules were maintained by these stations at 7 a. m. and 10 p. m., and messages were handled in both directions during each period. A total of more than 1,200 words were transmitted.

AUTOS BOOST THE TRAFFIC

Fred W. Catel, owner of radio station 9DTK of Milwaukee, and a prominent member of the American Radio Relay League, has effected a novel plan for getting a large amount of relay message traffic through his station. Working in co-operation with a local newspaper, he has arranged to send radiograms from motor tourists for transmission to other parts of the country. The newspaper provides the necessary blanks and distributes them in the motor camp-sites near Milwaukee. The messages are gathered each day and turned over to Catel, who puts them on the air for other members of the league engaged in relay traffic.

Tourists are sending ahead information of proposed destinations, and also friendly dispatches are relayed to their homes. The early messages filed indicate bona fide traffic, with few of the "greetings by radio" variety among them.

FALL RIVER CALLS UP CZECHS

Jefferson Borden 4th, owner and operator of radio station 1CMX of Fall River, Mass., got into communication the other night with radio station OKI, giving his address as Prague, Czecho Slovakia. The European station working on 7,140 k. c. (42 meters) sends the greetings of the Czechoslovakian Radio Club to the American Radio Relay League and to the president of the League, Mr. Hiram P. Maxim of Hartford.

WHAT IS INSIDE A MICROPHONE?

Continued from Previous Page

speech amplifier.

This last device is nothing more than an audio frequency vacuum tube amplifier. By using two of three tubes in tandem, the feeble currents from them are stepped up to a point where they are powerful enough to work the modulator system of the broadcasting station. This may seem like a roundabout method, but it results in getting audio reproduction which is clear and undistorted, and is also largely independent of the position of the speaker.

Bakelite—How Made and Molded

This Strange Material is Used for Many Things Besides Radio

An Interview by ALLAN BROWN

WHEN you hurt your hand on the Fourth of July, how did you treat the wound? Perhaps you doused it with iodine, or again maybe it was carbolic acid that killed all infection.

Carbolic acid, or phenol, as it is called by the chemists, is a wonderful materi-

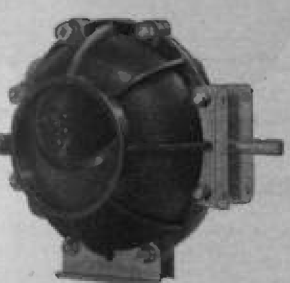


Fig. 1. Variometers Are Usually Molded in Halves

al. In concentrated form it is clear with perhaps a shade of pink color and is quite oily in feeling. But do not feel of it with your fingers, as it will burn them severely unless diluted with water. Sometimes when a solution is to be made up, a little of the strong phenol is poured into a cup of water and the fingers are used to stir it up. In such a case you will often see the burns on your hands where the strong acid touched it before it was thoroughly mixed with the water. That is why it is much better to use a stick or spoon to stir the diluted mixture.

Kills Germs and Hardens Films

This same phenol is one of the main ingredients of bakelite. The other is formaldehyde or formalin, as it is sometimes called. It is a very pungent gas which perhaps may remind you of ammonia. It makes a very good disinfectant and formaldehyde candles are often bought from the drug store to use in fumigating a room where there has been contagious sickness. When the candle is lighted it gives off the formaldehyde gas and when concentrated it is death to all germs. It is also used in a water solution to harden photographic films in the summer time when they are apt to get soft from the heat.

When these two substances are properly combined they make bakelite. This was the discovery after long years of research by Dr. Leo H. Baekeland in 1907. This is the same man who invented velox photographic printing paper and who was president at one time of the American Chemical Society.

Smells Like Horse Jockey

When the bakelite has been made by combining the ingredients, it is a thick, syrupy liquid like heavy honey. It is dark red in color and has a peculiar odor, which smells very much like the clothes of a man who has been a lot around horses. Any one who has worked very much with this material, may easily be mistaken for a horse jockey by the smell. Another form of the material which has been heated somewhat, is in the shape of crystals like resin. In fact, bakelite is often called a synthetic resin.

Owing to the expense of the material and also to obtain greater strength, the pure bakelite is usually mixed with some kind of a filler before use. If it is to stand a high temperature, then asbestos is mixed up with the heavy liquid. For ordinary temperatures, fine sawdust, which has been dried, makes a very good filling material. As a matter of fact, almost any finely ground dry powder will mix well with the liquid bakelite to make a good product. Of course, if considerable strength is wanted in the finished form, a binder having a thread-like form is often used.

Fig. 2. This Complicated Piece is Made from Bakelite

Fig. 3. This Machine Makes Flat Discs as Seen at the Right

How Panels Are Made

Ordinary sheet bakelite, such as is used for panels, has paper as the binder. Great quantities of this panel are made by coating a strong kraft paper on one side with bakelite and then allowing it to dry. Later on a great many of these sheets are assembled together under a flat press, which is heated and makes the various sheets of bakelized paper stick firmly together into a solid mass.

Parts which are molded, of course, can not contain sheet paper as the latter would not bend round into the various intricate shapes. Take the variometer shown in Fig. 1 for instance. This might be molded from pure bakelite, but would most likely contain a filler of some kind. Fig. 2 is even a more complicated piece, but in spite of being so intricate there is no trouble at all in making the material flow into every crevice of the mold.

This brings us to a consideration of the way the finished products are made. The mold itself is all important, as its

Fig. 4. A Steam-heated Mold Cooks the Mixture After Pressing

surface is reproduced exactly by the surface of the finished article. How absolutely true this is may be seen from the fact that Edison Phonograph Records are made by this process out of condensite, which is a form of bakelite. Although the indentations, or little hills and valleys in the record are so tiny as to require the microscope to pick out many of them, still they are so exactly like the original, that you can immediately recognize the voice of the singer if you have heard him a few times.

For Roughness Blame the Mold

From this you can see that the mold must be kept in a highly polished state if the finished articles are to have a smooth finish. Any sign of roughness here can not be blamed on the molding process, but only on the surface of the steel which gave the piece its shape.

A simple mold for making flat disks is shown in Fig. 3. The bakelite mixed with its filler resembles wheat middlings or prepared flour. A small quantity of this material is carefully weighed out and poured into the mold, the lid clamped on, and placed under a press which forces the two halves of the mold together tightly and then the heat is turned on. After the proper length of time, the heat is turned off, the mold removed and placed under a cooling press. When cool enough to handle, the upper half of the mold is removed, and out falls a shiny dial or socket as the case may be. The graduations or lettering on the object is patterned on the mold and is faithfully reproduced on the object itself, and the surface of the object is smooth and has a shiny finish.

Speeding Up the Mold

When many objects of the same pattern are to be made, the process is speeded up considerably by compressing the flour into small pellets or biscuits, saving the time needed to weigh the materal for each molding. The timing of the process and the amount of heat is taken care of automatically in the design of the machinery.

A more complicated mold appears in Fig. 4. This makes a cup of bakelite like Fig. 5. Notice at the right hand lower corner of Fig. 4, the two pipes connected to the mold. These carry the steam under about twenty pounds pressure, which is used in getting the proper temperature of the bakelite to make it set. The steam circulates in through one pipe and out through the other. The time necessary in the mold varies according to the temperature and also the size of the piece, but usually runs from fifteen minutes to an hour.

A still more ambitious piece of die work appears in Fig. 6. This is the tool which turns out the dial in Fig. 7. It

Fig. 5. This is the Cup Made by Machine in Fig. 4

has taken a great many days labor to cut this tool out of die steel. Not only must the shape and size be right, but as already mentioned, the surface of the die must take on a high polish. Note, too, that the little lines around the edge of the dial from zero to 100 are sunk below the level of the dial itself, which means that that must stand *above* the surface of the die. It would be an easy matter after finishing this tool to engrave 100 lines in it around the edge but that does not work—100 lines around the edge must be left as they are, everything else on the surface must be engraved away. These projecting lines will then leave the well known depressions on the dial.

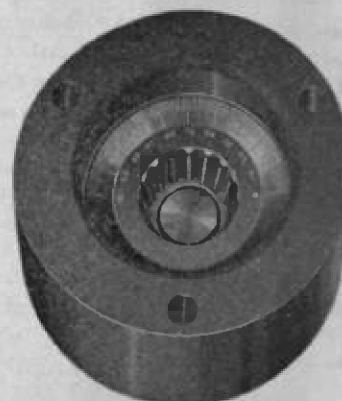


Fig. 6. This Mold Required Days in Its Engraving and Polishing

Notice the three holes around the edge of Fig. 6. These take the three dowel pins, which appear in the other half of the die, Fig. 8. This, of course, gives the shape to the underside of the dial and is not nearly as important as the top. In the completed set you can not tell what is on the back of the dial. However, it is given a bright polished finish, as you would probably not want to buy dials with rough looking backs, even if they did not show.

Another dial of a similar pattern, but requiring of course an entirely different set of dies, appears in Fig. 9. It is made in the same way. Fig. 10 represents a bakelite socket which is a very popular seller. It is better than the metal socket in that there is no capacity effect to grid or plate of the vacuum tube.

Two Kinds of Finished Bakelite

Fig. 11 shows a combination of the two styles of bakelite. The dials and knob are made by the molding process, as has just been described, while the insulating ends of the condenser are made of sheet bakelite consisting of many layers of bakelized paper pressed together.

Radio is not the only line which benefits from this material. Bakelite may be made in a transparent style, which resembles amber so closely that short of a chemical test, about the only way to tell it is to hit it with a hammer. If it breaks it is amber, but if not it is bakelite. This form is used quite largely in making the mouth pieces of the better class of pipes. The same material has been quite successfully used for the barrels of fountain pens.

Bakelite Gems in Jewelry

Besides this, many jewels have been imitated so successfully, that they are almost better looking than the genuine. Considerable work has been done along these lines and a great many different kinds of ornaments made of this substance are on the market. They are hard and durable, and they are very handsome although the price is quite low.

What are some of the qualities of bakelite that make it so good for radio use? Professor M. I. Pupin of Columbia, the President of the American Institute of Engineers speaks about radio insulation in this way.

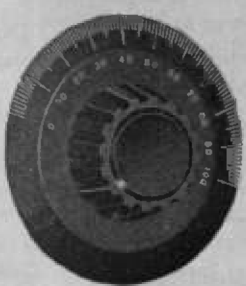


Fig. 7. When Mold Fig. 6 is Opened This is What Falls Out

"A good insulating material must not soften or warp or sag with moderate heat. It should not suffer from 'cold flow' under pressure as from a screw head. It ought not to break from a fall or drilling. It must not lose its lustre or become discolored. Finally, it will not undergo chemical changes that cause gradual deterioration in its electrical properties.

It Even Improves with Age

"Set makers have been forced to discard many insulating materials because they do not stand up and the life of the radio sets equipped with these materials is short. The manufacturers have adopted the synthetic resin products, more generally known under the name of bakelite, either in moulded or laminated form, and these are being used almost universally. Bakelite has none of the changeable qualities of other insulating materials like rubber, and retains its good qualities indefinitely. Bakelite in all its forms gets better with age and is in a class by itself in its rigidity and strength and resistance to atmospheric attack. The amateur can do no better than imitate the manufacturers."

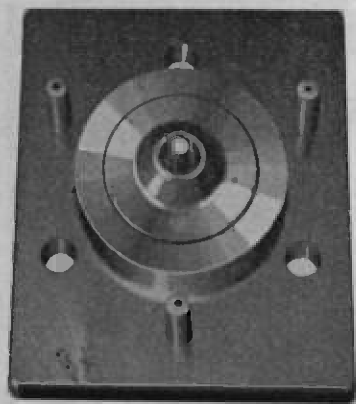


Fig. 8. The Base Plate Which Mates with Fig. 6

Indeed bakelite insulation is used by over 80 per cent of all radio manufacturers, as well as the government departments like the Navy, the War Department, Signal Corps, etc. Manufacturers like the Andrea, Atwater-Kent, De Forest, Federal, Freed-Eisemann, Grebe, Jones, Magnavox, the Radio Corporation of America, and Western Electric, are among the largest users. Panels, for instance, made of such materials as Bakelite-Dilecto, Celeron, Fibroc, Formica, and Micarta are simply laminated bakelite under various trade names.

Fig. 9. Although This Dial Resembles the Other One, it Requires a Different Mold

Insulation Alone Not Enough

In appraising the qualities of an insulating material, it should be borne clearly in mind that it must possess other qualifications besides good electrical insulation. This quality is of course essential, but it is equally important that such a material have the necessary physical factors to fit it for the service for which it is to be employed.

Thus, for radio duty, a panel must have mechanical strength and rigidity, so that it will not warp under the weight of the instruments mounted on it. It must not soften at mid-summer temperature. It must be so hard that it will not "cold flow" or crack under the pressure of a screw head. "Cold flow" is defined as a tendency of material to give or flow when locked to equipment under the high pressure of screw or bolt heads.

Finally, material for panels must be so nearly inert chemically, that it will not deteriorate with age, or lose any of the electrical qualities that it originally possessed. As bakelite is perhaps the only material that combines all of these desirable qualities, we find that it has a decided advantage over such products as porcelain, metal, hard rubber, glass, shellac, etc.

Fig. 10. Here is a Popular Bakelite Socket

As the insulating properties of Bakelite are of particular importance in relation to its use in radio, we shall attempt to define the various terms used in determining the value of a dielectric.

Meet the "Phase Difference"

The first phrase you are apt to run across is "Phase Difference." All insulating materials, when placed in the region of electrical stresses, will absorb small amounts of energy, which result in liberating heat. This absorption is expressed in degrees. In the case of dry air or a vacuum, the ideal insulation, this difference will be 90 degrees, but for all solid insulation, it will be less than 90 degrees, as the result of the energy losses in the material. This departure from 90 degrees is known as the phase difference, and is a measure of the energy lost in the insulation.

A pure grade of hard rubber when

Continued on Next Page

Coal Hole to Concert Star

Some time ago a man wandered into the office of KYW, Chicago. The stranger was Frederick W. Lange, who has since become an exclusive artist of this station.

His career as a concert singer dates back to the days before the war, (1910) when he was serving as a stoker in the coal hole on board a private steam yacht. Gifted with one of those rare, deep, resonant baritone voices that comes natural to only a limited number of people, and with a natural desire to sing, he frequently burst into song during his working hours, and it was on one of these occasions that the Commander when passing near one of the vents leading to the stoke room, heard Mr. Lange's voice. He ordered the man who was singing to report to him. Lange, of the "black gang" as the stokers are referred to in maritime circles, hastened, in response to this order, confused, flustered and not overneat because of the vocation he was just then engaged in.

To make a long story short, he sang by request in the Captain's cabin, and his voice was so good that from that day on, Lange was taken out of the stoke room and assigned to light duties, and almost daily was in the cabin, up to the end of that cruise.

Frederick William Lange

With Lange's coming to Chicago, he drifted into the KYW studio, unknown, and unprepared to sing. Steve Trumbull was conducting the program that evening, and he was asked to permit Mr. Lange to sing. His first song so impressed the people in the studio that he was immediately asked to render another. This was his first attempt to sing into a microphone, and from those who were tuned in on KYW came numerous letters, speaking of the wonderful voice. He soon appeared on the KYW program again, and became an exclusive artist of that station. Musical critics have commented wonderfully on Lange's singing and he today stands well in the fore of becoming one of radio's real luminaries. Having sung in Berlin's opera, he comes to the radio world as not only a natural singer, but as a cultured vocalist, and his presentation thus far has deeply impressed his listeners-in and earned him great praise.

BAKELITE—HOW MADE AND MOLDED

Continued from Previous Page

new has a smaller phase difference than the bakelite materials. This, however, is offset by the fact that a gradual deterioration takes place in almost all hard rubber compounds, caused by the giving off of free or uncombined sulphur, which is an essential ingredient in its manufacture, whereas on the other hand, bakelite is stable, and often improves with age.

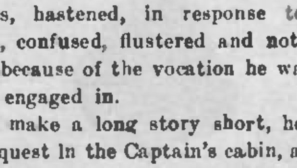


Fig. 11. Two Kinds of Bakelite Used in This Unit

How to Find the Power Factor

"Power factor" is the sine of the phase difference angle, and is merely another way of expressing the same thing. Phase difference is expressed in degrees, and power factor in per cent. Thus, the use of these terms is like saying that $95.00 is $5.00 less than $100.00, or that it is 5 per cent less. The power factor for good materials is obtained by multiplying the phase difference in degrees by 1¾.

"Dielectric constant" is the next term you hear. Another name for this is "specific inductive capacity." Dielectric constant is a ratio, air serving as a unit of measure. Under given conditions a condenser having air between the plates will give a certain value of capacity. If the air is replaced by an insulating material, a larger value of capacity is obtained. The ratio of the latter to the former is the dielectric constant of the material.

Lowest Capacity in Air

It happens that air or vacuum has the lowest capacity effect of anything known, and so the value of all other materials is greater than one. Most ordinary insulators run around 2 or 3, although good mica may have six times the efficiency of air, giving a large amount of capacity. Of course the air is better as an insulator for a condenser—it has no losses at all. The air insulated condenser has all its losses in the metal plates and the solid insulation.

"Volume restivity" is often discussed. This refers to the mass resistance of an insulating body to the flow of electric current. The ohm is the unit used to express this resistance. The volume resistance of bakelite is far beyond the requirements of the electrical stresses required in the radio service.

As the term implies, "surface restivity" refers to the resistance which the surface of insulation offers to leakage of current. It is also expressed in terms of ohms. For bakelite, the average value is so high as to provide an ample margin of safety for all radio requirements. It can thus be seen from the above facts that bakelite has proven to be one of the most valuable assets to the modern radio set, and both manufacturer and amateur have recognized its superior advantages.

Build Up-to-Date Crystal Set

By Using a Coupler You Get Effects of Wave Trap

By HARRY A. NICKERSON, Boston, Mass.

DO you know a man with a Rolls Royce and a Ford? Many wealthy people have both kinds and they find that the cheaper car is used a lot for certain things. In the same way a radio fan with a five-tube set may discover that he will have considerable use for a crystal hook-up besides.

Why construct a crystal set? One reason is low-cost, both originally and for up-keep. The crystal is likewise noted for its purity of tone, and freedom from static. Of course it is very much less sensitive than the vacuum tube; the very sensitiveness of the latter apparently makes it less clear than the crystal, since "side noises" are usually heard with the vacuum tube which are not present with the cheaper set.

Have You a Long Aerial?

The ability to pick up distant stations and to receive locals with good volume depends on many factors. Location has a great deal to do with it. Besides that, most crystal set owners cannot use the 125 to 175-foot long antenna which is of so great advantage in securing loud signals, and distance. Location and antenna must both be right.

A ground connection to a large area of permanently moist earth may mean success, where a connection between a dirty wire and a corroded water pipe, or to dry earth, will result in failure. One advertiser who specializes in "getting out of town" on a crystal, recommends a number of grounds in parallel as one great secret of success. He suggests the use not only of the cold water pipe as near the street as possible, but also of any and all more or less permanently grounded objects. In general, however, the ground wire should be clamped to the cold water pipe between the water meter and the street, care being taken that the pipe is cleaned bright with sand paper so that good electrical contact is assured. Or tin-foil may be placed between clamp and pipe and the clamp "set-up" hard on the foil. The use of gas pipes for grounds is tabooed both by common sense and the Insurance Underwriters.

The Simplest Crystal Set

Perhaps the simplest crystal set which works well is that which is shown in Fig. 1. If this used a vacuum tube you would call it "Single Circuit". It is not very selective, but the volume is pretty fair. The coil consists of about 50 turns of No. 22 or 24 double cotton covered wire wound either on a spider-web form or a three-inch diameter tube.

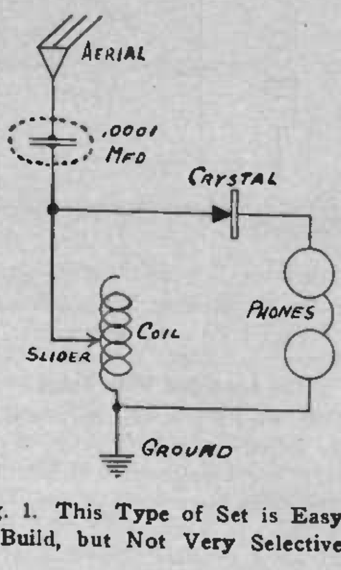


Fig. 1. This Type of Set is Easy to Build, but Not Very Selective

The slider may rub against the wire which has had its insulation scraped off, or else a tap switch may be used with the points connected to taps taken off every six to eight turns. Of course a variometer may take the place of the coil, but it is much more expensive.

Notice that no by-pass condenser is shown around the phones. This is unnecessary as the 6-foot cord on the phones has enough capacity to by-pass the radio frequency which goes through the crystal. An additional capacity of .001 mfd. may be used here if you wish.

When to Use Aerial Condenser

The .0001 mfd. capacity shown in series with aerial is a fixed mica condenser which is not ordinarily needed. That is why it is surrounded by dotted lines. It may be tried in order to reach the higher radio frequencies (short wave lengths) or it may sometimes be a help where it is desired to separate two conflicting stations.

A much better and more selective set is shown in Fig. 2. This employs two separate circuits for the primary and secondary. The primary coil is like the winding shown in Fig. 1. and is tuned by a slider as just described. The secondary, which is wound on the same tube, is a duplicate of the primary, except that no taps are needed since it is tuned by the .0005 variable air condenser.

The advantage of this hook-up over the first is two-fold—the coupling is loose between primary and secondary circuits and also the secondary is tuned individually by its condenser. Inasmuch as the reliable range of a crystal receiver is only about 25 miles, where there are several local stations Fig. 2. is the thing. It is especially designed for selectivity.

Why the Loose Coupler is Passé

The old type "loose-coupler" with a maximum wavelength of several thousand meters is of course no longer in fashion. Better volume and selectivity should be had where only the turns necessary for tuning to the broadcast minimum of about 550 kc. (545 meters) are employed without having unused turns to produce the losses of "dead ends." A great many broadcast listeners, who still use this old type coupler with the secondary winding on a tube which slides on a long rod inside the tubular outside primary winding, would do well to reduce the number of turns in the secondary considerably down to the number actually necessary to receive these waves as a limit.

In Fig. 2. the variable condenser should be 21 or 23-plate (.0005 mfd. capacity) and of the modern low-loss type preferred. If you don't know what a low-loss condenser is, pay at least $3.00 for it, and you probably will get a good one. The variable condenser, like a good pair of phones, is usable in almost any type of tube set, so it is economy to buy a good one even if the crystal is being built as an experiment only.

Use Straight Line Condenser

Again, to be modern, one should buy a so-called "straight line" type of variable, rather than the more usual style. The latter has semi-circular plates, while the better type has the rotary (movable) plates, wing or spiral shaped. The advantage of this style is that the stations on the higher frequencies (lower wave lengths) are heard separated by a greater number of divisions on the condenser dial, while with the semi-circular type, the stations are crowded together on the higher frequencies (lower waves) on the dial. The difference in the usefulness of the types is usually very apparent to the operator of a tube set when there are so many Class A stations now operating at the higher frequencies.

In building a crystal, or tube set for that matter, of course, connections should be as short and direct as possible, with as few binding posts as may be. The end wires on the tubing should be secured merely by passing them through small holes,—running the wire down through one hole and up again ¼-inch or so distant.

Hunting the Elusive Spot

It goes without saying that the value of the set depends greatly on the crystal used. With the older style of crystal, of the more usual galena type, hunting the sensitive spot, is necessary. A number of so-called fixed and semi-fixed crystals are now available and give excellent satisfaction, without the continual necessity for adjustment of the cat whisker. The purchaser of this last named type of crystal, however, should if possible, try several different manufacturer's products, until a really sensitive specimen is had.

The phones used should be chosen for their sensitiveness. One cannot expect good volume with low-grade phones. If the builder wishes to be extravagant anywhere, it should be in the matter of phones, since they, like the condenser, are useful with any type set.

The "home-made" part of the set of Fig. 2. is the coupler represented by "P" and "S". This consists merely of two small coils of wire wound around the same tubular form about three inches in diameter, as already described.

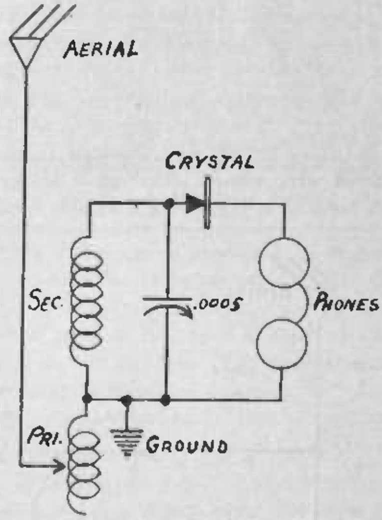


Fig. 2. By Making These Changes, Fig. 1 Becomes Selective

Use Load Coil With Tubes

If "P" were a part of a multitube set where selectivity was of prime importance, it might well consist of but three to five turns, separated by say 3/16" from "S." In series with "P," there might be a so-called "load-coil" of 50 turns, placed at right angles to "P" and some distance away. By adjustment of taps on the load-coil, greater volume as well as more selectivity might be had. This refinement is hardly necessary with the crystal hook-up.

Those readers who are familiar with simpler radio theory know that the increase of the number of turns in "P" (within certain limits) increases the *volume* of signals heard. The same effect is found when "P" is moved nearer to "S" and when the length or height of the aerial are increased. Now with the crystal set, volume is of more importance, as a rule, than selectivity. With a certain number of turns in "P," let us say that a certain selectivity is obtained. With the tube set, there would be sufficient volume if this number were perhaps three to twelve turns, but with the crystal set and this small number of turns, the volume would be inadequate. Therefore some sacrifice of possible selectivity must be made until satisfactory volume is had. With the old "single circuit" set, using a vacuum tube, the hook-up was pretty much as though there were just as many turns in "P" as in "S," and selectivity suffered. So the present popular "Double Circuit" tuner with so-called untuned primary, is now used for tube sets as well as in the diagram Fig. 2.

Balance Loudness and Selectivity

With this explanation in mind, that selectivity is usually obtained only at a sacrifice of volume, which is compensated for in tube sets by regeneration, radio frequency amplification and the like, it will be evident that a large number of turns in "P" is desirable. Just how large this number should be depends somewhat on the length and height of the aerial and the particular wishes of the user as to degree of volume vs. selectivity wanted.

It is suggested that "P" first be wound with 60 turns, tapped every five or ten turns, beginning with the fifth turn from the junction of "P" and "S." The tap may be made by taking off a small loop in the wire at the desired point and scraping off the insulation at that point. A spring clip may then be fastened to the antenna and clipped on each tap one after another until best results are had. The slower (longer) wave stations, for best volume, require more turns in "P" than those which broadcast at higher wave frequencies.

Selecting Your Wire

The size of wire used for winding "P" is not very important; it may be any usually specified for coil winding, say between Nos. 18 and 24. Silk covering has one advantage over cotton because it excludes moisture; while on the other hand, the slightly greater separation afforded by the thicker cotton covering is in favor of the latter.

When "S" has been wound with enough turns as directed, it will have an inductance value of about .18 millihenry. This is sufficient to tune to 550 kc., with the usual 21 or 23-plate variable condenser, that is labelled .0005 mfd., shunting it, as shown in Fig. 2.

The advantage of the condenser tuning is of course that it is much finer than that of a slider running across the turns on the coil. There are many arguments pro and con relative to large coils with small condensers in shunt, and small coils with larger condensers. One argument is that while a larger number of turns theoretically produces a higher voltage across the terminals of the coil, the resistance of these added turns often more than makes up for the theoretical gain, and that a real "low-loss" condenser shunted across a coil of less turns in practice produces an actual higher voltage, because of the very low losses of the condenser as compared to those in the extra turns of the coil.

Spacing the Turns

If you want to experiment with the winding, here are some pointers. The authorities seem to agree that if large sized wire be used for coil winding, such as No. 16, it is a great advantage to space the turns apart by about the diameter of the wire used in winding. It is suggested that if No. 18 wire be used in the coil of the set being described, then the turns be wound on a four-inch tube, rather than a three-inch tube, and that they be spaced with grocer's twine rather than the width of the wire; otherwise the length of the coil will be too great for a good appearance or for convenience in mounting. On the other hand, it is suggested that the smaller sizes of wire, such as No. 24, be wound close, on a three-inch tube. A few more turns are needed with the spaced winding method.

Here are some different windings which have worked out well as a secondary: 55 turns of No. 18 DCC wire on a three-inch tube, 45 turns No. 24 DCC wire on three-inch tube, 36 turns of No. 22 DCC wire on four-inch tube. Of course the exact winding is not important as the variable condenser is used to tune exactly to the wave speed which you are to pick up. In using other sizes of wire or tubes, remember that the larger the diameter of wire including insulation and the smaller the size of tube the greater the number of turns you will need.

How to Reduce Losses

The tube on which "P" and "S" are wound may be of Bakelite or hard rubber or even of pasteboard if it is thoroughly dried out and treated. The walls should be as thin as possible and yet have enough strength to prevent injury. This is to reduce the dielectric losses as much as possible. The air has no such loss at all but no solid material has as yet been found which does not absorb some energy. By reducing the amount of insulation the losses are cut down.

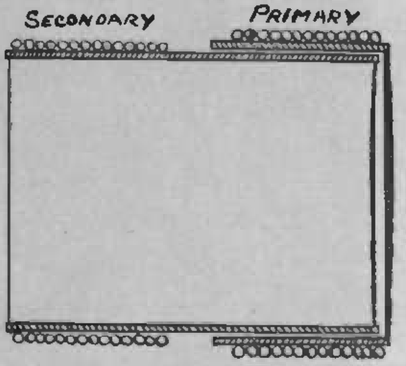


Fig. 3. A Scheme Like This Will Give Just the Right Coupling

The tube if made of pasteboard should be boiled in parafin before it is wound. This will prevent any moisture from being absorbed from the air or damp days. For the same reason many people use "dope" or collodion dissolved in amyl acetate as a coating for the wires after winding. This increases the losses and the distributed capacity to a very slight extent but not nearly so much as would occur if the coil became the least bit damp. If you live in a very dry climate omit the dope, while if your weather is quite damp by all means use it.

Varying the Coupling

The amount of coupling between the primary and secondary has a very great effect both on loudness and selectivity. The farther apart these two coils are spaced the easier it is to separate conflicting stations. This seems to indicate that the coil should be as far apart as possible. On the other hand the volume is greatest at a definite amount of coupling. And if the separation is either more or less than this the loudness falls off. It may seem surprising that bringing the coils still closer together will decrease the volume but such is the case.

It is very difficult to calculate the exact separation for loudest signals and the only way to do is to experiment. An easy method of trying this out is shown in Fig. 3. The secondary is wound on a tube which is a couple of inches longer than necessary to contain it.

The primary goes on another tube which fits over the projecting end of the first one. A fairly close fit makes it easy to adjust but is not at all necessary from the electrical point of view. Such a tube can easily be made by winding six to eight wraps of heavy brown paper on the top of the secondary tube and sticking the wraps together with shellac.

Make Nice Sliding Fit

If such a method is used do not shellac the first two layers. They can then be unwound from the inside when the tube is withdrawn and this will allow the bigger tube to slide easily on the outside of the smaller one.

The direction of winding the wire coils makes no difference,—they do not even have to be both alike. If the double tube as just outlined is not used then both primary and secondary may consist of a continuous wire with a tap taken off at the proper number of turns as shown. The tap will be connected to the ground and also to the phones.

This article will be concluded in our next issue; methods of separating the turns and a description of the best way of operating the set, will be explained together with a description of the way it may be used as a wave trap for a tube set. Reports from fans who pick up various out of town stations will be invited.

Trains for Radio

Pullman Passengers Hear Harmonies While Traveling on Trains

ALTHOUGH you may be speeding along at 60 miles an hour, the radio waves will get you if you don't watch out. To their speed of 186,000 miles a *second*, you are moving so slowly that you may even be going backwards.

Passengers traveling on the transcontinental trains of the Canadian National Railways still rely on radio as their chief form of entertainment in spite of summer static generally resulting in poorer reception. This road claims the distinction of being the only system in the world operating broadcasting stations and passenger trains equipped with radio receiving sets. In the past few weeks a number of cards have been received at WBZ from passengers traveling this road stating that American concerts have been heard in their entirety and that the radio is an improvement over the "time killing" magazines.

The American trains have perhaps not been quite as enterprising as their friends to the north. However, the Louisville and Nashville R. R. has recently equipped its Pan-American train with a Mohawk one dial five-tube receiver.

Shower Baths and Everything

The Pan-American is a deluxe all-Pullman train running between Cincinnati, Louisville and New Orleans, on which is carried brand new Pullman cars of the very latest and luxuriant type, including club car, observation car, drawing room and compartment sleepers, dining cars, and as added features a ladies' lounging room, shower baths for men and women, together with ladies' maid and valet service. It is in every way one of America's finest trains.

In the rear of the parlor-observation car are twelve movable easy chairs in a room which has been especially designed for those passengers who care to enjoy the radio concerts en route. Here the receiving set has been installed as a part of the regular standard equipment. Behind each chair is a small box in which a pair of head-phones are to be found. Any passenger may make use of the radio, and the passenger agent of the L. & N. R. R. already reports that it has met with great success. Fig. 1 shows how the equipment looks.

Must Work in Steel Train Shed

The radio was selected for the Pan-American by R. R. Hobbs, general superintendent of telegraph for the railroad, and Mr. Hobbs personally conducted all the tests. During several thousand miles of travel over the 11,000 miles of track of the L. & N., Mr. Hobbs tried out 47 different standard radio sets. They were subjected to all sorts of conditions relative to radio reception, including special tests made while the train was running in the vicinity of super-power broadcasting stations and smaller stations, as well as while miles from any station whatsoever. Other tests included selectivity and volume under way, and the effect of steel train-sheds on reception while the train was in depots.

The car, Fig. 1, in which the Mohawk was installed was designed and built by the Pullman Car Company of Chicago, who assert it is the first car they have constructed in which the radio has been given such prominence. Engineers in the electrical department were very painstaking in perfecting a suitable aerial for the car, having experimented over a period of several weeks before the best one was found. This is a single wire running a few inches above the roof the whole length of the car.

The Pullman Company is watching the Pan-American train with great interest, and believe that a receiver will be installed on most of the best trains in the United States within a short time.

Fig. 1. Passengers Are Listening to Mohawk Set at 60 Miles an Hour

Measuring the World for Radio

A Map That Shows True Distances As Well As Direction

By VANCE

DID you ever cut a toy rubber ball into halves? If so you know that even though it was elastic you couldn't flatten one of the halves down so that distances on it were the same as before.

That is the trouble with making a map which will show the real miles between different places. And if it is hard to make half a ball into a map, just think how much harder to get a whole globe into a shape which will be true for distance.

Can't Beat 12,500 Miles

Such a map would have some use when it comes to recent radio communications. Of course in distances of 500 or even 2000 miles, the distortion of the surface on as big a globe as the world is slight. But when we hear of talking to Tasmania and conversing with Constantinople, you cannot use any ordinary map to measure the airline distance. Indeed wireless code has been transmitted by some members of the American Radio Relay League for distances of 12,500 miles. Farther than this no one can go, since this is one-half the way around the globe and sending to any other spot than the one opposite you (the antipodes) will be less than this mileage.

There used to be one catch question in geography at school which ran like this, —if you were at the North Pole, in what direction from you would the following places lie: Timbuctoo, Patagonia, Podunk? Of course, the answer to each is "south." Most maps of the whole world are built on this principle, that is lines north and south and parallels east and west are recorded correctly. That means that the North Pole is shown due north of every point on the map. Of course, it can no longer be a point, but strings out for the entire length of the page. In the same way countries lying near the North Pole are spread out in a way which makes them all out of scale with places near the equator.

Takes Care of Curvature

So if you have ever tried to figure the distance between any point in North America and a city in Asia, or perhaps South Africa, making due allowance for the curvature of the earth, you will appreciate this distorted map, Fig. 1, which was drawn for the convenience of radio engineers of the General Electric Company in interpreting transmission tests.

It is known as an "equidistant zenithal projection," which means that you don't have to resort to trigonometry or a slide rule to get either direction or distance between two points on the face of the earth, one point of which is the center of the map.

This map is drawn with Schenectady as a center and all measurements, to be accurate must be from or to Schenectady. An entirely different distortion would be produced if the map were drawn with London or Melbourne as a center.

4000 Miles to the Inch

Although strictly true only for Schenectady, the map will be practically correct for any other place in Eastern United States. In order to find how far radio has travelled in any particular country, measure from your location (assumed to be within 1000 miles of Schenectady) to the place where the signals were heard. Multiply this distance in inches by 4000 and the answer will be in miles of air line route. Or if you prefer, use the scale of mile found in the lower left hand corner, but the answer of course will be the same in either case.

This map has three main uses. In the first place as mentioned, it gives the straight line distance between Eastern United States and any other point on the earth's surface. It must be emphasized that this is the *shortest* line between the two places. Thus if you wish to travel 5000 miles to a point due west, the shortest will not be west, but in a direction a little bit north of west. After passing the half way mark, you will be aiming a little bit to the south, and when you finally reach your destination, you will find that you have saved a good many miles over the route which lay due west.

Like an Ant on an Apple

If this idea is not clear to you, take an apple and cut on it a line round the center to represent the equator. Then cut another circle about half way up to the pole (stem). This roughly represents the latitude of the United States. Now mark two spots on this circle some distance apart and then imagine the course taken by an ant in crawling from one to the other. You will see that the shortest distance is not along the circle of latitude which you have cut, but one which varies to the north a bit. Naturally, if you were in the southern hemisphere, the course would lie a little to the south of the parallel.

The map is valuable, in the second place, as it shows the nature of the intervening territory between Schenectady and any other point.

This is highly important to the radio engineers for, as is well known, the distance over which radio signals can be transmitted depends, among other things, on the nature of intervening territory, that is, whether it is land or water. Distance transmission over territory three-fourths of which is water and one-fourth land, is not so difficult as sending over the same distance three-fourths land and one-fourth water.

Going North to Manila

In the third place, the map gives the exact bearing or direction from Schenectady to any other point on the earth's surface. This bearing is obtained by extending a straight line through Schenectady and the point in question to the scale on the periphery of the map which reads directly in degrees. It would not be supposed, for example, that radio signals from Schenectady would travel within a few degrees of the North Pole to reach Manila. Or suppose you were aiming for Calcutta (you will find this located half an inch above and to the right of the word "Asia.") Most people would probably think the direct route lay to the east or even to the southeast. Instead of that, an airplane would take a direction almost due north, as you can see from Fig. 1.

We have mentioned how with the ordinary map the poles are strung out so they appear thousands of miles long. That does not happen with this map. However, the spot on the earth which is exactly opposite Schenectady has received this same peculiar treatment. The reason is here. Let us call the place X. If you go north for 12,500 miles, you will of course reach X, so we must put the place down $3\frac{1}{4}$ inches north of the center of the map. Also if you go east for 12,500 miles you will strike X. This spot again appears the same distance to the east. In fact, if you go for that distance in any direction, you will still arrive at the same place, and so X must be spread around the edge of the entire circle.

Digging a Hole Through Earth

We are often told that if we should dig a hole from anywhere in the United States through the earth, we should come out in China. This map shows that it is not true. To be sure, China is opposite us on the same parallel of latitude. If we should dig through the center of the earth, we should not come out in the northern hemisphere but south of the equator. This place opposite is shown to be a few hundred miles off Australia. Since this latter country lies so close to our antipodes, it is stretched out in the way shown, and so is not at all in scale for measurement from one part of its own country to another. It is in scale in regards to its distance from the United States.

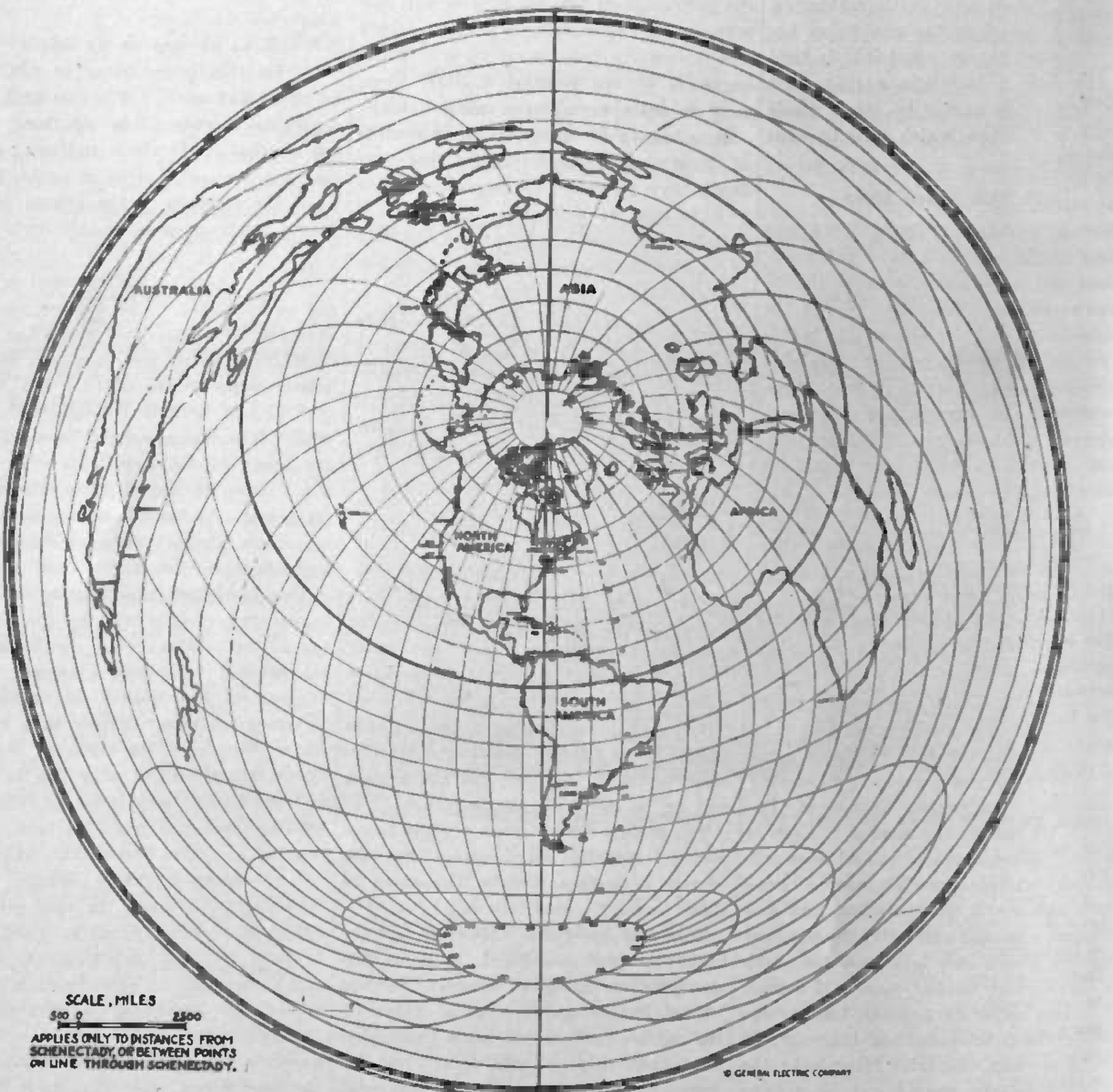


Fig. 1. Measuring from Eastern United States, Each Inch Represents 4,000 Miles

How Quartz Helps Radio

It Works in Laboratories And Also in Tube Sets

An Interview with E. R. BERRY, General Electric Company

QUARTZ itself is not new. It is one of the names given to the pure form of sharp, clean sand, which is often found on the seashore. But it is only very recently that pure quartz, which can be melted, has been developed.

The basis of this material is silicon, which is a silvery-like metal. It is used quite extensively in silicon steel, as when added to iron it makes it tougher. The biggest use of silicon in radio is in the transformer iron, used in making your audio transformers. When iron is made into sheets in a pure state, it is found that although it makes a pretty good transformer core when new, it will change with age and the losses increase very greatly. By adding a small proportion of silicon, not only are the losses reduced at the start, but they stay put without increasing, as the iron grows old. For this reason it might be called the fountain of youth for iron.

One Inch Crystals on Beach

When silicon rusts or oxidizes, each part of the metal unites with two parts of oxygen, which makes silicon oxide. The common name for this, as already explained, is quartz. When it forms in crystals, it is as clear as glass. Along the beach you will oftentimes pick up pieces an inch across, which are just like crystal. In fact, that is the chief trouble with it—the crystals are large in size and break easily, so that they can not be used except as sand in concrete.

For more than a century scientists have been trying to work this material by heat, but the melting point is so high that the hottest flames apparently made no impression on it. About twenty-five years ago, modern methods of getting high temperature succeeded in melting a little and fused quartz was found to have a wonderful transparency, as well as several other useful qualities. The expense, however, was so great that no commercial use could be made of it. During the last year E. R. Berry, of the General Electric Company, has designed a special electric furnace, which melts quartz into a clear liquid and this can be made in tubes and rods up to thirty feet long.

Red Hot in Ice Water

One of the most startling things about this material is the fact that you can heat it red hot and plunge it into ice water without a sign of cracking. A piece of glass, which looks just like it, will fly into a thousand pieces. The reason this experiment works is found in the fact that although glass expands as it is heated, quartz does not. When the tip of the glass rod strikes the water, it is cooled suddenly, and immediately shrinks considerably. The part of the rod next to it, which is still much hotter, does not shrink, and so the glass cracks. Since the quartz does not change its size when heated and cooled, no such action goes on because of temperature changes.

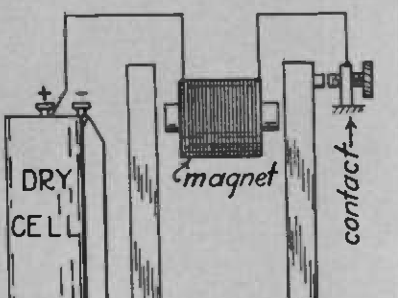


Fig. 1. The Electric Tuning Fork for Tuning Keeps Itself Running

How is this property made use of in radio? One of the principal laboratory needs is for a method of timing, which will not change. This is required to check up on the wave frequencies of sending stations. The various broadcasters are given waves which are so close together in frequency or wave length, that many sets find it difficult to separate two which are nearly alike. You can easily see that if one of these stations should change its timing only a small per cent, it would cut down the margin between it and the next one so that the interference would be much worse, even than at present. That is why it is quite necessary to have standards of timing, which do not vary with the temperature.

Tuning by Tuning Fork

The general principle of this timing is that of the tuning fork. Fig. 1 shows the general scheme. A tuning fork, which vibrates at the frequency you wish to use as a standard, is mounted on a base as shown. Of course, when this is struck, it will give out a note corresponding to its vibration speed. For instance, high C is 1024 vibrations per second. This method of exciting the fork by hitting it occasionally is not very satisfactory, as it requires a lot of work and does not give a smooth tone.

A coil is therefore mounted between the prongs, and this coil is supplied by current from a dry cell. In order to make the coil pull and then let go, it is necessary to have an interruptor in the circuit which breaks the current whenever the prongs have been sucked in. The easiest way of working this interruptor, is to make the tuning fork do its own work. A contact is mounted on one of the prongs which mates with an adjustable thumb screw supported on the base. One lead of the coil is connected to the contact screw and the current returns to the dry cell through the tuning fork itself.

What Makes it Vibrate

You will now see the action of the device. When the prongs are at rest, the current flows from the plus terminal of the dry cell through the coil contacts and tuning fork, back to the battery. This makes the coil a magnet, and it sucks both prongs in toward the center. Of course, this breaks the contact and so opens the circuit, and this allows the coil to release the prongs so they immediately fly back again. As soon as the contacts touch, the action is repeated, and this goes on indefinitely. The speed of the vibration is governed by the length and the thickness of the arms of the tuning fork.

Such an instrument is very satisfactory for timing any fast vibration, provided the temperature of the room does not change. But unfortunately the note is different in summer and in winter. As the temperature varies the steel also changes its dimensions with the result that the note is not constant as is needed in a standard for timing. If some material could be found which did not vary with temperature and yet had plenty of springyness like steel, it would be just the thing.

Quartz to the Rescue

Here is where quartz comes on the scene. It is not affected by temperature and it is quite elastic. For these reasons it makes an ideal material for a tuning fork. Naturally, it is not magnetic, and so a small piece of iron must be attached near the end of each prong of the fork to be attracted by the magnetism of the coil. Such a timing device gives the same note winter and summer.

A tuning fork built along the lines described, has an audio frequency of several hundred up to several thousand vibrations a second. When it is desired to get up into the hundreds of thousands or millions of oscillations per second to check with radio frequency, it is necessary to use a crystal, shaped like a cube. Fig. 2 shows a crystal, which may be about one inch on a side of pure fuzed quartz. When vibrating at about a million times a second it is not possible to use an electric contact, which makes and breaks, as was done in Fig. 1. Instead, two sheets of tin foil are mounted one on each side by cementing to the crystal faces. These two sheets act like the two plates of a condenser when connected into an oscillating vacuum tube circuit. By attaching a light wire to each of the tin foil strips, the whole crystal may be inserted into the tube circuit of the oscillator.

Bends the Crystal Ends

You may wonder what supplies the energy to make the crystal vibrate. No doubt you remember that opposite charges of electricity attract each other and the condenser when filled has a negative charge on one plate and a positive one on the other. These two charges, although small, have enough pull on each other to bend the end surfaces of the crystal in very slightly. An instant later when the vacuum tube, in its electrical oscillation, has discharged

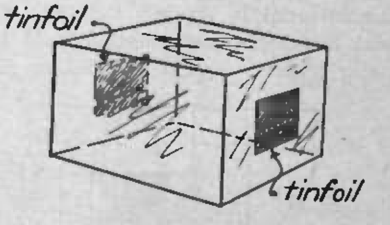


Fig. 2. When Tuning Radio Vibrations, a Quartz Crystal is Used as an Oscillation.

the condenser, the sides of the cube will spring back again. This action is enough to keep the crystal oscillating and the speed at which it vibrates depends on the size and shape of the quartz.

As Professor Elihu Thomson recently pointed out, another quality which makes silicate glass (quartz) so suitable for this purpose is the fact that it can be adjusted to the right note by grinding on an emery wheel. This is not practical with a steel tuning fork since the grinding heats the metal and so changes its pitch. As it cools down again, it does not immediately get rid of the strain which was put in by the high grinding temperature and so the tones will shift slightly over a great many hours. Since quartz does not change its size under the temperature of the grinding the adjustment can be checked immediately after holding it on the wheel.

After 10 Years Hard Work

Some account of the work done in developing this material and its uses aside from radio will be of interest. When E. R. Berry, assistant director of the Thomson Research Laboratory of the General Electric Company at West Lynn, gave to the scientific world and the general public the results of his ten years of costly experimentation with the production of clear fused quartz, he probably opened the door as nothing else could to the rapid development of the use of ultra-violet rays.

This unbelievably clear quartz—nature's own glass amazingly purified and workable—may well prove, in the belief of medical, chemical and biological authorities, to be the long-sought key to previously unlocked secrets of health.

Fused quartz, formerly produced only in quantities that made it many times as costly as gold by weight, has many unusual qualities, which suggest a variety of uses, now that it is on the point of becoming easily available. One of the qualities which stands out equal to its use in radio, is that of transmitting ultra-violet rays. Its importance, therefore, is certain to increase with the effective employment of these rays. Talks with scientists now engaged in using fused quartz to further ultra-violet rays experiments, show, despite their caution of utterance, that they hope for, and even expect, remarkable results.

A Sun Room to Use it

His work of producing in quantity, in practicable form and at reasonable cost, this prized substance has been virtually finished. Mr. Berry has now turned his attention to its use in the healing and disease-preventive fields. He has enlisted the services of two eminent scientists and of the institutions with which they are connected. They are Dr. Clarence C. Little, president of the University of Maine, at Orono, Maine, a leading biologist, and Dr. W. T. Bovie, professor of bio-physics at Harvard Medical School, Boston, and an officer of the American Chemical Society. Other scientists and institutions, including a famous hospital which will build a sun room lighted through the new "glass," are following developments with intense interest.

You will remember that it is vibrations in the ether which make both light and also radio. When they are very slow they are known as "heat" rays. If they are condensed by a large magnifying glass they will set a piece of paper on fire. Faster vibrations of the same sort give us light varying from the red end of the rainbow through to the violet. The only difference between these colors is that of vibration speed. When the oscillations become faster than that of violet they no longer affect our eyes, and we can not see them, but they can be "seen" by a camera very easily. They also affect our skin to cause sunburn.

Radio Goes Through Glass

It is these same vibrations in the ether which are known as radio waves when they oscillate at a much slower speed than that necessary to give light and heat. Such leisurely waves do not find any difficulty is going through most all ordinary materials. They penetrate the walls of your house and you will find that if you use a loop for your receiving set that it works just as well after the window is closed as it did when open. This shows that they go through glass as though it were not there. The high speed vibrations of ultra violet rays, however, can not penetrate ordinary glass, although the latter is transparent to light.

Fused quartz has the property of being perfectly transparent, even to these immensely high speed vibrations. Although bright sunlight that has filtered through ordinary window glass has lost most of its health giving powers, still it is found that windows made of silicate glass do not kill the effect of the sunlight as a curative agent for those in poor health.

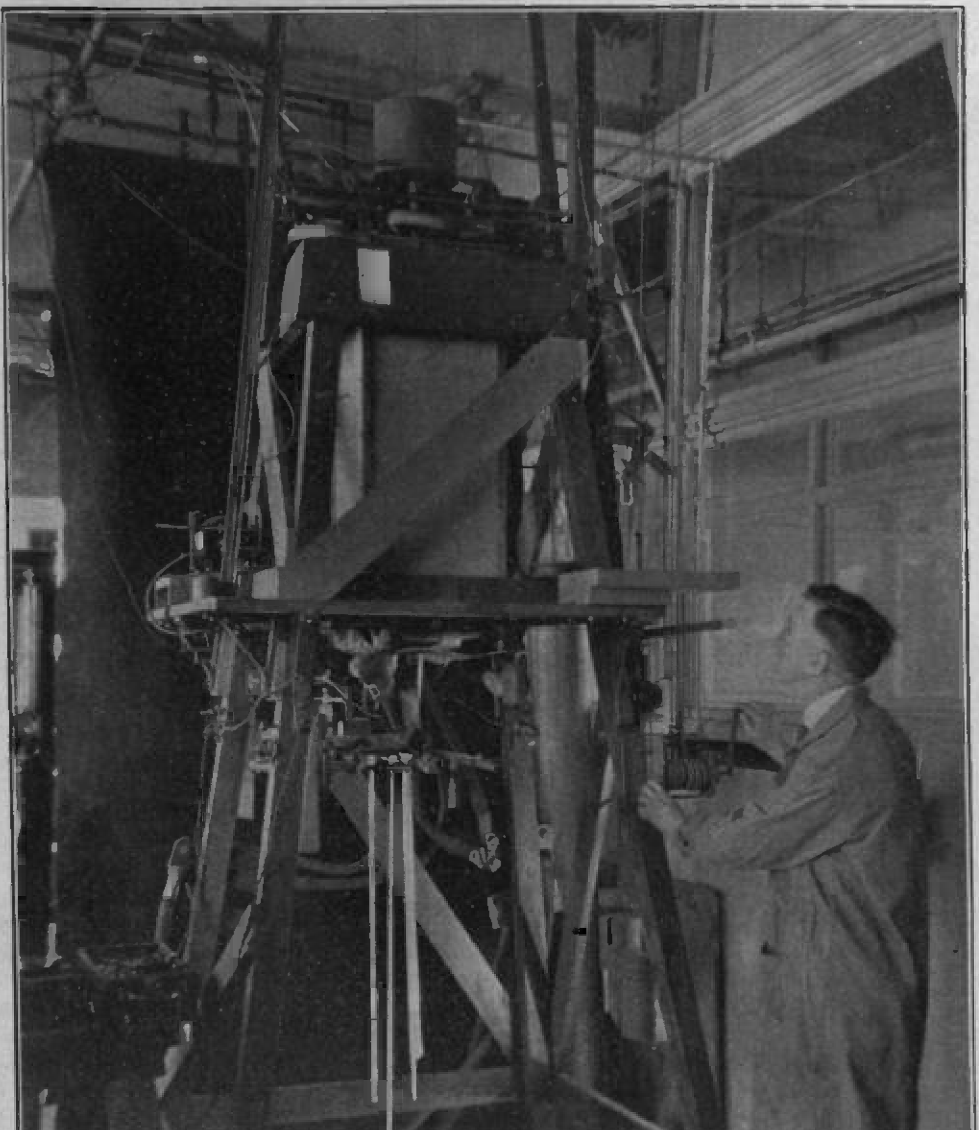


Fig. 3. Here Is the Special Vacuum Furnace in Which the Quartz is Melted. A Carbon Resistance is Used in Generating the Tremendous Heat

Quartz in Harvard Greenhouse

Following these same lines, there is

planned on the ground of Harvard University a greenhouse glassed with quartz in which will be determined certain effects of the rays upon growing plants. Of course, this is with a view of applying any knowledge thus gained to improving human health or preventing human disease.

With a like object experiments are to be made in the University of Maine laboratories, where conditions are especially favorable. It is expected that new knowledge will be gained on the effects of ultra-violet rays on poultry, with reference to disease and fertility, and upon mice, inbred to the 70th generation.

All concerned in these developments have avoided raising false hopes regarding the possibilities of curing or preventing certain stubborn diseases, but some of the results encourage the hope that infant mortality, particularly in crowded cities, may be further reduced. In this case the insidious enemy is rickets. This point, recently developed on both sides of the Atlantic with the revelation of astonishing facts, was discussed by Dr. Bovie.

No Sunshine Blanches Plants

"We all know that exclusion of light results in the blanching of plants," said Dr. Bovie. "They may become more succulent for table purposes, but their tissues are not stout and well developed. This is because calcium and phosphorous salts are not deposited in the absence of the ultra-violet rays in sunlight.

"Similarly, if babies are submitted to the same absence of sunlight, or of ultra-violet rays, their bones do not grow properly, and this disease is called rickets. This is a common disease—how common is not generally realized. It is perhaps not well known, either, that it is prevalent among the babies of the well-to-do who are not allowed to play in the streets.

"Remember that playing in the sun, behind glass windows, does not expose them to these beneficial rays. However, quartz windows, which do permit these rays, are now entirely within the bounds of possibility as a result of Mr. Berry's work.

Spring Babies Lack Rickets

"But, to get back to rickets. Autopsies on babies in Dresden showed that of those who were born in the fall, and died in the spring, 96 per cent had rickets. Of those who were born in the spring and died in the fall only a very small percentage had rickets. The babies born in the spring were outdoors in the sunlight during the summer."

Similar experiments by Dr. Alfred E. Hess of New York is said to have justified the statement that three out of four young children in city blocks have rickets, which may appear as only a mild form of bone trouble, or may lead to slight deformities, grippe and pneumonia. He is quoted as having determined that it is much more prevalent in winter, and that sunshine is the preventative and the cure.

The same possibility was expanded upon by Dr. Bovie, as follows: "If we can provide artificial lights that will emit ultra-violet rays, we shall not have to depend on the sun, which is so uncertain in winter. We can get the sun's effects on cloudy days by using quartz bulbs or tubes with incandescent lights.

Quartz Light While You Eat

"Certain foods," he continued, "act sympathetically to sunlight. It is not nconceivable that we could light our restaurants with sources of ultra-violet light, so that while partaking of foods rich in phosphorous and calcium we could also absorb light energy that would enable us to utilize these salts in a normal manner.

"Altogether, the availability of quartz suggests very interesting possibilities. With Dr. Little we are undertaking an investigation of the effects of the ultra-violet rays in milch cows. The object, of course, is to see if the rays can have any effect on the milk we feed our babies.

"It is not improbable. Other animals feel the effects of the lack of these rays. Deep-sea fish do not produce bones, though living in water prodigally saturated with calcium (lime) salts. Fish of the same species living in the upper water, where the sun's rays strike through, have bones in profusion.

Ultra Violet Hen's Eggs

"Likewise, poultrymen in the north are unable to grow chickens for early market satisfactorily. In the darkness of the long winter, the chickens suffer from 'weak legs.' This is nothing but rickets, and ultra-violet rays cure them. Hughes of the Kansas experiment station exposed hens to ultra-violet rays 10 minutes a day and doubled their egg production. Further, the weight of the individual egg was increased 20 per cent.

"In America, however, progress has been retarded, and some such event as the production of this quartz has been needed to redirect attention to the subject," said Dr. Bovie. "American doctors did not understand the scientific side of ultra-violet therapy. Its use developed into a bad form of quackery. Apparatus called ultra-violet lamps which did not emit any of the rays Finsen relied upon were used. The result has been that many reputable physicians of America have refused to have anything to do with it."

Men Grown Under Glass

If the new quartz merely makes it possible eventually for the average home to have the essence of sunlight, artificial or natural, the year round, bad weather and good, it will mean better health to countless thousands who, "grown under glass," have been depriving themselves of the most beneficial qualities of sunlight, heat excepted. The action of the ultra-violet rays apparently is already well enough understood and gauged to make the prediction safe. Indoor living or residence in regions overcast for long periods, need not be so hazardous in the future.

But, aside from this most beguiling phase of Mr. Berry's hard-won accomplishment, the substance he has produced so dexterously is in itself fascinating.

It looks like glass, surpassingly colorless and transparent, and is about as easily broken by a blow as glass is. But its other properties—long known to be posessed by quartz, but heightened by the new process—are quite different. As these become apparent, uses suggest themselves to the limit of the beholder's imagination and scientific knowledge.

Much Clearer Than Glass

To begin with, it is the most transparent substance yet known to man. Light rays will pass through a solid rod of it a meter (39 inches) long, with only 8 per cent loss. The best optical glass loses 35 per cent, ordinary glass 65.

It has similar efficiency in transmitting heat. A flame may be applied at one end and the tube held in the hand. The surface is cool, but touch your finger to the far end and you receive a burn.

The most spectacular test, however, is in transmitting light around a corner with a bent rod or ribbon. Mr. Berry demonstrated this with a long rod of fused quartz that had eight clearly defined bends, which amounted to nearly three complete circles.

Can't Look Through Glass of Water

The reason that the light works like this is because it can not leave a substance and go into the air if the angle is slight like a glancing blow. To show what is meant by this hold a tumbler of water in your hand slightly above the level of your eye and try to look up through the surface of the water against the ceiling. You will find that the water surface acts like a polished mirror and you can not see through it. In the same way a rod of glass will conduct light rays, which are applied at the end, since the light can not break through the glass into the air as the rays glance along the walls of the rod. It is just as if the outside surface of the rod were a mirror turned inward.

Of course, the same idea holds in an ordinary piece of glass, but the trouble there is that the light is about all absorbed before it gets to the end of the rod. The difference in the case of the quartz is that almost the same amount of light comes out the far end as went in at the lamp. By making use of this action it is possible for a throat specialist to flood his patient's larynx with light so that he can see its condition. All he has to do is to use a bent silica rod and hold the upper end against a strong electric light. The illumination on the throat is much greater than if he used a small electric bulb in the patient's mouth and besides that it does not cause any trouble from heating or from danger of breaking. And though light pours through the rod as if siphoned with a hose, more astonishing still is the lack of changeability of the color of light flowing through clear fused quartz.

Tuning Fork Like a Tramp

A bell or goblet of fused quartz rings melodiously with a pitch that can be altered by shaping and sizing. Once fixed, as has been explained, temperature does not change it. So stable is it that a tone thus recorded can be carried down the generations—which makes the tuning fork of metal look like a mere tramp.

Despite these stable qualities, the clear fused quartz can be easily worked. It is forced downward out of the greatest vacuum electric furnace in the world and appears as perfectly smooth rods, tubes, ribbons or ingots. It can be molded into any shape. It can be cast into great disc blanks, which easily take a lens polish.

Fig. 3 shows the vacuum furnace which has been developed for this use. Tremendous quantities of electrical energy are poured into the small space which you will notice in the upper centre of the photograph. Observe the heavy cables carrying the current which may be seen in the lower center. Four rods of quartz are observed coming out from the bottom of the furnace.

No Bubbles in the Vacuum

Brazil furnishes the crude quartz crystals, which are refined into the fused form. The crystals look like big grains of sand. They are packed into a carbon crucible, which is placed in the vacuum furnace. Around the crucible are the carbon grids, which carry the heavy current. The whole furnace is placed in an air tight container and the air exhausted. This is to prevent the formation, as much as possible, of bubbles in the molten mass.

The current is now turned on full and the quartz brought up to the melting point just as fast as possible. The crystals all run together into a clear, transparent mass, but there are some bubbles of gases, which do not come to the surface in spite of the vacuum.

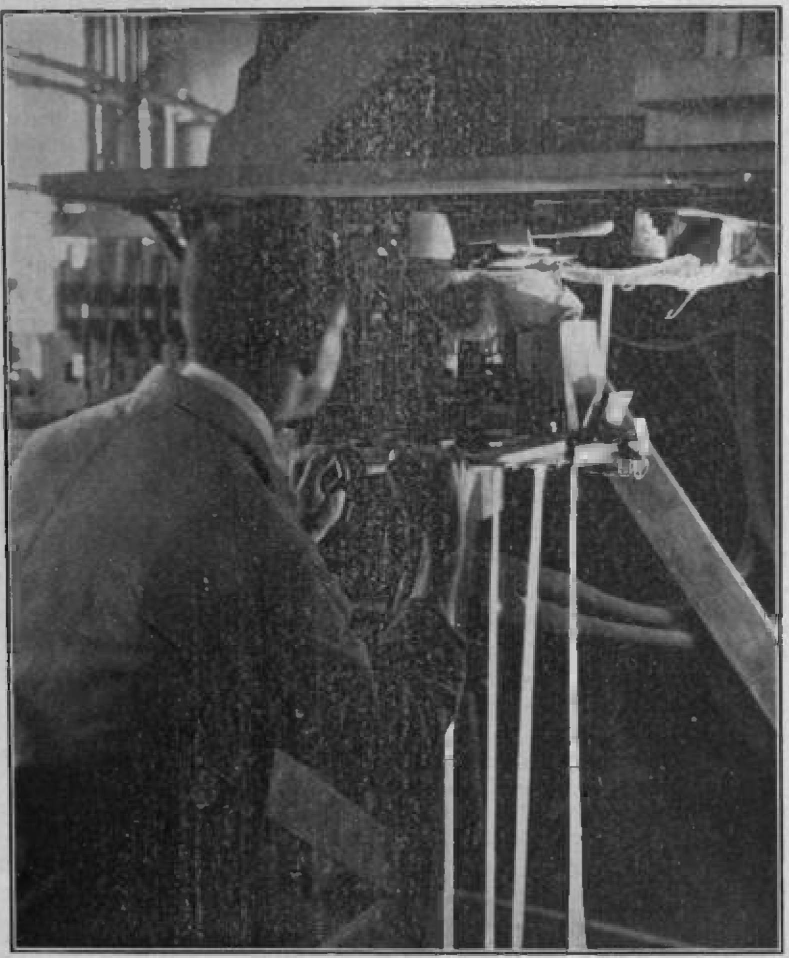


Fig. 4. Details of White-Hot Tubes Flowing from Furnace. Notice Heavy Leads Which Carry the Electric Current

Crucible for Cooking Quartz

The molten mass is then quickly poured into a graphite cylinder which is suspended in an electrical furnace, which has upright carbon tubes for heating elements. The current is again turned on and when the mass is quite hot and fluid, a graphite piston which just fits the crucible like a cylinder, is brought down on top of the melted quartz. This piston is forced down with great pressure at the same time the heat is applied and any bubbles are squeezed out. The bottom of the crucible has some openings which correspond to the rods to be made and when the material has finished cooking, these holes are opened and the molten quartz is squeezed through. By making the holes various sizes and shapes the different forms of rods are made.

The quartz tubes themselves are seen clearer in Fig. 4, which is a detail of the underside of the furnace. After the material has once been melted the fused quartz can be worked in a glass blower flame like ordinary glass, except that it needs much higher temperature to make it flow.

Tubes Which Vanish

"The tubes in the picture are coarse," remarked Mr. Barry. "We have made some tubes so small that, once dropped on the floor, they are lost for good. Only a microscope could tell you they were tubes and not rods."

Though Mr. Barry sees a variety of potential uses not already made for the clear quartz crystal—of which he has in his laboratory a thousand times as much as exists elsewhere in the world—it is in its possible meaning to human health and to the furthering of experiments that will bring a dimunition of human suffering and inefficiency, that he takes greatest pleasure. Regarding these possibilities he declines to be quoted, however, on the plea that he is not a medical man.

Although it has been stated that quartz has no temperature expansion, this is not strictly true. When the Bureau of Standards recently ran a series of tests on this material, they found that the expansion was so small that it could not be measured by ordinary meters, still they were able to determine that its co-efficiency is but a small fraction of that of glass. Strange to say, as the quartz is cooled down it shrinks (although very slightly) until the temperature is considerably below zero and when cooled still more, it expands again. This is quite a curious effect and does not occur with any other ordinary material.

DeForest Uses it in Tubes

Another use for quartz which is quite different from that mentioned, has been developed by the DeForest Radio Company. They have succeeded in making a form of quartz which possesses most of the characteristics which have just been described. They are about to put it out in large quantities at a low enough price so that it can be used in their new tubes.

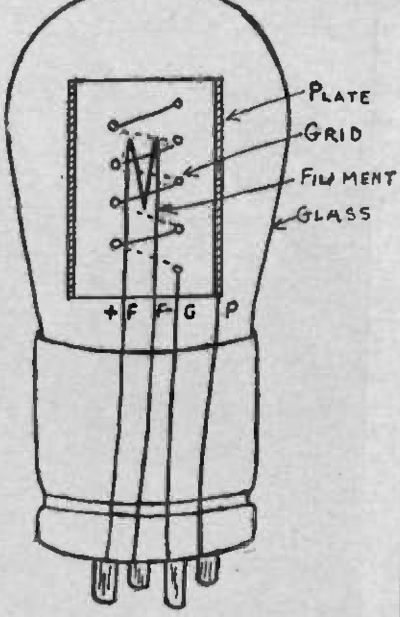


Fig. 5. The Construction of a Tube Affects the Internal Capacity from Grid to Plate.

Isolantite, or synthetic quartz, is used for the base of their new DV-5 tube, and the romance of its discovery dates back to the first years of the World War, when the German forces consistently held supremacy of the air because their planes could fly higher than those of the Allies. It was finally discovered that this flight superiority was due entirely to the insulating material used in their spark plugs, possessing qualities previously unknown to the Allied scientists and engineers.

Heat Resisting at High Speed

First, they had great mechanical strength, combined with insulating qualities so great that losses of electrical energy at high frequency were almost nothing, and finally their heat-resisting element caused them to stand up under the high temperatures produced when motors were turning at thousands of revolutions per minute.

Eventually it was learned that the material was a natural substance found only in its pure state in a small area in Silesia, immune from Allied attack. World wide search for other deposits proved fruitless. The Allies immediately concentrated their research on a synthetic material which would take its place and possess the additional factor of freedom from combined water, found even in porcelain. This resulted in the discovery of Isolantite and its perfection to the present modern form. The advantage of such a material as a tube base may be understood better by referring to Fig. 5. This shows a tube with the three elements, filament, grid and plate. A brass shell surrounds the base. This shell acts like the plate of a condenser and increases the capacity between the grid and plate. By leaving off this shell and substituting an insulating material, as is now being done, the capacity of the tube itself is reduced. However, If we use as an insulator, some kind of material which has a particularly low capacity effect, the result will be better yet. It has been found that quartz possesses this good characteristic.

It Passes These Tests

The resistance of Isolantite to temperature is remarkable. Its heat treatment takes place at a temperature that would cause metals, even iron, to become a gas. It will stand 17,000 volts to the millimeter (1/25 of an inch), and this breakdown is not affected by increasing the frequency. Its phase angle (which indicates its losses) even measured at 600,000 cycles is less than 1/100 of a degree, and its resistivity at the limits of these measurements give but an inadequate picture of its value. It has been used under glowing temperatures with frequencies of 20 million cycles and with unusual voltages, and even under these high temper-

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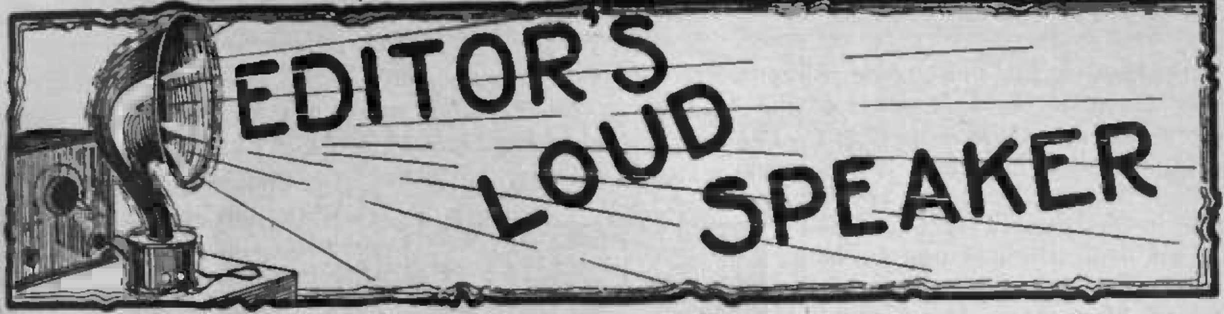

"CONCERT COMING IN FINE"

Do you remember how back in the dark ages (a couple of years ago) we picked up from nearly every station a line of talk running something like this: "and here's a telegram from Mr. and Mrs. Smith of Keokuck. They say, 'concert coming in fine—you have the best station'?"

After hearing the same thing from Mr. and Mrs. Brown and from the Greens, you probably got so bored that you shut off the loud speaker (either by the switch or by throwing a book at it) and went to bed. If you did keep on listening, the only other fact to be learned from the telegrams was that "your modulation is perfect," whatever that means.

She Forgot Her Date

One of the signs of the times these days is that none of the really first-class stations pull this kind of so-called entertainment any more. Once in awhile one of the backwoods stations will fill in a yawning gap when perhaps their soprano has forgotten the date she has for broadcasting by giving us a reading from the messages which have presumably just been received.

When our radio set starts to skim this kind of cream off the ocean of ether it gives us the feeling of being transported back to thousands of years ago, at the time when the cave man did his stuff. Then we heave a sigh of relief at the thought that we do not live in the "good old days."

SHALL WE FOLLOW CONVENTION?

There is an old and well-known magazine convention which requires that each new article starts at the top of the page and preferably on the right-hand side. We have been observing this idea ever since we started this publication.

Only a few articles happen to end right at the bottom of the page. If they fall a little bit short it is easy to piece out the leaf with news items, and this causes no trouble. But if they happen to run over a quarter or half a page, it means that the article must be cut by that amount (which will often spoil the meaning) or else it must run over to the foot of some other sheet.

Breaking Old Custom

Some of our readers have criticized this broken-up appearance of this magazine and say that they would prefer that in such an event we continue the article on the following page, even if we have to break the custom of beginning the next story on the upper right hand margin as already explained.

Of course, by this time you have realized that we are making an unusual attempt to make this a readers' magazine. As one of our family, we want to do what you wish. If you have any ideas on this subject (or on anything else about the magazine, for that matter), sit down at your desk right away and tell the Editor what you want him to do. Thank you.

FASHIONS FOR FANS

Although this is the time of the year when the sale of radio supplies drops to a low ebb at the retail stores, it is also when the big manufacturers first start showing new styles for sets.

It is interesting to look over the field and trace the tendencies and trends of the new radios. In the

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HOW QUARTZ HELPS

Continued from Previous Page

atures and enormous frequencies, Isolantite retains its insulation qualities; losses are not appreciable and it does not give off gases or deteriorate to the slightest degree.

Chief Engineer Roy A. Weagant of the DeForest Radio Company found that an Isolantite based tube decreased grid plate capacity from twelve micro microfarads to eight or less at frequencies from 100,000 to ten million; while the tone quality remained practically constant, regardless of variations in frequency.

This high insulation value was combined with improved internal tube construction that is said to give freedom from disturbing noises and crackling, with radical increases in volume from weak signals.

Mr. Berry a Maine Graduate

A few words about Mr. Berry himself may be of interest. He is quiet and unassuming, as a scientist should be. His home was in Lynn and he exercised his bent for two years obscurely working for the General Electric Company. He then took a scientific course at the University of Maine and was graduated in 1904 with a B. S. degree. In 1907 he won his M. S.

He worked for a time in a hydroelectric plant in Maine, then started for Niagara Falls to another job by way of Lynn. He never reached Niagara. A place was open in the General Electric laboratory, and he has been there ever since.

At heart an experimental scientist, his great triumph came only recently, when he read before the 45th meeting of the American-Chemical Society at Philadelphia a paper giving in full detail the result of his long labor in making "transparent" quartz crystals—Nature's best—and rendering them amorphous instead of crystalline, free from impurities, and wholly adaptable to men's use.

first place, a lot more care is being taken of the *appearance* of the receiver. This is probably owing to the influence of the women buyers. They are apt to take it for granted that a well-known firm will put out an instrument which works properly, and so other things being equal, they naturally choose the set which has the appearance of a fine piece of furniture.

A Slant on New Panels

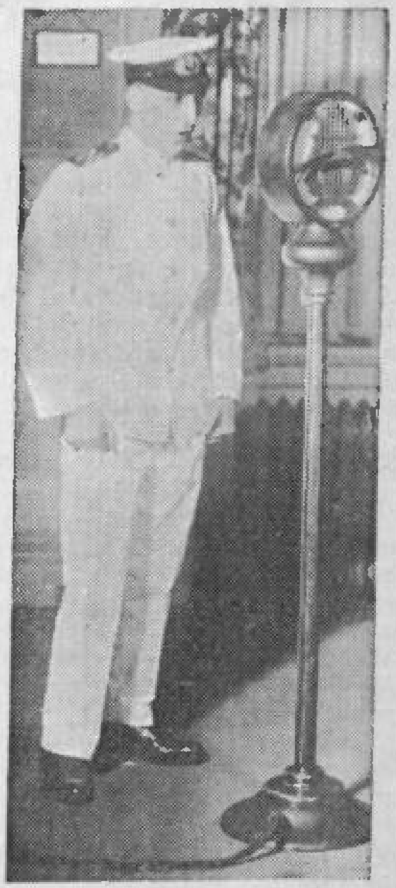
This has resulted in largely eliminating the radios which look like piles of junk. The new models have nicely finished cabinets and often times engraved and decorated panels. The slanting panel is coming considerably into vogue, as it is supposed to give a more finished appearance, and also to be more convenient for the one who operates the dials.

As an aid to the appearance and also in order to make it easier to operate, most sets are cutting down tremendously on the number of knobs and handles As we predicted more than a year ago, the scheme of having as many rheostats as there are tubes has completely passed out. Where are those fellows now who claimed that they were necessary? Several manufacturers are now using only a single knob to pick out the various stations.

Where is Reflex Hiding?

There is quite a pronounced swing towards the sets using five or six tubes. Even the DeForest Company and Preiss, who claim to have invented the reflex principle, are bringing out models which use the full number of amplifier tubes without combining both audio and radio frequency through the same tube, as found in the reflex idea.

The super-power stations are having an effect on designs. Time was when 500 or 1000 watts was considered a real station. But the leaders no longer wish to piffle with such puny power; 5,000 watts is now par, with the prospect of raising the ante to 10,000 and up. Plans are under way for a 50,000 watt station to be located in New Jersey far enough away from New York City so as not to cause too much interference with the local stations.



William Ballyn, Chief Steward. Steward is Sea Song Singer.

William Ballyn, is the Chief Steward on the Cunard liner "Berengaria." He also has a good voice and knows a lot of rollicking songs of the sea. When he is on shore, he is one of the favorite broadcasters from station WJZ, New York. Radio fans who like a nautical flavor in their entertainment are always glad when the "Berengaria" docks.

Chopping the Aerial

With this in mind, the set builders are taking advantage of the more powerful waves to do away with the long aerials formerly recommended. Whereas, 200 feet was thought to be a very good length for an antenna a couple of years ago, the present tendency is to struggle along with 50 feet or even 20.

There are two advantages in the short aerial. The more obvious one is that it is much easier to put up the shorter wires. The favorite outdoor sport of the average radio fan used to be trying to solve the puzzle of how to stretch a 200-foot wire across a 75-foot lot. The second advantage of the smaller aerial is that static and disturbances of all kinds are cut down in proportion to the length.

Bolstering Weak Signals

Since the signal which you want to hear is also reduced, it becomes necessary for the designer of the radio set to provide more amplification of the weak signals before the detector turns them into music. This accounts for the increase in the number of radio frequency amplifier tubes.

A last item of change which is quite noticeable is that of decreasing cost. There is now so much competition in this line, and the performance of radios has been so well standardized, that no one company can hope to run away with the field. Of course, that means that price will be quite a factor when Mr. Fan consults with his wife as to which set to buy. A natural result is that the big companies no longer try to put a fancy price on their products. Reduction of cost all along the line will undoubtedly be seen for the next two or three years.

Shielding Your Condensers

It is a Good Thing, But Don't Do it Too Much

By HARRY J. MARX

It isn't only when you are having your picture taken that your hands seem to be in the way. Often when tuning in that distant station you may get the exact setting of the dial so that the music is as clear as though it were in the same room, but presto—when you take your hands off the dials, it fades into nothing. Why?

The idea may be obtained from Fig. 1. This represents the plates of variable condenser which are shown by the dial on the right to be in mesh up to 40. Underneath the main condenser is another one of only two plates, acting as a vernier. Its dial is set at 40, too. Now suppose that the vernier has a ratio of 10 to 1. That means that the value of the lower one (40) divided by the ratio (10) is the equivalent of 4 on the main scale. Adding the reading of 40, we get the total value of capacity of 4 plus 40, or 44. This is the amount of capacity which we find by experiment must be used to tune the wave we are after.

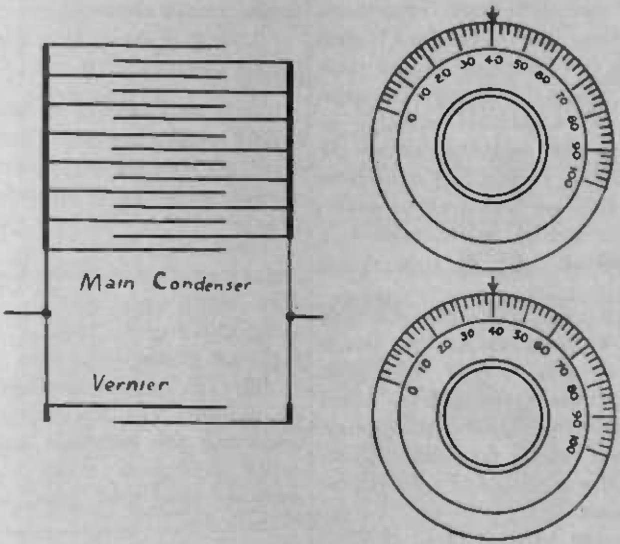


Fig. 1. Vernier Dial is Underneath the Main Condenser Control. Both Are Set at 40.

When Vernier Spoils It

Now suppose that we change the vernier as shown in Fig. 2. It now reads 20, so will be equal to 2, making the total 42. This evidently will not pick up the station we want, as we have already found by trial that 44 is right. In order to get this amount with the vernier as shown, the main dial should read 42. Until it is adjusted to that place the wave will be lost.

In an unshielded set, the main condenser shown in these two cuts is the one you do your tuning with. It is your hand which forms the small vernier which is shown. As you have it resting on your dial, it forms one plate of the vernier, while the metal parts of the set make the other. Your hand is at ground potential, or thereabouts. So you can readily see that the total capacity that you are using to tune with is the dial reading, plus the amount which your hand happens to have. Now when you take the latter away, it immediately drops the total, with the result that the tuning is changed and of course the music immediately fades away.

Preventing Body Capacity

What is the way of overcoming this trouble? Notice that it is the *change*

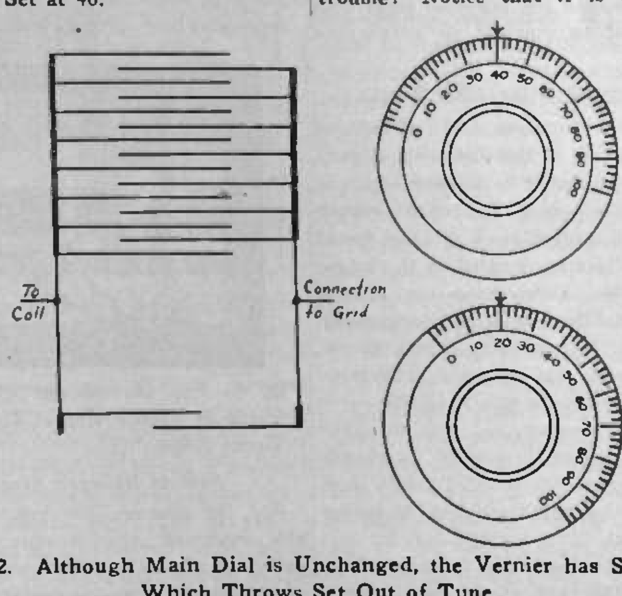


Fig. 2. Although Main Dial is Unchanged, the Vernier has Shifted, Which Throws Set Out of Tune

in the small capacity, not its size, that causes the trouble. The answer must be to fix it so that it does not vary. This is done by shielding. One result of such treatment may be that the small amount of capacity which was there before is increased. but that does no harm, as to tune to a given station it will be necessary only to use a slightly lower dial reading of the main condenser. If the small capacity does not shift, then this reading will stay constant, whether or not the hand is there.

It seems strange that the average radio fan appears to hesitate in making

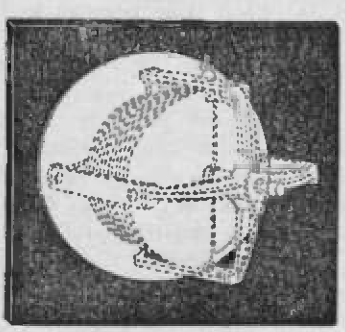


Fig. 3. A Round Plate Like This Under the Condenser Makes a Fine Shield.

use of metal shielding when building sets. Examine the more popular and most efficient manufactured receivers and it will be found that proper shielding is incorporated in the majority of them. Surely if the makers with their expert engineering staff find it essential, it behooves the fan who constructs his own set to consider its advantages seriously.

Buying Shielding Like Panel

Possibly one reason for its lack of general use, is in the difficulty of purchasing sheet metal in small pieces. It is only the large hardware supply houses that carry a stock of sheet metal and these firms are limited to the larger cities. Radio stores have not always handled shielding material. Fortunately this demand is now being taken care of and standard size sheets in envelopes like panel stock are now available.

Aluminum, copper and tin foil have all been placed on the market for shielding. Unfortunately thin foil stock does not always adapt itself for fastening to the panel.

Probably the best way to fasten it is to shellac the back of the panel where the foil is to go, and when it has partly dried, so that it is quite sticky, apply the metal. It will stick quite readily. It takes a long time for it to set from this point on, as there is no way for the alcohol to get out in evaporation except underneath the edges of the foil. Holes for screws. shafts, etc., can be cut in the metal with a sharp knife later on.

Sheet metal, having some degree of stiffness is sometimes convenient. This can be held in place behind the apparatus as shown in Fig. 3.

Some Metals Not Good

The question arises, which metal should be used. Copper is often more expensive than the others, and corrosion makes it turn green after a time, especially where soldering is done. Aluminum has a habit of collecting an oxide coat which tends to destroy the good electrical contact. Furthermore aluminum does not lend itself to soldering without special solder and skill. Magnetic metals such as iron should never be used.

During the war, nickel-zinc was employed to a large extent for trench mirrors. This is a pure zinc sheet metal which has been given a nickel coating, producing a mirrorlike finish. It lends itself readily for shielding purposes, and the nickel decidedly enriches the appearance of the inside of the set. Connections can be soldered to it without any trouble. The metal can be purchased in convenient sizes and is very inexpensive.

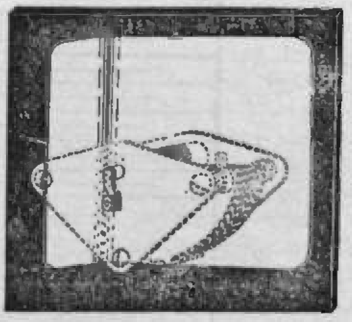


Fig. 4. For Inter-Stage Shielding a Piece of Apollo Nickel Zinc is Bent Up at Edge.

Protect Between Stages

For the average use behind a variable condenser the circular shield as shown in Fig. 3 is about the best. In cases where some protection between stages is desirable, the shield with a flap, (see Fig. 4) is recommended.

Where shielding of this sort is used, it should be electrically connected to the *rotor* plates and on the ground side of the circuit.

A little more general use of shielding will do much toward solving the body capacity problem which is characteristic of home built sets. Some manufacturers are going to the extent of completely lining the inside of the cabinets in order to entirely eliminate any possible external interference. Where a cabinet is lined in this manner the shielding is as a rule directly connected to the ground terminal.

PHILHARMONIC TO FILL US WITH HARMONIES

WGY, with WJZ of New York and WRC of Washington, is privileged to offer to its audience the entire summer schedule of the New York Philharmonic Orchestra, from New York. These programs began Tuesday evening, July 7 at 8:25 o'clock, daylight time, and are being offered every Tuesday, Friday and Saturday evenings through the months of July and August, concluding August 29. William Van Hoogstraten is again conducting the orchestra and arrangements have been made to introduce many soloists, both vocal and instrumental.

The pick-up will be in charge of the engineers of WJZ. Milton Cross of the studio staff of that station will be announcer.

Fone Fun For Fans

Try This

Motor Cop (after hard chase): "Why didn't you stop when I shouted back there?"

Driver (with only five bucks but presence of mind): "I thought you said, 'Good morning, Senator.'"

Cop: "Well, you see Senator, I wanted to warn you about driving fast through the next township."—Carolina Motorist.

Longevity Among Schoolmarms.

Student: "I wonder how old that Mrs. Jones is?"

Second Student: "Quite old, I imagine. They say she used to teach Caesar."

—Dirge.

Merely Convalescent

"I think her voice is improved a great deal, don't you?"

"Yes, but not cured."—Penn State Froth.

Just the Boy for the Job

Father: "I want to apprentice my boy to you."

Master Plumber: "Where is 'e?"

Father: "Well—er—he forgot his references and has gone back home for them."

Master Plumber: "Righto!—I'll take 'im!"—London Opinion.

Drinks are on Them

Lady Jane—"Have you given the goldfish fresh water, Janet?"

Janet—"No, mum, they ain't finished the water I gave them yesterday yet." Jack o' Lantern.

These Fresh Taxi Drivers

Lady (in taxi)—"What's the matter, driver?"

Driver—"The engine misses."

Lady—"Pardon me, 'Miss,' not 'Mrs.' please."—Crosley Radio.

The Absent Minded Professor Had Evidently Been Enjoying a Good Program

YOU DID NOT WIN THE SONG PRIZE

By G. D. Fleck, Program Director, Station KDKA

It has not been possible to select a winner in the Patriotic Song Contest which was recently held through the Westinghouse radio stations.

The judges were Dr. Carl Engel of the Musical Department, Library of Congress, Washington, D. C.; Dr. Sigmund Spaethe, critic, composer, author and lecturer of New York, and Dr. Will Earhart, Director of Music, Pittsburgh Public Schools, and were assisted by a carefully chosen committee of experts in the realm of literature and music. But after an exhaustive study of the 1400 manuscripts submitted, they have found that no poem of any contestant would measure up to the requirements of a patriotic song expressive of the hopes and ideals of our nation.

Like Jewels in the Mud

Many of the stanzas submitted were of a high quality from a literary standpoint, but did not fit the music. Others were rythmically correct but did not express the ideas required in such a song. Here and there among the verses submitted, certain lines would sparkle as real gems, only to be clouded by the thoughts surrounding them. In a few instances whole single stanzas might have been acceptable, but unfortunately they were accompanied by others which would never do in making up the complete song.

The study of the verses submitted was a very interesting one and gave to the committee of judges considerable insight into the patriotic thoughts of the many classes of people represented.

The most notable fact was that the writing of words for a patriotic song must be free and spontaneous and cannot be forced. Many of the manuscripts bore evidence that the authors had hastened the completion of their tasks, probably due to the time limitations imposed by the rules of the contest. The first verse was good, the second fair, and the last very poor.

Choice to be Made Later

In view of the absence among the manuscripts submitted of any which could be accepted as fulfilling all the requirements of a patriotic song, those in charge of this attempt to find suitable words for the melody of young Robert Saudek, have decided to defer the choosing of these words until some future time.

In the meantime the music for this song has been dedicated to the nation, and it is hoped that soon will come the expression of national ideals and hopes which will make this piece, in words as well as in music, a song of America.

Those who submitted words for this music will be permitted to improve their manuscripts in every possible manner and new verses will be gladly received at Station KDKA, pending the reopening of the contest which will probably be some time next fall.

BROADCASTING FROM A BELFRY

Through an Oversight the Following Was Omitted from Page 28 in Last (July 1) Issue

The solution of this problem was hit upon by Mr. John C. Knight, a vice-president of the Company, who has in his charge the huge Metropolitan Building, which houses 8,500 workers, and the tower, which shelters several hundred more. He secured a set of small chimes which were exactly tuned to the tones of the big ones overhead, but with very much less volume. This small set was placed in the broadcasting studio. The operating mechanism was connected in parallel with that of the big bells overhead.

Fig. 3 shows the details of this mechanism. When a key is struck, the contacts close the circuit of the six volt battery, and the current divides at the point A. Part of it goes up to the chimes in the Tower, where it works an action like that shown in Fig. 2. The other part of the current goes to an electric bell mechanism by which the plunger of the magnet is used as a hammer to strike the small model bell. The microphone is mounted right in front of this junior edition of the chimes overhead.

Just Like Madison Square

Some listeners have said that even in the studio a deep undertone can be heard by a keen ear when the studio chimes are being played. This probably comes from the big bells way up in the tower, which are sounding at the same second. Such a strengthening of the tone is, of course, picked up by the microphone and sent out on the air with the result that when you hear it in your radio you get exactly the same effect as if you were down in Madison Square listening to the power chimes several hundred feet above you.

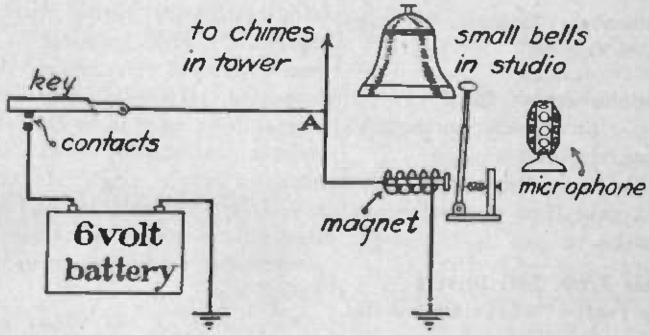


Fig. 3. The Junior Edition of Chimes Is Used in the Metropolitan Tower to Do the Broadcasting

THEY NEVER SIGN OFF

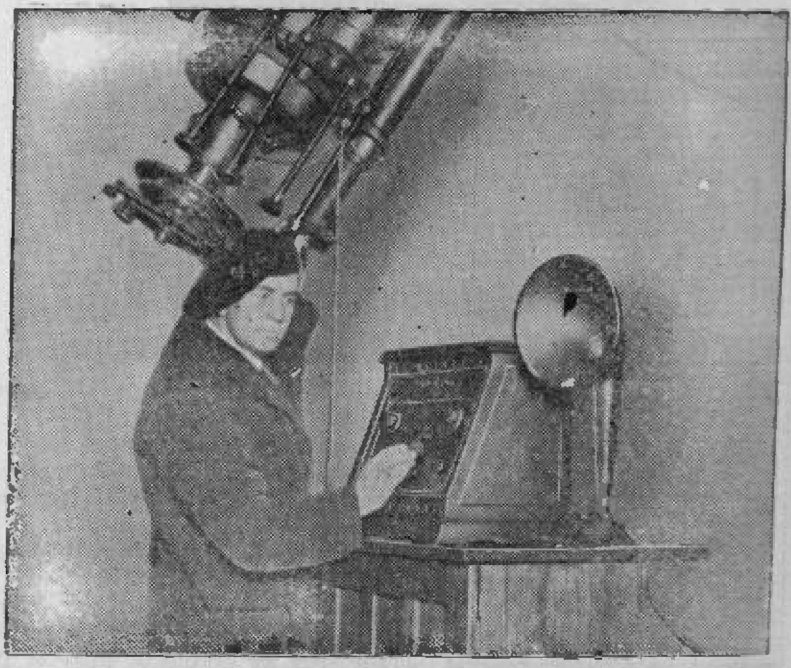
"Now signing-off" will be heard no more from the Crosley WLW radio broadcasting station at the completion of the programs. Instead, there will be given an appropriate quotation, such as, "Great thoughts, like little deeds, need no trumpet; good night."

When "signing-off" came into use in the early days of wireless telegraphy, it served a definite purpose in informing the other radio operators that they could answer the message and the sender would, if possible, listen-in for it. Since the modern radio broadcasting does not touch the general field of conversation but is used principally for entertainment purposes, there is no longer any need for the "signing-off."

SEES STARS—HEARS THEM, TOO

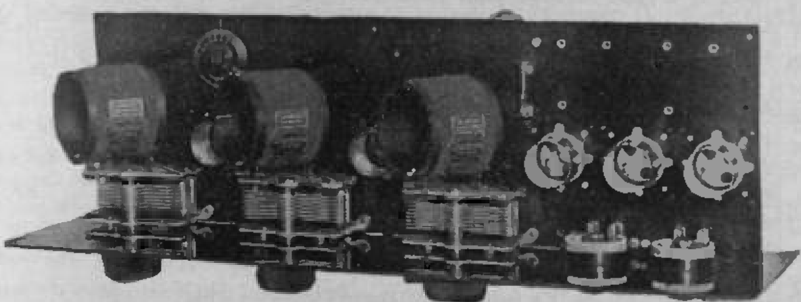
Our photograph shows the busy astronomer in his observatory. It is rather tedious to watch a star or a nebula as it rushes through the heavens, even though it may be traveling thousands of miles per second.

While waiting for it to get somewhere our astronomer is catching a few minutes of entertainment from his loud speaker and his Mohawk Set. The framework holding the glass dome of the observatory was used for an aerial, and the big telescope itself makes a fine counterpoise. Try this on your own observatory.



Selectrol Super-Five

ENGLAND, SCOTLAND, SPAIN HEARD ON LOUD SPEAKER



HERALDING
THE
Wonder Set
THE
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WORLD
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AND
ANXIOUSLY
AWAITING

It is impossible to even begin to describe the many unusual and novel features embodied in this wonderful new receiver

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INCLUDING

Five Radiotron 201A Tubes—Tower's Scientific Phones
Highest Grade Storage Battery—B Batteries, 90 Volts
Leader Loud Speaker Equipped with Novel Tone Control
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DEALERS—Write for our Attractive Proposition

℞ DR RADIO PRESCRIBES.

NOTE: In this section the Technical Editor will answer questions of general interest on any radio matter. Any of our readers may ask not more than two questions, and if the subjects are of importance to most radio fans they will be answered free of charge in the magazine. If they are of special interest to the questioner alone, or if a personal answer is desired, a charge of fifty cents will be made for each answer. This will entitle the questioner to a personal answer by letter. However, if the question requires considerable experimental work, higher rates will be charged.

Question. Will a crystal burn out in a reflex set on "B" battery voltage?

Answer. In the reflex standard hookups you will find that no "B" battery voltage is ever impressed on the crystal. The output from the last step of radio amplification is led from the plate of the tube through the primary of an RF transformer to the "B" battery. The secondary of this transformer conveys the energy to the crystal to be rectified. Since no direct current is ever induced in the secondary of any transformer, there is no chance of the "B" battery affecting the crystal.

Question. What is the best way of connecting a potentiometer?

Answer. The two ends of the resistance wire are always hooked up to the two terminals of the "A" battery. However, there is an advantage in making the connection to the dead side rather than the live terminal of the filament switch. By observing this point, you will make the switch control the current which is used by the resistance wire. When the set is turned off, no current will then be wasted in the potentiometer.

If instead, the terminals are connected direct to the "A" battery binding posts, there will be a constant leak of current day and night. While this amount is small, still there is no sense in having such a useless drain on the source of current.

Question. Some articles recommend wrapping one piece of busbar around another when making a joint inside the cabinet. Is this an improvement?

Answer. By twisting the two pieces together a good mechanical connection is made. However, to make an electrical contact it is far better to solder the two. If a good soldered joint is made, then the wrapping is entirely unnecessary.

Indeed it is usually much better not to wrap the wires. If the job of soldering is a poor one it will not be discovered as the wrapped joint will hold together, even though it is not making good contact. On the other hand a butt joint, poorly soldered, will pull apart and so give you the signal that the contact is poor and needs a better job. For that reason the butt joint is recommended.

Question. Is it true, as often stated, that increased selectivity can be obtained only at the expense of reduced volume?

Answer. No, this is often true, but not always. For instance, a single circuit tuner when properly made into a two-circuit unit, will show much better selectivity, and slightly larger volume at the same time. When every scheme for best selectivity has been employed, then a further increase can be had only by reducing the primary coupling which gives still better selectivity, but cuts down the volume.

Question. Several companies are advertising that their phone plugs can be reversed quickly. What is the advantage of this?

Answer. Some styles of loud speakers and practically all kinds of telephones use a permanent magnet with a coil in series in the magnetic circuit in such a way that the coil either adds or subtracts its effect and that of the permanent magnet. If the polarity is correct the two will add. When you connect up the phones by plugging in the jack you are running a current through the coil in a direction which depends on the way the cord tips are inserted in the plug. If this happens to be arranged so that the two magnetic effects oppose each other then you will get better results if you reverse the polarity. The kind of plug which you mention is arranged to give a quick method of reversal. Of course, once the right polarity is found it should never be changed as long as you use that particular set of phones or loud speaker.

Question. How does it happen that sometimes the audio transformers in my set will give out music even when the loud speaker has been disconnected?

Answer. In this case there must be some loose iron in the transformer of the last step. Since the loud speaker is not operating there is no current flowing out of the plate of the last tube, but current will be passing through the windings of the primary of the last transformer as it is in the plate circuit of the next to the last tube. As this current fluctuates corresponding to the music it will magnetize the iron core more or less. If there is any looseness in this member the laminations will naturally vibrate just as a diaphragm does in a telephone receiver. This gives out a sound like a speaker if the transformer is fastened to the wood of the cabinet. Of course, there is a slight amount of loss in such a case which can be stopped by running shellac into the cracks between the laminations.

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

Abbreviations: W.L., wave length in meters; K.C., frequencies in kilocycles; W.P., wattpower of station.

K.C. W.L. W.P.

KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburg, Pa. 970-309-1000
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O...1200-250- 500
KDYL—Newhouse Hotel, Salt Lake City, Utah......... 900-333- 500
KDZB—Frank E. Siefert, Bakersfield, Cal...............1430-210- 500
KFAB—Nebraska Buick Auto Co., Lincoln, Neb.........1250-240- 200
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz....1100-273- 100
KFAE—State College of Washington..................... 860-349- 500
KFAF—Western Radio Corp., Denver, Colo.............1080-278- 500
KFAJ—University of Colorado, Boulder, Colo............1150-261- 100
KFAU—Boise High School, Boise, Idaho.................1090-275- 500
KFBK—Kimball Upson Co., Sacramento, Cal............1210-248- 100
KFCF—Frank A. Moore, Walla Walla, Wash...............1170-256- 100
KFDM—Magnolia Petroleum Co., Beaumont, Tex........ 950-316- 500
KFDX—First Baptist Church, Shreveport, La............1200-250- 100
KFDY—S. Dak. Ste. Col. Ag. & Mech. Arts, Br'kngs., S. D.1100-273- 100
KFEQ—Scroggin & Co. Bank, Oak, Nebr..............1120-268- 100
KFFV—Graceland College, Lamoni, Iowa................1200-250- 100
KFGC—Louisiana State Univ., Baton Rouge, La.........1120-268- 100
KFGD—Oklahoma College for Women, Chickasha, Okla...1190-252- 200
KFGH—Leland Stanford Junior Univ., Stanford Univ., Cal.1110-270- 500
KFGX—First Presbyterian Church, Orange, Texas.......1200-250- 500
KFI—Earl C. Anthony, Los Angeles, Cal............ 640-469-2000
KFIF—Benson Polytechnic Institute, Portland, Ore......1210-248- 100
KFIQ—First Methodist Church, Yakima, Wash...........1170-256- 100
KFIZ—Daily Com'lth & Seifert Rad, Corp., Fondulac, Wis.1100-273- 100
KFJF—National Radio Mfg. Co., Oklahoma, Okla........1150-261- 225
KFJM—University of No. Dak., Grand Forks, No. Dak...1080-278- 100
KFKQ—Conway Radio Laboratories, Conway, Ark.......1200-250- 100
KFKU—University of Kansas, Lawrence, Kas.............1090-275- 100
KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb...1040-288-2000
KFLR—University of New Mexico, Albuquerque, N. Mex.1180-254- 200
KFLV—Swedish Evangelical Mission Church, Rockford, Ill.1310-229- 100
KFLZ—Atlantic Automobile Co., Atlantic, Iowa..........1100-273- 100
KFMQ—University of Arkansas, Fayetteville, Ark........1000-300- 500
KFMR—Morningside College, Sioux City, Iowa...........1150-261- 100
KFMT—George W. Young, Minneapolis, Minn............1140-263- 100
KFMX—Carleton College, Northfield, Minn.............. 890-337- 750
KFNF—Henry Field Seed Co., Shenandoah, Iowa.........1130-266- 500
KFOA—Rhodes Dept. Store, Seattle, Wash.............. 660-454- 500
KFOC—First Christian Church, Whittier, Cal...........1270-236- 100
KFON—Echophone Radio Shop, Long Beach, Cal.........1290-233- 100
KFOO—Latter Day Saints Univ., Salt Lake City, Utah...1270-236- 250
KFOX—Technical High School, Omaha, Nebr............1210-248- 100
KFPG—Oliver S. Garretson, Los Angeles, Cal...........1260-238- 100
KFPR—Los Angeles County Forestry, Los Angeles, Cal...1300-231- 500
KFPY—Symons Investment Co., Spokane, Wash.........1130-266- 100
KFQA—The Principa, St. Louis, Mo.....................1150-261- 100
KFQB—Searchlight Publishing Co., Fort Worth, Texas...1140-263- 150
KFQC—Kidd Brothers Radio Shop, Taft, Cal...........1300-231- 100
KFQU—W. E. Riker, Holy City, Calif..................1350-222- 100
KFQZ—Taft Radio Co., Hollywood, Calif...............1330-226- 250
KFRB—Hall Bros., Beeville, Texas.....................1210-248- 250
KFRU—Etherical Radio Co., Bristow, Okla............. 760-395- 500
KFSG—Echo Park Evangelistic Asso., Los Angeles, Cal...1090-275- 500
KFUM—W. D. Corley, Colorado Springs, Colo...........1240-242- 100
KFUO—Concordia Seminary, St. Louis, Mo............. 550-545- 500
KFUT—University of Utah, Salt Lake City, Utah........1150-261- 100
KFVE—Film Corporation of America, St. Louis, Mo.....1250-240- 500
KFVJ—First Baptist Church, San Jose, Cal.............1330-226- 500
KFVK—Sacramento Chamber of Com., Sacramento, Cal...1210-248- 500
KFVW—Airfan Radio Corporation, San Diego, Cal.......1220-246- 500
KFWA—Browning Bros. Co., Ogden, Utah...............1150-261- 500
KFWB—Warner Bros. Pictures, Inc., Hollywood, Cal.....1190-252- 500
KFWD—Arkansas Light & Power Co., Arkadelphia, Ark...1130-266- 500
KFWH—F. Wellington Morse, Jr., Chico, Cal...........1180-254- 100
*KFWI—Radio Entertainments, Inc., So. San Fran., Cal..1360-220- 500
KGO—General Electric Co., Oakland, Cal.............. 830-361-2000
KGU—Marion A. Mulrony, Honolulu, Hawaii...........1110-270- 500
KGW—Portland Morning Oregonian, Portland, Ore....... 610-491- 500
KHJ—Times-Mirror Co., Los Angeles, Cal.............. 740-405- 500
KHQ—Excelsior Motorcycle & Bicycle Co., Seattle, Wash.1100-273- 100
KJR—Northwest Radio Service Co., Seattle, Wash....... 780-384-1000
KJS—Bible Institute of Los Angeles, Los Angeles, Cal....1020-294- 750
*KLDS—Reorg.ChurchofJesusChristofLatterDaySts., Ind., Mo.680-441-1000

K.C. W.L. W.

KLS—Warner Bros. Radio Supplies Co., Oakland, Cal.....1240-242- 2
KLX—Tribune Publishing Co., Oakland, Cal............ 590-509- 5
KLZ—Reynolds Radio Co., Denver, Colo...............1130-266- 2
KMO—Love Electric Co., Tacoma, Wash...............1200-250- 2
KNX—Los Angeles Express, Los Angeles, Cal........... 890-337- 5
KOA—General Electric Co., Denver, Colo.............. 930-322-20
KOB—New Mexico Col. of Agriculture, State Col., N. Mex.860-349- 7
KOP—Detroit Police Dept., Detroit, Mich..............1080-278- 5
KPO—Hale Bros., San Francisco, Cal.................. 700-428- 5
KPRC—Houston Printing Co., Houston, Texas..........1010-297- 5
KQV—Double-Hill Electric Co., Pittsburg, Pa..........1090-275- 5
KSAC—Kansas State Agric. College..................... 880-341- 5
KSD—Post-Dispatch, St. Louis, Mo.................... 550-545- 7
KSL—The Radio Service Corp., Salt Lake City, Utah....1000-300-10
KTCL—American Radio Tel. Co., Inc., Seattle, Wash.... 980-310-10
KTHS—New Arlington Hotel Co., Hot Springs, Ark...... 800-375- 5
KTW—First Presbyterian Church, Seattle, Wash........ 660-454- 7
KUO—Examiner Printing Co., San Francisco, Cal.........1220-246- 1
KUOM—State Univ. of Montana, Missoula, Mont.......1230-244- 2
KWKC—Wilson Duncan Studios, Kansas City, Mo.......1270-236- 1
KWWG—City of Brownsville, Brownsville, Texas........1080-278- 50
KWKH—W. G. Paterson, Shreveport, La...............1110-273- 2
KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill..... 560-535-150
KZKZ—Electrical Supply Co., Manila, P. I..............1110-270- 1
KZM—Preston D. Allen, Oakland, Cal..................1240-242- 10
KZRQ—Far Eastern Radio, Manila, P. I.................1350-222- 50
WAAB—Valdemar Jensen, New Orleans, La..............1120-268- 10
WAAC—Tulane University, New Orleans, La............1090-275- 10
WAAF—Chicago Daily Drovers Journal, Chicago, Ill.....1080-278- 20
WAAM—I. R. Nelson Co., Newark, N. J................1140-263- 2
WAAW—Omaha Grain Exchange, Omaha, Neb...........1080-278- 5
WABA—Lake Forest University, Lake Forest, Ill.........1320-227- 2
WABI—Bangor Hydro-Electric Co., Bangor, Me.........1250-240- 10
WABN—Ott Radio (Inc.), La Crosse, Wis...............1230-244- 5
WABO—Lake Avenue Baptist Church, Rochester, N. Y...1080-278- 10
WABX—Henry B. Joy, Mount Clemens, Mich............1220-246- 5
WADC—Allen Theatre, Akron, O......................1160-258- 10
WAFD—Albert B. Parfet Co., Port Huron, Mich.........1170-256- 25
WAHG—A. H. Grebe Co., Richmond Hill, N. Y......... 950-316- 50
WAMD—Hubbard & Co., Minneapolis, Minn............1230-244- 50
WARC—Am. Rad. & Research Corp., Medf'd H'lsde, Mass.1150-261- 10
WBAA—Purdue University, West Lafayette, Ind.........1100-273- 25
WBAK—Pennsylvania State Police, Harrisburg, Pa.......1090-275- 50
WBAO—James Millikin University, Decatur, Ill..........1090-275- 10
WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex. 630-476-1000
WBAY—Erner & Hopkins Co., Columbus, Ohio..........1020-293- 50
WBBG—Irving Vermilya, Mattapoisett, Mass............1210-248- 100
WBBL—Grace Covenant Church, Richmond, Va.........1310-220- 100
*WBBM—Atlas Investment Co., Chicago, Ill............1330-226-150
WBBP—Petoskey High School, Petoskey, Mich..........1260-238- 100
WBBR—People's Pulpit Assoc., Rossville, N. Y.........1100-273- 500
WBES—Bliss Electrical School, Takoma Park, Md.......1350-222- 100
WCBN—Foster & McDonnell, Chicago, Ill................1130-266- 500
WBOQ—A. H. Grebe Co., Richmond Hill, N. Y..........1270-236- 100
WBT—Southern Radio Corp., Charlotte, N. C...........1090-275- 250
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass. 900-331-2000
WCAC—Connecticut Agric. College, Mansfield, Conn......1090-275- 500
WCAD—St. Lawrence University, Canton, N. Y.........1140-263- 250
WCAE—Kaufmann & Baer Co., Pittsburg, Pa........... 650-461- 500
WCAG—Clyde R. Randall, New Orleans, La.............1130-226- 200
WCAH—Entrekin Electric Co., Columbus, O............1130-266- 500
WCAJ—Nebraska Wesleyan University, Univ. Place, Nebr.1180-275- 100
WCAL—St. Olaf College, Northfield, Minn.............. 890-337- 500
WCAO—Kranz-Smith, Baltimore, Md....................1090-275- 100
WCAP—Chesapeake & Potomac Tel. Co., Wash., D. C... 640-469- 500
WCAR—Southern Radio Corp. of Texas, San Antonio, Tex.1140-263- 100
WCAU—Durham & Co., Philadelphia, Pa................1080-278- 500
WCAX—University of Vermont, Burlington, Vt..........1200-250- 100
WCAY—Milwaukee Civic Br'dcstng Asso., Milwaukee, Wis.1130-266- 250
WCBC—University of Michigan, Ann Arbor, Mich.......1310-229- 200
WCBD—Wilbur G. Voliva, Zion, Ill..................... 870-345-2000
WCBI—Nicoll, Duncan & Rush, Bemis, Tenn...........1250-240- 150
WCCO—Washburn Crosby Co., Minneapolis, Minn....... 720-416-1500
WCEE—Charles E. Erbstein, Elgin, Ill..................1090-275- 500
WCK—Stix, Baer & Fuller Dry Goods Co., St. Louis, Mo.1100-273- 100
WCM—Texas Markets & Warehouse Dept., Austin, Tex...1120-268- 250
WCN—Foster & McDonnell, Chicago, Ill.................1130-266- 500
WCTS—C. T. Sherer Co., Worcester, Mass..............1120-268- 500
WCUW—Clark University, Worcester, Mass.............1260-238- 250
WCX—Detroit Free Press, Detroit, Mich................ 580-517- 500
WDAE—Tampa Daily News, Tampa, Fla.................1100-273- 250
WDAG—J. Laurence Martin, Amarillo, Tex..............1140-263- 100
WDBE—Gilham-Schoen Electric Co., Atlanta, Ga........1080-278- 100
WDBK—M. F. Broz Radio Store, Cleveland, O..........1320-227- 100
WDBO—Rollins College, Winter Park, Fla..............1250-240- 100
WDBR—Tremont Temple Baptist Church, Boston, Mass.1150-261- 100
WDBY—North Shore Congregational Church, Chicago, Ill.1160-258- 500
WDWF—Dutee W. Flint, Cranston, R. I................ 680-441- 500
WDZ—James L. Bush, Tuscola, Ill.......................1080-278- 100
WEAA—Frank D. Fallain, Flint, Mich..................1280-234- 100
WEAF—American Tel. & Tel. Co., New York, N. Y..... 610-492-2500
WEAH—Wichita Board of Trade, Wichita, Kas..........1120-268- 100

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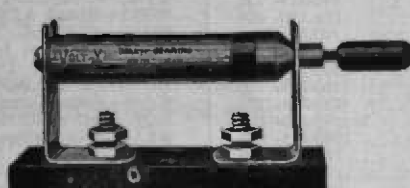

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ADDRESS. . . . .

Station	K.C. W.L. W.P.
WEAI—Cornell University, Ithaca, N. Y.	1180-254- 500
WEAJ—University of So. Dakota, Vermilion, So. Dak.	1080-278- 100
WEAM—Borough of North Plainfield, No. Plainfield, N. J.	1150-261- 250
WEAN—Shepard Co., Providence, R. I.	1110-270- 250
WEAO—Ohio State University, Columbia, Ohio	1020-294- 500
WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio	770-389-1000
WEAU—Davidson Bros. Co., Sioux City, Iowa	1090-275- 100
WEAL—Iris Theater, Houston, Tex.	1110-270- 500
WEBH—Edgewater Beach Hotel Co., Chicago, Ill.	810-370-1000
WEBJ—Third Avenue Railway Co., New York, N. Y.	1100-273- 500
WEBL—Radio Corp. of America, United States (portable)	1330-226- 100
WEBM—Radio Corp. of America, United States (portable)	1330-226- 100
WEBW—Beloit College, Beloit, Wis.	1120-268- 500
WEEI—Edison Electric Illuminating Co., Boston, Mass.	630-476- 500
WEMC—Emmanuel Missionary Col., Berrien Springs, Mich.	1050-286- 500
WEW—St. Louis University, St. Louis, Mo.	1210-248- 100
WFAA—Dallas News & Dallas Journal, Dallas, Tex.	630-476- 500
WFAV—University of Nebraska, Lincoln, Neb.	1090-275- 500
WFBG—William F. Gable Co., Altoona, Pa.	1080-278- 100
WFBH—Concourse Radio Corp., New York, N. Y.	1100-273- 500
WFBI—Galvin Radio Supply Co.	1270-236- 100
WFBK—Dartmouth College, Hanover, N. H.	1170-256- 100
WFBL—Onondoga Hotel, Syracuse, N. Y.	1190-252- 100
WFBM—Merchant Heat & Light Co., Indianapolis, Ind.	1120-268- 250
WFBR—Fifth Infantry, Maryland N. G., Baltimore, Md.	1180-254- 100
WFBY—U. S. Army 5th Corps Area, Ft. Benj. Har'sn, Ind.	1160-258- 100
WFI—Strawbridge & Clothier, Philadelphia, Pa.	760-395- 500
WFKB—Francis K. Bridgman, Chicago, Ill.	1380-217- 100
WGAQ—W. G. Paterson, Shreveport, La.	1110-273- 250
WGAZ—South Bend Tribune, South Bend, Ind.	1090-275- 250
WGBA—Jones Electric & Radio Mfg. Co., Baltimore, Md.	1180-254- 100
WGBB—Harry H. Carman, Freeport, N. Y.	1240-244- 100
WGBQ—Stout Institute, Menomonie, Wis.	1280-234- 100
WGBS—Gimbel Bros., New York	950-316- 500
WGBX—University of Maine, Orono, Me.	1190-252- 100
WGCP—D. W. May, Newark, N. J.	1190-252- 500
WGES—Coyne Electrical School, Oak Park, Ill.	1200-250- 500
*WGMU—A.H.Grebe&Co.,Inc.(portable),Richmond Hill,N.Y.	1270-236- 100
WGPH—George Harrison Phelphs, Inc., Detroit, Mich.	1110-270- 500
WGN—The Tribune, Chicago, Ill.	810-370-1000
WGR—Federal Telephone Mfg. Corp., Buffalo, N. Y.	940-319- 750
WGS—Georgia School of Technology, Atlanta, Ga.	1110 270- 500
WGY—General Electric Co., Schenectady, N. Y.	790-380-2000
WHA—University of Wisconsin, Madison, Wis.	560-535- 750
WHAD—Marquette University, Milwaukee, Wis.	1000-275- 500
WHAG—University of Cincinnati, Cincinnati, O.	1290-233- 100
WHAM—University of Rochester, Rochester, N. Y.	1080-278- 100
WHAP—William H. Taylor Finance Corp., Brooklyn, N. Y.	1250-250- 100
WHAR—Seaside Hotel, Atlantic City, N. J.	1090-275- 500
WHAS—Courier Journal & Louisville Times	750-400- 500
WHAV—Wilmington Electric Specity Co., Wilmington, Del.	1130-266- 100
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y.	790-380- 500
WHB—Sweeney School Co., Kansas City, Mo.	820-366- 500
WHBF—Beardsley Specialty Co., Rock Island, Ill.	1350-222- 100
WHBH—Culver Military Academy, Culver, Ind.	1350-222- 100
WHBP—Johnstown Automobile Co., Johnstown, Pa.	1170-256- 100
WHBW—D. R. Kienzle, Philadelphia, Pa.	1390-216- 100
WHDI—Wm. Hood Dunwoody I. Inst., Minneapolis, Minn.	1080-278- 500
WHEC—Hickson Electric Co., Inc., Rochester, N. Y.	1160-258- 100
WHK—Radiovox Co., Cleveland, O.	1100-273- 250
WHN—George Schubel, New York, N. Y.	830-361- 500
WHO—Bankers Life Co., Des Moines, Iowa	570-526- 500
WHT—Radiophone Broadcasting Corporation, Deerfield, Ill.	1260-238-1500
WIAD—Howard R. Miller, Philadelphia, Pa.	1200-250- 100
WIAK—Journal-Stockman Co., Omaha, Nebr.	1080-278- 250
WIAS—Home Electric Co., Burlington, Iowa	1180-254- 100
WIBA—The Capital Times Studio, Madison, Wisc.	1270-236- 100
WIBC—L. M. Tate Post No. 39, V.F.W. St.Petersburg, Fla.	1350-222- 100
WIBF—S. P. Miller Activities, Wheatland, Wisc.	1300-231- 500
WIBK—University of the City of Toledo, Toledo, O.	1460-205- 100
WIBL—McDonald Radio Co., Joliet, Ill. (Portable)	1390-215- 250
WIBO—Nelson Brothers, Chicago, Ill.	1330-226- 500
WIL—St. Louis Star, Benson Radio Co., St. Louis, Mo.	1100-273- 250
WIP—Gimbel Bros., Philadelphia, Pa.	590-508- 500
WJAD—Jackson's Radio Eng. Laboratories, Waco, Texas.	850-353- 500
WJAG—Norfolk Daily News, Norfolk, Nebr.	1110-270- 250
WJAK—Clifford L. White, Greentown, Ind.	1180-254- 100
WJAR—The Outlet Co., Providence, R. I.	980-306- 500
WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa.	1090-275- 500
WJAZ—Zenith Radio Corp., Chicago, Ill. (portable)	1120-268- 100
WJBC—Hummer Furniture Co., La Salle, Ill.	1280-234- 100
WJBD—Ashland Broadcasting Committee, Ashland, Wisc.	1290-233- 100
WJBI—H. M. Couch, Joliet, Ill.	1400-214- 100
WJJ—Supreme Lodge L. O. Moose, Mooseheart, Ill.	990-303- 500
WJY—Radio Corporation of America, New York, N. Y.	740-405-1000
WJZ—Radio Corporation of America, New York, N. J.	660-454-1000
WKAQ—Radio Corporation of Porto Rico, San Juan, P. R.	880-341- 500
WKAR—Michigan Agric. Col., E. Lansing, Mich.	1050-286- 750
*WKBG—C. L. Carrell (portable), Chicago, Ill.	1390-216- 100
WKRC—Kodel Radio Corp., Cincinnati, O.	710-422-1000
WKY—WKY Radio Shop, Oklahoma, Okla.	1090-275- 100
WLAL—First Christian Church, Tulsa, Okla.	1200-250- 150

Station	K.C. W.L. W.P.
WLBL—Wisconsin Dept. of Markets, Stevens Point, Wis.	1080-278- 500
WLIT—Lit Bros., Philadelphia, Pa.	760-395- 500
WLS—Sears, Roebuck Co., Chicago, Ill.	870-345- 500
*WLTS—Lane Technical High School, Chicago, Ill.	1160-258- 100
WLW—Crosley Radio Corp., Harrison, O.	710-422-5000
WLW—Crosley Radio Corp., Harrison, O.	710-422- 500
WMAC—Clive B. Meredith, Cazenovia, N. Y.	1090-275- 100
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833-360- 500
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833-360- 100
WMAK—Norton Laboratories, Lockport, N. Y.	1130-466- 500
WMAQ—Chicago Daily News, Chicago, Ill.	670-448- 500
WMAY—Kingshighway Presbyterian Church, St. Louis, Mo.	1210-248- 100
WMAZ—Mercer University, Macon, Ga.	1150-261- 100
WMBB—American Bond & Mortgage Co., Chicago, Ill.	1200-250- 500
WMBF—Fleetwood Hotel, Miami Beach, Fla.	780-384- 500
WMC—Commercial Appeal, Memphis, Tenn.	600-500- 500
WMCA—Greeley Square Hotel Co., New York, N. Y.	880-341- 500
WNAB—Shepard Stores, Boston, Mass.	1200-250- 100
WNAC—Shepard Stores, Boston, Mass.	1070-280- 500
WNAD—University of Oklahoma, Norman, Okla.	1180-254- 250
WNAP—Wittenberg College, Springfield, Ohio	1210-248- 100
WNAT—Lennig Bros. Co., Philadephia, Pa.	1200-250- 100
WNAV—People's Tel. & Tel. Co., Knoxville, Tenn.	1290-233- 500
WNAX—Dakota Radio Apparatus Co., Yankton, S. Dak.	1230-244- 100
WNJ—Radio Shop of Newark, Newark, N. J.	1290-233- 100
WNYC—City of New York, New York, N. Y.	570-526-1000
WOAI—Southern Equipment Co., San Antonio, Texas	760-395-1000
WOAN—James D. Vaughn, Lawrenceburg, Tenn.	1060-283- 500
WOAW—Woodmen of the World, Omaha, Nebr.	570-526-1000
WOC—Palmer School of Chiropractic, Davenport, Iowa	620-484-2000
WOI—Iowa State College, Ames, Iowa	1110-270- 500
WOO—John Wanamaker, Philadelphia, Pa.	590-508- 500
WOQ—Unity School of Christianity, Kansas City, Mo.	1080-278- 500
WOR—L. Bamberger & Co., Newark, N. J.	740-405- 500
WORD—People's Pulpit Association, Batavia, Ill.	1090-275-5000
WOS—Missouri State Marketing Bureau, Jefferson City, Mo.	680-441- 500
WOWL—Owl Battery Co., New Orleans, La.	1110-270- 100
*WOWO—Main Auto Supply Co., Fort Wayne, Ind.	1320-227- 500
WPAJ—Doolittle Radio Corporation, New Haven, Conn.	1120-268- 100
WPG—Municipality of Atlantic City, Atlantic City, N. J.	1000-300- 500
WPSC—Pennsylvania State College, State College, Pa.	1150-261- 500
WQAA—Horace A. Beale, Jr., Parkesburg, Pa.	1360-220- 500
WQAC—Gish Radio Service, Amarillo, Tex.	1280-234- 100
WQAM—Electrical Equipment Co., Miami, Fla.	1120-268- 100
WQAN—Scranton Times, Scranton, Pa.	1200-250- 100
WQAO—Calvary Baptist Church, New York, N. Y.	833-360- 100
WQAS—Prince-Walter Co., Lowell, Mass.	1190-252- 100
WQJ—Calumet Rainbow Broadcasting Co., Chicago, Ill.	670-448- 500
WRAA—Rice Institute, Houston, Tex.	1170-256- 100
WRAF—The Radio Club, Laporte, Ind.	1340-224- 100
WRAK—Economy Light Co., Escanaba, Mich.	1170-256- 100
WRAM—Lombard College, Galesburg, Ill.	1230-244- 100
WRAV—Antioch College, Yellow Springs, Ohio	1140-263- 100
WRAX—Flexon's Garage, Gloucester City, N. J.	1120-268- 250
WRBC—Immanuel Lutheran Church, Valparaiso, Ind.	1080-278- 500
WRC—Radio Corporation of America, Washington, D. C.	640-469-1000
WREO—Reo Motor Car Co., Lansing, Mich.	1050-286- 500
WRK—Doron Bros. Electrical Co., Hamilton, O.	1110-270- 200
WRM—University of Illinois, Urbana, Ill.	1100-273- 500
WRNY—Experimenter Publishing Co., New York, N. Y.	1160-258- 500
WRR—Dallas Police & Fire Dept., Dallas, Tex.	1150-261- 350
WRW—Tarrytown Radio Research Labs., Tarrytown, N. Y.	1100-273- 500
WSAC—Clemson Agric. Col., Clemson College, S. C.	890-337- 500
WSAG—Gospel Tabernacle, St. Petersburg, Fla.	1130-266- 250
WSAI—United States Playing Card Co., Mason, O.	920-326- 500
WSAJ—Grove City College, Grove City, Pa.	1310-229- 250
WSAR—Doughty & Welch Electric Co., Fall River, Mass.	1180-254- 100
WSAV—Clifford W. Vick Radio Const. Co., Houston, Tex.	833-360- 100
WSB—Atlanta Journal, Atlanta, Ga.	700-428- 500
*WSBC—World Battery Co., Chicago, Ill.	1430-210- 200
WSDA—The City Temple, New York, N. Y.	1140-263- 250
WSMB—Saenger A'm'b Co., & Maison Blanche N. O. La.	940-319- 500
WSMK—S. M. K. Radio Corp., Dayton, Ohio	1090-275- 500
WSOE—School of Engi'rng of Milwaukee, Milwaukee, Wis.	1220-246- 100
WSRO—Radio Co., Hamilton, Ohio	620-483- 100
WSUI—State University of Iowa, Iowa City, Iowa	620-484- 500
WSY—Alabama Polytechnic Institute, Auburn, Ala.	1200-250- 500
WTAB—Fall River Daily Herald Pub. Co., Fall R'vr, Mass.	1130-266- 100
WTAC—Penn. Traffic Co., Johnstown, Pa.	1430-210- 100
WTAM—Willard Storage Battery Co., Cleveland, O.	770-389-1500
WTAQ—S. H. Van Gorden & Son, Osseo, Wis.	1180-254- 100
WTAR—Reliance Electric Co., Norfolk, Va.	1150-261- 100
WTAS—Charles E. Erbstein, Elgin, Ill.	990-302-1000
WTAT—Edison Illum'ting Co., Boston, Mass. (portable)	1230-302- 100
WTAW—Agric. & Mech. Col. of Texas, Col. Station, Tex.	1110-270- 250
WTHS—Flint Senior High School, Flint, Mich.	1370-219- 250
WTIC—Travelers Insurance Co., Hartford, Conn.	860-349- 500
WWAD—Wright & Wright, Philadelphia, Pa.	1200-250- 100
WWAE—Lawrence J. Crowley, Plainfield, Ill.	1240-242- 500
WWAO—Michigan College of Mines, Houghton, Mich.	1140-263- 250
WWI—Ford Motor Co., Dearborn, Mich.	1130-266- 500
WWJ—Detroit News, Detroit, Mich.	850-353- 500
WWL—Loyala University, New Orleans, La.	1090-275- 100

*Additions and corrections.