

NEW ENGLAND

5

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RADIO PROGRESS

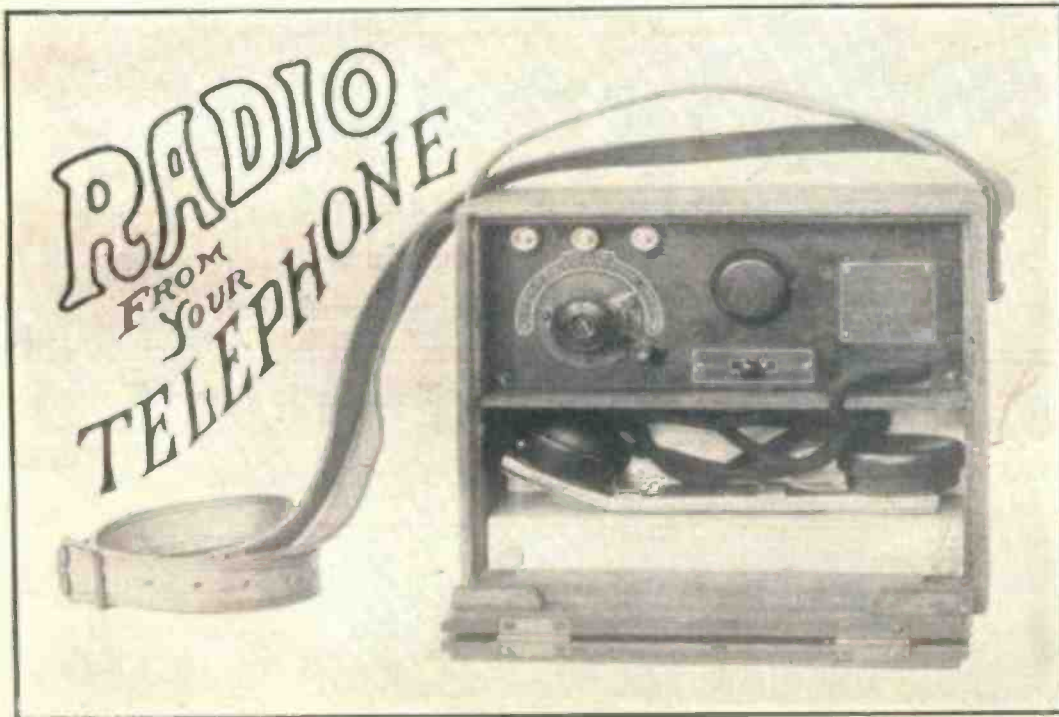
REG. U. S. PAT. OFF.

Acknowledged Authority
and Guide for Radio Fans
in New England

Established March, 1924

JANUARY 15, 1926

Published Twice a Month



See Page 24.

UNLIKE ANY OTHER RADIO MAGAZINE
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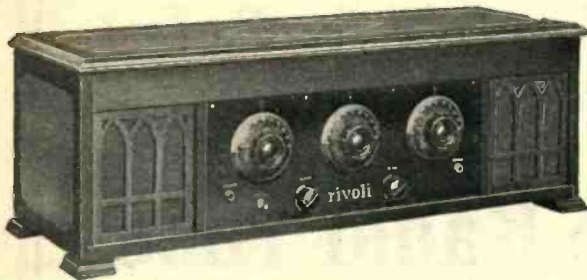
C. J. Connor



RIVOLI

"ALWAYS GOOD COMPANY"

RIVOLI is always good company—good company because it is a thing of beauty and because if there is anything on the air, Rivoli will get it to entertain you. No skill is needed to bring in the broadcast stations.



The Rivoli De Luxe combines all the convenience of a built-in speaker and a built-in battery compartment with the grace and beauty of a finely designed table model radio set. The cabinet is fashioned in two-tone mahogany with panel to match and sunburst dials that lend a pleasingly original touch. Symmetry is retained by the two silk-backed **\$75.00** grills.



The Rivoli Junior has been designed for those who must economize in space. In point of quality, the Junior is fully up to Rivoli standards. The cabinet is considerably better and more carefully finished than sets selling at a low price. Finished in mahogany with a generous flare to set off the panel... **\$60.00**



The Rivoli Speaker has successfully combined extreme beauty with acoustical perfection. Its tone chamber is constructed entirely of two-tone wood, seasoned by a special process. The front of the Rivoli Speaker is a grill, fashioned in a pleasingly decorative motif. The well known balanced type of unit is used. The Rivoli Speaker always harmonizes perfectly with **\$30.00** its surroundings.

The Rivoli Radio Line is manufactured by the Radio Industries Corp., 131 Duane St., N. Y. City

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Rivoli

"ALWAYS GOOD COMPANY"



\$125.00



\$50.00

The Rivoli Console is a beautiful creation. It is designed in the period of William and Mary, and is constructed of two-tone mahogany. The finely carved legs, the cleanly cut grill which hides the speaker and battery compartments, the metal fittings, all lend an expensive air which seem out of all proportion to the remarkably low price. The built-in speaker is a revelation and recreates the broadcasting artist so clearly that he seems to be standing in the same room.

The Rivoli Table is a radical departure in the construction of radio tables. It has ample space for any table type of radio set, either large or small, generous battery compartments for housing A and B batteries and chargers or eliminators, and features a grilled speaker outlet behind which any form of horn or cone can be mounted. Aside from its utility, the Rivoli Table is a beautiful piece of furniture, designed in two-tone mahogany or walnut. It solves the problem of where to put your radio set.

(Space allowed for radio set is 36 in. long x 11 in. deep x 10½ in. high)

Write for interesting literature describing the entire Rivoli Radio line.

Radio Industries Corporation, 131 Duane St., New York City

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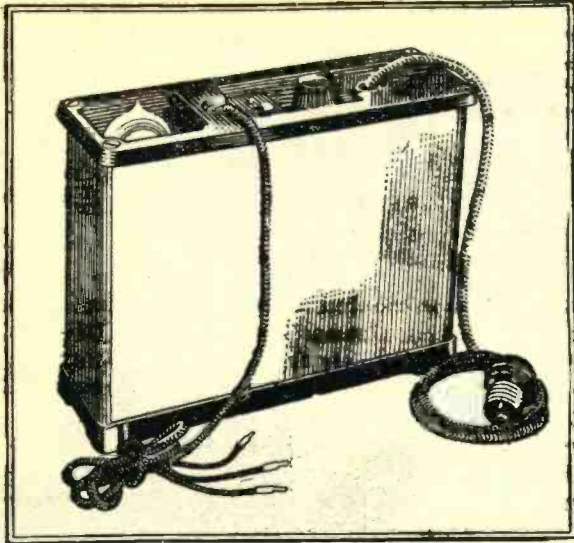


Illustration at left shows
ACME B-ELIMINATOR

Made in two types:

Type E-1, (110 volts 60 cycle), \$50.

Type E-2, (110 volts, D. C.), \$20.

For details see text below.

Acme B-Eliminator Gives — Greater Distance, Greater Volume and Better Quality With no noise—nor hum—no distortion

The big job in finding a method of hooking up house electric current to replace "B" batteries in radio sets has not been to eliminate the hum. That was easy. The problem was to discover a way of overcoming the distortion.

Now, after two years of experimental and research work, we have won. The Acme B-Eliminator has no noise, no hum, no distortion.

You can guess the result. NO B-Batteries to quit cold when you need them most. You get permanent reception, better reception and higher voltage that is constant. There is nothing to wear out. The first cost is the last—and the current consumed is trifling.

Not only this, but the new Acme B-Eliminator has two voltages—100 and 150. It is highly effective on any set from 2 to 10 tubes. What is more, the detector voltage is 0 to 70.

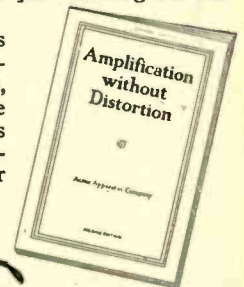
The rectifier consists of an Acme Transformer and vacuum tube, with no filament to burn out. This rectifier (Raytheon) tube handles both sides of the wave and will last indefinitely.

The filter current so successfully smooths out

the rectified pulses in current and voltage that a source of power is delivered of a better nature than batteries.

The full story of not only this new B-Eliminator, but the new MA-2 closed type transformer, the new Acme "double free-edge cone" loud speaker and all other Acme receiving apparatus is contained in the 11th edition of "Amplification without Distortion," which is just coming off the presses.

Most of you, as old friends of Acme, are probably familiar with former editions, over 200,000 of which have been issued. The new one is more complete and interesting than ever. Send for your copy.



Claude Hains

President, Acme Apparatus Co.

ACME

~ for amplification

ACME APPARATUS COMPANY,
Dept. (10), Cambridge, Mass.

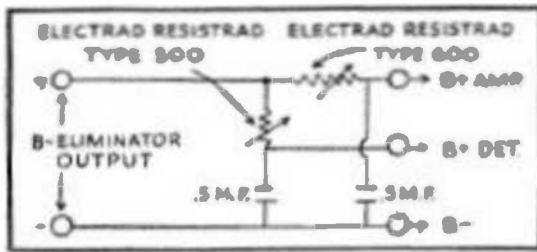
Enclosed find ten cents stamps or coin for my copy of the new 11th edition of "Amplification without Distortion."

Name

Street

City State

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Control Your Voltage With Electrad Resistrads

YOU will be surprised at the improvement in your reception made by these new-type Resistrads. They insure smooth and noiseless variable resistance—accurate, dependable and sensitive to your slightest adjustment. A few turns of the knob give you an available voltage variation equivalent to a B Battery with 100 taps.

By using Electrad Resistrad Type 500 to control detector plate voltage, and Electrad Resistrad Type 600 to control amplifier plate voltage, you can adjust your eliminator to operate any kind of receiver with maximum clearness and volume.

Ask your dealer to show you Electrad Resistrads. If he hasn't them, send us his name and we will see that you are properly supplied.

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- Electrad Resistrad Type 600—500 to 15,000 ohms, for amplifier plate control—\$1.50.

ELECTRAD, Inc.

438 BROADWAY
NEW YORK CITY

NEW ENGLAND RADIO PROGRESS

HORACE V. TAYLOR
Editor

Vol. 2, No. 21

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New England Radio Progress

"ALWAYS ABREAST OF THE TIMES"

Vol. 2, No. 21

JANUARY 15, 1926

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How Radio Makes Phonograph Records

Two Ancient Enemies Have United to Help Each Other Out

By HORACE V. S. TAYLOR

WHEN the band plays "Dixie," almost everybody applauds—for the Northerners are just as proud of the South as those who live below the Mason and Dixon line. Thus two parties who were once opposed are now firmly united.

In the same way up till recently radio was generally considered a very severe competitor of the phonograph. By "phonograph" we include in this article all the different makes of talking machines no matter what their trade name. To be sure most of the musical instrument dealers denied that their sales were suffering owing to the advent of radio. However, they were not very widely believed by radio fans in this remark.

Music Dealers Coming Back

For instance many a broadcast listener who used to buy records every few weeks has not spent a cent this way for the last year or two. How can this fail to have had an effect on the phonograph business? But with the

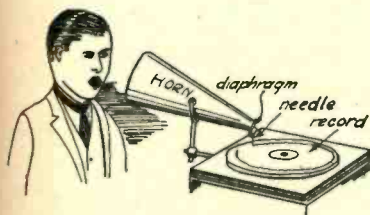


Fig. 1. Here is the Way Records Have Been Made Time Out of Mind

combining of both radio and talking machines in the same cabinet the sales of the music dealers are coming back strong.

But besides this the supposed enemies

have recently joined hands and are producing wonderful results. The developments of radio are actually assisting the phonograph manufacturers to turn out records better than they have ever made before. You all doubtless know how the wax discs have been made in the past. Fig. 1 gives a sketchy view of this process. The singer or orches-

over with a very thin coating of graphite which makes the wax a conductor of electricity. Next it is suspended in a bath of an electrolyte and is plated with just the same process as is used in nickel or copper plating. When this is formed to a sufficient thickness it is stripped off the wax and we have an exact duplicate of the record, except

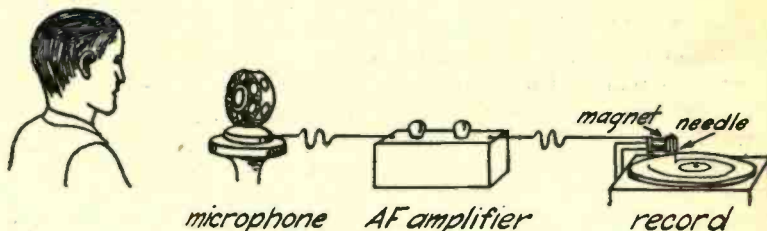


Fig. 2. This New Method Does Away With the Horn and Gets Better Music. Notice the Audio Frequency Amplifier.

tra is stationed before a large horn and as the music is produced the sound waves are gathered in and brought to a focus at the diaphragm located at the small end of the horn.

They Have Ups and Downs

This diaphragm has attached to it a sharp cutting needle. Of course the vibrations of the disc are taken up by the cutter and as the latter rests on a soft wax plate which is being twirled around at constant speed it cuts a groove as appears in our diagrams. In the Edison and Pathe type the vibration is up and down and so the track left consists of a series of hills and valleys arranged in a spiral groove. In the Brunswick and Victor type the oscillating needle moves back and forth across the track and so we get a wavy line which has a constant depth.

This soft wax record is then dusted

that the track is raised above the surface instead of grooved into it. It corresponds to a negative used in photography. This matrix is then employed in stamping out ordinary records something the way a printing press is used in producing this page you are now reading.

Can Paint the Lily

The method of making the master record would seem to be simplicity itself and could hardly be improved on. Ah, but you don't know radio. The broadcasting art has developed so wonderfully that we are now able to paint the lily—get better results in recording our master record than by using the needle directly attached to the vibrating diaphragm.

This is shown in Fig. 2. Again we have the performing artist but this

time before a microphone. This latter unit picks up sound waves very much more accurately than any horn can do. The trouble with a horn is that it tries to play notes of its own. In an orchestra one of the brass instruments is called a "French horn," and it is very similar in its construction to any ordinary type of horn. But when a skilled musician blows it he can coax all

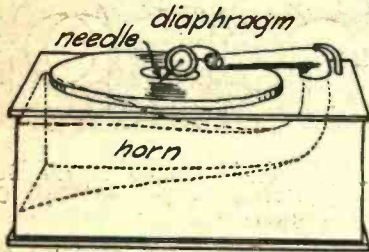


Fig. 3. Almost Every Brand of Phonograph or Talking Machine Looks Like This

kinds of noises out of it which you did not know were there.

One-Half of 1%

By a similar action the broadcasters often are able unintentionally to put a lot of weird wheezes into their selections which are not discovered until the record is played. All this is missing in a microphone. Then why not use a microphone for ordinary recording instead of the horn? This is a natural question and the answer is very clear. The microphone has only a tiny fraction of one per cent. of the energy which the vibrating diaphragm possesses.

If we tried to hitch a cutting needle to a microphone we should get a record which was perfect—perfectly silent. But here is where radio steps into the breach. Let us attach an amplifier such as you use on your own set to the output from the microphone and step it up. Fig. 2 shows the idea. The perfect vibrations which are obtained from the "mike" are reproduced with absolute accuracy but a thousand times as loud in the output of the audio amplifier.

Goes Round in Spirals

Now let us run this output current through a device patterned after a loud speaker but instead of having a diaphragm to convert the vibrations into sound we shall use a light arma-

ture attached to a cutting needle. The latter will rest on a wax disc and so cut a track round and round in spirals which will be just like that shown in Fig. 1, except that it will be louder and (here is the point) will correspond exactly to the vibrations of the music which started it.

But it is not at the "sending end" or recorder alone that radio development has played a part. When you come to make music in the living room a further benefit from the art may be obtained. Of course the records which are made as just described can be played on any standard phonograph without modification. When they are used in that way the volume of sound will be slightly larger than before and the tone quality will be greatly improved. This is because as already explained the track which has been etched by the cutter corresponds exactly to the sound waves as sung rather than being a pretty good approximation of them as with an ordinary record.

Why Wear is Greater

There are some objections however to playing such a record on an ordinary machine. In the first place it is the groove which must furnish enough power to the needle (Fig. 3) to vibrate it thousands of times per second and the relatively heavy diaphragm with it. This means that there will be some wear in the record itself as well as

instrument. Suppose you have two watches, one a Hamilton that you paid \$150.00 for and the other a \$2.00 Ingersoll. Which is likely to be damaged more if you let a boy carry it in his pocket while he is playing football? The fine adjustments of the high grade device will undoubtedly suffer to a greater extent than the coarser parts of the cheap one. For the same reason it seems too bad to subject such a finely formed record to the action of an ordinary talking machine needle.

It Weighs Too Much

Another objection to Fig. 3 lies in the fact that even though the record itself may be perfect in its reproduction of the music, still there will be distortion when this mechanical oscillation of the groove is transformed into sound waves in the air. The trouble is that the weight of the diaphragm is too heavy to set in motion at these high speeds without some loss. To be sure the metallic disc is made just as light as possible but the amount of power which can be picked up by the vibrating needle is quite limited and it is impossible to give an exact reproduction of the music of the record no matter how perfect the latter may be.

Radio to the rescue! Fig. 4 shows how these difficulties are overcome. Instead of a heavy diaphragm and the air column of the loudspeaker throat we find only a light iron reed attached to the needle. This is so small and

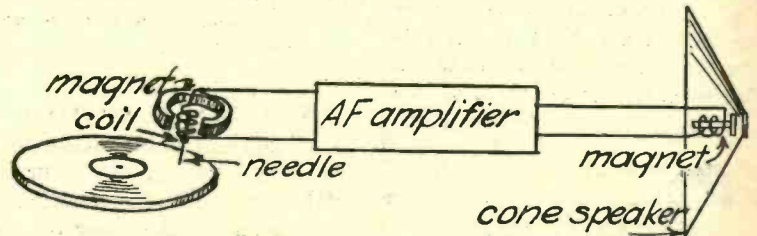


Fig. 4. Here the Record "Plays" a Radio Set, and a Loud Speaker Gives Wonderful Volume and Tone

in the needle. Even with the ordinary reproducer and record the latter wears after continual use so that you can notice the quality is not what it was at first. But in these special records which have the fine shading of tones owing to the peculiar method of recording the loss from wear will naturally be greater.

It is the same way with any fine in-

light that the wear on the record groove is reduced to a fraction of what it otherwise would be. Its lightness also enables it to follow with fidelity the vibrations of the record. Expressed in another way, a small child (with only a little power) finds it difficult to shake a heavy iron safe but it can easily wiggle a small chair back and forth.

Reed is Made a Magnet

This iron reed is magnetized by the effect or field of a permanent magnet placed close to it as shown. Right at the end of the reed is located a coil of many turns of fine wire. As the magnetized reed moves back and forth across the end of the coil it induces a voltage in the winding in the same way

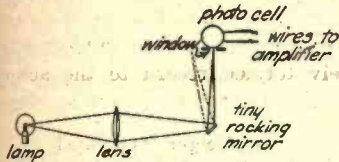


Fig. 5. In This Device the Music Rocks Mirror, and it Passes the Waves on to the Cell

that an ordinary automobile generator develops six volts by turning its armature coils across the magnets of the fields.

The motion is so slight that the voltage developed is perhaps only a few millionths of a volt. That isn't enough to do anything at all, you may say. But let us feed it to a radio amplifier. After going through a few stages you will find that it comes out so powerful that if desired it can rattle the diaphragm of any ordinary loudspeaker.

Is Fed to a Cone

In the Panatrope as this special phonograph is called the output is fed not to an ordinary speaker but to the coils of a special cone. These coils are mounted directly on the point of the cone and are surrounded by the steel of a strong magnet. The combination of magnetism and current imparts motion to the parchment. The result is that the cone vibrates exactly in step with the tiny oscillation of the little reed attached to the needle. In this way we get an accurate reproduction in sound of what was grooved into the record by the original cutting needle.

The process which has just been described above works wonderfully well. However, there is a modification of the recording and which is a still further improvement. Instead of having the sound waves from the broadcasting studio strike a microphone they are allowed to fall on a little rocking mirror. This is about the size of a pin head and a thickness of a piece of paper. If you should sneeze ten feet away it

would probably blow this little reflector right off the table. So you can see how easily it will take up any vibration.

Only One Small Window

Shining on the mirror is a beam of light from a powerful lamp focussed by the lens (Fig. 5). As the looking glass rocks back and forth under the influence of the sound waves it shines the rays into the window of a photo electric cell. This you will remember is a tube something like a 201-A except that it is silvered all over inside except for one small window where the light can penetrate.

Instead of a filament inside there is a sensitive coating which has the strange effect of giving out an electric current whenever light strikes it. So when our mirror shoots light in through the window we instantly get a current from the terminals of the cell. Fig. 6 gives an idea of how the spot of light will produce more or less electrical energy. At the left most of the beam is wasted as it is just about at the edge of the window. When the mirror has turned slightly the rays now pour in to the tube through the window as appears at the right of Fig. 6. The action of the photo cell immediately results in an increase in the electric current.

The wires from the photo cell are then run to an audio frequency amplifier set just as was done in Fig. 2. The greatly strengthened current leaving this device may now be fed through the magnet and the result will appear in a record which is one hundred per cent distortionless.

Rocking Light to Electric Eye

A map of the waves through this apparatus appears in Fig. 7. We have

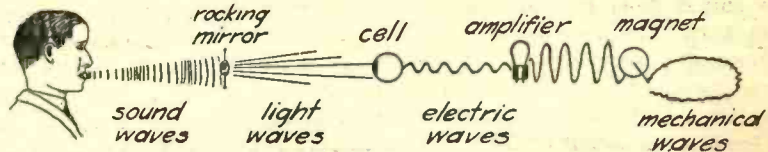


Fig. 7. You Might Think the Music Would Get Lost With All These Changes, But it Comes Out Better Than New

the vibrations in the air resulting from the notes sung by the artist as shown at the left. When these strike the rocking mirror the pulsations are converted into light waves. These go over and strike the electric eye or photo

cell which immediately converts the power into electric waves. The amplifier steps these up and feeds them to a little motor which oscillates on its shaft instead of rotating. The needle which the motor carries at the end of its shaft produces the groove in the record.

It might be mentioned here again

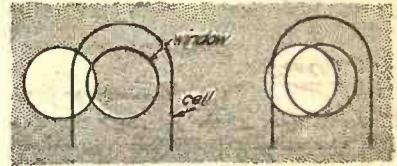


Fig. 6. This "Eclipse of the Sun" Shows How the Spot of Light Can Sing Sweet Strains

that the sending and receiving ends of this process are not necessarily both required. In other words the records made by this scheme are better than those mechanically cut when played on any kind of a phonograph. And on the other hand records played on the new style of phonograph sound better no matter what record is used. Of course the combination of the two for recording and reproducing naturally combines the benefits of both inventions.

It Gathers Them All

The Panatrope is the combined development of the Brunswick-Balk-Collender Company and the General Electric Radio Department. The name comes from the Greek words "Pan," meaning "all," (like Pan-American), and "trope" which signified "Octaves." Panatrope will then imply "All the octaves." It was developed with the idea of reproducing the low tones, which are largely omitted by a phonograph, and also the high notes, which

are often distorted. This device was recently demonstrated before a brilliant company of experts along musical and radio lines, and everyone was charmed by the production.

American Radio Relay League

WORLD LIST OF AMATEURS

A large part of the population of the community around Halifax was enabled during the recent Christmas holidays to send the season's greetings to friends in all parts of the world, through the medium of local member stations of the American Radio Relay League.

One of the largest theatres in this city made provisions for receiving messages from all of its patrons throughout the week preceding Christmas. Free service was given on all of these messages by amateur wireless stations in Halifax and vicinity. These stations through their membership in the American Radio Relay League and connection with wireless amateurs the world over, were enabled to transmit all of the greetings to fellow amateurs with stations near the people to whom these messages were addressed.

Couldn't Use Their Radios

An interesting phase of this effort was the understanding of a number of broadcast listeners, that it would be necessary for the recipients of messages to have receiving sets within their own homes. League members in charge of the work cleared up this misunderstanding by pointing out that amateur message work was telegraphic and was carried out on a wave speed that could not be picked up on the average broadcast receiving set.

As an instance of the type of service that amateur wireless may furnish in such a case, local amateurs noted the list of countries in which amateur stations are now working internationally, that is outside the limits of their own countries. The list, which resembles the index of the atlas, is as follows:

Alaska
Algeria
Argentina
Australia
Belgium
Bermuda
Bolivia
Brazil
Canada
Canal Zone
Chile
China
Columbia

Costa Rica
Cuba
Czecho-Slovakia
Denmark
Dominican Republic
England
Egypt
Finland
France
French Indo-China
Germany
Greenland
Hawaii
Holland
India
Ireland
Italy
Japan
Luxemburg
Madeira
Mesopotamia
Mexico
Morocco
Newfoundland
New Zealand
Norway
Philippines
Porto Rico
Portugal
Samoa
Scotland
Spain
Sweden
Switzerland
Tasmania
Union of South Africa
Union of Soviet Republics
United States.
Uruguay

SAVOY REBROADCAST HERE

Amateur radio station 2NM of Caterham, England, owned and operated by Gerald Marcuse, Vice-President of the International Amateur Radio Union, has been acquiring a record of unusual performance in radio in rebroadcasting programs of the British Broadcasting Company. Mr. Marcuse, who is also secretary of the Radio Society of Great Britain and a member of the American Radio Relay League, has attained remarkable success with his broadcast work.

Working on a wavelength of 6.670 kc.

(45 meters), he has succeeded in presenting a number of concerts from the Savoy Hotel, London, to fellow radio amateurs in the Eastern parts of Canada and the United States. Mr. Marcuse has received reports from many of these stations that the vocal parts of these rebroadcasts have been particularly satisfactory and life-like in their quality.

LEAGUE STOPS RADIO ROW

By Powel Crosley, Jr.

The League of Nations is doing much valuable work, in a rather quiet way, although this may not be apparent to the American public. One of the latest tasks it has undertaken is the straightening out of a rather serious radio broadcasting problem in Europe.

Even with our stations numbering more than 500, the interference problem is by no means so important as it is in Europe with its 50 odd stations. If any hard feelings are engendered here, there is no international significance. In Europe, however, the stations may cause considerable ill-feeling between nations.

The countries are so small that any powerful station in one country easily reaches out into every other nation. Because the band of frequencies available for broadcasting on the continent permits only 42 channels, with 57 stations operating, some interference is bound to occur.

The technical committee of the International Radiophone Union, under the auspices of the League of Nations, has met to discuss this European broadcasting situation. This committee decided that two month's testing will be required to obtain all the data available to solve the problem.

It is rather fine to know that this problem, which would be so fraught with serious consequences without such a medium as the League of Nations, will undoubtedly be settled in a friendly manner. Such a settlement will do more for the progress of radio in Europe than the combined salesmanship of all the manufacturing companies in these foreign nations.

This "B" Eliminator Won't Burn Out

*It Contains No Filaments
Nor Acid to be Renewed*

By McMURDO SILVER, A. I. R. E.

A TUBE without a filament! That seems about as reasonable as an automobile without an engine. However, it has been made and works wonderfully well.

We are referring to the Raytheon tube. This has been described recently in a number of radio publications, but little attempt has been made to tell how or why it works. Some fans are content to make up mysterious boxes which will



Fig. 1. This New Tube Has No Filament, So Won't Burn Out.

stand on their hind legs and bark without knowing why. But most intelligent broadcast listeners want to have some idea of what is going on behind the panel.

Using Current from Main

To start with, why do we need any kind of device at all for enabling us to use electric light current on our radio set? As a matter of fact we do not, provided that the electric light company furnishes direct current of about the

right pressure. In such a case, supposing that the service is 110 volts direct current, it is possible to use a resistance or potentiometer in such a way that we may impress the electricity from the house mains directly on our radio tubes.

But the service which is supplied now by practically every light company is not direct, but alternating current (AC). This has the characteristic that it changes its direction of flow back and forth quite rapidly. In the Eastern and Central parts of the United States the standard is 60 cycles or complete changes of direction every second. In some parts of the West 40 and 50 cycles are used.

Hearing Horrible Hums

Now, if you have ever tried hooking up your "B" battery with the terminals reversed, you will know that it does not work unless the positive (plus) pole of the battery runs to the plates of the vacuum tubes. If you attempt to use 110 volts of alternating current (AC), then the direction of flow will be correct half the time and wrong the other half. This rapid reversal will of course make a horrible hum in the loud speaker.

How can this nuisance of noise be nullified? A rectifier of some kind is needed for this job. Such a device will cut out the negative halves of each wave and allow only the plus ones to reach the tube if a "half wave" rectifier is used. But if it is a "full wave," then the negative halves will be reversed in direction and fed to the vacuum tubes instead of being suppressed.

Filter Fixes Fluctuations

In addition to the rectifier to give out direct current, there will also be needed a transformer to adjust for the correct voltage. With these two units we can supply a direct current of the proper pressure to the plates of our amplifier tubes. But there will still be a bad noise since the output will not be a smooth, but a fluctuating voltage. To get rid of this trouble we must use a chain of

coils and condensers known as a filter.

The idea of a rectifier will probably not startle you. You are already using several of them, in all probability, in your radio set. Every vacuum tube is itself a rectifier, as only current of one direction will flow from the plate. Why not use a 201A tube to obtain the DC. which is needed? Indeed, this can be done and such a hook-up will work satisfactorily for a little while. However, it is very rough on a 201A tube to try to get enough high voltage direct current from its plate circuit to operate a set. As a result the life of the sensitive coating on its filament is very short.

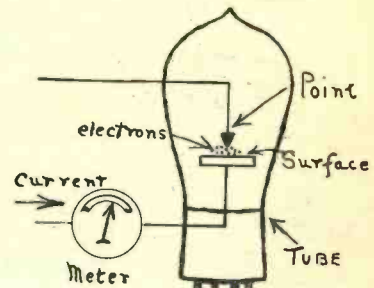


Fig. 2. Here is the Principle on Which New Tube Works.

Such a tube may last only a few hours when operating a heavy duty set.

It Hasn't Any Coating

Here is where the Raytheon tube enters the scene. It is indeed hard to burn off its sensitive coating, because it hasn't any. There is no filament at all, and so the rectifier action must work in a different way from the ordinary tube. A glance at Fig. 2 will show the general idea.

It has been found that when two electrodes or pieces of metal are placed near each other inside a partial vacuum and a high voltage is impressed across the terminals that current will flow from one to the other inside the tube. When

the polarity is reversed the current also reverses. This, then, will not do for a rectifier, since the flow is the same in either direction.

Jumps Right Off the Stool

But when one of the electrodes is made a point and the other a flat surface the conditions are different. Electric current will start at the point and go over to the surface without any trouble. But an instant later, when the alternating current tries to reverse, it finds itself blocked, as current will not start from the plate and jump across to the tiny point. The same sort of action may be explained in Fig. 3. A boy is quite willing to jump from a stool, even though it may be very small in size (point), to the floor (surface), although he does not want to try to jump from the floor to the stool.

By making the distance between the point and the surface just right and by



Fig. 3. An Aid to Memory. Current Runs from Point to Surface.

using the proper gas (helium) inside the partial vacuum, as is done in a Raytheon tube, it is possible to get a rectifier which allows current to flow easily in one direction but not in the other. However, it seems a shame to waste half the wave. To get around this difficulty, two surfaces and a double point are made use of as shown in Fig. 4. In this manner both halves of the AC wave may be rectified.

Throwing it Into High

We are now ready to look at the hook-up, Fig. 5. The 110-volt AC from your house arrives at the primary of the transformer as shown at the extreme right. By this current the iron core of the transformer (represented by the two long straight lines) is magnetized, and from here the energy is passed on to the secondary, whose terminals are labeled "high" and "low." This trans-

former will work with a number of hook-ups, but for the present one we shall use the binding posts marked "high."

This transformer steps the pressure up to roughly 200 volts on each half when there is no load. As you will see, this pressure is fed direct to the two surface terminals of the Raytheon tube. You might expect that this would cause a short circuit, but remember that neither of these surfaces is able to give off negative electrons and so no short circuit current can pass through the transformer.

Condenser and Choke Bar Billows

However, the point electrons in the center can give off these little negative particles of electricity which form the current, and they proceed in a stream out to the left through the choke coil labeled R-196. The two condensers of four microfarads (mfd.) each are used with the choke coil to form a filter, which gives a smooth constant pressure instead of a billowy one.

The upper terminal, as shown at the left of Fig. 5, now has a pressure of nearly 200 volts on it, and may be used directly on your radio set when you need such a high potential to work a power loud speaker. The return lead from this circuit is labeled B minus and goes to the center tap of the transformer.

But 200 volts is way too high for your detector and gives more than the best results even for the amplifiers. This may be reduced to any value desired by the high resistances which connect to the amplifier and detector binding posts as shown. A .5 mfd. condenser is used across each terminal to insure a smooth and noiseless output to the set.

Several Makers Market Parts

During the past few months considerable attention has been given by the radio press of the country to the Raytheon Rectifier tube due to its particular fitness for use in a good rectifier-filter system—so much so that recently several manufacturers have put on the market various transformers, chokes and condensers intended for operation in conjunction with this tube. The complete unit to be described is a combination of the best equipment on the market into a simple, easily assembled system, the use of which is certain to give a very high measure of satisfaction.

The completed unit is shown in the accompanying photograph, Fig. 6, while the pictorial diagram appears as a sepa-

rate cut, Fig. 7. Probably the first feature to strike the eye is the simplicity of the filter system, particularly as compared to some of the early models of eliminators intended for use with the Raytheon tube, in which the total filter capacity ranged up to 20 microfarads, accompanied by several choke coils. This simplicity is due to the excellent design of the Thordarson choke coil, the inductance of which is fifty henries as compared with the twenty or thirty henry values of many others available.

Gets Rid of the Bank

While this advantage might at first seem to be offset by a high resistance, this is not the case with this unit, as its resistance is but 280 ohms, so low

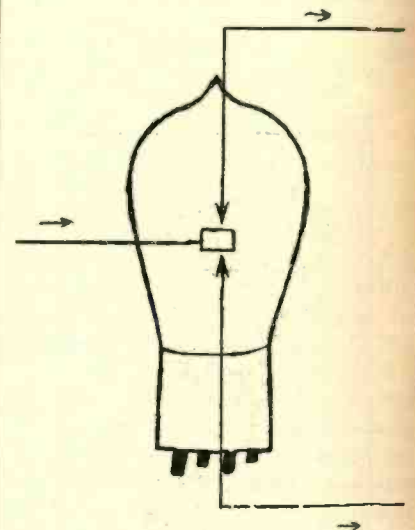


Fig. 4. Direction of Flow of Negative Electrons. Of Course Current Goes in Opposite Way.

as not to interfere with the proper working of the unit under all practical operating conditions. The use of this high inductance in a single choke coil obviously renders the use of a second or third unit unnecessary, as well as dispensing with the necessity for an excessively large filter condenser bank such as would be necessary with the low inductance coils.

The choke, as well as the transformer necessary for stepping up the 110-volt AC line voltage, and the filter condensers, are entirely shielded, which is a valuable feature, since the cases of all may be connected together to eliminate any hum due to placing the eliminator too close to a receiving set.

Plug as On-Off Switch

The step-up transformer is provided with a detachable cord and plug for connecting the unit to any lighting socket, current for which is supplied from a 110-volt, 60-cycle power source—the common supply. The separable plug serves as an on-off switch. The transformer secondary is provided with five

eliminator cost about \$34.00 including the tube. They are all standard and may be purchased at most any good radio shop. Each item has been especially selected because of its suitability, proved by exhaustive tests.

Waits to Pick Hums

The efficacy of the system can best be attested to by citing a single example: an

when it is understood that the set would respond excellently to low hum notes, thus showing up any defect of the eliminator—something an ordinary receiver would never do.

Here is a list of the parts you will need:

- 1 Raytheon tube.
- 1 Acme transformer—195R.

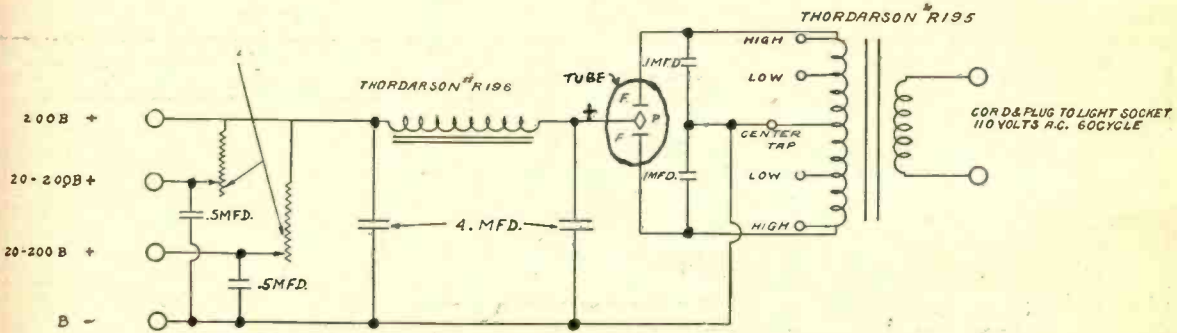


Fig. 5. Here is a Hook-up of Entire Device. For Heavy Outputs, a Second Choke Coil with Another Condenser Across from Its End is an Advantagee.

binding posts—one center tap used as the negative terminal of the output, together with two "LOW" and two "HIGH" posts. Using the "LOW" posts as shown in the photo, the output of the system is 140 volts at 50 milliamperes.

Besides this maximum, two adjustable voltages of from 15 to 140 are available by merely adjusting the two telostats. If a higher voltage is desired, it is merely necessary to shift the two lugs shown on the "LOW" posts of the transformer to the "HIGH" posts, and the output voltage jumps to 200, easily adjusted from 20 to 200 by means of the Telostats. This voltage, together with the high current output—sixty milliamperes may be safely drawn—is sufficient to handle any standard receiver using the new power tubes or resistance coupled amplification.

All the Voltages You Want

Due to the adjustable feature, not only may the maximum output voltage be obtained, but two additional values from 15 or 20 volts up are also available simultaneously. Any number of additional voltages may be obtained by merely adding an extra telostat and .5 by-pass condenser across the output. Those shown are sufficient for any ordinary receiver, however.

The parts necessary to build this

eight-tube super, equipped with three resistance coupled audio amplifiers and a Western Electric cone speaker, was operated from the eliminator with perfect results and no noticeable hum in the speaker. This test will be appreciated

- 1 Acme choke—196R.
- 2 Tobe .1 mf. condensers—705.
- 2 Tobe .5 mf. condensers—707.
- 2 Tobe 4.0 mf. condensers—711.
- 1 Electrad resistrad, type 500, range 10M to 700M ohms, for detector plate control.

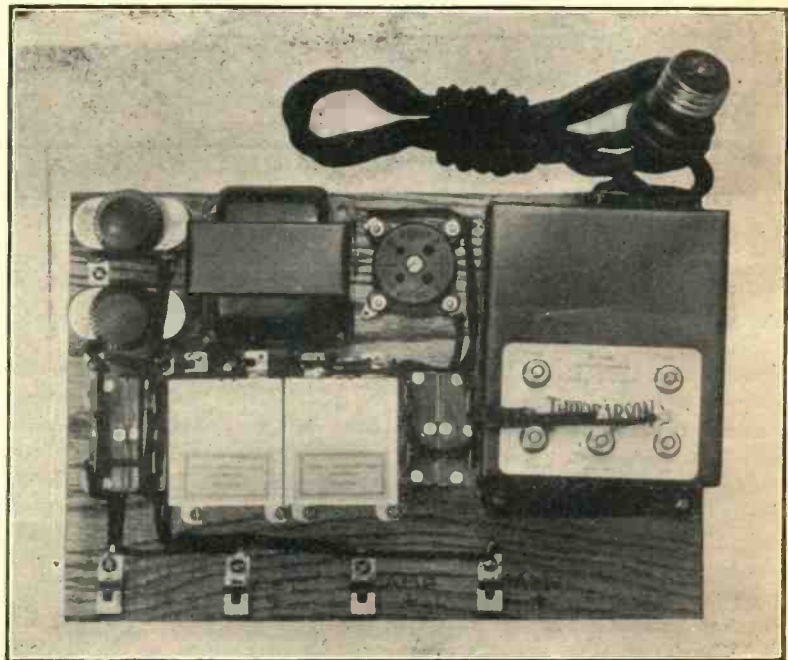


Fig. 6. The Complete Unit Looks Like This. See How Compact it Is.

- 1 Electrad resistrad, type 600, range 500 to 15,000 ohms, for amplifier plate control.
 - 1 Tube socket.
 - 1 7x10x1/2 oak baseboard.
 - 4 Fahnestock clips.
 - 22 No. 6 brass wood screws, 1/4 inch.
 - 10 Feet insulated hook-up wire.
- Tools required for assembly: Screw-driver, cutting pliers, and soldering iron.
- Arranged as You Like**

of other instruments for fastening purposes. The transformers should be fastened down last, the condensers, first upon the baseboard.

Don't Use a Voltmeter

In connecting the finished eliminator, the minus clip goes directly to the B minus post of the receiver; the clip connected to the Electrad Resistrad—type

which no Resistrad is included.

Little can go wrong with the eliminator—the tube life is stated by the manufacturers to be more than 5,000 operating hours, so no thought need be given to its operations except to turn it on and off. The cost of operation is astonishingly slight—well below that of a fifty-watt lamp. The tube may get hot in

The placing of the instruments on the 500, connects to the detector B plus post,

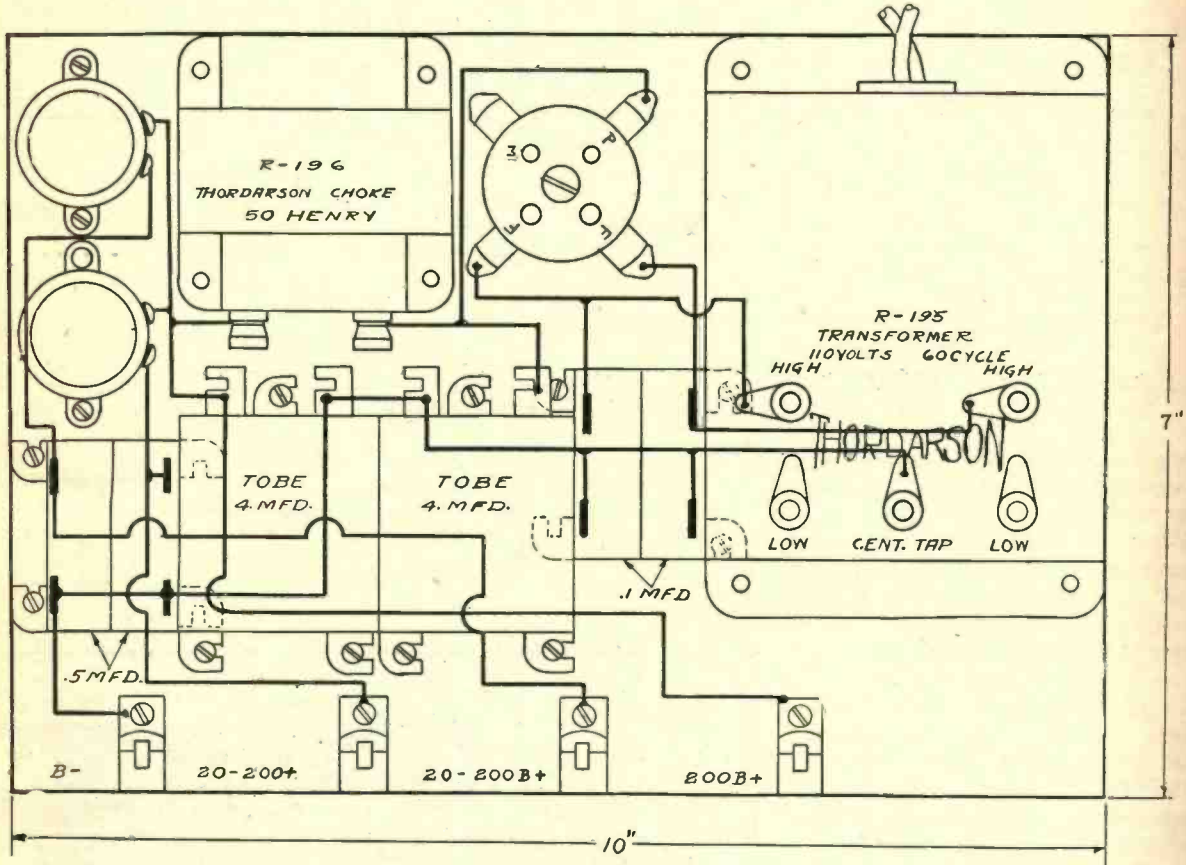


Fig. 7. The hook-up of Fig. 6 is Revealed Here. Observe That the Socket for the Tube Has One Terminal Omitted. Although Both "F" Posts Are Used, There is Really No Filament.

baseboard is not critical—any arrangement suiting the constructor may be followed, though that illustrated is about as compact a layout as can be effected. The actual assembly is so simple as to require little comment. Each part is screwed down as shown, and the various connections made following either diagram. If this is done correctly, the eliminator will not fail to work.

One point might be stressed—the feet on the four smaller condensers are bent at right angles to the case with pliers, and in several instances where they are represented by dotted lines in the pictorial drawing, slipped under the cases

and the clip connected to Resistrad, type 600 connects to the amplifier B plus post. This leaves one clip free, not to be used unless the receiver requires a fixed voltage of either 140 or 200 on some special circuit—as in the case of a resistance amplifier. Then, with the Resistrads screwed partly in, the eliminator is turned on, after which both Resistrads are adjusted for best signals. It is not advisable to try to test the output voltage by means of a voltmeter, since it will go up as soon as the voltmeter is removed, due to the series method of regulation used. This is not true of the maximum output circuit—the one in

operation, but its plate should never be allowed to become red, since it may be destroyed. Should this occur, it indicates trouble in the receiver or filter. The latter would be due to a shorted by-pass condenser.

How to Get a Case

No thought has been given to a case. The entire unit might be built in a metal switchbox of suitable size, or some small pieces of half-inch oak can be procured from the local carpenter, varnished and attached to the base as sides and top. This makes a thoroughly satisfactory case, but the ends or top should be pro-

Continued on Next Page

Making Money On a Radio Patent

How Inventors Often Turn Their Skill Into Cold Cash

By LEO T. PARKER

RADIO patents have had a great influence in the highly developed present day radio equipment. And many of the widely adopted improvements are netting their inventors a nice sum each month.

It is very important to know the best method of disposing of your inventions at a nice profit and without the risk of disclosing the structure of the improvement. An inventor of radio equipment has an important advantage over the man who develops mechanical improvements. As an example, suppose you should design a new door hinge. There is no method of demonstrating such a device without showing it to the prospective purchaser and explaining its operation to him. Then of course he will know exactly how the device is made and can in fact, very easily make one himself. However, this is usually different with radio inventions, and so is very much to the advantage of the inventor.

Can Hear, But Not See It

Among the objects of radio inventions are: tone quality, selectivity, distance and volume. An improvement which relates to any of these things, can be demonstrated to prove its value without in any way disclosing the structure of the apparatus. This is particularly advantageous because even though the inventor may have just filed an application for a patent and has of course not received it yet, he can at once proceed to negotiate with firms, in view of selling the invention.

So in such a case he may demonstrate

the actual worth of the improvement without in the least jeopardizing his interest in the invention. And for these reasons an inventor does not need to waste any time in waiting to receive his patent before starting to receive an income from his endeavors. It is just as binding and legitimate to sell an application for a patent as to sell the patent itself. This has been done many times by employees who avoid personal ex-

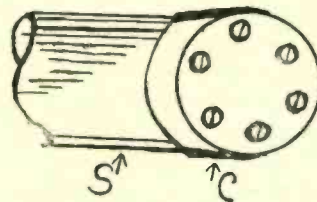


Fig. 1. A Patent Describing Fastenings Like This Would be Worthless.

penses and sell the application to their employer, who proceeds to obtain a patent on the invention.

If He is a Clever Liar

Of course, after an application is on file in the Patent Office the inventor has established his rights and his date of priority at least as early as the filing date of the application. Nevertheless there is a certain risk connected with promiscuously showing an invention to many persons immediately after an application is filed and previous to receiving a patent. This is true because the law says that the true inventor shall receive the patent. So if after seeing the

invention an unscrupulous person should file an application for a patent, the Patent Office would call upon both parties to prove which is the true inventor. So in such a case the inventor may be put to considerable expense and trouble in proving his rights. Moreover, he stands a chance of losing the patent, mainly because any person who is so dishonest as to file a false application for a patent under these conditions will naturally use lies and other unfair but convincing methods of proving that he really invented the device first. And if he is a clever enough liar, the patent will probably be lost to the inventor.

Of course when the patent is issued, generally speaking, quite a period of time must have elapsed from the record date on which the application is filed, and therefore unscrupulous persons are put to greater difficulty in proving priority, besides having important U. S. Court decisions in favor of the inventor.

Tries to Avoid Royalty

I once heard of a man who examined each patent that was issued on radio apparatus. He did so especially for the purpose of improving the inventions and obtaining patents, thinking he could avoid paying royalties to the original patentees.

Now, if I must say it, this man was following a thoroughly unfair, as well as a very foolish plan. Plainly enough he endeavored to rob inventors of those profits which they justly deserve, and unfortunately for him, he believed for a time he could do it.

THIS "B" ELIMINATOR WON'T BURN OUT

Continued from Previous Page

vided with two or three fair-sized ventilation holes in case the tube becomes warm in operation. The unit should always be located several feet away from the receiver, if possible—otherwise hum-

ming may be evident unless all condenser, transformer and choke cases in the eliminator are connected together and grounded.

This instrument just described, as already mentioned, can be made up complete, including tubes, for \$34.00. It will handle any ordinary set without a trace of a hum. Some fans, however, want a

super power eliminator to be used with sets which require a particularly large amount of plate current or for purposes of experimenting. For such a heavy duty rectifier more capacity in the form of condensers and more choke action in the coils are desirable. A complete heavy duty equipment will cost about \$45.00 for parts.

One of the most important rules laid down by the patent laws is that merely adding to an invention does not give the improver the right to make and sell the article, providing of course, that the claims of the original patent are properly drawn and are sufficiently strong to justify the courts in upholding the validity of the patent. However, to avoid obtaining a "weak" patent every inventor should be certain to secure the services of a competent patent attorney to handle his case. The specification and the claims must be correctly and properly written if a valuable patent is to result.

Cutting Down

Fig. 1 will give a rough idea of how necessary it is for the details of a patent

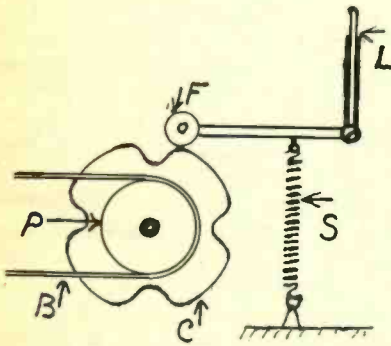


Fig. 2. Here is a Simple Device Which Might Result in a Strong Patent.

to be correctly described. Here is a cap, C, fitting over the end of a shaft, S. They are fastened together by six screws as shown. Now of course in making a drawing of such a device it is necessary to show some definite number of fastenings. However, in describing the apparatus it is inadvisable to specify the number of screws and in the claims it would be fatal to say that there must be six of them. Such patents have sometimes been sent through by incompetent attorneys with the result that anyone wanting to manufacture the article could use four or five screws and thus avoid the patent.

This brings up an interesting point. Suppose that Fig. 2 represents a description which reads as follows: "A pulley is driven by a belt, B, and in this manner the cam, C, is rotated. The follower, F, is driven by the cam and it in turn operates Lever, L. Spring, S, holds the follower up against the cam." This is

quite clear and anyone can readily understand it from the diagram.

Improving the Invention

Now suppose that you should be experimenting with such apparatus and you found that by adding weight, W, (Fig. 3) at the lower end of the spring, you got very much better results in the operation of the machine. Naturally you would want to take out a patent on this addition, and if no one else had already thought of it, you could get your application through without serious trouble.

However, when you came to manufacture the device you would find that the original or basic patent was being infringed by you since you are using all the elements already claimed. The first inventor could absolutely forbid you to manufacture your own device without paying him what royalty he asked even though your machine would do a lot more than his. If he refused to give you a license or set a prohibitive price and refused to buy your patent on the improvement you would simply be out of luck.

Leaves Out the Spring

But on the other hand, in experimenting perhaps it would be found that the machine would work just as well even though the spring, S, (Fig. 4) were omitted. Since the original inventor has claimed the spring, S, in combination with the other elements, and you find that it is unnecessary, you may be allowed a patent on the combination of this smaller number of parts, and your patent will completely avoid his. You will be allowed to go ahead and manufacture without any reference to him. Expressed in another way, if you can get results omitting one or more parts which he specified as necessary, your article will not come under his patent, but if you use all his elements and more besides, even though the addition gives very much better results, he is protected against you.

The courts have held repeatedly that a patent positively must read to protect the invention to which it relates. Even though the drawings and the written description or specification are accurate, if the claims are incorrectly worded and do not adequately cover the invention, the intended meaning of the claims will not be construed by the courts. The claims must stand the acid test. So a

patentee may lose a court decision, even though he actually is the real inventor of the device in litigation, if the claims are poorly, improperly or loosely drawn.

Attorney Sees it Through

Furthermore, considerable experience, perseverance and knowledge of the patent laws is needed to prosecute successfully and competently a patent application, even after it is prepared and filed in the Patent Office. In fact, seeing it through after it is filed in the Patent Office frequently is more difficult than preparing the first papers themselves for filing.

As soon as a patent application is received at the Patent Office the attorney in the case receives a small blue colored

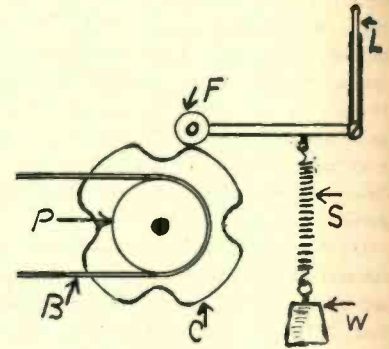


Fig. 3. This Invention Infringes the One Shown in Fig. 2, as it Adds a Weight, W.

slip of paper upon which is printed the serial number of the application and its filing date, together with the applicant's name and address. The papers are placed in the files and not examined until their turn comes. All those ahead relating to the same classification of inventions must be examined first.

Eighteen Months Behind Hand

The period of time an inventor may be compelled to wait to receive the first action from the Patent Office depends entirely upon the number of cases that are not yet acted upon, before his is filed. Moreover, if the invention is in a new classification a longer period usually is required. For example, the radio industry is considered a new class, and inasmuch as many applications for patents on radio apparatus are received at the Patent Office each day, from six months to one year may expire before an inventor of a radio improvement is likely

to receive any action. However, in many other classifications of older things an official action may be received, at this writing, within six weeks from the date of filing. During 1919 to 1923 the Patent Office was far behind in its work, and it was impossible to receive the first Office action, in many classifications, under one year to eighteen months.

When its turn comes, the patent application is examined by a Government Official who makes a thorough search of the already issued patents for the purpose, if possible, of locating any other inventions which may be similar to the one being examined. If none are found among the United States patents, then the search is continued through the files of other countries, all of which are duplicated in the United States Patent Office.

Foreigner Fails to File

While it is not generally known among inventors, if a device has been patented in a foreign country, such prior art will prevent the issue of a patent in this country on the same invention. And this is true even though the foreigner never obtained a United States patent.

If after the Patent Office search is completed, patents similar to the one being examined are found, the Government official in charge of the examination writes the applicant or his attorney and refuses to allow some or perhaps any of the claims. In that event, considerable experience and knowledge of the patent laws is required to amend the application by way of requesting changes in the specifications, or cancelling those claims that are anticipated by prior patents or perhaps presenting written arguments for the allowance of those claims which may have been improperly rejected on wrong references or dissimilar cited patents.

Why They Are Weak

In this manner it is sometimes possible to convince the examiner that he has rejected certain claims that should have been allowed. Also, the attorney may find it worth while to quote similar court decisions, so that the examiner may look it up, with relation to existing patent laws and refer to cases which he may have overlooked. If the attorney has insufficient knowledge to do this, (which naturally consumes considerable time) then he may obtain a patent that is not as strong as the inventor really deserves.

In the latter event, if the patent should ever be presented before a court in an infringement proceeding, where such a patent's validity and broadness is thoroughly tested, it will not do any good for the attorney or the inventor to try to show that a stronger patent *might* have been obtained. The court simply refers to the patent exactly as it reads, and if it does not cover the invention as it should, the inventor may lose the law suit as a result.

Looking at its Face

This method of deciding infringement suits may seem to place inventors in an unfortunate position. Yet if it were not the law, and the courts should render

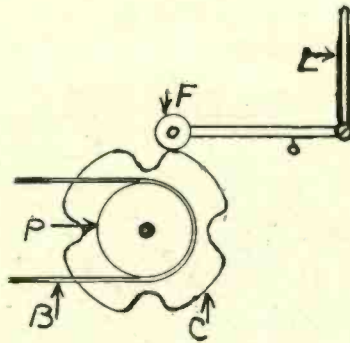


Fig. 4. Here the Inventor Has Avoided the Patent of Fig. 2, and Has Something Worth While.

decisions in consideration of how the patent *should* read, but not be governed by its actual construction, then it would be impossible for anyone to refer to a patent and determine its value. So for this reason, a patent stands upon its face value.

However, there is a provision in the patent laws for the protection of the inventor who may have received, through accident or mistake, a patent that is not as broad as is deserved. He may apply (with additional cost) for a reissue patent any time within two years after the original letters were issued. But he will not be protected against infringements of the new patent that may have occurred before the reissue was obtained.

If Started, May Finish

Also, there is another provision in the law to be considered. It is to the effect that if any person has started to manufacture or sell a patented invention which does not conflict with the original patent, even though the article may infringe the reissue, that person is privi-

leged to continue the business.

Therefore, the man who believes he is permitted to manufacture and sell a thoroughly protected article simply because he improves it, is doomed to disappointment, not to mention the loss of money so invested. Then there is the possibility of litigation and a judgment being rendered against him for damages and profits.

Furthermore, this man usually finds himself confronted with one of two courses. He must pay the original patentee a royalty for permission to make the older patented article in its improved structure, or he must sell the improvement to the owner of the original and basic patent for what he can get.

MICA IN YOUR SET

Mica is used extensively in the radio industry. Perhaps you have seen it used in the "windows" of the old wood-burning stove. Some people confuse it with "isinglass," although it is entirely different in texture. True isinglass is the form of gelatin which is obtained from large fish bladder, such as that of the sturgeon. Mica, which is used in many forms for commercial work and now extensively in radio apparatus as an insulating material particularly in fixed condensers, is a mineral silicate that readily separates into thin leaves and is more or less elastic.

The Indians Used It.

Although mica has been found in some of the Indian mounds in Ohio, not very far from Cincinnati, it is not of the fine quality mined and imported from India. There is a great quantity of domestic mica used, most of it coming from North Carolina and other Southern States but it is not of the high quality required in the manufacture of the best fixed and variable book-type condensers. Home production of mica is exceeded by our imports.

Mica is mined with hand-picks in the smaller mines, while pneumatic drills are used (with great care) in the larger ones. When taken from the mines, this mineral ranges in size from a few inches to several feet in diameter and the better quality has brought \$1000 a ton. Splitting knives are used to separate the mica into sheets of the required thickness. A good splitting for a day is about three and a half pounds per worker.

A 3,000 Mile Road Map You Can Travel from Maine to California by It

WHAT is the best route from Boston to Brockton? Or from Portland to Portland, 3,000 miles away? Of course one way to find out is to buy a set of road maps and look it up on them.

That is a very good way, too, but in many cases it doesn't seem to be quite adequate as along some routes the detours seem to be as thick as berry patches. The road book is usually three years old (some new books *must* be purchased each year, but those which every-

ing house of information, which is to be known as the "Stewart-Warner Tourist Bureau."

The bureau will not only aim to give motorists current and reliable information concerning road and weather conditions, tourists' camps and other help that is generally associated with a large and efficient tourist organization, according to Miss Baker, but will further specialize in the planning of both long and short motor trips for automobile owners who

telling of little known beauty spots to visit over the week-end or during the vacation period, the best route to get there, what to take along, how to dress for the trip, how to keep well and fit on the road, methods of handling the baggage, and the thousand and one other things necessary to make the automobile trip one of real pleasure. Affiliations have been established with more than 2,000 motor clubs, chambers of commerce, garages, hotels, resort and information bureaus, and the prestige and resources of all of these will be available for tourists who make use of the bureau's services.

The Decatur Motor Club, which was first organized by Miss Baker some six years ago, is one of the best and most progressive in Illinois. Later she established the Chicago Tribune Touring Service with which she remained until leaving to organize this newest up-to-date Tourist Service Bureau for Radio Station WBBM. More than a thousand people called on Miss Baker every day last summer to get definite travel information and road maps.



Fig. 1. Miss Nina Baker Will be Glad to Tell You the Detours on That Trip You Were Planning to Take.

one uses seem to be dated 1923), and of course detours are never shown anyway.

Traffic Expert on Air

To get around these difficulties one of the central broadcasting stations of the country, WBBM, Chicago, has lately started a tourist service for automobilists, which is probably the first one in the world to be conducted by radio. Miss Nina Baker, an experienced tourist and traffic expert, is in charge of this clear-

may need help along this line. Road maps and charts, approved routes to Canada, New England, Florida, California, and other places, and copies of traffic laws in the different states, will be furnished *without cost* by the bureau to all who desire it.

Two Thousand Will Help

At regular periods each week, Miss Baker (Fig. 1) will appear at the microphone of WBBM with a brief travel talk,

HOW LOS ANGELES BEATS FLORIDA

Isolated Army posts in the Philippine Islands finally have a regular link of communication with the United States through the medium of transmitting radio amateur stations in Southern California and in various parts of the Islands. While ordinary methods, including commercial radio, furnish rapid communication with the thickly populated and civilized sections of the Islands, it remained for amateur radio to furnish a message system that provides a round trip in the space of forty-eight hours to remote areas.

Ernest O. Knoch, owner and operator of station 6BJX in Los Angeles, one of the official relay stations of the American Radio Relay League, has been one of the outstanding contributors to this excellent work. His station has been ably assisted by station 6BQ at La Jolla, California.

What 1925 Did for Radio

Many Interesting Developments Especially on the Broadcasting End

By JOHN LISTON, General Electric Co.

HAVE you got so that you can write January, 1926, without using an eraser yet? If so, you really realize that this is another year. What did the old one do for you? It made quite a difference in radio and we shall describe a few of the developments which were carried out at one of the big electric companies. On the receiving end there was no very pronounced change during the twelve months. The movement towards low loss especially in coils and condensers perhaps became a little more widespread. Then there was a trend towards using tuning coils of the doughnut or toroid shape. Whether this movement will continue or ordinary straight coils will come back into universal use will remain to be seen.

They Changed Their Dresses

Perhaps the most obvious change of the year was the sudden popularity of sloping panels. Just as most of the changes in the yearly automobile models nowadays seem to be the altering of the lines of the bodies, so many a radio which is heralded as the "latest style" is one of our old friends with a new dress on it.

When it comes to the broadcasting end, however, there is a different story to tell. There have been quite a number of improvements during this last period which have made your radio give out much better programs than before. When you see a little tot after a year's absence, you exclaim "My, how he has grown." But those around him have not noticed it much. And since the improvement has come a little bit at a time, we are apt not to realize how much better our music is now than it was last January. But meters and recording devices tell the story to anyone who has used them.

What the Year Brought

Probably the most outstanding developments in radio transmission during 1925 consisted of the production of large high-power rectifier sets, improvements in low-power sets for transmission from

ship to shore, and developments in broadcasting on different waves from a developmental station provided with the most powerful and up-to-date apparatus available.

The more important high-power sets developed can briefly be described as follows:

A 50-kw. output "kenotron" rectifier, Fig. 1, was constructed which is able to

deliver 3.3 amps. of direct current at pressures adjustable from 2500 to 15,000 volts and to draw power at 220 volts A. C. at 25 cycles per second. The output ripple was reduced to less than one-quarter of one per cent by means of a two-stage filter.

Your Meter Won't Tell

Just consider what this means when compared with your "B" battery voltage.

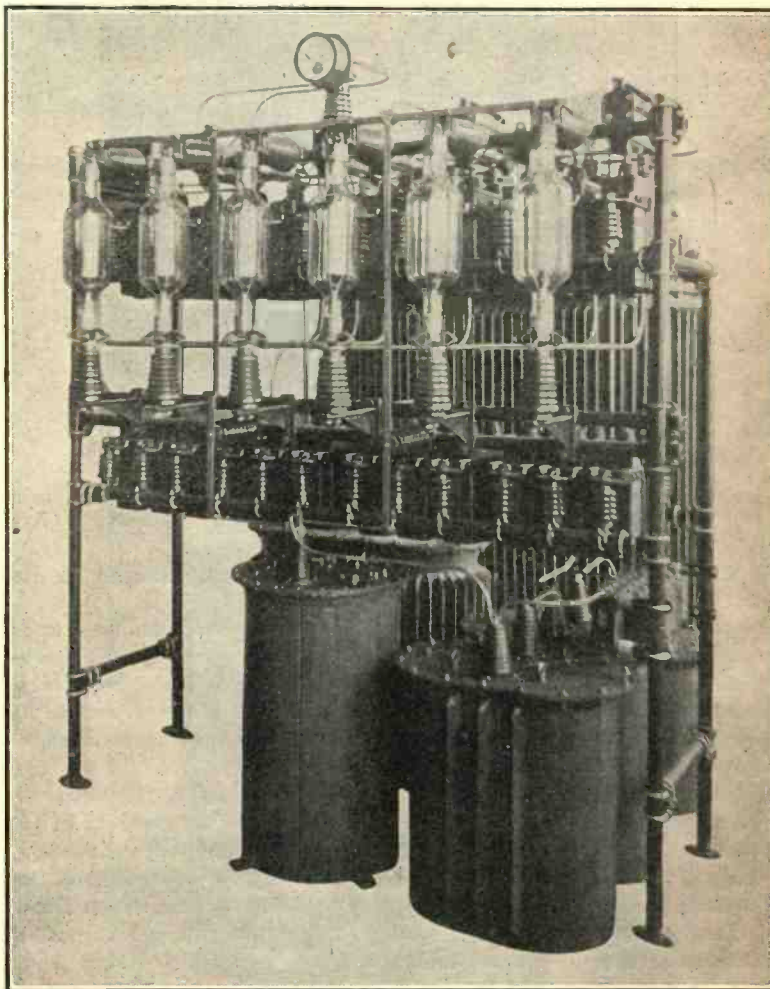


Fig. 1. This High Voltage Rectifier Uses the Six Tubes Seen at the Top to Give Plate Current to the Highest Powered Sending Equipment—Like a Giant "B" Battery.

A regular unit will show 45 volts when the battery is new. As you use it it gradually falls off until finally the pressure drops to around 30 volts. Even now it is still able to get a tune out of your radio but it is best to discard it when down to this value or a little before. Here is a falling off of 33 per cent. Suppose instead of dropping to 30 it fell off from 45 to 44 9/10 volts. This would be

of entertainment, still the wireless telegraph is perhaps more important from the commercial point of view, as it is used every day in transmitting "cables" back and forth between America and Europe.

A 20-kw. output transmitter of the most modern type used for long-wave, continuous-wave telegraphy, utilizes a kenotron rectifier to obtain high-voltage

signals which are being sent on the other side of the wire netting.

A 40-kilowatt output transmitter for use at Kahuku, Hawaii, was the largest tube set built for commercial use at the time it was shipped and is only exceeded in output rating by apparatus now in process of construction. The design comprises a rectifier, a master oscillator and a power amplifier. The master oscillator employs a 20-kilowatt tube, while the power amplifier requires four of these tubes.

Keying One Hundred Words

A special feature is the type of coils employed, (Fig. 3) these permitting of so compact a design of the transmitter that it requires a floor space of only 12 feet 6 inches by 29 feet. The wave range is believed to be the slowest (longest) of any commercial tube set, viz., 21 to 17 kilocycles (14,000 to 17,000 meters.) The set may be operated at keying speeds up to 100 words per minute at outputs of 5 to 40 kilowatts.

The power amplifier circuit is of the push-pull type which is the first time this arrangement has been used in a high power tube set.

In Fig. 3 the two big Bakelite tubes in the foreground act like variocouplers. The rotors are connected to hand wheels instead of the dials which you find on your own radio. Notice what large wire is used. This is because the current may run up to 5 or 10 amperes instead of a few millionths of an ampere in a receiving set. How would you like to have to pay for the Bakelite cylinders of such a large diameter?

Why They Don't Change

A number of ship transmitters with an output of 200 watts were produced which have a wave range of 500 to 330 kc. (600 to 900 meters) and any wave speed within this band may be selected quickly by the operator. Fig. 4 illustrates one of these compact transmitters. It uses a small tube with tuning coils to get the right frequency of vibration and then steps this wave up with amplifiers like those in your set until the power is great enough to talk for hundreds of miles. In this way the frequency stays constant. This gives it considerable advantage over the sending stations which use a tuner on the big bulbs as in the latter case the large amounts of power make any slight changes in the appa-

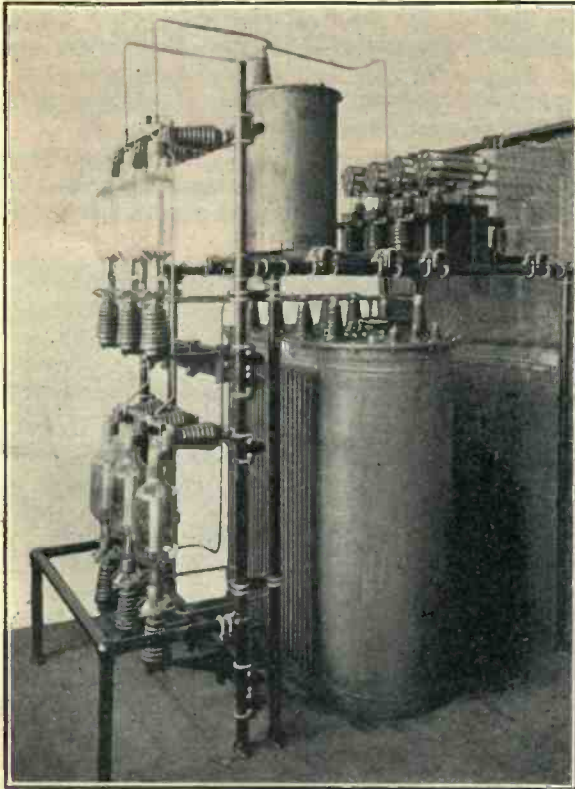


Fig. 2. This Outfit Talks to Europe. See the Wire Netting in the Rear.

¼ of 1 per cent. change. Of course your meter would not be able to detect that there had been any difference at all.

Notice the six tubes in Fig. 1. They are the kenotrons and are like a big brother of the 201-A tube except that they have no grid but only a filament and plate. Current can flow in one direction through them but not in the other and that is why they act as rectifiers. The meter on top shows what pressure is being put out. The transformers and choke coils are in the steel tanks underneath and at the rear.

Cables Through the Air

As you no doubt know, although the radio has the most interest as a matter

of entertainment, still the wireless telegraph is perhaps more important from the commercial point of view, as it is used every day in transmitting "cables" back and forth between America and Europe. A 20-kw. output transmitter of the most modern type used for long-wave, continuous-wave telegraphy, utilizes a kenotron rectifier to obtain high-voltage signals which are being sent on the other side of the wire netting.

Keeps Out the Mess

Fig. 2 shows the assembly of this apparatus. The transformer, which supplies the current to be changed from alternating to direct, is located just behind the six tubes. The wire screen is interesting. It separates this high voltage equipment from the sending room on the other side. In this way, any leakage of current or magnetism from the 15,000-volt apparatus cannot get through and mess up the

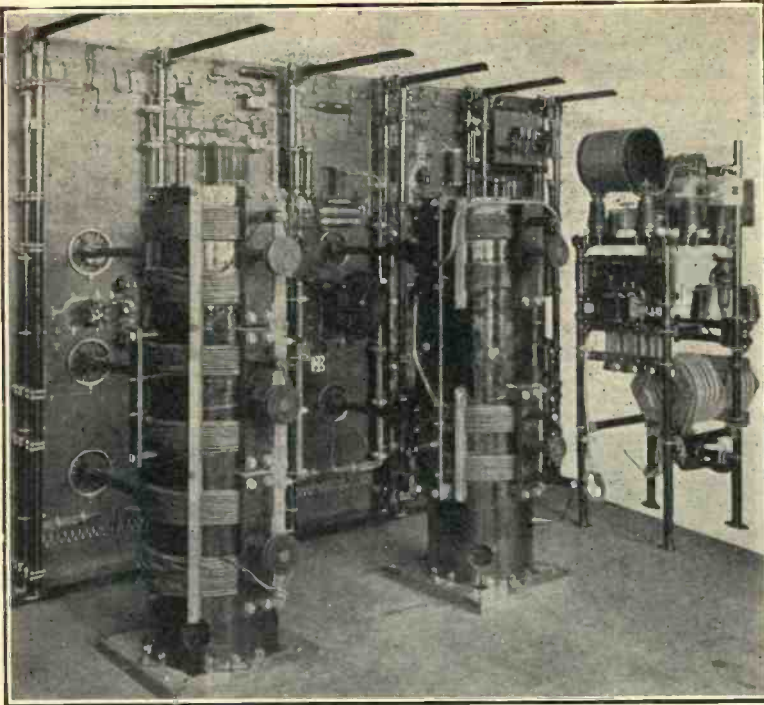


Fig. 3. The Two Columns Are Giant Variometers, Which Control the Wave of the Sending Station.

ratus give out a variation in the wave speed.

The possibilities of radio telephone communication from a tug boat to a shore station were investigated and several successful demonstrations were carried out. Have you ever seen a big ocean liner come into port? The little tug boats push and shove the ocean greyhound here and there in a way which is surprising. Once in a while there is an accident, since it is hard for the tug captains to see where they are going. Radio equipment on a tug boat enables the pilot to receive orders directly from the dispatcher on shore, so that much time is saved when maneuvering in a crowded harbor.

At Their Natural Speed

Several applications of quartz crystals as a means of frequency control for a radio transmitter were developed. One of the characteristics of a quartz block, when oscillating in suitable circuits at the natural speed of the crystal, is to maintain the frequency of the vibration with great steadiness despite the variations which normally occur in high frequency circuits. Broadcast Station WGY is crystal controlled.

At South Schenectady there has been constructed a large Radio Developmental Station where experiments in all con-

ceivable forms of broadcast transmission are being carried out. On an area of 54 acres there are located three 300-foot steel towers, a 150-foot tower, a number of wooden masts, a main brick building and numerous smaller buildings. In the center building is located the power supply apparatus for the entire plant, the modulating equipment for all of the high-power transmitters, and super-power transmitter.

The power supply is obtained at 2300 volts and is converted by means of high-voltage kenotron rectifiers to plate supply for the large transmitting tubes at pressures of 15,000 and 30,000 volts. There are also many auxiliary machines which supply low-voltage power for filament excitation, and intermediate voltages for plate supply of smaller tubes and for biasing potentials (like "C" batteries).

Raising the Power Limit

One of the greater accomplishments was the construction and operation of a super-power broadcasting transmitter. At the regular WGY wavelength, powers

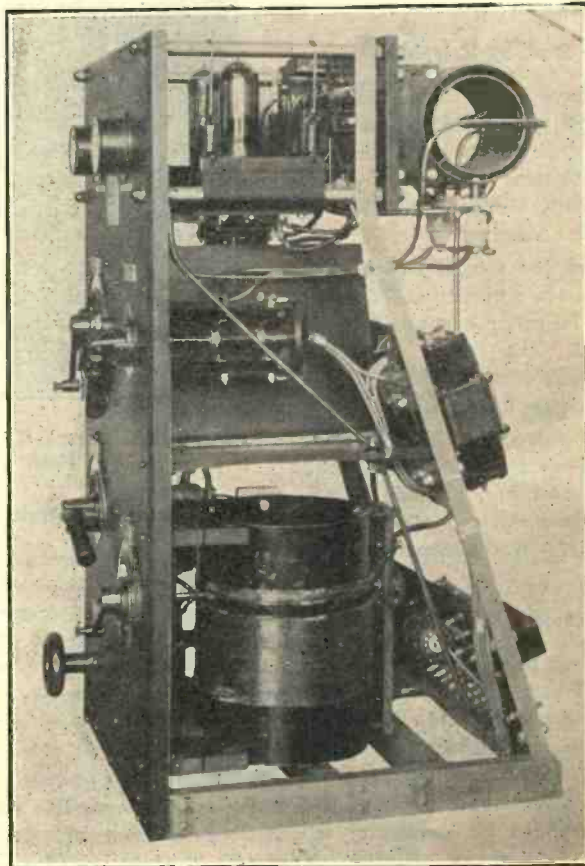


Fig. 4. This Panel is the Transmitter on Shipboard. Some Day it May Save Hundreds of Lives.

to 50 kw. have been radiated since the first tests in July. Last August, in cooperation with the Bureau of Standards, a special series of tests was conducted which demonstrated that improved service can be supplied to more broadcast listeners, without serious interference to reception of other stations in the immediate vicinity, by transmitting at much greater powers than are now normally used. This super-power transmitter, the first of its kind, is now handling an increasing number of programs.

During the last two months of the year, very extensive wave propagation tests were conducted. Measurements were obtained at various points in this country and abroad on eight different wave speeds ranging from 20,000 to 200 kilocycles (15 to 1,500 meters). As a result of these studies, the best wave speed, the most advantageous form of antenna, and the proper power value for each type of broadcast service may be discovered. It is probably the most extensive investigation that has been undertaken with the object of improving broadcast service.

Radio Sent by Telephone

Several improvements were made in carrier current service. This you will recall is the "wired wireless" which is sent over telephone and power cables to sets specially designed to pick up this special broadcasting.

A typical set has the multipower feature for operation normally at 7.5 watts out-put and in emergency at 50 to 75 watts, Fig. 5. The change is accomplished by means of a switch.

A complete new design uses but one type of bulb throughout, the 7.5-watt tube. This is operated in the receiver at six volts filament and 125 volts plate, while in the transmitter it is normally provided with 7.5 volts filament and 350 volts plate.

Way Beyond Rated Range

The improved patrolman's equipment weighs but slightly over 15 pounds complete, including power supply (see front cover), and has given remarkable service in the field, covering distances greatly in excess of its rated range. No means are provided for emergency operation as it is designed primarily to fill the demands for an instrument to

work with multipower sets over distances which are very conservative, as for instance, when working from a point on a line between two big power houses.

The increasing number of carrier installations brought out numerous operating problems involving intersystem operations, gap bridging (where two powerlines do not connect), high-frequency transmission lines, and remote control of carrier equipment over telephone wires. To answer each of these problems equipment was produced which is described briefly as follows:

When Switches Are Open

Operation requirements on some lines have made necessary the production of gap-bridging equipment for by-passing transformers, open switches, and the like. This development also has been greatly facilitated by single-frequency operation inasmuch as it is only necessary to by-pass a single frequency instead of two.

High-frequency transmission line tuning equipment was designed for the purpose of connecting the carrier set with

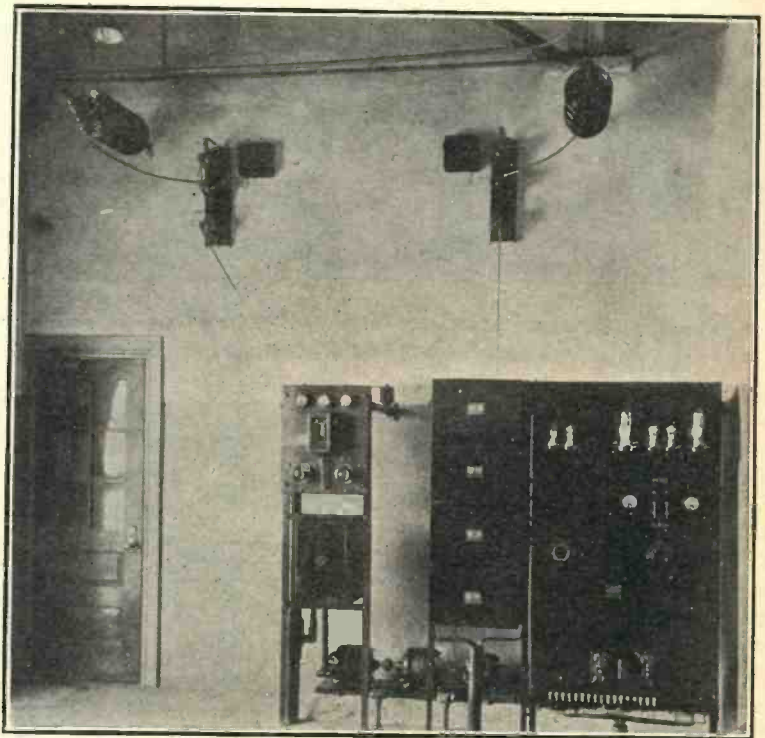


Fig. 5. Many Electric Light Companies Are Sending Out Radio Programs Over Their Wires. Here is Such a Sending Station.

Talking Between Different Companies

By intersystem operation is meant service between dispatchers of different wire lines. On each system the carrier communication is normal with other sets on the same generator frequency. Dispatchers who desire to communicate from two adjacent systems, however, may make provision for doing so by the addition of a new connection attachment which makes it possible for them automatically to communicate on an intersystem frequency which differs from either main frequency.

the high tension coupling equipment which may be a mile or so away. By this means efficient coupling may be secured even though it is necessary to locate the set at such a distance from the transmission line.

In quite a number of cases it is desired to operate the carrier equipment from a point several miles away. This point may be the dispatcher's office or perhaps that of an official. To accomplish this, remote-control apparatus gives full control by means of four wires over any distance up to ten miles.

All About International Radio Week

Here's a Chance to Boast That You Heard Europe

By OLIVER D. ARNOLD

IF you're a liar you will not like Radio Week. For many fans who stick to the truth will be able to say that they picked up England or some other European country.

Perhaps you will be able also to hear these distant signals if you tune in at the right times during this notable week. For all the United States will be quiet (not including the squealing of those of your neighbors who have regenerative sets and who do not know how to use them), and this will give you a chance to catch the faint whispers from far away.

Get a Thousand Miles

Maybe you think that because a set is very sharp tuning it will not be benefited much by the quiet which will descend on the American broadcasters. It seems reasonable to think that if a radio can tune out the locals and get a thousand miles away, then the fact the locals shut down will not be much of a help.

However, consider what happens in a theatre during an intermission. The orchestra plays softly in the distance and all your friends and their friends all over the auditorium start talking in low tones. If you have good ears and put your mind on it you can pick up what the man at the end of the aisle is saying although he is not talking very loudly. But suppose that he spoke in the same tone of voice just after the hush which follows the rising of the curtain. His voice would be heard clearly all over the theatre without the listener having to strain his ears as was necessary during the general conversation.

Tremendous Total of Talkers

In other words, you have been able to tune out the throng of talkers and pick up his sending. When all the talkers get off the air you are able to hear him much easier than before, although you were not especially conscious that they were going. And in the same way with over five hundred stations in America

and a large number of them running at once, the total volume of vibrations is big enough to have a large deadening action on your set even though you may tune out individual local stations.

An American DX contest which will be participated in by broadcasting stations in every state in the Union, as well as by Canadian and Mexican stations, will be one of the features of International Radio Week, January 24 to 30, accord-

Our map, Fig. 1, shows the four divisions of time in the United States during which it is possible to tune in on Europe. Unfortunately this comes at a rather late hour in the evening for the Eastern fans, as they must sit up until midnight to get the best results. On the other hand, the Pacific Coast will start listening in at the early hour of 8 P. M.

On Friday, January 29, at the customary silent hour a variation in the plan

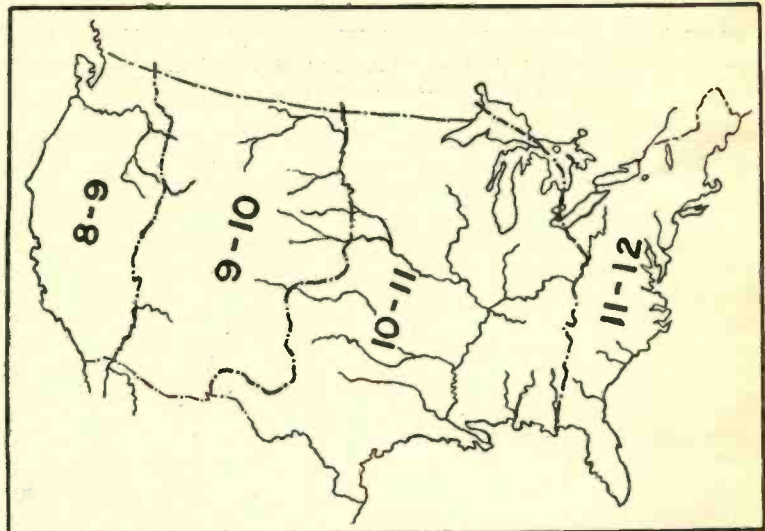


Fig. 1. Here is a Map Showing the Local Time When Europe Transmits. U. S. at that Time is Silent.

ing to announcement by officials of the committee who have charge of the movement.

Canada and Mexico, Too

The first five nights of the week will be devoted to International Broadcasting Tests, American stations transmitting special programs to overseas listeners during the hours from 10:00 to 11:00 Eastern time; while American listeners will hear special programs from overseas in the hours from 11:00 to 12:00, Eastern time. During this hour, all American, Canadian and Mexican stations will remain silent.

of broadcasting will be made and instead of listening to transmitters in Europe, radio fans in the country will hear for the first fifteen minutes of the silent hour, broadcasting stations in the Eastern Standard time zone. Promptly at the conclusion of the first fifteen minutes of the silent hour, the Eastern time zone stations will be silent, and broadcasters in the Central Standard time zone will be heard on the air while stations in all other districts remain silent. The third fifteen-minute period of the hour will be devoted to stations in the Mountain standard time zone, while

the last fifteen minutes of the silent hour will be reserved for Pacific Coast stations who expect to reach listeners in every state in the Union with hundreds

Fig. 3 shows a map with this information on it. As described above the recorded times are those when an Easterner will hear the various sections of North

broadcasters who will participate in these North American Continent tests, numbers that will permit of the frequent announcement of call letters so the fan can rapidly log the DX stations that will possibly be coming into his receiver for the first time. Local radio clubs in many cities are arranging contests, according to the radio week committee, and prizes will be offered by newspapers and clubs in some cases for the best log arranged by listeners in their own communities.

A complete log of the programs broadcast from overseas will be kept by the International Radio Week Committee, and every effort will be made to secure also complete logs of American broadcasters who are on the air during the special tests on Friday and Saturday. Broadcasters participating have pledged themselves to acknowledge all reports and claims of reception from distant fans, and there is no doubt that many thousands of people will hear stations this week that are normally not in the range of their sets because of local station interference.

Program directors in all broadcasting stations will set their watches by the Arlington time signal each night of the

Continued on Page 28

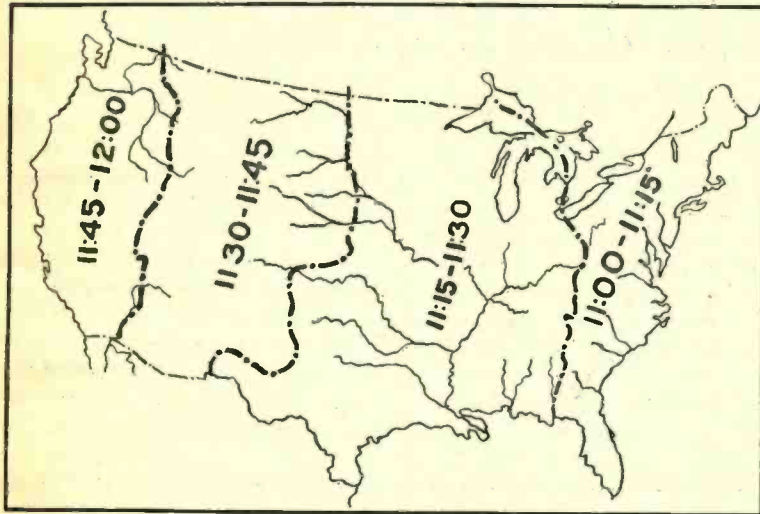


Fig. 2. These Are all Eastern Time, and Show When Each Section Will Go on the Air

of thousands of fans glued to the ear-pieces.

Fig. 2 gives the times when the various sections will broadcast as shown on an *Eastern Standard* clock. If you live in the Central zone you must subtract an hour from each reading. Mountain and Pacific times are two and three hours respectively, earlier than those on the map. The times as recorded are those during which the stations will be on the air. For the rest of the hour the stations will be silent.

On Saturday, January 30, another variation of the DX contest will be arranged, right after the conclusion of the hour broadcast from all American stations for the benefit of overseas listeners. Transmitting stations in Canada will have the air exclusively to themselves during the first fifteen minutes of the silent hour. Sixteen minutes after this special hour has begun broadcasters in the Northern half of the United States will take up the broadcasting, while the Canadian stations shut down for the remaining forty-five minutes of the test hour. The third quarter of the hour will be devoted to stations in the Southern half of the United States, while the last quarter of the silent hour will bring in Mexican and Cuban stations on the air to entertain listeners throughout the entire American Continent.

America. The other divisions must subtract from one to three hours from the figures given to convert it to their local time.

Special programs are planned by

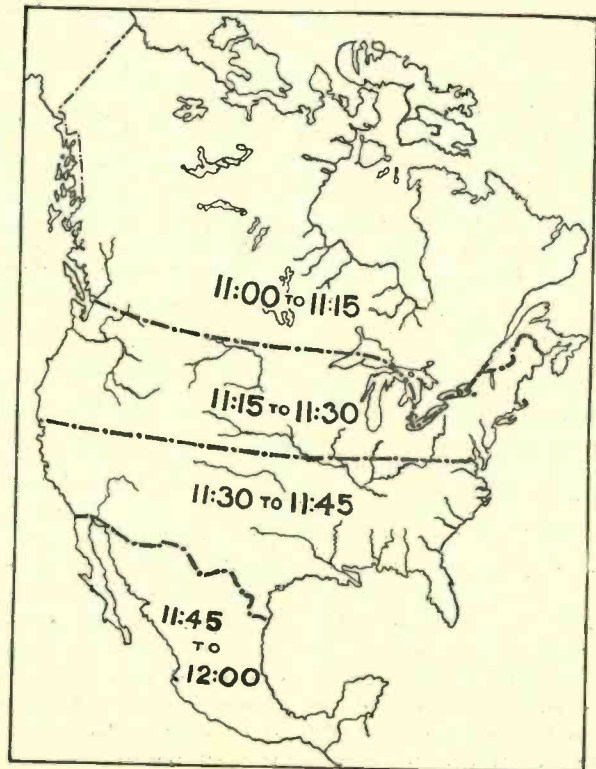


Fig. 3. On Saturday, Canada and Mexico Will Join the Tests as Above

Britain Broadcasts Year's Beginning

Big Ben Boomed Its Greetings To America on New Year's

IN spite of Volstead it is reported that some of our citizens saw pink-tailed pazoocas on New Year's. Others probably heard weird sounds as well. But if you happened to pick up on that evening the tones of Big Ben in London, you needn't be alarmed about your condition.

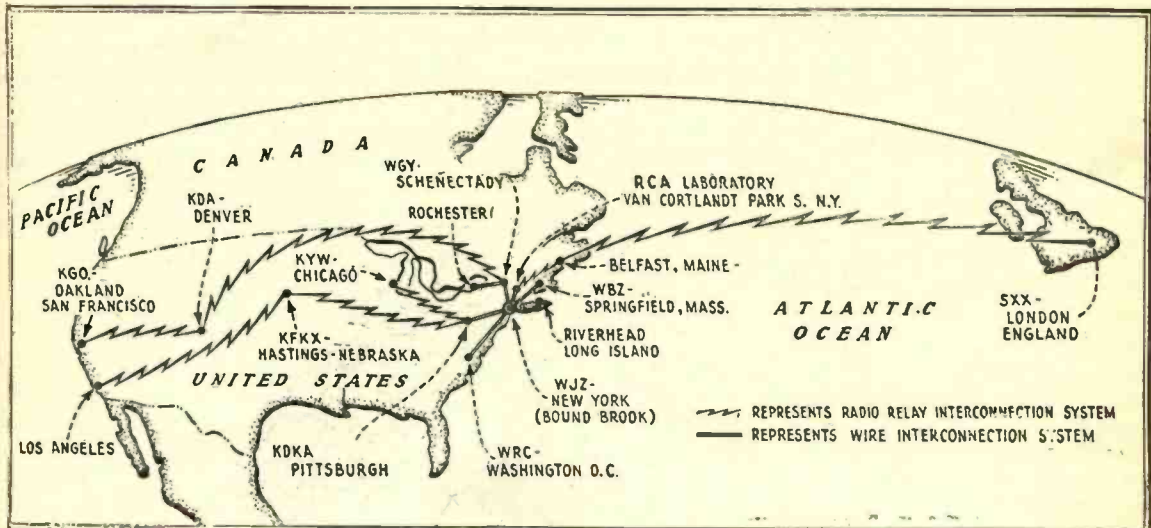
This latest achievement of tying up England and the United States by radio was accomplished following a well-laid plan. The chimes of London, tolled by unseen hands thousands of miles away, resounded in millions of homes in the

the New Year's Day celebration by radio by pealing forth a greeting to the United States from the chimes in the tower of the Parliament Building in London. The New World then replied with a program rendered by leading operatic artists, transmitted with sufficient power to be heard clear across the seas.

Fig. 1 shows how the music of the bells found its way across the vast wastes. Starting in London from Station 5XX the slow speed vibrations were picked up at Belfast, Maine. There they

Then to demonstrate the extent to which radio has become the art of instantaneous communication, Mr. Kent Cooper, General Manager of the Associated Press, broadcast some brief Associated Press news dispatches from the leading capitals of Europe. These press dispatches were transmitted to the New York Office of the Associated Press by their world-wide wireless system.

Official "listening posts" on land and sea were established so that exact engineering data might be gathered as to



United States on January first. In return, a large part of the civilized world was thrilled by a special New Year's Day gala program, rendered by great operatic stars, and broadcast by high power from the experimental station of the Radio Corporation at Bound Brook, N. J., in co-operation with the group of coast-to-coast broadcasting stations maintained by the General Electric Company and the Westinghouse Electric Company.

Peals Across the Sea

The British Broadcasting Company co-operated with the American stations in the most elaborate demonstration of world-wide broadcasting ever before attempted. The Old World inaugurated

were converted to high frequency waves and sent to New York. Wire connections out of this center put the program into the sending stations of WRC, Washington; KDKA, Pittsburgh; WGY, Schenectady, and WBZ, Springfield. Each of these latter radiated the music on their own wave.

Talked Everything But Slang

Immediately preceding the special musical program broadcast from the United States, an official spokesman from America greeted by radio the leading countries of the world. To overcome the barriers of language, a linguist repeated these greetings in French, German, Italian, Spanish, Polish, Swedish, and Japanese.

reception conditions throughout the world. The information thus collected in London, Paris, Berlin, Rome, Warsaw, Stavanger and Honolulu, Tokyo and other points will undoubtedly be of the greatest importance in determining some of the problems of radio transmission.

Were You One of 10,000?

In the United States, the data was gathered by over ten thousand designated listeners in practically every city and town in the country. Many radio dealers and others devoted the hours from 7 P. M. to midnight on January first to demonstrating radio reception conditions.

Continued on Next Page

INTERNATIONAL RADIO WEEK

Continued from Page 26

test, and it is expected that perfect harmony will be found in the air for the benefit of fans reaching out for new distance records.

Because of broadcasters in widely separated parts of the country operating on the same wave frequency it will be easy for fans to pick up a local station and bring their receivers into sharp tune at the time just before the tests start, and then wait for the distant station to come in at the exact dial setting of the local. In England, standard frequency signals will be sent out for the benefit of local listeners wishing to tune their receivers sharply, and thus the British fan will be prepared for the overseas stations broadcasting on the same frequency sent out by the British test station.

International Radio Week is now in its fourth year, and steadily grows in popularity with the public, according to the committee heads. The movement has the endorsement of practically every radio trade body in the country. Powel Crosley, Jr., of Cincinnati heads the Executive Committee. Other prominent officers are Paul B. Klugh, executive chairman of the National Association of Broadcasters, heading the committee on American Broadcasters; Arthur Lynch, editor of Radio Broadcast, heading the Test Committee, Herbert H. Frost, president of the Radio Manufacturers' Association, heading the Committee of Manufacturers.

Many organizations have already come out with whole-hearted support of the movement. Among the first of these was the Radio Manufacturers' Association, which contributed a check for \$500 as an initial donation toward the support of the movement. It is planned during the week to conduct many broadcasting tests of an international nature which are expected to develop new possibilities in this feature of the science and to draw the radio fans of the various countries into closer connection.

Fig. 4 shows a photograph of two prize cups. We have to mention them, as otherwise you might not be able to tear your eyes away from the girl who is holding them. She is Miss Dorothy Knapp, who is now being featured in

Earl Carroll's Vanities at New York. She has won cup after cup herself in various beauty contests, but those she is displaying have nothing to do with fairness of face.

They have been contributed by the Freed-Eisemann Radio Corp., one to be given to the person who reports first hearing Europe on a set of their manufacture during the test and the other to the person with the best log of foreign stations received on any set.

In conclusion we urge that if you have a regenerative set please *do not* turn up your tickler coil so high as to squeal and thus wreck the chances of your neighbors of picking up the faint waves from across the water.

BRITAIN BROADCASTS

Continued from Previous Page

General James G. Harbord, President of the Radio Corporation of America, in announcing the program for the New Year's Day celebration said:

"It is fitting that this world-wide demonstration of radio broadcasting should be initiated in the United States. Ameri-

ca is the recognized center of radio communication and our achievements in the art have brought to us the responsibility of leadership.

"International broadcasting upon an assured and regular scale awaits only the perfection of technical facilities. It is a reciprocal service in which we must be ready to give as well as to receive. Our immediate effort is to prove that in our experimental station at Bound Brook, we have a voice great enough to bridge the ocean as well as serve the major portion of the American public."

Like Aerial Wire

Cityboy: "Are the mosquitoes thick around here?"

Farmer: "No; long and thin."

—Exchange.

He Makes Swiss Cheese

Irate Customer: "Here; look what you did!"

Laundryman: "I can't see anything wrong with that lace."

"Lace? That was a sheet!"

—Exchange.



Fig. 4. Here Are Some of the Prizes Offered in Connection With Radio Week

Make Your Radio Beat Your Friend's

Small Details, But They Add a Lot to Your Set

By C. WM. RADOS, Arlington

ONCE there was a boy who ate so much honey it made him sick and he didn't like it after that. Then you remember King Midas in the fable whose touch turned everything to gold and he got so sick and tired of the yellow metal that he never wanted to see it again. There comes a time in the lives of all of us when we get tired of the radio and it receives scant attention for several weeks,

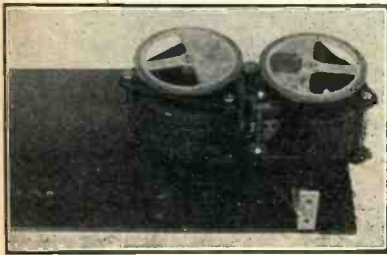


Fig. 1. Here is a Simple Method of Combining Two Controls on One Shaft

particularly last summer when all outdoors was calling. But now that winter is with us again, our interest begins to deepen in the old set, knowing that we shall spend much time indoors until Spring. However, we know its limitations from past experiences, and like all true radio fans, we should not remain satisfied until we have rebuilt the set and added several improvements.

Sit Back with Smile

By incorporating the following ideas you will have a radio set that will be a top-notch in distance, volume and clarity. Then you can sit back with a quiet smile on your face while others boast of their receivers and wait until they listen to yours.

Most of the writers seem to agree that a five-tube or six-tube radio gives about the best results for the money. My ideal set is a two stage radio amplifier, detector, and three stages resistance coupled audio amplifier or one transformer coupled and a two-tube push pull amplifier. A first class heterodyne is better, of course, but so is a Rolls Royce better than a Buick if you can afford it. The beginner should not start with so many tubes in his set, as it would be too complex.

Let the Wife Decide

Do you like to turn several handles, buttons, dials, levers, etc., in order to hear some music which may be lost immediately by some one touching one of the controls? If so, do not read this. However, if your wife is not an extra-first-class commercial operator, she probably does not care for multi-control, so read on.

A one dial radio is not much harder to build than any other kind, but once accustomed to it you will always use one,

even if it took a week more to put together. The photograph in Fig. 1 shows how two condensers may be geared together. As luck would have it, these condensers (General Radio) are made up with a geared vernier. If two condensers are brought together, the pinion of one will mesh with both of the large gears. In the photo the author has removed one pinion as it is unnecessary. Turning either of the condensers with a dial will run the other one too. Of course it is just as easy to gear three such units together.

Making Them Run Smoothly

The condensers are mounted on a small sheet of Bakelite or hard rubber, behind the main panel. If the condensers mentioned are used, I would recommend a

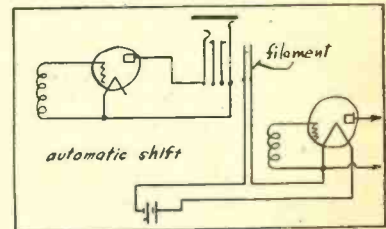


Fig. 3. The Secret of Making the Tube Light When You Plug in

National Velvet vernier dial as its shank is long enough to reach back of the main to the sub panel. A drop of oil on each bearing to make the unit run smoothly will help greatly.

The idea is applicable to many other condensers, such as the double Remler, or to other geared constructions. See Fig. 2 for diagram. Naturally they must all turn in the same direction, which necessitates a small gear between each pair of big ones.

Is it Broadcasters Fault?

The audio amplifier gives us our volume and quality (?). At the risk of stepping on the toes of some people, I am going to say that in spite of all the talk about quality reception, the claims for perfect radio reception and distor-

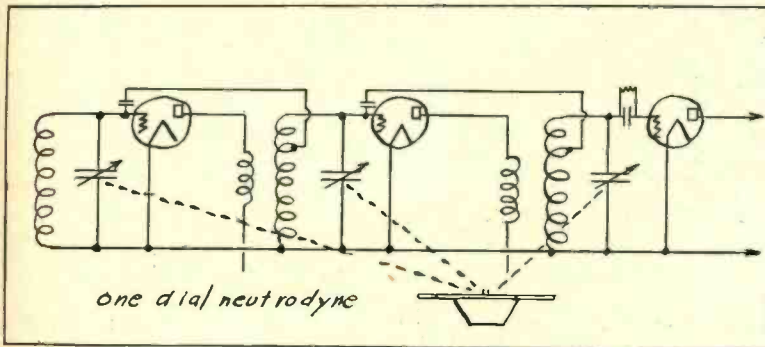


Fig. 2. By Hooking up Three Condensers as in Fig. 1 We Obtain a One-dial Neutrodyne

tionless loud speakers are largely exaggerated. The broadcasting stations do not yet give us absolutely perfect quality, so we can not expect poor radios to give perfect reproduction. The majority of amplifiers distort and so do the majority of horns. As far as I know, there is no loud speaker on the market today which will give uniform even reproduction. Of the three, broadcaster, receiving set, and

What Makes Tube Light?

Automatic shifting from head telephones to loud speaker is often omitted, but it can be done very simply. The scheme is to put a special jack in the output of the first audio amplifier. This jack has three pairs of contacts which are so connected that when the phone plug is in, the first audio tube only is used. Thus the operator tunes in distant stations

music will be heard in the phones when the plug is withdrawn, the music will be coming from the horn.

Leave Out the Dope

The simplest and perhaps best of the "low-loss" coils is one which is wound on a cylindrical form with cotton covered wire, spaced by a thread or string and not shalcked or doped.

Building moving coils as in variometers, ticklers, etc., is usually a hard job. An easy way to get around this is to use a fixed coil and a variable condenser in the plate circuit. The condenser will nicely control the regeneration and volume, without the uncertainty of the usual home-made, lop-sided movable coil.

If buying or making coils, the new toroidal or "fieldless" coils should be used if possible, as a set is less apt to howl, even if put together poorly, when these are employed.

Don't Come in Crowds

If you are purchasing condensers, it will pay you to get the straight line frequency style, as they make easier tuning

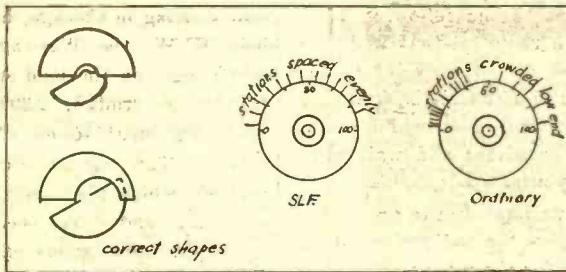


Fig. 4. Of Course You Will Want to Get the Straight-Line-Frequency Results on Your Set

horn, we can improve only the radio set. However, with a good horn, or a new cone type loud speaker which puts the resonant tone up to about 1500 cycles, it seems as though we may be able to have as perfect reproduction as the stations will send.

The best distortionless amplifier is probably of the resistance type. This has the property of amplifying equally all frequencies (notes). A three stage amplifier consists of three tubes, six small resistances, and three blocking condensers. If you are purchasing a set or making one, or buying an amplifier, be certain to consider the resistance amplifier, as this is regarded by many as positively the best yet produced.

Makes Loud Speaker Dance

For the information of some of the experimenters who try everything, we include the other types of amplifiers. For brute volume, where it is desired that the loud speaker should get up and jump around the table, the push-pull connection will give signals loud enough to drive the family out. For maximum volume, the four-tube amplifier is used; two stages of ordinary transformer coupled and the third stage, of push-pull amplification.

In any audio amplifier it is well to mount each tube socket on spring rubber as well as the detector tube socket, thus eliminating many noises due to mechanical coupling.

comfortably with enough amplification to hear well. When he is through tuning, he pulls the plug out just a little and presto—the other tubes light up and the music comes pouring out of the loud speaker. When the plug is pushed in again the extra amplifier tubes go out and the phones are in use again. Fig. 3 shows the hook-up.

Another way to shift from phones to loud speaker is to put a double circuit (four terminal) jack in the plate connection of the last tube. Connect the two outer terminals to the plate circuit and the two inner terminals to the loud speaker. When the plug is inserted, the



Fig. 5. A View of a Condenser Which Shows no Crowding of High Frequency Stations

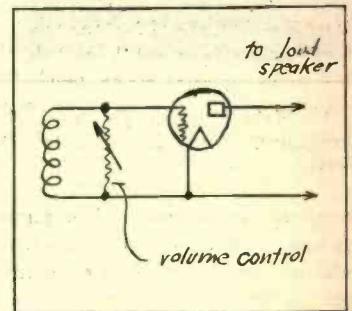


Fig. 6. This Volume Control Does Not Distort the Music

A SLF condenser does not crowd the stations at the lower end of the dial as does the ordinary type. See Figs. 4 and 5.

When you are buying new parts it is just as well to get low-loss apparatus. However, it is unnecessary to throw away good apparatus to buy new parts which may be no better than the old.

Rheostats or ballasts are necessary. However, since you have to pay for them, why not buy only one instead of several? By using a low resistance rheostat such as the Bradleystat, you can control all the tubes in your set with one knob.

Looking somewhat like a rheostat is the volume control. This is a large range variable resistance which increases the quality of the audio amplifier as shown

in Fig. 6. This is much better than dimming the tubes with the rheostat as no distortion will take place. A resistance which is adjustable up to 50,000 or 100,000 ohms goes across the secondary of the last audio transformer, as shown.

Increasing Selectivity 50%
Shielding a multi-tube set is almost a

gether in one evening by a man unskilled with tools, with the to-be-expected poor results. The apparatus is badly crowded, and of course in a reflex (the set is a three-tube reflex), this guarantees howling. The tuning condenser is inside of the tuning coil, and the radio and audio transformers are in contact with each

the customary self-stamped addressed envelope is enclosed.

MOVIE MEN USE BROADCAST

Radio music as an incentive to motion picture production was the innovation recently made by the producers of Christie Comedies.

According to Gordon De Witt, an assistant director with the company, and now visiting in Chicago, his organization held KYW, the Westinghouse Station at Chicago, on the loud speaker in their Hollywood studios, 2,300 miles away, while the final scenes of a film were "shot." The regular orchestra, he explained, which plays while the pictures are being "shot," had been dismissed for the night when orders came through to rush the film at hand to completion.

Radio was called upon and it was soon discovered that all West Coast stations were off the air. Then the "KYW parade" came in. The actors took their places, the lights were lifted, and work went on.

A JAGGED SPARK

A new insignia for United States naval radio electricians, until recently classified as gunners radio, in the form of "a jagged spark," has been adopted for uniform wear.

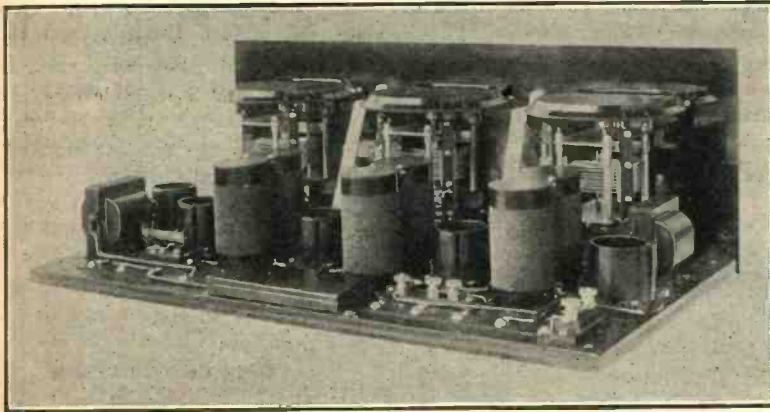


Fig. 7. Exhibit A—A well Designed Set Showing a Lot of Thought, and Working Accordingly

necessity if you live in a large city. The set, sitting in its polished cabinet, sometimes picks up almost as much house current hum and click as it does radio waves. A well shielded set will get only radio, and will cut out much of the static and interference. However, it should be well shielded, including the back of the panel, baseboard, top and sides of cabinet, audio transformers with metal cases grounded, and all neutral points grounded. If the shielding is well done as advised, the selectivity may be improved as much as fifty per cent. However, best results will not be obtained unless it is well done.

Too many people plan excellent receivers, buy the very best parts, spend a great deal of time and money and then throw their sets together in an evening, making a poor job. To show the tremendous difference between care and haste, I am including two photographs; one the inside of the Grebe Synchronphase (Fig. 7), and the other a novice built radio, Fig. 8.

Because it Works Well

The former was carefully planned, developed, and built in a factory where much thought was expended. The result is apparent,—it works well, looks well, and gives the owner a feeling of reliance.

The novice-built radio was thrown to-

other, which produce a fine crop of howls.

Do not build your set like the three-tube reflex shown. Take some time; have pride in your work; and when you finish you will have a set which will give you results and satisfaction.

In closing, the author wishes to state that he will be glad to hear from fans if

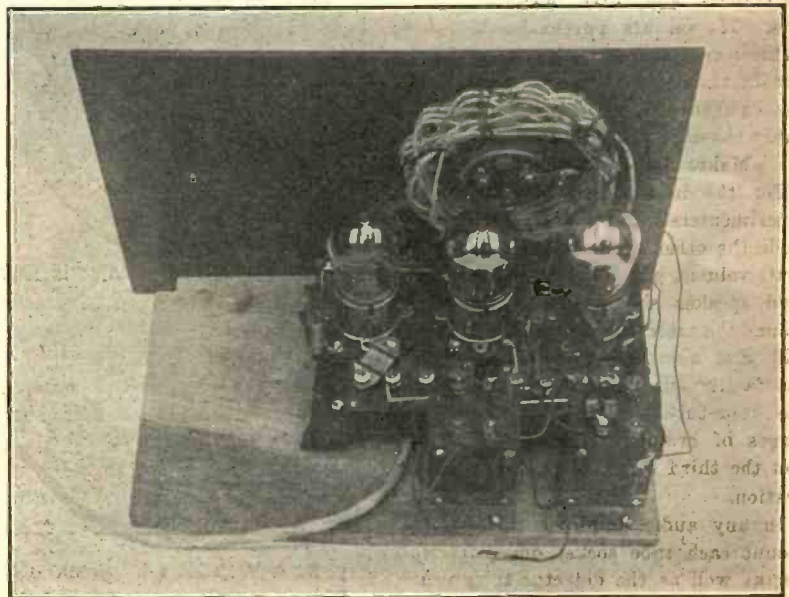


Fig. 8. Exhibit B—A Radio Displaying a Burst of Speed in Building and It Sounds that Way, Too.

A Pioneer Broadcaster Shuts Up

One of the Popular Announcers Has Gone Off the Air

WHEN a friend of yours loses his voice perhaps you recommend that he take Smith Brothers cough drops (Editor's note: we do not sell them). But when a certain voice you have heard for perhaps four or five years is suddenly stricken dumb, it is not always a time for flowers, but for felicitations.

One of the best known speakers in the world became silent, as far as the radio audience is concerned, last month, when Harold W. Arlin, pioneer announcer of the world and chief of Station KDKA, (E. Pittsburg,) since its beginning severed his connection with the station. He left to take a position in the commercial world that required him to end his residence in Pittsburg.

Why Did He Shine?

Mr. Arlin remains with the same company, however, as he has been appointed manager of personnel for the Westinghouse Electric Products Company, at Mansfield, and with his removal to this Ohio city has resigned his position as Chief Announcer of KDKA.

Mr. Arlin was connected with the Westinghouse organization when the company first started broadcasting by establishing the world's pioneer station in 1920, and became its announcer. No one in those days had any very clear idea of the qualifications of such a position, but it quickly became apparent that he had qualities that made him a valuable asset to the station. His virile, resonant voice, exceedingly clear enunciation, his tact in handling people under the peculiar nervous strain of broadcasting, his coolness and good judgment under trying circumstances, his wide knowledge of music, sports and other matters most commonly broadcast, together with the amiable disposition reflected in his voice, soon endeared him to the rapidly growing radio audience.

The hold Mr. Arlin has on the radio audience is evidenced by the thousands of letters he has received from every section of the United States and from nearly every civilized country in the world. These are friendly personal letters, from

people who have never seen him, but who write to him as they would to a warm and highly esteemed personal friend of long standing. "The best known American voice in Europe," the London Times editorially calls him. "Young 'Arry W.," Johannesburg, South Africa, affectionately dubs him. Among the radio fans in Australia, South Africa and the British



Fig. 1. His Silvery Voice is Lost

Isles, especially, his name is almost a household word and his photograph is familiar. In the outside world, as well as among the officials of the company itself, his work as announcer has received commendation.

A List of Notables

Marshall Foch and Lloyd George are among the international celebrities whom Mr. Arlin has introduced to the radio audience. Other notables whose appearance in the air he has announced are Theodore Roosevelt, Jr., Governor Pin-

chot, Fritz Kreisler, Manager "Bill" McKechnie of the world champion Pittsburgh Pirates, Babe Ruth, Hughey Jennings, Lillian Gish, Priscilla Dean, and a host of other stage and movie stars.

Mr. Arlin is one of the incorporators and the first vice-president of the National Association, Radio Announcers of America. He has made addresses before Rotary and Exchange Clubs in various cities, and has appeared as guest announcer from stations in Chicago, New York, Boston, Providence, Rochester, Syracuse and other cities.

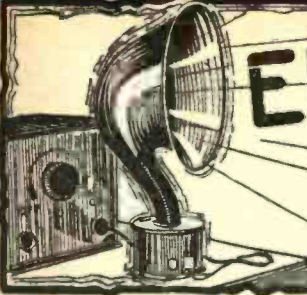
In his new position Mr. Arlin will be in charge of employment, the educational activities, relief, safety and all factors pertaining to the personnel of the Mansfield works, where the Westinghouse household electrical products are manufactured.

They Must Know Everybody

"Radio announcing has been a fascinating thing for me, with its opportunities for studying the character and oddities of people, and its peculiar possibilities for making friends," Mr. Arlin said. "Due to my position as KDKA announcer, I have been able to make friends and acquaintances in numbers exceeded by few people, even politicians, who are supposed to know everybody. I can go into any city and feel that I am among friends, instead of in a strange land, and hosts of people will instantly connect me with the station upon hearing my name.

"One factor that helps to make this true is the fact that the name Arlin is a rather unusual one. Personally I know of no one outside my immediate family who bears that cognomen. Consequently when people hear the name, they constantly associate it with the radio station and as they have heard me announce, my first meeting with them seems more in the nature of a renewal of acquaintance than an introduction."

Mr. Arlin is a native of Missouri and is a graduate of the University of Kansas with the degree of bachelor of science in electrical engineering.



EDITOR'S LOUD SPEAKER

A BIG-SIZED NICKEL

Talk about Florida lands as a scheme for doubling your money—here you have tripled it with every copy of NEW ENGLAND RADIO PROGRESS which you buy. Fans used to think that each issue was worth 15 cents, but now the same thing is obtained for a nickel.

As we mentioned in a previous number, we shall lose money on such a severe price cut unless you get busy and show the magazine to your friends. It is only by increasing our circulation that we can afford to retain the price at such a low figure. If you like this paper (and we hope you do), you will feel that you are doing that fellow across the street a favor if you give him your copy after you are through with it.

A Personal Invitation

We are not asking you to become a subscription agent, but only that you show yourselves friendly to your neighbors by letting them in on this five-cent investment. And to make sure that you and they will like it more and more as time goes on, we extend you a gilt edge invitation to jot down your criticisms and suggestions and address them to the editor.

IS IT YOUR AIR?

If a deep hole is dug on your lot and it makes a clear well of sparkling water, then of course it is yours. That is, you own everything from the surface down. But how about up?

In other words do you own that part or any portion of the ether so that you can send out radio waves? The government says *no*. If anyone wishes to send code messages he must first get a license from the government. Such permission is easy to obtain, however, if the applicant can prove that he is skillful

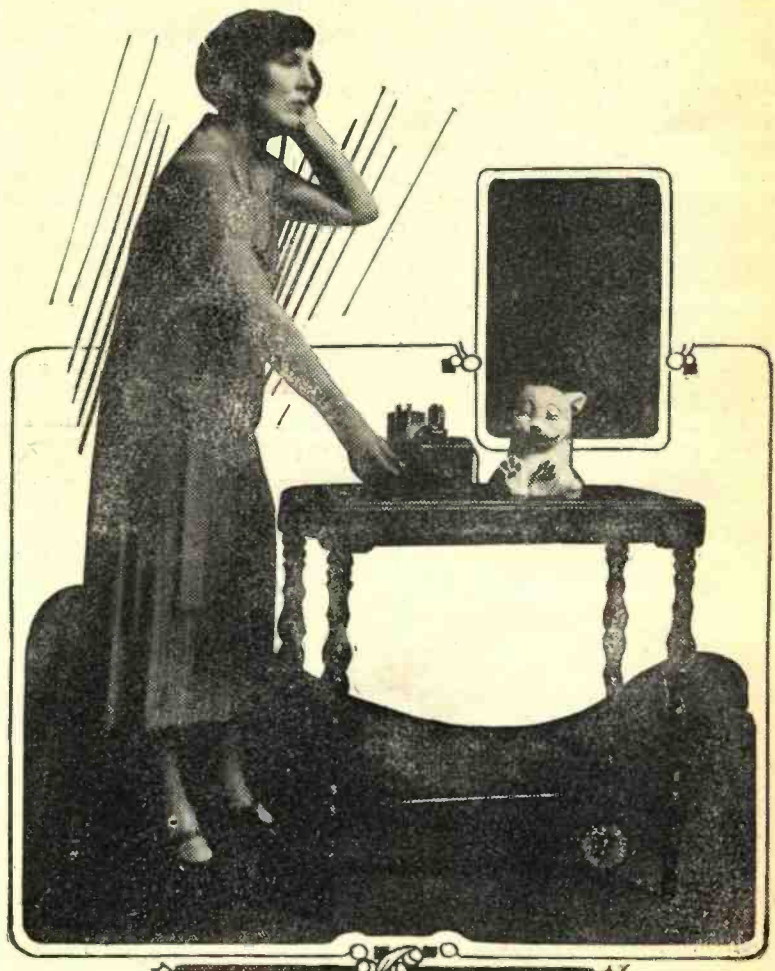
enough in sending and receiving the dots and dashes.

Made it Unanimous

In the same way a person wanting to broadcast must also get a license, but with this difference—it is now almost impossible to obtain. To be sure, this difficulty is caused at present not by law, but by the results of the last radio conference at Washington where Secretary Hoover was almost unanimously supported by the interested

parties in his determination to restrict the further increase in broadcasting stations.

As a result of this situation, although there are nearly 150 applications on file for permission to broadcast, it seems likely that the total of these which are granted will be about 000. It is only when some of the present sending stations decide to go off the air that the Secretary of Commerce will permit new ones to start.



Lady Diana Manners Listens In

No. 1 for Radio

Although, as mentioned, this is not the law it is likely to become so during the present session of Congress. There are several bills which have been introduced to regulate radio. Indeed, House Bill No. 1 is such an attempt at legislation. If it is true that "Aerials show which way the waves go" it seems likely that some laws will be passed limiting the number of stations on the air.

Now that everyone is familiar with this situation it is reported that many of the weaker sisters among the broadcasting stations, who were about to do a fade-out, have taken renewed courage with the idea that perhaps they can sell their wave frequency to some newcomer who wants to broadcast. However, such an idea is all wrong, and we hope that the Department of Commerce will not tolerate it.

Must Not Sell it

A station which has a certain wave assigned to it naturally has some rights in the matter, as it would be unfair suddenly to deprive that station of its wave and so force it to scrap the thousands of dollars worth of equipment which have been bought. But if they decide to give up their wave of their own free will they should not be allowed any right to assign it to anyone else for pay.

We think it is safe to leave this matter in the hands of a man who has shown himself so astute and fair-minded as Secretary Hoover. But you ought to keep in touch with the situation and if any Congressman tries to jam a tricky bill through the legislature it is your cue to write to your representative and tell him what you want done.

PACIFIC PLANS POLITE-NESS

Have you got your radio set well groomed for the International Test Week? Let's hope that it isn't a case of being "all dressed up and no place to go," but that you will be able to reach London before the week is out.

Of course those in Eastern United States have a much better chance in picking up Europe than those in the center of the country. Broadcast listeners on the Pacific Coast have a mighty slim chance of hearing our neighbors across the water. Not only are they twice as far away, but in addition, half the country which the waves must cross consists of land, while Easterners have only a stretch of water to be spanned. And water you will recall is much kinder to broadcast radiations than land is.

The Westerners have realized that they have practically no

chance of picking up these extra-extra-DX waves and so they decided that it would be foolish for them to observe the evening hour of silence every day during the test week. As far as they are concerned their position was undoubtedly well taken. But it was pointed out to them that broadcasting stations running full blast on the coast would spoil the chances of Central United States and would probably dim the opportunities even of the East for hearing London.

Now see what a civilizing effect radio has on its devotees. Instead of taking the natural commercial attitude that they were deciding for themselves without thinking of states hundreds or thousands of miles away, the Pacific Radio Trade Association through its Board of Directors passed a resolution that the organization will co-operate with the rest of the country and observe the quiet hour.

Good for our Pacific Coast friends!

Free Mailing Lists

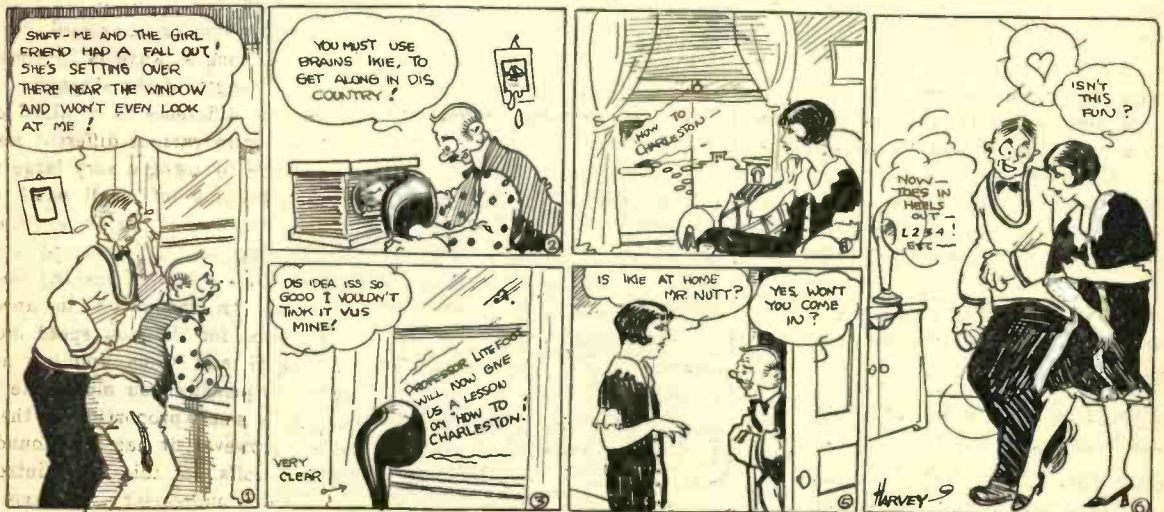
Will help you increase sales and profits on thousands of classified names of your best prospective customers—National, State and Local—Individuals, Professions, Business Organizations.

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IZZY A. NUTT—He Gets at the Heart of the Matter.

By HARVEY



R_X 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. I see a lot about tuning coils which have no external field. What is the objection to the latter?

Answer. The "field" is only another name for the magnetism which the coil makes when a current flows through the wire. If the radio oscillations through any coil in your radio send out magnetic waves in step with the current they will naturally affect other coils and wires in your set. A coil which has no field will not produce this confusing action.

Question. Why is it necessary to have two separate units for supplying current to a radio set when connected to an electric light socket?

Answer. The reason is found in the difference in the kind of service. The filament needs a large amount of current (more than one ampere in most sets) at a low pressure of one to five volts. On the other hand the plate current is only a few hundredths of an ampere but the pressure is 90 volts. Of course this high potential could be cut down to a value low enough to use on the filaments by employing a large resistance. However, this would be a very wasteful and unsatisfactory method of getting the results. The only practical solution is to have one high current source instead of the "A" battery and one high voltage source to replace the "B" battery.

Question. How far ought a three-tube set to reach on a good night?

Answer. This is almost like asking "How far can a dog hear?" It all de-

pends on the loudness of the sound which is being listened for. However, the most that can be promised for any three-tube set for reliable five-day-a-week reception is usually about a thousand miles.

Question. Some loops are built diamond shaped and others in the form of a rectangle. Which one is considered to be the more efficient?

Answer. There is not a great deal of difference in the performance of the two types. According to theory the rectangle is slightly better. However, it is harder to build, and so is often replaced by the diamond shaped needing only two wooden stretchers.

Question. Many concerns are putting out cables with six or seven wires in them for making the outside connections to a radio set. What are the various leads used for?

Answer. The "A" battery requires two connections and the "B" battery three. The latter comprise the negative, plus 22 volts for detector and plus 90 volts for the amplifier. The ground wire makes a sixth lead. Those cables having seven conductors are supposed to carry in the aerial connection on the last one. However, in general this is bad policy as it is much better to separate the lead-in by several inches from all its neighbors. The same is not true of the ground.

If you happen to use a "C" battery (and it is good practice if you are using more than 60 volts of "B") it is not necessary to have outside leads for

this unit. It is so small that you will be able to find room inside the cabinet of any set for the "C."

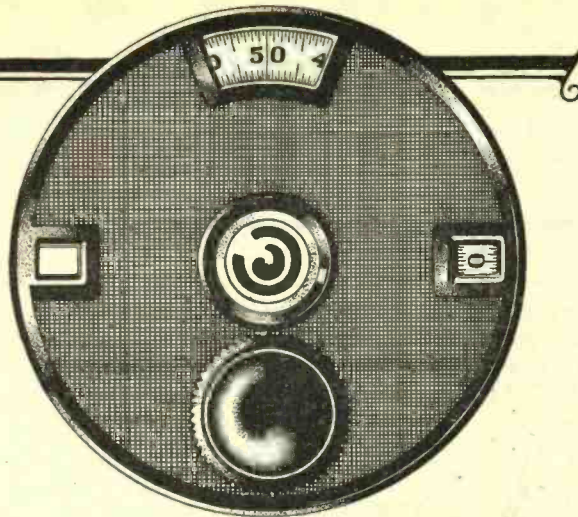
Question. Why are adapters needed to use the new power tubes in practically every style of set?

Answer. The reason is that the UX120 has the new type of long prongs and will not fit in any socket except the UX one designed for it. The adapters are a combination of a base to fit the old style sockets in your set united with a socket which has springs and holes to take the new variety of tubes.

Question. How good are the "Universal" sets which are supposed to cover a very wide band of frequencies (wavelengths)?

Answer. Some of these sets are claimed to have a 20 to 1 range. That is, the high frequency is 20 times as fast as the low or expressed in wave length, the longest wave is 20 times the meter length of the shortest. This tremendous difference is obtained either by plugging in various different sizes of coils or else by using a very large winding and tapping off small parts of it. In the first case there is no objection to changing the coils, except for the slowness and bother of making the substitution. In the latter instance the coils needed for the slow speed must be very large and when running at the higher frequencies you must take a tap off only a small proportion of the total turns. However, it has been found that tapping coils in this way introduces considerable unnecessary resistance.

Jot down the call letters in the handy slots, right on the dial itself. Then, as each station swings in, its letters flash into sight



Searching dial-action — for today's needs

To sweep the air with fine, sure touch—
To feel a swift response from every dial—
This is what it means to change from tuning that "gets by", to tuning that gets the best out of your set.
Dials of ordinary design fail to meet the needs of radio today. Replace them on your set tonight — with MAR-CO dials. These 1926 model tuning controls

Nickel-plate \$2.50
Gold-plate \$3.00
Scales reading either 0-100, or 100-0, as desired.

give the supreme accuracy, the hair-trigger response, you need today. Moulded from flashing black Bakelite, they add distinction to your set. And they can never be guilty of backlash,—patented friction drive prevents it. Go to your dealer today. Have him show you MAR-CO dials. You'll need no further urging. Made by Martin Copeland Company, Providence, R. I.

MAR-CO DIALS

The 1926 model tuning control

In 15 Minutes I Will Give You the Secret of a Perfect Memory

I Guarantee to Increase Your Memory 100% In 10 Days

Not by any abstract, tiresome, difficult-to-master method; not by the old system of association of ideas or thoughts. Not by hard study, rotation exercises or repetition of words or sounds. It is not a book. There is nothing to study—nothing to repeat. It is by far the newest, best simplest method ever devised. I will give you a memory in one week's time that will surprise you. In one month things that occurred 30 days ago will be as fresh and clear in your mind as if they happened yesterday.



My Secret for 30 Years

I have given my secret to thousands. I have used it myself for more than 30 years. It enabled me to rise to my present position as an educator in professional and scientific circles; it gave me a good vocabulary, developed my powers of perception and analysis and fitted me to write on a hundred subjects.

Command Success

My VI-FLECT method of memory-building is for those who are ambitious to improve their business, professional, social or financial condition. VI-FLECT will develop your brain-power—your ability—lift you out of the rut; you will no longer stumble, mumble, nor grope for words with which to express yourself. You will be surprised how easily you can remember names, faces, dates, figures, appointments, duties, etc. It will enhance your importance as an employer, your value as a manager or employee, increase your worth, your ability, expertness, raise your salary, help you in business, professionally, socially, politically—in every way.

Learn My Secret

I prefer to place my secret within the easy reach of everyone. Therefore, the price I am going to ask for VI-FLECT—my wonderful method of memory-building, which I have developed and perfected during my 30 years of constant study and application is ONLY \$5.00. Let nothing stand between you and a successful, happy, prosperous future. If it is not convenient to enclose the money, or if you prefer, I will mail your copy of VI-FLECT and you can hand the small amount to your postman when he delivers the package. The important thing is—SEND NOW.

COUPON

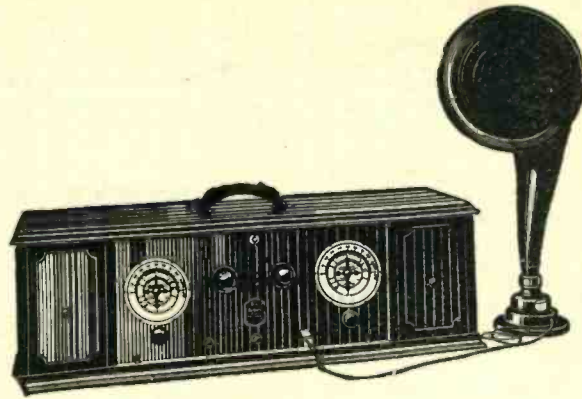
Geo. J. Spinner,
416 S. Dearborn St., MB738
Chicago, Ill.

Dear Sir: Please send me my copy of VI-FLECT for which I enclose \$5.00. I will try your VI-FLECT method of memory-building for 10 days, and if it does not increase my memory 100% I am to return it and you are to give me my money back without argument.

Name

Address

City State



Which is Better—

**A Cheap Set for Cash---or
A GOOD Set ON TERMS** ?

The Good Set is Cheapest in the End

Bay State specializes on the better grade sets, like Radiola, DeForest, Adler Royal, Magnavox, and sells on **Convenient Terms.**

Write for information. Address Dept. A,

BAY STATE RADIO CO.

The House of Radio Service

116A Washington Street

Boston, Mass.

Always Mention New England Radio Progress When Writing to Advertisers.

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. Pittsburgh, Pa.	970-309	var.
KDZB—Frank E. Siefert, Bakersfield, Cal.	1430-210	100
KFAB—Nebraska Buick Auto Co., Lincoln, Neb.	880-341-1000	
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz.	1100-273	100
KFAJ—University of Colorado, Boulder, Colo.	1150-261	100
KFAU—Independent School Dist. of Boise, Boise Idaho.	1060-283	750
KFBK—Kimball Upson Co., Sacramento, Cal.	1210-248	100
KFBL—Leese Brothers, Everett, Wash.	1340-224	100
KFBU—Bishop N. S. Thomas, Laramie, Wyo.	1110-270	500
KFCB—Nielsen Radio Supply Co, Phoenix, Ariz.	1260-238	100
KFCF—Frank A. Moore, Walla Walla, Wash.	1170-256	100
KFDJ—Oregon Agricultural College, Corvallis, Ore.	1060-283	500
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	500
KFGH—Leland Stanford Junior Univ., Stanford Univ., Cal.	1110-270	500
KFI—Earl C. Anthony, Los Angeles, Cal.	640-469-3000	
*KFJF—National Radio Mfg. Co., Oklahoma, Okla.	1150-261	500
KFKU—University of Kansas, Lawrence, Kans.	1090-275	500
*KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb.	1040-288-5000	
KFLR—University of New Mexico, Albuquerque, N. Mex.	1180-254	100
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	750
KFMR—Morningside College, Sioux City, Iowa.	1150-261	100
KFMC—Carleton College, Northfield, Minn.	890-337	500
*KFNF—Henry Field Seed Co., Shenandoah, Iowa.	1140-263	500
KFOA—Rhodes Dept. Store, Seattle, Wash.	660-454-1000	
*KFON—Echophone Radio Shop, Long Beach, Cal.	1290-233	500
KFOO—Latter Day Saints Univ., Salt Lake City, Utah.	1270-236	250
KFOR—David City Tire & Electric Co., David City, Neb.	1330-226	100
KFOX—Technical High School, Omaha, Nebr.	1210-248	100
KFPR—Los Angeles County Forestry, Los Angeles, Cal.	1300-231	500
KFPY—Symons Investment Co., Spokane, Wash.	1130-266	100
*KFOA—The Principia, St. Louis, Mo.	1150-261	100
KFOQ—Searchlight Publishing Co., Fort Worth, Texas.	1140-263	150
*KFQU—W. E. Riker, Alma (Holy City), Calif.	1380-217	100
KFRB—Hall Bros., Beveline, Texas.	1210-248	250
KFRU—Stephens College, Columbia, Mo.	600-500	500
KFSG—Echo Park Evangelistic Asso., Los Angeles, Cal.	1090-275	500
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
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
KFWH—F. Wellington Morse, Jr., Chico, Cal.	1180-254	100
KFWI—Radio Entertainments, Inc., So. San Fran., Cal.	1330-226	500
KFWM—Oakland Educational Society, Oakland, Cal.	1430-207	500
KFWO—Lawrence Mott, Avalon, California.	1420-211	250
KFWU—Louisiana College, Pineville, La.	1260-238	100
KFXB—Bertram O. Heller, Big Bear Lake, Cal.	1480-202	500
KFXF—Pikes Peak Broad. Co., Colorado Springs, Col.	1200-250	500
KFYD—N. Baker, Muscatine, Iowa.	1170-256	250
KGO—General Electric Co., Oakland, Cal.	830-361-3000	
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—Louis Wasmer, Spokane, Wash.	1100-273	500
KJR—Northwest Radio Service Co., Seattle, Wash.	780-384-1000	
KLDS—R. Ch. Jesus Christ, L. D. Sts., Independence, Mo.	680-441-1000	
KLS—Warner Bros. Radio Supplies Co., Oakland, Cal.	1200-252	250
KLX—Tribune Publishing Co., Oakland, Cal.	590-508	500
KLZ—Reynolds Radio Co., Denver, Colo.	1130-266	250
*KMA—May Seed & Nursery Co., Shenandoah, Iowa.	1190-252	500
KMTR—K. M. Turner Radio Corp., Los Angeles, Cal.	1260-238	500
KNRC—Clarence B. Juneau, Los Angeles, Cal.	1440-208	250
KNX—Los Angeles Express, Los Angeles, Cal.	890-337	500
KOA—General Electric Co., Denver, Colo.	930-322-5000	
KOB—New Mexico Col. of Agriculture, State Col., N. Mex.	860-349-1000	
KOCH—Omaha Central H. School, Omaha, Neb.	1160-258	250
KOCW—Oklahoma College for Women, Chickasha, Okla.	1190-252	200
KOIL—Monarch Manufacturing Co., Council Bluffs, Ia.	1080-278	500
KPO—Hale Bros., San Francisco, Cal.	700-428-1000	
KPRC—Houston Printing Co., Houston, Texas.	1010-297	500
KPSN—Pasadena Star-News, Pasadena, Cal.	950-316	1000
KOP—H. B. Read, Portland, Ore.	1410-213	500
KQV—Double-Hill Electric Co., Pittsburg, Pa.	1090-275	500
KQW—First Baptist Church, San Jose, Cal.	1330-231	500
KRE—Berkeley Daily Gazette, Berkeley, Cal.	1170-256	100
KSC—Kansas State Agric. College.	880-341	500
*KSD—Post-Dispatch, St. Louis, Mo.	550-545	500
KSL—The Radio Service Corp., Salt Lake City, Utah.	1000-300	1000

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

KSO—A. A. Berry Seed Co., Clarinda, Iowa.	1240-242	500
KTAB—Tenth Ave. Baptist Church, Oakland, Cal.	900-333-1000	
KTBI—Bible Institute of Los Angeles, Los Angeles, Cal.	1020-294	750
KTCL—American Radio Tel. Co., Inc., Seattle, Wash.	980-310-1000	
KTHS—New Arlington Hotel Co., Hot Springs, Ark.	800-375	500
KTNT—Norman Baker, Muscatine, Iowa.	1170-256	500
*KTW—First Presbyterian Church, Seattle, Wash.	660-454-1000	
KUO—Examiner Printing Co., San Francisco, Cal.	1200-250	150
KUSD—University of South Dakota, Vermillion, S. D.	1080-278	100
KUOM—State Univ. of Montana, Missoula, Mont.	1230-244	250
KUT—University of Texas, Austin, Texas.	1300-231	500
KVOO—Voice of Oklahoma, Bristow, Okla.	1080-275	500
*KWCR—H. F. Paav, Cedar Rapids, Iowa.	1080-278	500
KWKC—Wilson Duncan Studios, Kansas City, Mo.	1270-236	100
*KWKH—W. G. Paterson, Kennonwood, La.	1150-261	500
KWSC—State College of Washington, Pullman, Wash.	860-349	500
KWWG—City of Brownsville, Brownsville, Texas.	1080-278	500
KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill.	560-535-2000	
KZKZ—Electrical Supply Co., Manila, P. I.	1110-270	100
KZM—Preston D. Allen, Oakland, Cal.	1250-240	100
KZRQ—Far Eastern Radio, Manila, P. I.	1350-222	500
KZUY—F. Johnson, Elser, Baguio, P. I.	833-360	500
NAA—United States Navy, Arlington, Va.	690-435	1000
WAFF—Chicago Daily Drovers Journal, Chicago, Ill.	1080-278	200
WAAM—J. R. Nelson Co., Newark, N. J.	1140-263	500
WAAM—Omaha Grain Exchange, Omaha, Neb.	1080-278	500
WABI—First Universalist Church, Bangor, Me.	1250-240	100
WABO—Lake Avenue Baptist Church, Rochester, N. Y.	1080-278	100
WABQ—Haverford College Radio Club, Haverford, Pa.	1150-261	100
WABX—Henry B. Joy, Mount Clemens, Mich.	1220-246	500
WADC—Allen Theatre, Akron, O.	1160-258	500
WAFD—Albert B. Parfet Co., Port Huron, Mich.	1090-275	500
WAHG—A. H. Grebe Co., Richmond Hill, N. Y.	950-316	500
WAIU—American Insurance Union, Cloumbus, O.	1020-294	500
WAMD—Hubbard & Co., Minneapolis, Minn.	1230-244	500
WAPI—Alabama Polytechnic Institute, Auburn, Ala.	1210-248	500
WARC—Am. Rad. & Research Corp., Med'd H'lsde, Mass.	1150-261	100
WBAA—Purdue University, West Lafayette, Ind.	1100-273	250
WBAK—Pennsylvania State Police, Harrisburg, Pa.	1090-275	500
*WBAL—Consolidated Gas, Elec. Lgt. & Pr. Co. Balt., Md.	800-375-1000	
WBAO—James Millikin University, Decatur, Ill.	1110-270	100
WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex.	630-476-1500	
*WBBL—Grace Covenant Church, Richmond, Va.	1310-229	100
WBRR—People's Pulpit Assoc., Rossville, N. Y.	1100-273	500
WBCN—Foster & McDonnell, Chicago, Ill.	1130-266	500
WBNS—Bliss Electrical School, Takoma Park, Md.	1350-222	100
WBNY—Shirley Katz, New York, N. Y.	1430-210	500
WBOQ—A. H. Grebe Co., Richmond Hill, N. Y.	1270-236	100
WBRE—Baltimore Radio Exchange, Baltimore, Md.	1300-231	100
WBT—Charlotte Chamber of Commerce, Charlotte, N. C.	1090-275	250
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass.	900-331-2000	
WBZA—Westinghouse Elec. & Mfg. Co., Boston, Mass.	1240-242	250
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
WCAJ—Nebraska Wesleyan Univ., Univ. Place, Nebr.	1180-254	500
WCAL—St. Olaf College, Northfield, Minn.	890-337	500
WCAO—A. & A. S. Brager, 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	500
WCAU—Durham & Co., Philadelphia, Pa.	1080-278	500
WCAX—University of Vermont, Burlington, Vt.	1200-250	100
WCBD—Wilbur G. Voliva, Zion, Ill.	870-345	5000
WCBQ—First Baptist Church, Nashville, Tenn.	1270-236	100
WCCO—Washburn Crosby Co., Minneapolis, Minn.	720-416	5000
WCCE—Liberty Weekly, Elgin, Ill.	1090-275	1000
WCLS—H. M. Couch, Joliet, Ill.	1400-214	150
WCSS—Congress Square Hotel Co., Portland, Me.	1170-256	500
WCWS—Charles W. Selen, Providence, R. I. (Portable).	1430-210	100
WCX and WJR—The Detroit Free Press and Jewett Radio and Phonograph Co., Pontiac, Mich., (operating jointly).	580-517	2500
WDAD—Dad's Auto Accessories, Inc., Nashville, Tenn.	1330-226	150
WDAE—Tampa Daily News, Tampa, Fla.	1100-273	250
WDAF—Kansas City Star, Kansas City, Mo.	820-366	500
WDAG—J. Laurence Martin, Amarillo, Tex.	1140-263	100
WDBE—Gilham-Schoen Electric Co., Atlanta, Ga.	1110-270	100
WDBK—M. F. Broz Radio Store, Cleveland, O.	1320-227	100
*WDBO—Rollins Garage, Winter Park, Fla.	1250-240	500
WDBR—Tremont Temple Baptist Church, Boston, Mass.	1150-261	100
WDCH—Dartmouth College, Hanover, N. H.	1170-256	100
*WDOD—Chattanooga Radio Co., Inc., Chattanooga, Ill.	1170-256	500
WDWF—Dutee W. Flint, Cranston, R. I.	680-441	500
WEAF—American Tel. & Tel. Co., New York, N. Y.	610-492	5000
WEAI—Cornell University, Ithaca, N. Y.	1180-254	500
WEAM—Borough of North Plainfield, N. Plainfield, N. J.	1150-261	250
WEAN—Shepard Co., Providence, R. I.	1110-270	500
WEAO—Ohio State University, Columbus, Ohio.	1020-294	500
WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio.	770-389	750
WEAU—Davidson Bros. Co., Sioux City, Iowa.	1090-275	100

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ADDRESS

Always Mention New England Radio Progress When Writing to Advertisers.

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

WEBC—Walter C. Bridges, Superior, Wis.....	1240-242- 100
*WEBH—Edgewater Beach Hotel Co., Chicago, Ill.....	810-370-1500
WEBJ—Third Avenue Railway Co., New York, N. Y.....	1100-273- 500
WEBK—Grand Rapids Radio Co., Grand Rapids, Mich.....	1240-242- 100
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
WENR—All-American Radio Corp., Chicago, Ill.....	1130-266-1000
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
WFBJ—Galvin Radio Supply Co., Camden, N. J.....	1270-236- 250
*WFBJ—St. John's University, Collegeville, Minn.....	1270-236- 100
WFBJ—Onodoga 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
WFDL—Frank D. Fallain, Flint, Mich.....	1280-234- 100
WFI—Strawbridge & Clothier, Philadelphia, Pa.....	760-395- 500
WFKB—Francis K. Bridgman, Chicago, Ill.....	1380-217- 500
WFRJ—Robert Morrison Lacey, Brooklyn, N. Y.....	1460-205- 100
WGBB—Harry H. Carman, Freeport, N. Y.....	1230-244- 100
WGBF—Finke Furniture Co., Evansville, Ill.....	1270-236- 100
WGBS—Gimbel Bros., New York.....	950-316- 500
WGBU—Florida Cities Fin. Co., Fulford By-The-Sea, Fla.....	1080-278- 500
WGBX—University of Maine, Orono, Me.....	1190-252- 100
WGCP—D. W. May, Newark, N. J.....	1190-252- 500
WGES—Coynes Electrical School, Oak Park, Ill.....	1200-250- 500
WGHG—Geo. H. Bowles Developments, Clearwater Fla.....	1130-266- 500
WGHP—Geo. H. Phelps, Inc., Detroit, Mich.....	1110-270-1500
WGMU—A.H. Grebe & Co., Inc. (portable), Richmond Hill, N.Y.....	1270-236- 100
WGN—The Tribune, Chicago, Ill.....	810-370-1000
WGR—Federal Telephone Mfg. Corp., Buffalo, N. Y.....	940-319- 750
WGST—Georgia School of Technology, Atlanta, Ga.....	1110-270- 500
WGY—General Electric Co., Schenectady, N. Y.....	790-380-5000
WHA—University of Wisconsin, Madison, Wis.....	560-353- 750
WHAD—Marquette Univ. and Mil. Jour., Mil., Wis.....	1090-275- 500
WHAM—University of Rochester, Rochester, N. Y.....	1080-278- 100
*WHAP—Wm. H. Taylor Finance Corp., New York, N. Y.....	1250-250- 500
WHAR—Seaside Hotel, Atlantic City, N. J.....	1090-275- 500
WHAS—Courier Journal & Louisville Times.....	750-400- 500
WHAT—George W. Young, Minneapolis, Minn.....	1140-263- 500
WHAV—Wilmington Elec. Supply Co., Wilmington, Del.....	1130-266- 100
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y.....	790-380-1000
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—Radio Air Service Corp., Cleveland, O.....	1100-273- 250
WHN—George Schubel, New York, N. Y.....	830-361- 500
WHO—Bankers Life Co., Des Moines, Iowa.....	750-526-5000
*WHT—Radiophone Broadcasting Corporation, Deerfield, Ill.....	1260-238-2500
WIAD—Howard R. Miller, Philadelphia, Pa.....	1200-250- 100
WIAS—Home Electric Co., Burlington, Iowa.....	1180-254- 100
WIBA—The Capital Times Studio, Madison, Wis.....	1270-236- 100
WIBC—L. M. Tate Post No. 39, V.F.W. St. Petersburg, Fla.....	1350-222- 100
WIBO—Nelson Brothers, Chicago, Ill.....	1330-226-1000
WIBW—L. L. Diill, Logansport, Ind.....	1360-220- 100
*WIBX—Grid-Leak, Inc., Utica, N. Y.....	1460-205- 150
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- 200
WJAM—D. M. Perham, Cedar Rapids, Ia.....	1120-268- 100
WJAR—The Outlet Co., Providence, R. I.....	980-306- 500
WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa.....	1090-275- 500
*WJAX—City of Jacksonville, Jacksonville, Fla.....	890-337-1000
WJAZ—Zenith Radio Corp., Mt. Prospect, Ill. (Limited).....	930-322-1500
WJBI—Robert S. Johnson, Red Bank, N. J.....	1370-219- 250
WJBL—Wm. Gushard Dry Goods Co., Decatur, Ill.....	1110-270- 500
WJBQ—Bucknell University, Lewisburg, Pa.....	1420-211- 100
WJJD—Supreme Lodge L. O. Moose, Mooseheart, Ill.....	990-303- 500
WJR—Same as WCX.	
WJY—Radio Corporation of America, New York, N. Y.....	740-405-1000
WJZ—Radio Corporation of America, New York, N. Y.....	660-454-1000
*WKAF—WKAF Broadcasting Co., Milwaukee, Wis.....	1150-261- 500
WKAQ—Radio Corporation of Porto Rico, San Juan, P. R.....	880-341- 500
WKAR—Michigan Agric. Col., E. Lansing, Mich.....	1050-286-1000
WKBB—Sanders Bros., Joliet, Ill.....	1400-214- 100
WKBE—K. and B. Electric Co., Webster, Mass.....	1300-231- 100
WKBG—C. L. Carrell (portable), Chicago, Ill.....	1390-216- 100
WKBK—Shirley Katz, New York, N. Y.....	1430-210- 500
WKRC—Kodel Radio Corp., Cincinnati, O.....	710-422-1000
WKRC—Kodel Radio Corp., Cincinnati, O.....	920-353-1000
WKY—E. C. Hull and H. S. Richards, Oklahoma, Okla.....	1090-275- 100

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

*WLAL—First Christian Church, Tulsa, Okla.....	1200-250- 100
WLBL—Wisconsin Dept. of Markets, Stevens Point, Wis.....	1080-278- 500
WLIB—Liberty Weekly, Elgin, Ill.....	990-302-2500
WLIT—Lit Bros., Philadelphia, Pa.....	760-395- 500
WLS—Sears, Roebuck Co., Chicago, Ill.....	870-345-1500
WLSI—Lincoln Studios, Inc., Providence, R. I.....	680-441- 500
WLTS—Lane Technical High School, Chicago, Ill.....	1160-258- 100
WLW—Crosley Radio Corp., Harrison, O.....	710-422 } 500 15000
*WLWL—Mis. Soc. of St. Paul the Apostle, New York.....	1040-288-1500
WMAF—Round Hills Radio Corp., Dartmouth, Mass.....	680-441-1000
WMAK—Norton Laboratories, Lockport, N. Y.....	1130-466- 500
WMAQ—Chicago Daily News, Chicago, Ill.....	670-448- 500
WMAZ—Mercer University, Macon, Ga.....	1150-261- 500
WMBB—American Bond & Mortgage Co., Chicago, Ill.....	1200-250- 500
WMBG—Michigan Broadcasting Co., Detroit, Mich.....	1170-256- 100
WMBF—Fleetwood Hotel, Miami Beach, Fla.....	780-384- 500
WMC—Commercial Appeal, Memphis, Tenn.....	600-500- 500
WMCA—Greeley Square Hotel Co., Hoboken, N. J.....	880-341- 500
WNBAB—Shepard Stores, Boston, Mass.....	1210-248- 250
WNBAC—Shepard Stores, Boston, Mass.....	1070-280- 500
WNAD—University of Oklahoma, Norman, Okla.....	1180-254- 250
WNAP—Wittenberg College, Springfield, Ohio.....	1090-275- 100
WNAT—Lennig Bros. Co., Philadelphia, Pa.....	1200-250- 500
WNBH—New Bedford Hotel, New Bedford, Mass.....	1210-248- 250
*WNJ—Radio Shop of Newark, Newark, N. J.....	1290-233- 150
WNOX—People's Tel. & Tel. Co., Knoxville, Tenn.....	1120-268- 500
WNYC—City of New York, New York, N. Y.....	1190-233- 100
WOAI—Southern Equipment Co., San Antonio, Texas.....	760-395-2000
WOAN—James D. Vaughn, Lawrenceburg, Tenn.....	1060-283- 500
WOAW—Woodmen of the World, Omaha, Nebr.....	570-526-1000
WOAX—Franklyn J. Wolff, Trenton, N. J.....	1250-240- 500
WOC—Palmer School of Chiropractic, Davenport, Iowa.....	620-484-5000
WODA—O'Dea Temple of Music, Paterson, N. J.....	1340-224- 250
WOL—Iowa State College, Ames, Iowa.....	1110-270- 750
WOK—Newtrowound Radio Mfg. Co., Homewood, Ill.....	1380-217-5000
WOO—John Wanamaker, Philadelphia, Pa.....	590-508- 500
WOQ—Unity School of Christianity, Kansas City, Mo.....	1080-278-1000
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
WOWO—Main Auto Supply Co., Fort Wayne, Ind.....	1320-227- 500
WPCG—North Shore Congregational Church, Chicago, Ill.....	1160-258- 500
WPG—Municipality of Atlantic City, Atlantic City, N. J.....	1000-300- 500
WPRC—Wilson Printing & Radio Co., Harrisburg, Pa.....	1390-216- 100
WPSC—Pennsylvania State College, State College, Pa.....	1150-261- 500
WQAA—Horace A. Beale, Jr., Parkersburg, Pa.....	1360-220- 500
WQAM—Electrical Equipment Co., Miami, Fla.....	1140-263- 100
WQAN—Scranton Times, Scranton, Pa.....	1200-250- 100
WQAO—Calvary Baptist Church, New York, N. Y.....	833-360- 100
WRAC—Economy Light Co., Escanaba, Mich.....	1170-256- 100
WRAM—Lombard College, Galesburg, Ill.....	1230-244- 100
WRAX—Flexon's Garage, Gloucester City, N. J.....	1120-268- 500
WRC—Radio Corporation of America, Washington, D. C.....	640-469-1000
WRCO—Wynne, Radio Co., Raleigh, N. C.....	1190-252- 500
WREO—Reo Motor Car Co., Lansing, Mich.....	1050-286- 500
WRM—University of Illinois, Urbana, Ill.....	1100-273- 500
WRMU—A. H. Grebe & Co., Richmond Hill, N. Y.....	1270-236- 100
WRNY—Experimenter Publishing Co., New York, N. Y.....	1160-258- 500
*WRR—Dallas Police & Fire Dept., Dallas, Tex.....	1220-246- 500
WRST—Radiotel Mfg. Co., Bay Shore, N. Y.....	1390-216- 250
WRVA—Larus & Brother Co., Inc., Richmond, Va.....	1170-256-1000
WRW—Tarrytown Radio Research Labs., Tarrytown, N. Y.....	1100-273- 500
WSAI—United States Playing Card Co., Mason, O.....	920-326-2500
WSAJ—Grove City College, Grove City, Pa.....	1310-229- 250
WSAN—Allentown Call Publishing Co., Allentown, Pa.....	1310-229- 100
WSAR—Doughty & Welch Electric Co., Fall River, Mass.....	1180-254- 100
WSAX—Zenith Radio Corp., Chicago, Ill.....	1120-268- 100
WSB—Atlanta Journal, Atlanta, Ga.....	700-428-1000
WSBC—World Battery Co., Chicago, Ill.....	1430-210- 500
WSBF—Stix, Baer & Fuller, St. Louis, Mo.....	1100-273- 250
WSBT—South Bend Tribune, South Bend, Ind.....	1090-275- 250
WSDA—The City Temple, New York, N. Y.....	1140-263- 250
WSKC—World's Star Knitting Co., Bay City Mich.....	1150-261- 100
WSMB—Saenger A'm'h Co. & Maison Blanche N. O. La.....	940-319- 500
WSM—Nat'l Life & Accident Ins. Co., Nashville, Tenn.....	1060-283-1000
WSMK—S. M. K. Radio Corp., Dayton, Ohio.....	1090-275- 500
WSOE—School of Eng'ring of Milwaukee, Milwaukee, Wis.....	1220-246- 500
WSRO—Radio Co., Hamilton, Ohio.....	1190-252- 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.....	1120-268- 100
WTAG—Worcester Telegram Pub. Co., Worcester, Mass.....	1120-268- 500
WTAM—Willard Storage Battery Co., Cleveland O.....	770-389-3500
WTAR—Reliance Electric Co., Norfolk, Va.....	1150-261- 100
WTAW—Agri. & Mech. Col. of Texas, Col. Station, Tex.....	1110-270- 500
WTIC—Travelers Insurance Co., Hartford, Conn.....	860-349- 500
WWAD—Wright & Wright, Philadelphia, Pa.....	1200-250- 250
WWGL—Radio Engineering Corp., Richmond Hill, N. Y.....	1410-213- 500
WWI—Ford Motor Co., Dearborn, Mich.....	1130-260- 500
WWJ—Detroit News, Detroit, Mich.....	850-353-1000
WWL—Loyala University, New Orleans, La.....	1090-275- 100

*Additions and corrections.

†Wave Length Temporarily Assigned.