December 15, 1925
15 Cents a Copy

RADIO PROGRESS

Reg. U. S. Pat. Off.

"Always Abreast of the Times"

IN THIS ISSUE:

YOU WILL UNDERSTAND THIS MAGAZINE — AND WILL LIKE IT

A New England Publication

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 2 Number 19

Contents for

DECEMBER 15, 1925

New York Representative

SHELDON C. KNIFFIN............503 Fifth Avenue, New York—Phone Murray Hill 3149

Western Representative

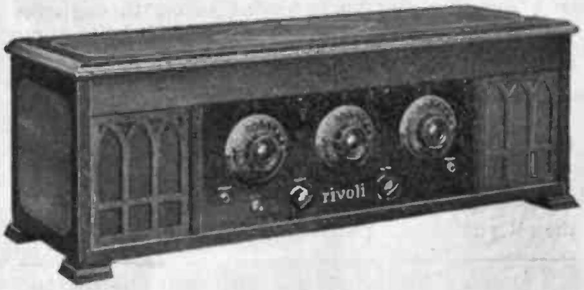
W. T. DIEHL.....................30 North Dearborn Street, Chicago—Phone Central 5410

RADIO PROGRESS is issued on the 1st and 15th of each month by the Oxford Press at 8 Temple Street, Providence, Rhode Island. John F. O'Hara, Publisher. Yearly subscription in U. S. A., $3.00. Outside U. S. A., $3.50. Single copies, 15 cents. Entered as second-class matter, April 4, 1924, at the Post Office at Providence, R. I., under the Act of March 3, 1879. Address all communications to RADIO PROGRESS, 8 Temple Street (P. O. Box 728), Providence. R. I. Title registered at United States Patent Office.

rivoli

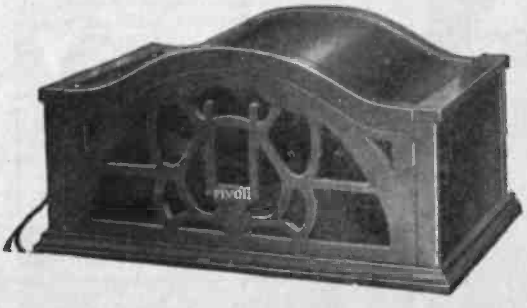
"ALWAYS GOOD COMPANY"

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 grills. **$75.00**

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 its surroundings. **$30.00**

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

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

Cold Questions

Which a Radio Manufacturer or his Advertising Agency should ask the publisher of a Radio Magazine.

If 80 per cent. of the answers are satisfactory and true, it will pay that manufacturer to advertise in that magazine

Here are the ANSWERS which NEW ENGLAND RADIO PROGRESS gives:

AND 100 PER CENT. OF OUR ANSWERS ARE TRUE!

How old is it? Two years next March.

What is there about its circulation distinctive or superior to other magazines? It is concentrated in the six New England States, and being "New England's Own Radio Magazine," the readers feel almost an affection for it. Thus, the reader-interest is unusually high.

What is the experience and education of the Editor? His literary and writing experience was acquired at Yale. His technical training came from Massachusetts Institute of Technology, of which he is also a graduate. The Research Laboratory of the Westinghouse Company gave him the practical experience in testing and engineering work which a radio editor needs. While there he was one of the two men who in 1913 first started all radio work of the Westinghouse Company.

What is the subscription price? 5c each; $1.00 a year.

Do you give a premium to subscribers? No.

How often issued? Twice a month.

What advantage is that as compared with a monthly publication? Changes and advances are being made in radio too rapidly to be covered in a monthly. Readers demand such news and descriptions while they are fresh and new.

How do you get circulation? Through radio dealers in New England, who sell yearly subscriptions,—and from news-stand sales.

How much circulation is outside New England? About 10%.

Who is the publisher? The Oxford Press, John F. O'Hara, Proprietor.

Is it connected with any society or association, or the organ of any? No.

Who reads it? Broadcast listeners or "fans."

What distinguishes its reading matter from other magazines? It is written so that anyone may understand it. It is so easy to read, so plainly written, that even the technical terms are clear, and the reader knows exactly what is meant.

How does the advertising rate compare with others? Compared with nine other leading radio magazines, NEW ENGLAND RADIO PROGRESS has a lower rate per page for each one thousand of circulation than six have. It is higher than one, and the same as the other two.

How do you prove circulation? By open books or sworn statement.

Do you guarantee the claimed circulation? Yes, and give a pro rata refund of the advertising rate should there be less than the rate is based on.

How much circulation? 40,000 net paid on all issues after January 1st, 1926.

Why don't you publish more pages of reading matter? Questionnaires to our readers prove that we give them all they want and all they have time to read. "Too much to read" is the kick now-a-days. There is a great waste in this on the part of publishers in this age, and it has to be paid for by the high advertising rates many have to charge.

Do you give write-ups of the products of your advertisers? When there is a news value.

Has NEW ENGLAND RADIO PROGRESS any dealer influence? Yes, a great deal.

Why? Because they sell yearly subscriptions for us and are every day handling our magazine, showing it to prospective subscribers, etc.

Double Barreled Advertising

is what you get in NEW ENGLAND RADIO PROGRESS. The only consumer magazine with a TIE-UP to the dealers in New England, who are our Subscription Agents.

This dealer influence and circulation which you surely get is of great value, yet costs you nothing extra.

NEW ENGLAND RADIO PROGRESS ADVERTISING RATES

Effective January 1, 1926,
and for Six Months Only

Per Issue	1 Time	4 Times	12 Times
Full Page	$120.00	$110.00	$100.00
Half Page	60.00	55.00	50.00
Quarter Page	35.00	30.00	27.50
Small space, agate line	.40	.35	.32
Back Cover, 2 colors	200.00	200.00	175.00
Inside Front Cover, 2 colors	150.00	135.00	125.00
Inside Back Cover, 2 colors	150.00	135.00	125.00

Issued on the 1st and 15th of every month. Forms close 10 days earlier.

See Standard Rate and Data Book for further data.

ANNOUNCEMENT

To Radio Advertisers Everywhere and Radio Dealers in New England

A New Policy—Another Progressive Step

A Radical Change to Meet the Demand of These Galloping Radio Times, Giving Advertisers a Concentrated, Controlled, Specialized Circulation of

40,000 Paid Subscribers in NEW ENGLAND

WITH A TIE-UP

With New England Radio Dealers who are the Subscription Agents for NEW ENGLAND RADIO PROGRESS

The Price has been Reduced from 15c. to 5c. a copy and from $3.00 to $1.00 a year

EFFECTIVE WITH THIS ISSUE

The addition of "New England" to the title and the concentration of the circulation to the New England States—the most fertile, easiest sold, most economical distribution territory in the world—will give advertisers wonderful results.

Our Page Rate Per Thousand Circulation is Very Low Compared with Other Leading Radio Magazines

And We GUARANTEE the Circulation

Don't Scatter Your Sales Efforts. Get Distribution and Sales Volume in New England FIRST. People and Places Are Close Together Here.

The One They All Like!

New England Radio Progress

COR. TEMPLE AND PUBLIC STS., PROVIDENCE, R. I.

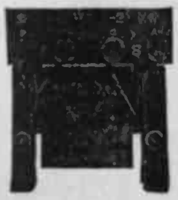
Established March, 1924, as Radio Progress

The Two Outstanding Parts In Radio !

Give Low Losses and Amplification Without Distortion to Any Set

QUALITY and distance are what a radio set must give. To insure Quality, amplification without distortion is essential. And to insure Distance, low losses are essential. That is radio in a nutshell.

People in whose sets Acme Transformers are used, are sure of hearing concerts "loud and clear" so a whole roomful of people can enjoy them.



Acme A-2 Audio Frequency Amplifying Transformer

The Acme A-2 Audio Amplifying Transformer is the part that gives quality. It is the result of 5 years of research and experimenting. It gives amplification without distortion to any set. Whether you have a neutrodyne, super-heterodyne, regenerative or reflex, the addition of the Acme A-2 will make it better.

To get the thrill of hearing distant stations loud and clear, your set must have low losses, for it is low losses that give sharp tuning to cut through the locals, and it is low losses that allow the little energy in your antenna to come to the ampifier undiminished. That's what the Acme condenser will do for any set. And it will do it for years, because the ends can't warp, the bearings can't stick and the dust can't get in and drive up the losses several hundred per cent.

The Acme Reflex (trade mark) owes its success and its continued popularity to these two outstanding parts in the radio industry, for low losses and amplification go hand in hand.

Use these two parts in the set you build. Insist on them in the set you buy.

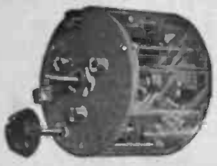
Send 10 cents for 40-page book, "Amplification without Distortion"

WE HAVE prepared a 40-page book called "Amplification without Distortion." It contains 19 valuable wiring diagrams. In clear non-technical language it discusses such subjects as Radio Essentials and Set-building; How to make a loop; Audio frequency amplifying apparatus and circuits; Instructions for constructing and operating Reflex amplifiers; How to operate Reflex receivers; Antenna tuning circuits for Reflex sets; "D" Coil added to Acme four tube reflex; "D" coil tuned R. F. and Reflex diagrams; and several more besides. It will help you build a set or make your present set better. Send us 10 cents with coupon below and we will mail you a copy at once.

ACME APPARATUS COMPANY

Transformer and Radio Engineers and Manufacturers

DEPT. (AS), CAMBRIDGE, MASS.



Acme Low-Loss Condenser

SEND THIS COUPON

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

Gentlemen:—

I am enclosing 10 cents (U. S. stamps or coin) for a copy of your book "Amplification without Distortion."

Name ....

Street ....

City .... State ....

ACME ~ *for amplification*

RADIO PROGRESS
"ALWAYS ABREAST OF THE TIMES"
Vol. 2, No. 19 DECEMBER 15, 1925 15c Per Copy, $3.00 Per Year

Fast And Slow Radio Waves

How They Differ and Which is Better for Broadcasting

By HORACE V. S. TAYLOR

If you say that a woman is "fast," you mean one thing. But if a postage stamp sticks fast, it is quite another. So this word has several different meanings. When you hear about a fast radio wave you may naturally conclude that it will arrive at its destination before a slow one. However, that is wrong. The fast wave does not get there a fraction of an instant before a slow one. What is the difference then between these two?

Do You Live Near River?

It all gets down to vibration and the speed at which the waves follow one another. Anyone who has lived near the water is quite familiar with waves. We know that when there is a strong wind blowing, the billows race across the surface of the water quite rapidly, whereas a gentle breeze will cause the ripples to travel at a rather slow rate. This illustrates very well the difference between vibration speed and the velocity of travel or "propagation," as it is called.

The high wind causes a high velocity of motion. If you are in a sail boat and are running before the wind, you may get on the forward slope of a big billow, which will carry you for several hundred feet at racing speed. The ripples on the other hand move lazily to the shore at maybe only one mile an hour. But now consider the spacing of the hills and valleys. The distance from crest to crest on the billows is so great that it takes several seconds for one wave to pass, even though it is traveling at fifteen or twenty miles an hour. The ripples, however, are spaced so close together that you may get two per second dancing by although as already mentioned, they could never be held up for speeding.

Racing to Boston

All radio waves travel through space at the uniform rate of 186,000 miles per second. This would mean they travel around the earth at the equator seven times in the tick of a clock and still have a good many thousand miles left over to find their way home. This is entirely independent of how fast they vibrate. Thus in Fig. 1 we have two sending stations in New York—WEAF, which oscillates 610,000 (610 kc) in a second (492 meters), and WGBS, which shakes up and down half as fast again, i. e., 950,000 vibrations (316 meters). Which one of these waves will reach a listener in Boston first? As a matter of fact, they will get there at the exact same instant.

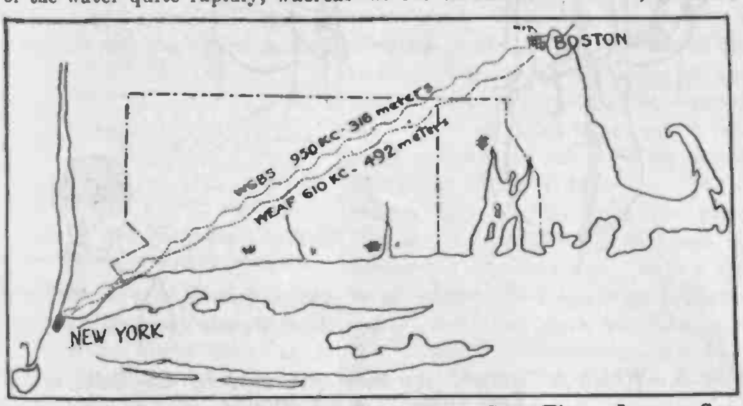


Fig. 1. In the Race to Boston the Slow Wave Gets There Just as Soon as the Fast One

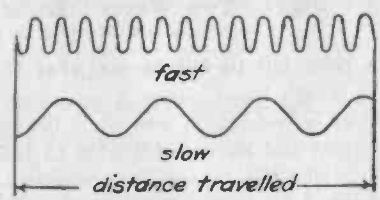


Fig. 2. The Time for These Vibrations is Zero—Nearly

To see how this works out, let us look at Fig. 2. Suppose that the waves travel the distance shown in a fraction of a second. Since the space illustrated is only about two inches, you will see that the fraction if written out would have enough zeros in it to fill up this page pretty full, so for that reason I will not attempt to write it out. We have two waves, a fast and a slow one, which both cover this small distance in the same infinitesimal fraction of a second.

An Imaginary Foot Rule

The upper one is able to get in quite a number of oscillations in this time, while the lower one is doing only a few. You can see from this diagram why a fast vibration is called a "short wave length." In the picture the distance between one crest and the next is short, while with the slow vibration the spacing is considerably longer. However, it is much easier for most people to think in terms of oscillations per second which is something that actually exists and may be timed rather than to imagine a picture of the waves drawn to scale, and then put a yard stick or rather a meter rule from hill to hill to see what the wave length is.

That is one reason why it is becoming more and more fashionable to talk about vibration speeds or frequencies rather than wave lengths. Another reason for this change is that the Government has assigned all the waves with equal spacing of 10 kc. rather than even and regular wave separation. For instance, turn to the back of RADIO PROGRESS and look down the columns of kc. and meters. The first always ends in an even 10 kc. while the meters jump all over the lot. Really it is even worse than it looks since the meters should not end in whole numbers but in decimal places carried one or two figures. However, to make it easier to remember, our column has dropped off the decimal point and gives you just the nearest whole number.

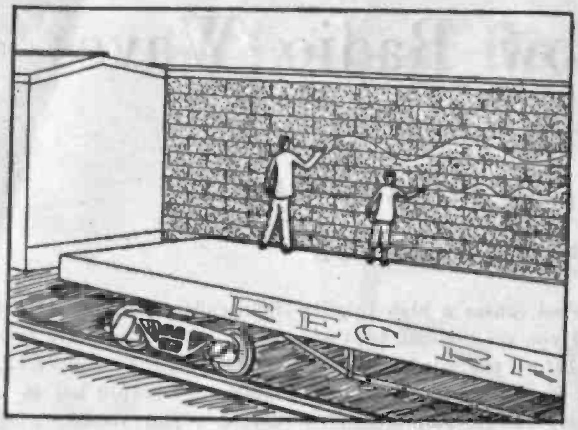


Fig. 3. Two Waves Starting From Moving Freight Car, But Vibrating at Different Speeds

Chalking the Brick Wall

How does it happen that the various waves have different frequencies but the same speed of propagation? A glance at Fig. 3 will make this clearer. Suppose we have a boy and a young man traveling along on a flat freight car. This is made up in a train of cars which is moving along towards the left. As they come to a brick wall just beside the track they each decide to mark on it with chalk.

The boy is a lively youngster and waves his arm up and down pretty fast. The man, however, is perhaps a little lazy and lets his hand rise and fall at a much slower rate. Now remember they are both on the same freight car traveling from New York to Boston just as our radio waves were in Fig. 1. For that reason they must be traveling along at the same rate (propagation).

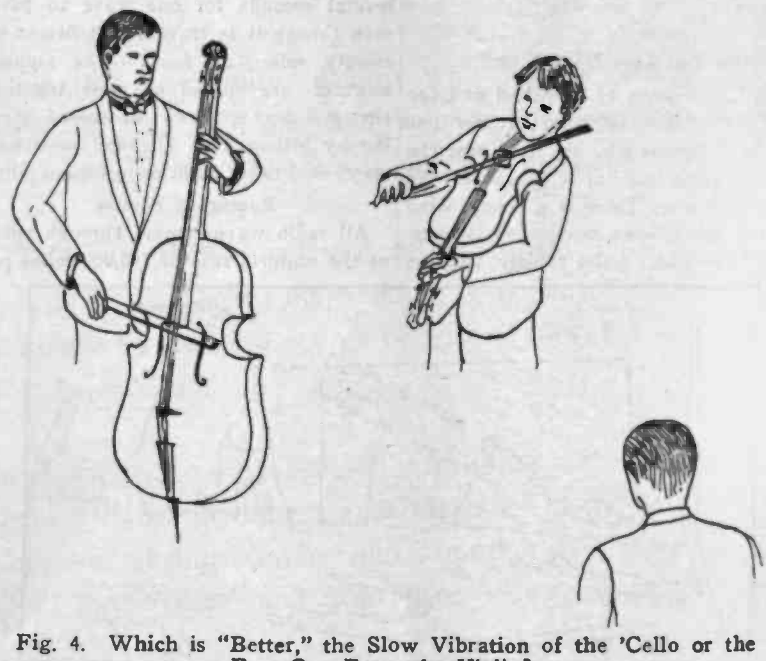


Fig. 4. Which is "Better," the Slow Vibration of the 'Cello or the Fast One From the Violin?

But look at the waves which their chalk makes. The upper curve has a slow speed of vibration since the man was "oscillating" slowly. The boy, however, had a fast vibration and so he is putting out a fast wave. And yet all the time, as already explained, they are moving along at the same speed. If you will keep this freight car experiment in mind, you will always remember the difference between these two styles of waves.

Is C or G Better?

Now the question arises as to which frequency is better. We might ask the same thing in regard to music. The various notes which we hear when a concert is being played are all the manifestations of vibrations of the air. A low note as you will remember is caused by a slow oscillation, whereas a fast one gives out a high pitch. Now the question is, which is better, a C or G on your piano? Of course, there is no real meaning to this question.

If the orchestra is playing in the key of C, then anyone who tried to "tune in" on another key would spoil the harmony. In the same way, if your radio is adjusted for say 1,000 kc. (300 meters) the best wave for you at the instant is naturally 1000 kc. But if you change your dials so that you are now regulated for 900 kc., then that is the wave which you will pick up best. In the same way a good pianist can play the "melody in F" by transposing to the key of G, if he likes and it will sound just as well to your ear.

Too High for Your Ears

Let us go a step farther. Suppose (Fig. 4) a violin and a 'cello are playing a duet. The listener down in front hears them both at the same instant since the sound waves, although at different pitch travel alike. They both are equally good as far as affecting his ears, even if he does prefer the music of one rather than the other. But if the violinist plays way up the scale he may reach a pitch which is so high that it no longer sounds like a pleasant tone, but becomes a squeak. In other words, he is getting outside the range of your ears.

In the same way, although radio waves are equally satisfactory for broadcasting purposes over quite a band of frequencies, still if the vibration is too high or too low, there are various troubles which show up. The normal band of wave speeds at the present time lies between 1500 kc. (200 meters) and 550 kc. (545 meters). However, these points are not at all sharply defined. For instance, Station KDKA at East Pittsburg has been using an extra frequency around 3000 kc. for a long time and has had very good results with it. Station WGY, Schenectady, has been trying speeds as high as 7500 kc. (40 meters) and reports great satisfaction.

Watch in Machine Shop

The chief trouble with such high speed vibrations is the difficulty of constructing radio sets which will tune to them. The coils and condensers in such

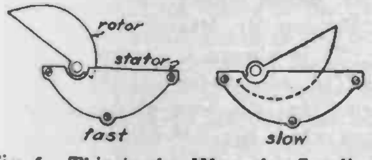


Fig. 5. This is the Way the Sending Station Gets the Right Wave

receivers must be so very small that they are hard to adjust properly and are much affected by outside conditions. It is just as if you tried to build a watch in an ordinary machine shop. The very slow waves go to just the other extreme and require unduly large sizes of coils and condensers.

Getting back to Fig. 1, how does it happen that WEAF chose the slow wave of 610 kc. while WGBS selected the much faster 950 kc. vibration? As a matter of fact, they didn't. The Government through the Department of Commerce at Washington is responsible for the assignment of the different waves and the individual stations have no choice in the matter. Some years ago when broadcasting first started, there were only two different waves allowed,—833 kc. (360 meters) and 750 kc. (400 meters). After a short time so many stations were transmitting on these two frequencies that there was terrible interference and the Department of Commerce reassigned waves as the fancy struck them. As already explained, there was no reason at all why they should have tried to work out any other plan.

Must Divide the Time

Recently in allocating waves to the more powerful stations they have done so with an eye to conflicts in frequency between adjacent sending stations. Thus if an Eastern broadcaster has a certain wave there will not be another sender in the East who will be given the same one. However, a Western station 2000 or 3000 miles away may operate at the same frequency without interference. Of course, in a few cases in the East two stations may both have the same assignment, yet they will not interfere as they are required to divide the time between them.

Let us assume now that Secretary Hoover has given a broadcaster a certain wave speed. How will the station be designed to fit it? The method of controlling it is exactly the same as that used in your own radio. The commonest way of adjusting is to have a variable condenser in the radiating circuit. When the rotor is turned so that it meshes only slightly with the stator (Fig. 5) the capacity will be small and the rate of vibration high. With a slow speed station the rotor must be turned pretty well into mesh and this gives the increased condenser capacity which is needed to slow the vibration down to the required figure.

May Take Their Choice

Another way of attaining the same results is by changing the coil which connects with the aerial. A small coil (Fig. 6) gives the same results as a small condenser—a high speed vibration or short wave length. When the adjustment is changed to include the whole winding the oscillation is reduced just as if the condenser had been all turned in. The sending stations have their choice of either of these two methods as long as they stick to the wave which the Government has given them.

In this series of articles it is wished

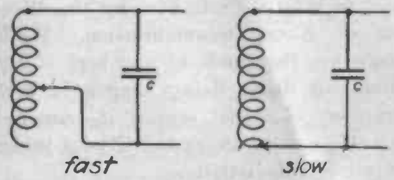


Fig. 6. Here is Another Method of Tuning the Sending Aerial

that the subjects may be the ones which fans are most interested in. If you have any question which you would like discussed, please write it out on a postal and mail it to the Editor.

THE VOICE WITH THE SMILE

Already letters are being received by the Correspondence Department of WEAF making inquiry as to the identity of the new announcer for the morning programs broadcast from WEAF, notwithstanding the fact that she was on the air for the first time only quite recently.

This new announcer is none other than Miss "Betty" Lutz, the charming hostess of WEAF, whose grace and courtesy have characterized her presiding over the affairs of WEAF's Reception Room and have endeared her alike to the studio staff, the broadcasting artists and the many studio visitors. To say that she has gained thousands of freinds during her two years' service as hostess would be but faint praise indeed. Her morning announcements through WEAF are the result of the thousands of comments concerning her admirable personality which indicates that such a quality has become too valuable to confine to the studio with its limited opportunity to become acquainted with WEAF's radio audience.

Because her new duties as announcer will be confined to the morning hours, she will continue to act in her capacity as hostess, thus holding her in the position in which she has achieved such popular success.

American Radio Relay League

WINS TITLE OF LEADER

The influence of the transmitting radio amateur upon the welfare of the Army and Navy is well illustrated in the recent citation of naval reserve signal unit in Winter Park, Fla., by the director of Naval communication. While there are thousands of members of the American Radio Relay League in both branches of signal service it remained for this unit to annex the title of leader of all Naval districts.

There are seven officers and forty-five men in this division, all serving under command of Lieutenant William J. Lee, U. S. R. F. The unit is part of the Seventh Naval District but carries on its work with radio station NKF, the naval headquarters station at Bellevue, D. C.

Transmitting radio amateurs make up more than half of the unit. Thirty of the fifty-two members of the command are members of the American Radio Relay League and are owners and operators of amateur transmitting apparatus.

SCHNELL GETS A RAISE

Once more the Navy Department has expressed its appreciation of the accomplishments of Lieutenant F. H. Schnell, Traffic Manager of the American Radio Relay League, who spent seven months in operating experimental short wave radio station NRRL with the fleet on its Pacific cruise. Admiral E. W. Eberle, chief of naval operations, has extended his thanks and at the same time announced that Lieutenant Schnell has been recommended for promotion to the grade of Lieutenant Commander in the Naval Reserve Force.

It is understood in naval circles that the navy expects to make changes in its methods of radio which will place a larger amount of high speed (short) wave equipment in active duty. These changes will be based upon the observations made by Lieutenant Schnell Admiral Eberle's letter of congratulation follows:

"My dear Lieutenant Schnell:

"On the occasion of your release from active duty in the Navy, I wish to extend to you the thanks of the Navy Department for your extremely valuable services in connection with high frequency radio communication in the fleet.

"It is considered that largely through your efforts, this is now a part of the Navy method. It is difficult to estimate the benefits to the Navy which will be derived through use of high frequencies, which use you have so ably furthered on your recent cruise with the Fleet to Australia.

"As an indication of the Department's keen appreciation of your services, I take pleasure in informing you that you have been recommended this day for promotion to the rank of Lieutenant Commander in the Naval Reserve.

"Very sincerely,
"(Signed), E. W. EBERLE,
"Admiral, U. S. Navy,
"Chief of Naval Operations."

MAKING GOOD OPERATORS BETTER

The American Radio Relay League has been designated as the organization to represent the American transmitting radio amateur in the forthcoming army-amateur radio communication nets throughout the country. This move follows the general staff approval of the plan which eventually is to provide an amateur radio station for each unit of the National Guard.

Where divisional boundaries of the League and Army Corps Area lines happen to coincide, the Division Manager of the League will act as directing head of amateur activities. In other sections a special liasion agent has been named, whose duty it will be to supervise the assistant divisional managers who have charge of each state.

This method of dividing the work, placing it in the hands of men intimately in touch with the local problems of each corps area, is being followed by the Army and by the League so that closer attention may be given to the multitude of details that are bound to crop out in the successful operation of such a scheme.

When Wires Are Knocked Out

To the Army the successful use of the plan means the upbuilding of a vast reserve of potential war-time radio operators who will be carefully trained in Army methods and routine. This training is expected to simplify the transitlon from a civil to a military status in time of necessity. Let us hope this will never be needed. Of secondary, but more immediate value is the independence it will grant to the military communications system in times of national stress, when ordinary wire communication may be knocked out.

Members of the League are enthusiastic, as it will give each one an opportunity to carry on a large amount of radio traffic, his favorite indoor sport. The training thus gained will help each member to realize his ambition of becoming a still better operator.

It is proposed by the Signal Corps to grant a certificate to each amateur enrolling for the work, officially designating him as an army-amateur radio operator for two years.

HOOVER HELPS HAMS

In a letter of appreciation to Hiram P. Maxim, president of the American Radio Relay League, Secretary of Commerce Herbert Hoover praises the accomplishments of radio amateurs in this country. The chief of all radio activity in the United States in commenting on the recent radio congress, expressed his pleasure at the fact that the American transmitting radio amateur will be permitted to continue his acivities in the same bands that he has heretofore occupied. Secretary Hoover's letter to Mr. Maxim follows:

"My dear Mr. Maxim:

"It is always a pleasure to see you at the radio conferences and I was very glad that you were able to attend the one which has just adjourned. As you know, I have been especially interested in the amateur side of radio. There was no desire manifested in the conference for any interference with amateur operations. It is gratifying to know that that was the condition and I am particularly glad that the conference did nothing to interfere with the amateurs in the slightest degree. I thank you very much for your service as chairman of the amateur committee.

"Very truly yours,
"(Signed), HERBERT HOOVER,
"Secretary of Commerce."

Revamping a Popular Radio

Recent Improvements Have Been Made in a Popular Set

By HARRY J. MARX, Chicago

MANY radio sets are described which are to be built complete by the fan. However, it is often interesting to see how the regular manufacturers hook up their receivers and indeed some of the improvements which they incorporate from time to time may be made by the broadcast listeners in their own sets.

The Deresnadyne radio has had some changes made which will give an idea of what is being done in the way of manufactured receivers. Many of the more expensive models put out by most companies now contain built-in loud speakers and this is true in this case as shown in Fig. 1.

Don't Dissect the Set

The cover contains the horn for the speaker and the unit itself with its diaphragm is connected to the electrical parts below by flexible leads which come out near the hinge. In this way it is possible to obtain a compact arrangement and yet have both speaker and operating mechanism so accessible that it is easy to make any adjustments without dissecting the whole instrument.

A few words of comment are necessary on the subject of the theory of the circuit. First of all as shown in the circuit diagram, figure 2, there is the usual five-tube hook-up, using two stages of tuned radio frequency amplification, detector and two stages of audio amplification.

The subject of tuned radio frequency amplification immediately introduces the subject of prevention of self-oscillation. The method here of prevention is based on limiting of the radio frequency voltage which is built up in the plate circuit, thus avoiding an amouut of feedback through the tube capacity which would be sufficient to cause oscillation.

Ten Megohm Variable

This is acomplished by reducing the number of turns in the primary of the coupling transformers so as to avoid a resonant or tuned condition at the wave frequencies intended to be received. Any remaining tendency toward oscillation is controlled by the adjustment of the "B" battery voltage by means of a series resistance control, known as the "Anostat." This unit has a maximum resistance of ten megohms (10,000,000 ohms) and is continuously variable to a zero resistance.

The effect of this resistance is to vary the voltage applied to the plates of the two radio frequency amplifying tubes. Lowering the direct plate voltage reduces the instantaneous voltage differences between the plate and the grid, and in that way prevents oscillation. It is important to notice that this resistance is *not* in the radio frequency circuit and therefore does not broaden the tuning. A one-half microfarad by-pass condenser leads the radio frequency current from the primaries of the coupling transformers directly back to the negative filament lead. This is seen in Fig 2, about

Fig. 1. A Five-Tube Set with Speaker in the Cover. "B" Eliminator and Trickle Battery Charger Are with Battery in Rear.

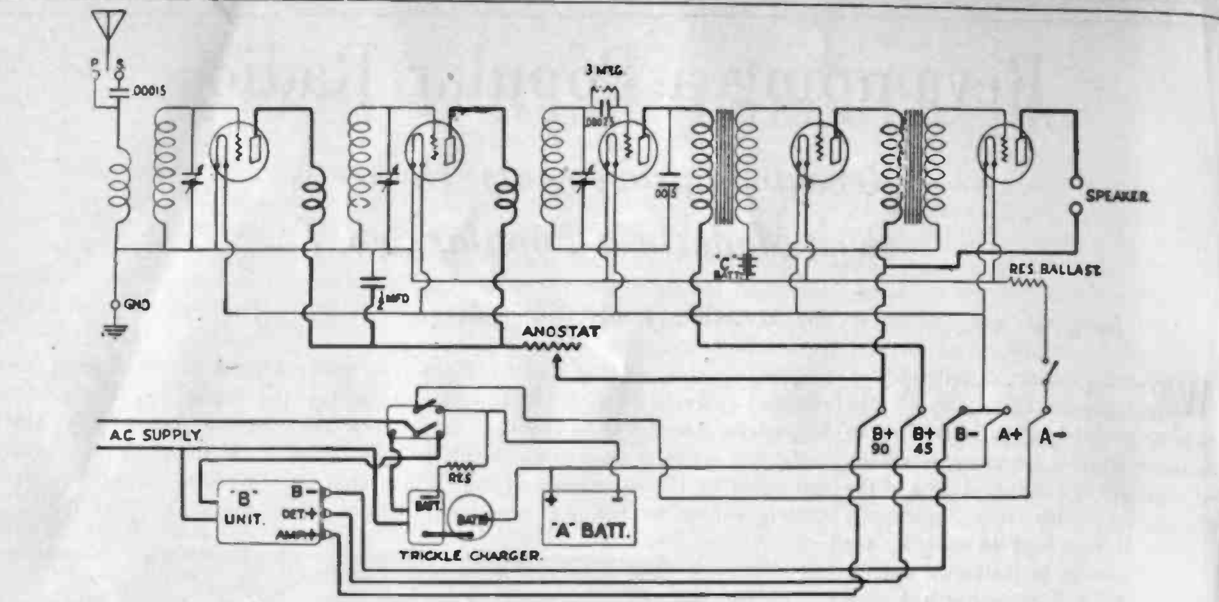


Fig. 2. This Hook-up of the Set Also Shows the Eliminator and Trickle Charger Wiring. Two Steps of Tuned R.F. Are Used.

one inch to the left of the rheostat. Of course, the current from the "B" battery cannot get through this condenser as direct current, you will recall, cannot pass a condenser.

No Burnt Out Tubes

The Anostat also has the important function of volume control. The filament voltage of all five tubes is handled by an automatic filament adjustment, the Brachstat, which also eliminates the danger of burning out five tubes if a wrong connection is made.

Instead of controlling the volume in the ordinary manner by means of the rheostat, the Anostat permits a volume change that operates by reducing or increasing the energy passed through the radio frequency stages.

This means that you don't overload your detector tubes with excessive signal energy and then choke down the volume by throttling the audio tubes and destroying quality. The Anostat maintains uniform high quality of reception regardless of the adjustment of volume.

Changing the Coil Angle

Vacuum tubes, as at present available, sometimes vary considerably in their characteristics. Some particularly cause oscillation in tuned radio receivers. A method has been provided in this set by which this difficulty can be overcome. By varying the angle of the three coils, as shown in Fig. 3, the steady oscillating characteristics of certain tubes can be compensated for, and clear operation without oscillation or whistling obtained.

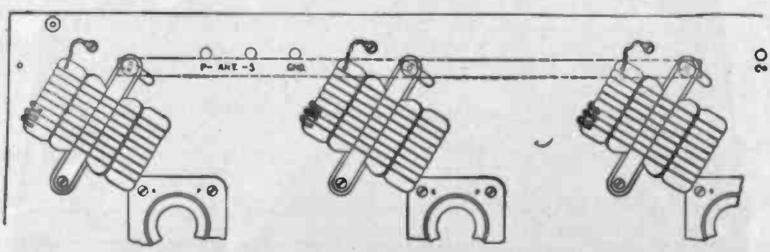


Fig. 3. The Three Coils Carrying R.F. Are Mounted So That the Rod in Rear Changes Their Angle.

By loosening the nuts holding the leg of each coil nearest the back of the set, all three coils, by means of a connector bar, can be swung from one end of each of the three slots to the other end. A distant station is tuned in with the Anostat knob turned as far to the right as possible, then the coils are swung on their pivots a little at a time, each time taking the hand away from the inside of the set and retuning. This is done until the reception is cleared up to perfection, when the nuts are tightened, locking the coils into position. This adjustment is necessary to keep some tubes from oscillating or whistling at the high wave speeds. Once the adjustment has been made, it holds good until other tubes are substituted.

How the Trickle Works

A striking feature of this set is the clever arrangement of the power units which furnish all current from your electric light socket. An electrolytic rectifier is used such as the Balkite. This allows a small current to trickle into the batteries all the time they are not being used for the set. Whenever the switch is turned to "on" the current from the light socket is cut off (to prevent hum) and the batteries are then hooked up to the radio itself.

In Fig. 1 notice the partition about two-thirds the way back. At the left hand side is the "B" battery eliminator, then comes the rectifier in the center and at the right is the three cell six volt storage battery. You do not need to worry about the battery, however, since the trickle charger takes entire care of it except to add a little distilled water every two or three months.

Don't Worry About Battery

A striking feature of this set is the power unit which furnishes all current

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How Do Waves Get There?

What Happens in the Ether While They're on the Way?

By E. F. A. ALEXANDERSON, Radio Consulting Engineer, General Electric Co.

WHEN you take a trip from say Boston to New Haven, you arrange to go to the station in your own machine. When you arrive one of the red caps will see to the handbag and help you into a taxi which takes you

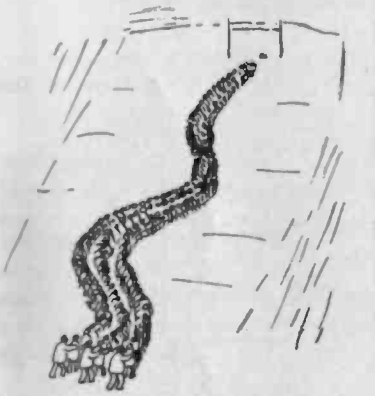

Fig. 1. College Snake Dance Like Horizontal Waves.

merrily to the house. So far, so good. But how about the train trip itself between the cities?

It has been something like this with radio. We have seen all sorts of experiments at the studio and in the sending stations. At the receiving end the radio sets have been improved in one way and another. But how about the ether trip itself between the cities? Not much has been done in experimenting with different ways of getting there.

Traveling Through Empty Space

Thus a large industry has grown up making practical use of wave propagation or travel through space, a phenomenon of nature which was very little understood. About two years ago, the Radio Corporation and associated companies decided to make a determined effort to shed new knowledge on this subject, upon which the further growth of radio depends.

This brings us to look into the question of "polarization." This word means that the wave motion is either entirely up and down or else entirely back and forth sidewise. Have you ever seen a lot of college boys dancing the "Snake Dance" after winning a big football game? They skip along three or four abreast, but instead of going straight down the street they sway from side to side (Fig. 1) and give the impression of a snake travelling along. This might be called a horizontally polarized wave, since all the motion is sidewise.

They Jump Over Chairs

Suppose the same joyous procession should come a little later on to some rows of chairs. First they jump over one row and then over another, but they are keeping a straight line as far as direction is concerned. This would be an illustration (Fig. 2) of a vertically polarized wave. If instead of keeping together, some of them went up and down and others sidewise so that there was no particular direction in which the vibration

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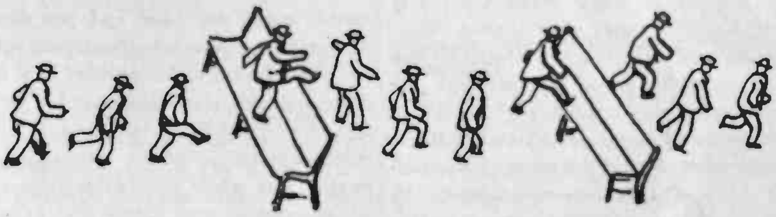

Fig. 2. These Chaps Are Making Vertical Waves Over the Benches.

REVAMPING A RADIO

Continued from Previous Page

from the light socket. The unit, Fig. 2, eliminates the "B" batteries. The "A" unit employs a tricke charger which automatically charges the "A" battery while the set is not working. An "A" battery is used, but there is no need of worrying about it, since it charges automatically when the switch is thrown over to shut off the set.

These power units are entirely noiseless, and have no bulbs or moving parts, with nothing to replace or renew. The cost of the house current used is one-fifth of a cent per hour of actual use. The wiring of these power units in the set is shown in the circuit diagram Fig. 2. and interior view Fig. 1 indicates how the units are located in the set.

Both Not On at Once

Notice the small switch panel. If the handle is thrown to the left side—the light current is thrown to the "B" unit and disconnected from the trickle charger. But when the switch is thrown to the right or "Set Off" position then the "B" is disconnected from the house current and the trickle charger is put into operation furnishing a charging current to the "A" or storage battery.

In the upper right hand corner of this switch panel is shown a small resistance unit which controls the charging rate. By removing this resistance and making a direct connection across the terminals the charging rate can be increased but this is not recommended except where the set is used for unusually long periods of time.

No binding post connections whatever are needed between the set and the power units. Cable plugs for each of the power units to the switch panel and to the set make all connections with no possibility of confusion.

HOW DO WAVES GET THERE?

Continued from Previous Page

took place, then it is more like ordinary waves which run with the vibrations in any plane.

One of the first results of the effort to explore the phenomena of wave travel led to the discovery of horizontally polarized radiation. Since these discoveries were first announced this subject has been brought into the limelight and is receiving much attention from radio investigators, amateurs as well as professionals. A feeling of optimism has swept over the radio fraternity and brings forth new reports of success in the struggle against the old enemies of radio—static and fading.

They Are the Last Word

The study of wave propagation over great distances requires organized effort. To this end the General Electric Company undertook to do the technical pioneer work in devising new forms of radiators and receivers, while the Radio Corporation decided to judge the practical value of this new development by making use of it in its communication system. It has become a tradition among radio engineers to accept the judgment of traffic operators as final in the valuation of the quality of a radio circuit. The reason for this is that the facts in regard to radio communication are not simple measurable phenomena such as we are accustomed to in most other engineering arts, but they are statistical averages.

Let us see what is meant by this. Suppose you wanted to find out whether the men in your office felt depressed whenever there was a rainy day. It would never do to find out how they felt the first time there was a downpour. One man would feel particularly good because someone had left him money the day before, and another might feel all broken up because his dog was sick. So on through the list. But suppose that *every* rainy day for six months you took a test of the men's feelings. Over such a long time the outside influences like the money and the dog would cancel each other and you would then know whether your particular group was affected or not by the weather.

Averaging Money and Dog

In cases like this where there are a good many variables which you cannot control, it is necessary to run the experiment time after time and take a sort of general average to get results that are worth while. This is called the "statistical method." But now let us get back to radio.

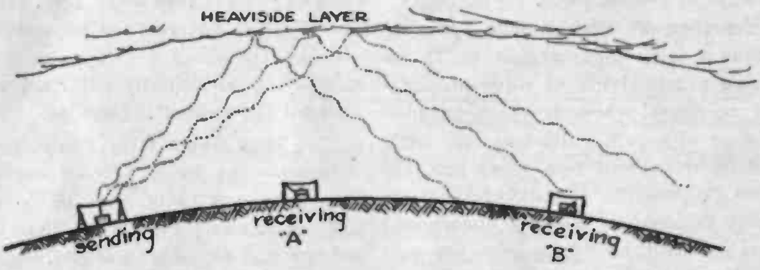

Fig. 3. Sometimes the Nearer Station, "A," Cannot Hear the Program as Well as the Distant One, "B."

The traffic operator measures how many words per hour and per day he can transmit over a radio circuit with a required degree of reliability, day after day, and the statistical results so obtained are as definite and reliable as the mortality figures of an insurance company. But when the radio engineer is called upon to cure a bad case of static or fading, he is in about the same position as a doctor in relation to his patient. It is individual. This makes his profession all the more fascinating and the science dealing with the diseases of radio is making rapid strides.

Flourished During Darkness

One of the important steps in exploration of high frequency (short) waves was taken when the Radio Corporation of America installed in a temporary manner six fast wave transmitters in its commercial (slow) wave stations to be used as supplements to the regular service. These transmitters were, to begin with, operated in the neighborhood of 3,000 kilocycles (100 meters). Similar senders were installed by the associated European companies. The first impression from this new service was that the short wave transmitters gave remarkably good communication at certain times during the hours of darkness, whereas, in daytime, the service was totally unreliable if any signals could be heard at all.

Some of these transmitters were kept in regular service, whereas others were modified in order to explore possibilities of improved results. Thus it was found that when the wave speed was above 6000 kc. (below 50 meters) the night signals became weaker, but on the other hand, service could be given during daylight hours. Tests with still greater reduction of wave lengths of a range between 20,000 and 10,000 kc. (15 and 30 meters) proved that it was often possible to give good service across the Atlantic Ocean at mid-day in the summer. The stations which are giving the best all-around service at the present time operate at a wave length of about 7,500 kc. (40 meters).

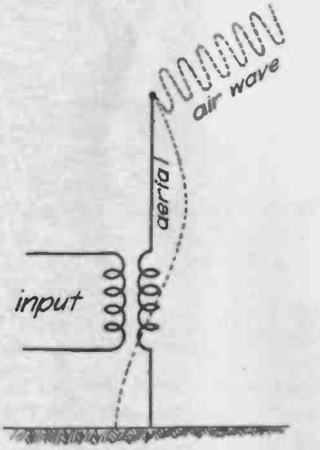

Fig. 4. Here is a Vertical Aerial Sending Off High-Angle Radiation.

Two Oceans Quite Different

So favorably have these results been that the Radio Corporation is now installing a chain of short wave stations to cover the Pacific Ocean supplementing the two long wave transmitters at the Hawaiian Islands. This new series of senders will include the Philippine Islands. The conditions for wave propagation over the Pacific Ocean are notably different from those on the Atlantic Ocean, and as a whole easier. So it is confidently expected that a good short wave service will be established over the Pacific. The findings on the Atlantic circuit in regard to wave length will not necessarily apply to the Pacific Ocean and the stations will be built in such a way that the best operating conditions can be determined experimentally. However, it is possible to make a reasonable forecast of expectations based upon the extensive experimental data already on hand and which are rapidly accumulating.

The experimental station built by the General Electric Company in Schenectady for the purpose of exploring these possibilities is now capable of operating with seven transmitters simultaneously with different wave speeds and different types of radiators, and observations from these transmission tests are being made all over the world. The object of these tests is partly to explore the propagation characteristics of different wave lengths and partly to make final tests of comparison between various types of radiators. Three styles of radiators are used in these comparisons, but these are the result of a sifting process conducted on a smaller scale in which a great many other antenna systems have been explored and at least temporarily discarded. The radiators which are now being compared are:

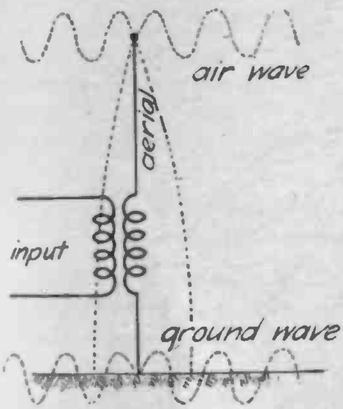

Fig. 5. When the Antenna Oscillates as a Whole, the Radiation Goes off Level.

Three Kinds of Aerial

1. The straight vertical antenna oscillating at a harmonic frequency.

2. The horizontal antenna with an over-all dimension of one-half wave fed in the middle through a transmission line.

3. The series tuned horizontal loop.

All these three radiators have one feature in common, that the radiation is projected at a high angle upwards. It has been found that only this type of wave is useful in reaching great distances. The high angle radiator has therefore the double advantage of economy of energy and the absence of objectionable signal strength in the neighborhood of the station.

Look at Fig. 3 to get a better idea of what is meant. The sending aerial instead of giving out waves in all direction as happens with the ordinary transmitter, puts out a series or bundle of waves up into the air at roughly 45 degrees. This bundle runs up 50 or 100 miles into the air before it strikes the reflecting layer and is brought down again as shown. A receiving antenna located at A will not be in the path and so will pick up very little energy. For this reason even though it is fairly close to a powerful broadcasting station, the latter will not be difficult to tune out. Receiver B, however, is in line with the vibrations and so although much farther away it will pick up a powerful signal from the broadcaster.

Omits the Ground Wave

The first type of antenna radiates a vertically polarized wave of the same general character as the waves that have been used heretofore in slow and intermediate wave stations. It differs from old type of radiation only by being a pure high angle radiator, whereas the old type of stations radiated a ground wave as well as a high angle vibration.

The particular feature which makes it different from the ordinary type is first that it is composed entirely of a vertical wire without any flat top. Besides this the vertical wire vibrates at a harmonic frequency. By this is meant that it oscillates in parts (Fig. 4) rather than as a whole (Fig 5). In this respect it is like a violin string which usually sounds the note given by moving as a unit. However, a good violinist when he wants to play particularly high notes can touch the string lightly so as to divide it into two or more sections and by properly drawing his bow he can make a note two or more times as fast and so get the correspondingly higher pitch. Notice that the radiation comes off antenna, 4, at a much higher angle than 5, which is what is wanted.

Sides Not Like Ends

The second type of antenna, the half wave doublet, is an intermediate form. At right angles to its length direction, it radiates a horizontally polarized wave, and in its length direction it radiates a high angle vertically polarized wave. Thus in its length direction it has a radiation of the same character as that emitted from the vertical high angle radiator, whereas in the broadside derections, it emits a wave of different type.

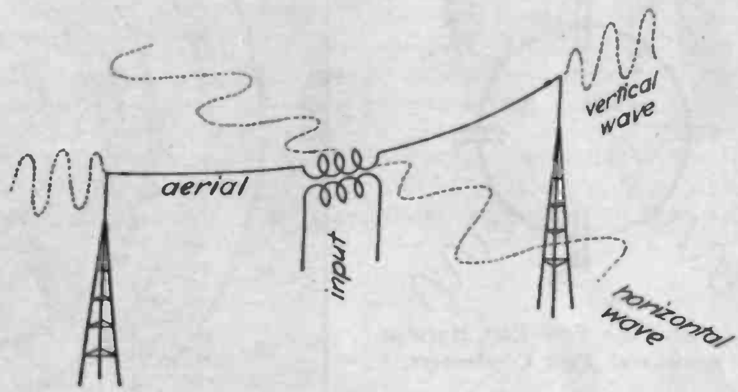

Fig. 6. This Type of Aerial Uses No Ground. The Radiation is Polarized in Different Directions.

A diagram of this type appears in Fig. 6. The exciting coil is in the center and it is coupled to the sending apparatus through a transformer as shown. The horizontal waves coming off at the two sides and the vertical ones at the ends may be seen clearly.

No End to This One

The third antenna system, the horizontal series tuned loop, emits a horizontally polarized radiation in all directions (Fig. 7). This consists of sections of a horizontal wire separated by tuning condensers. These are spaced round in the form of a circle. It differs in effect from the one just mentioned in the respect that there are no ends of the aerial where the vibration will be vertical.

For the analysis of the characteristics of high angle radiation, we are particularly indebted to Commander A. Hoyt Taylor of the Navy Department, who has made extensive tests and furnished valuable data on the so-called "skip" distance of the wave. He has found that the distance skipped by the wave, which means the length of the curved path required for the high angle radiation to come down again to earth, depends upon the wave speed, day and night condi-

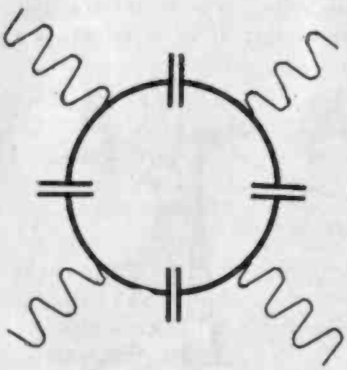

Fig. 7. Here is a Four-Part Horizontal Aerial with Four Condensers.

tions, and summer and winter temperatures, the general rule being that the shorter the wave, the greater is the skip distance.

Ten Times As Strong

The characteristics of the horizontally polarized waves have been explored in the neighborhood of the station in Schenectady up to about ten miles and also in the various stations of the Radio Corporation. For measurements of wave polarization at long distance we are indebted to Mr. Greenleaf W. Pickard who during last summer and fall made systematic tests of the radiation sent out from Schenectady as well as generally explored the conditions of wave polarization. His findings have been presented to the Institute of Radio Engineers and it may be sufficient to mention that he has shown that in the short wave range the horizontal component of polarization is usually twice as strong and sometimes ten times as strong as the vertical wave. He has also shown that fading conditions are different in the horizontal and the vertical plane.

A Very Close Race

A diagram which shows the comparison of horizontal and vertical waves appears in Fig. 8. This was prepared by the testing laboratory and so uses kilometers for distance instead of miles. The kilometer you will remember is slightly over a half mile, so dividing the figures by two, you will get a rough idea of the mileage. Notice that nearby stations reported louder results with the vertical waves, while up to 400 kilometers (250 miles) the horizontal radiation was ahead. But at 3200 kilometers (2000 miles) the vertical wins out again.

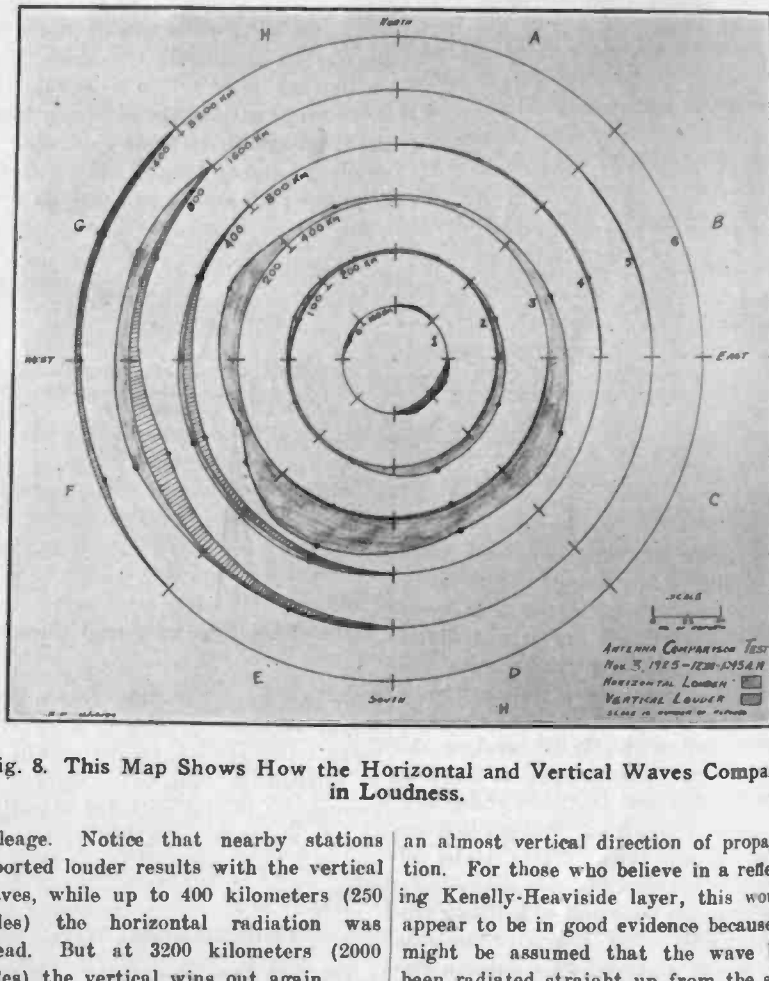

Fig. 8. This Map Shows How the Horizontal and Vertical Waves Compared in Loudness.

Mr. Pickard has also demonstrated that the wave does not maintain its original plane of polarization because the reception appears to be of the same nature regardless of whether the wave is radiated with a horizontal or a vertical polarization. These findings are in agreement with the original observation which led us to study horizontal polarization when it was found that a horizontally polarized wave from Schenectady was received with greater intensity on Long Island than the ordinary vertical vibration wave although in both cases a vertical receiving antenna was used.

Goes Right Up in the Air

Explorations of wave polarization in the neighborhood of the station have brought out many peculiarities which have not yet been fully explained. So for example, it is found at a distance of about ten miles from the horizontal loop radiator, that the wave comes down with an almost vertical direction of propagation. For those who believe in a reflecting Kenelly-Heaviside layer, this would appear to be in good evidence because it might be assumed that the wave has been radiated straight up from the station and is reflected directly downwards. A loop receiver under those conditions gave no orientation (line of direction) of the station whatever, because the signals came in apparently equally strong from all directions when the loop was rotated around its vertical axis.

Similar observations at a point only a few wave lengths distant from a horizontally radiating loop show that the wave comes down nearly vertical, but yet with a definite slant towards the station. Tests with a loop receiver gave in this case a distinct orientation, but the station appeared to be located at right angles from the direction where it really was.

Uses Magnetic Part

One of the loop radiators used in these tests is round, another is about one-sixth wave length wide and two wave lengths long. These horizontal loop radiators also differ from the ordinary types of antenna by radiating on the magnetic component of the wave. An ordinary long wave antenna creates an electro static field around the station, whereas the magnetic counterpart of the magnetic energy is confined to a tuning coil.

In the series tuned loop radiator this process is reversed. A magnetic field is created around the antenna, whereas the electrostatic counterpart of the oscillations is confined to artificial condensers inserted at regular intervals in series with the antenna conductor. One advantage of confining the electrostatic field to artificial condensers has been found to be the fact that the antenna is much less subject to fluctuations in its natural period due to swaying of the wires in the wind.

Calculations Upset Far Away

The radiation produced by these loops has a pure horizontal polarization. The oblong loop projects its principal radiation 45 degrees upwards broadside to its own length direction. Reception tests have proven that it is superior to the vertical radiator. From the elementary theory of directive radiation it would be possible to calculate a quite sharp directivity diagram for this antenna. Such a result was, however, not expected in reception tests at long distances because experience with a variety of types of directive antenna systems had proven that whereas the theoretical directivity diagram can be easily confirmed in the neighborhood of the station, the distant measurements do not bear out the elementary theory.

The reason for this seems to be that while the antenna sends out the energy as calculated, there is an additional radiation which is projected almost vertically upwards and then scattered in all directions by the upper layer of the atmosphere. Signals may, therefore, be received at distant points in directions where the elementary theory shows that they should be zero. A good deal more evidence must be collected before any definite conclusions can be drawn regarding these secondary phenomena because each case of evidence is usually subject to several interpretations. We have however, good reason to hope that in a not distant future such a mass of evidence will be available that valuable conclusions may be drawn which will have important bearings not only on the development of radio but on fundamental questions in allied sciences.

Horizontal is in Lead

From the point of view of the practical radio engineer, it is a satisfaction to be able to state that enough has been learned to create a new and promising field of radio communication as evidenced by the decision of the Radio Corporation to proceed with its chain of short wave stations in the Pacific Ocean. The stations which will thus be built will have antenna systems of the type classified as high frequency wave high angle radiators. Which one of the three types discussed above will be adopted will depend upon further results from the comparative tests that are now in progress and also upon final tests in the stations when installed. So far these tests have shown that the horizontally polarized radiation is superior to vertical.

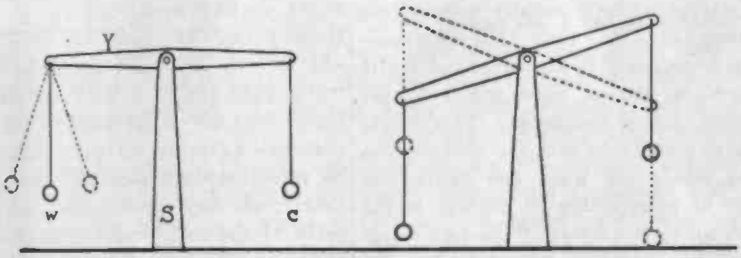

Fig. 9. A Mechanical Oscillator to Show How Waves Work.

I have made a mechanical model to show what happens when a wave is polarized. It consists of a series of weights as shown in Fig. 9. A stand, S, supports a yoke, Y, so that it can pivot up and down. At one end of the arm is suspended the weight, W, and at the other an equal weight, C, as a counter balance. Of course the weights will not move because they are equilibrium. However, the weight, W, may be set swinging so that it assumes the positions shown in the dotted line.

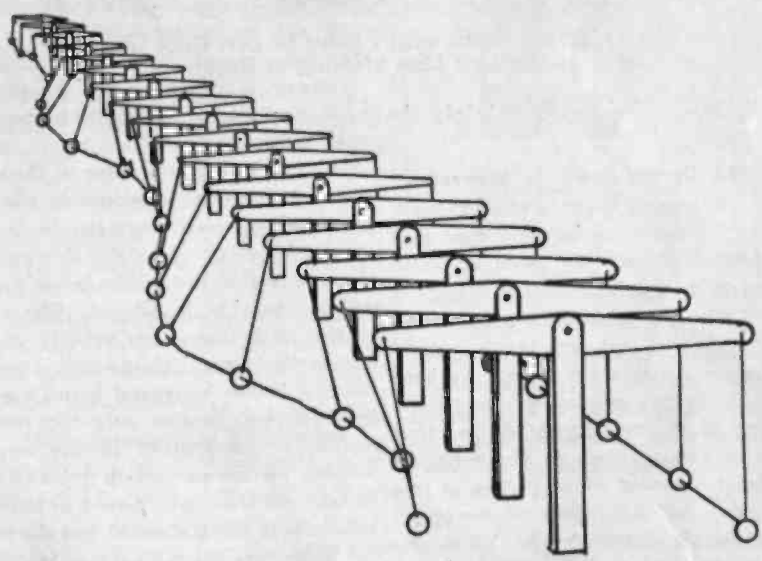

Fig. 10. Laboratory Model to Explain How a Polarized Wave Shifts Its Angle.

Tied Up with Elastic

The yoke may also be tipped back and forth to give an up and down motion of W as also appears in Fig. 9. In this case, of course the counter weight also has the identical motion, although when W is only swinging, as first mentioned, the counter weight will not swing but will hang straight down. There are 22 of these supports each with its weight and yoke arranged one behind the other as appears in Fig. 10. Each weight is tied to the one behind it by an elastic band.

Because of this connection by the piece of rubber, it follows that when the front weight is swayed back and forth it sets the one behind it into similar motion and this oscillation will then travel right down the line. The same thing applies to motion up and down. The vibration may be seen to travel along from one ball to the next. This model was set up especially to study the twisting of the plane of polarization, and the experiment has strikingly confirmed the theory which it was intended to illustrate. This theory is briefly the following:

The Up-and-Down is Slower

We will assume that the ether through which the radio waves pass has such characteristics that the speed of travel for a *vertically* polarized wave is slightly slower than the velocity for a *horizontal* wave. We shall not here try to explain the reason for this difference. Perhaps it is due to magnetic effects; to the retarding of the velocity of the vertical wave in passing close to the earth, or maybe it is caused by properties of free electrons in the upper atmosphere. Whatever the cause may be, let us admit that such a difference of speed exists. Then we shall build the mechanical model so as to reproduce this condition.

The weights on both sides are tied together with rubber bands, as mentioned. Wave motion in the horizontal or vertical planes can thus be studied independently, and these two wave motions may be adjusted for different velocities. A wave started in the horizontal plane maintains itself back and forth, and if started vertically it will continue up and down. However, if the vibration commences in a plane 45 degrees between the vertical and the horizontal, it is found that the wave motion proceeding from it assumes the shape of a cork screw.

Carries a Corkscrew Along

The straight line oscillation of the first weight is passed along as an elliptical motion which gradually widens into a circle, Fig. 11. Then this circle narrows down again to an ellipse and finally a straight line at right angles to the original line of oscillation. This is exactly in accordance with the theory. The point where the wave has shifted its plane of polarization 90 degrees is the point where the faster of the two waves is half a wave length ahead of the slower wave. From this point on the wave proceeds repeating this peculiar cork screw motion.

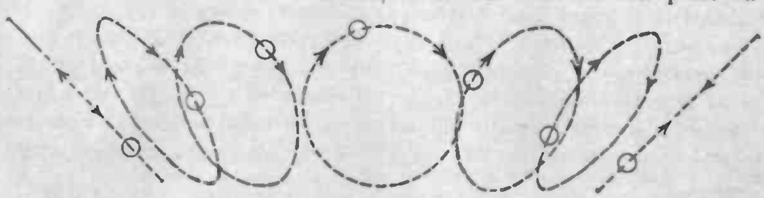

Fig. 11. A Vibration That Starts with a Slant to Left Goes Into a Circle, and Later to a Line Slanting to Right.

The fact that the twisting of the wave is due to different velocities in the two planes of polarization can also be demonstrated by this model. For this purpose the stiffness of the rubber bands on the counter weights is altered. The effect of this is to change the velocity of motive in the vertical plane only, since the velocity in the horizontal plane has not been affected, because only the vertical motion is transmitted to the counter weights by the suspension yokes. The system can thus be adjusted so that the velocities in the horizontal and the vertical planes are exactly equal. After this has been done it is found that the tendency to cork screw motion disappears and the wave remains strictly in the plane in which it has been started.

Radio and Weights Alike

While this mechanical experiment does not bring out any new facts that were not already known from the action theory of wave motion, it helps us to visualize the main action in the radio wave propagation which we are trying to explain. The idea of a constantly shifting plane of polarization, which we discovered experimentally in tests between Schenectady and Long Island, can thus easily be understood.

This conception of the wave motion is also a help in explaining the phenomena of fading. There is already much experimental evidence that fading is a form of interference. In other words, fading is due to the fact that the radio waves arrive at your aerial through two different paths. The waves will sometimes add to each other and sometimes neutralize each other. If we keep in mind the observation on the mechanical model that the waves in the two planes can be traced through separately and distinctly, we may conclude that the two paths of the radio wave which produce fading are not necessarily two separate physical routes but may be the two paths in the horizontal and the vertical planes of polarization.

It is not here suggested that this mechanical equivalent is sufficient to explain the fading in actual radio transmission. It is, however, offered for what it may be worth as a help to interpret the many observations in actual radio transmission which are being accumulated.

NO TIN PANS HERE

There are many aspects of broadcasting which rarely come to your attention, but which are important factors in the enjoyment of the programs. A case in point is the care which the studio staff of WEAF takes in keeping their four pianos tuned and in correct pitch. These pianos are tuned regularly each Saturday, and their tone is regulated once a month. After a year's service, they are returned to the factory for complete and thorough overhauling of the hammers and action. The pianos are played on an average of about thirty hours a week.

IF RADIO INTERFERES WITH BUSINESS

A gentleman who resided near a popular sending station recently was afforded a business opportunity which would require locating in Brazil, but before making a decision in this connection he wrote to the station making inquiry whether it would be possible to pick up their programs at such a distance from New York.

How Football Games Were Broadcast

Special Means Used to Bring the Game Right Into Your Room

An Interview from GEORGE H. JASPERT, Director, WBZ

"THIRD down and one yard to go," cries the lineman. Will they be able to make it? And there is only one more minute to play. How does it look to you?

As a matter of fact, it doesn't *look* at all, for this report you have just heard is not directed from the lineman, but floats from the throat of the loud speaker. Of course this is not quite as interesting and exciting as if you were watching the game, but it is a lot more satisfactory than just reading about it in cold type the next morning.

Fig. 1. Murley Knows Football So Well You Might Think He Invented It.

Hear the Pung of Pigskin

How is such broadcasting done? Why you can even hear the "pung" as the kicker's foot connects with the pigskin. That happens way out on the field. Yet the announcer's voice is just as clear, and comes from a position fifty yards away. A short description of the method by which this broadcasting is accomplished will interest you.

From the countless thousands of letters received from football enthusiasts all over the country, it is apparent that the Harvard-Yale game, one of the leading football classics of the East, played on the Harvard Stadium gridiron this year, was attended through the medium of radio broadcasting by the largest audience in the history of this annual struggle. Even with the capacity of Harvard Stadium (approximately 55,000), it is doubtful if all the alumni of America's two foremost universities could be eye-witnesses of this contest, and arrangements were made to broadcast a play-by-play description of the colorful battle for the benefit of the hundreds of thousands of listeners unable to secure the priceless pasteboards admitting the holders to Harvard Stadium on this gala occasion.

Broadcasting the Excitement

As Station WBZ, Springfield, is now engaged for its second year in broadcasting the home games of the Harvard eleven, it fell upon them to make available for the host of football enthusiasts and listeners of the station through the now famous football announcer, J. E. "Jim" Murley (Fig. 1), former sports writer on several Boston newspapers, and Publicity Director of Station WBZ, a running account of the game together with such sidelights as the cheering, band music, and general excitement current at important collegiate events.

The annual classic, scheduled to start at two o'clock Saturday afternoon, November 21, was broadcast direct from the Harvard Stadium and when "Jim" Murley went on the air about half an hour before the referee blew the starting whistle, it is doubtful if any other man in the country had as many people listening to his every word. Not only was his vivid play-by-play description of the game to be heard on the WBZ wave, but the voice of this popular football announcer was also sent out through the Radio Corporation Stations WJZ in New York, WRC in Washington, and the station of the General Electric Company, WGY in Schenectady.

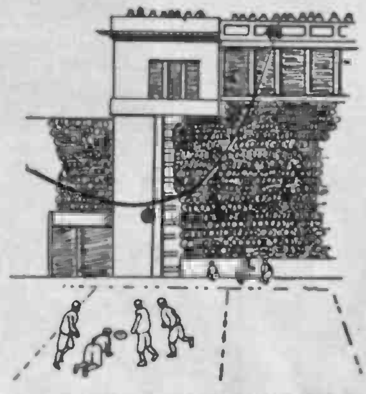

Fig. 2. How Were Signals Broadcast? Notice Microphone Over Field.

All America Could Hear

With these powerful stations along the Atlantic seaboard tied-in with WBZ, listeners in the eastern half of the United States and Canada were assured excellent reception of the report of this contest, and so powerful is the range of the stations linked together for this broadcast, listeners in the western half of the country were able to hear the signals sent out through the ether.

Very sensitive pick-up equipment, specially designed for this type of work, had been installed on top of the Harvard Stadium. You see the ordinary microphone is designed to get the sounds which come from the distance of a few feet up to across an ordinary sized room. But what would a football game be if you couldn't hear the cheers of the spectators and the singing of the "undertaker's song" by the Yale sections across the field?

Smelling the Hot Dogs

All these extra sounds must register in the pick-up if the occasion is to be realistic. Indeed, it is hoped that next year the art will have advanced far enough so that the broadcast listeners will even be able to get the smell of the hot dogs through their loud speakers. The diaphragm of the microphone and the sensitive button behind it were especially designed to listen to all sounds near and far.

Even at that it would be difficult to equalize the voice of the announcer and also the sounds out on the field in a single microphone. That is why the two of these units were under the control of "Jim" Murley, one suspended by wire into the stadium, and the other used in sending out his play-by-play account of the game. The stadium mike picked up every sound even to the referee's whistle, the thud of the ball and body impacts, and the barking of the quarterback's signals. Added to this was "Jim" Murley's knowledge of the game and his interesting and colorful style of transposing the rapid plays from an eye picture into a word picture, for which he has received the praise of thousands of WBZ's regular listeners.

Gritting of the Teeth

Fig. 2 makes this idea somewhat clearer. At the control station where the announcer spoke there was a switch which cut in one or the other of the two transmitters. While action was going on out in the field, the overhead microphone was energized. Through it you could almost hear the gritting of the teeth of the opposing quarterbacks as they made up their minds that the next play would score a touchdown.

During the lulls in the play, and whenever Murley wished to tell what was going on, he would snap his switch to hook up his local microphone, with the result that it was not necessary to try to catch his voice through an instrument fifty yards away. This change from one to the other of the two collecting units was made so smoothly that it is doubtful whether you and your friends listening in (if you were not fortunate enough to be at the game) were able to notice just when the switching operation was done.

Better Than Newspaper

Listening to the game play-by-play, has quite an advantage as already mentioned, over an account received long hours after. The stimulus of not knowing the answer at the time the ball is being passed, adds to the mystery and interest. Many groups got together around their loud speaker and arranged in some way to enact the contest which was consummated in Cambridge.

One of the most elaborate scenes which has been reported was enacted in a large Y. M. C. A. The crowd divided themselves into a Yale and a Harvard cheering section. A large hall was cleared and a scoreboard like the genuine one was installed at one end. At first they did not know how to represent the players. Someone finally had the brilliant idea of using folding chairs to simulate the elevens. Twenty-two of them were found and arranged, eleven at one end and eleven at the other. Over each chair was draped a crimson or blue banner to show the teams (Fig. 3).

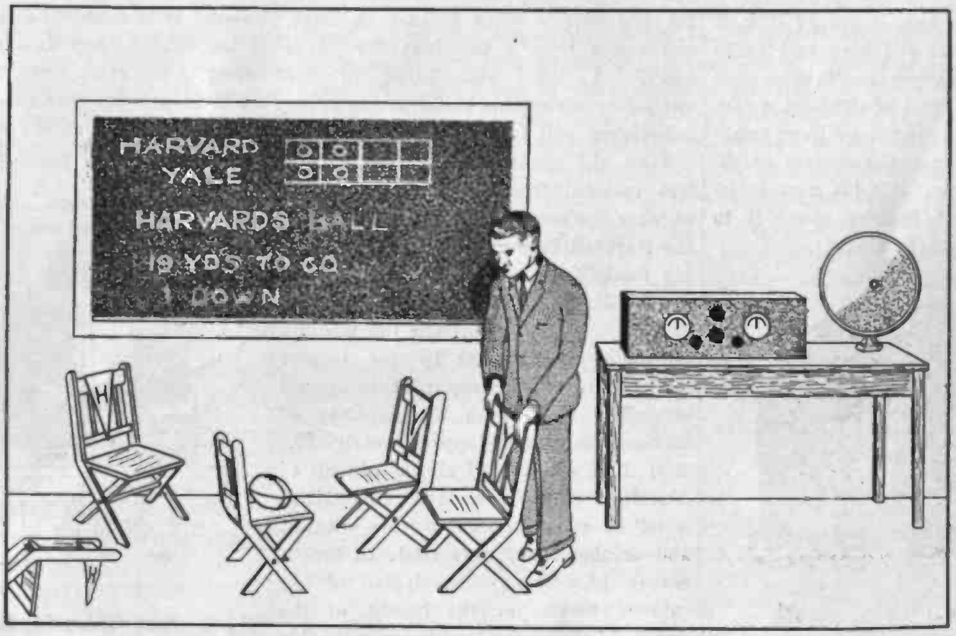

Fig. 3. With Chairs as Players, and the Radio to Direct, the Yale-Harvard Game Was Played in This Room.

Fun Grew Fast and Furious

Someone dug up a football and put it on the chair which was supposed to represent the player running with the ball. By manipulating these "players" in accordance with what the loud speaker directed, a very good idea could be had by

Continued on Next Page

Building Your First Radio

Here's One That Even Advanced Fans May Well Construct

By WILLIAM C. RADOS, Arlington Heights, Mass.

HOW much does a $40.00 set cost? That question isn't as easy as it seems, as many home made sets have to be rebuilt so often that the price runs up to perhaps double what it was expected to be. Here is a radio which can be held down to reasonable prices and will not need to be done over. The set is easy to work with few controls, Fig. 1.

With the coming of winter, we have with us thousands of new fans who will be obtaining their own radios for the first time. Many of the fans will buy their equipment outright, but large numbers of others will prefer to build their own sets, both for pleasure and economy. For the benefit of this second group, the following set is described.

You Can Make it Easily

This is a three-tube, three circuit radio, comprising a detector and two stages of audio frequency amplification. This means that it will give good loud speaker volume, distance and ease of handling. In addition, it is very easy to put together.

This circuit was selected for the above reasons and also because it is a very popular circuit with the home builders. This hook-up is old, but it will do almost anything that any other circuit will do. So you may be sure you are not building something which will not satisfy, but on the contrary, you are getting a receiver which has been tried and tested.

The list of parts gives every item that you will need for the set. These will

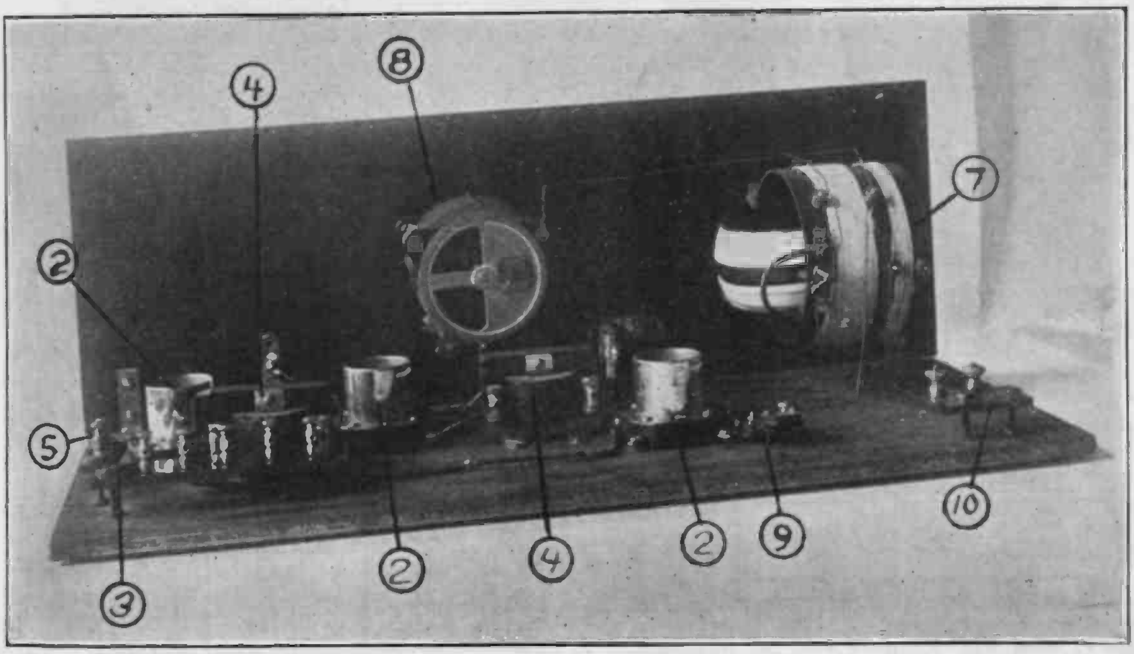

Fig. 2. A Rear View of the Panel Gives the Location of the Parts. The Numbers Refer to the List of Material.

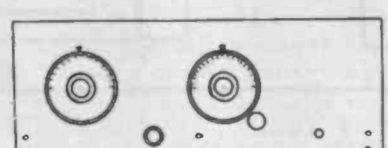

Fig. 1. See How Simply the Control is Worked Out.

BROADCASTING FOOTBALL GAMES.

Continued from Previous Page

the audience of just how the game was going. In fact, everything was worked very smoothly indeed, until near the end of the last quarter the crowd grew obstreperous, with the result that several of the folding chairs folded and had to be carried off the field.

On the whole, the radio listeners pronounced the event as a wonderful experience and second only to having been present at the game in person.

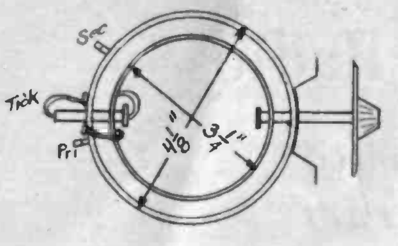

Fig. 3. Details of the Rotor for Adjusting Feedback.

cost you from $15 to $30, depending on where they are purchased. The accessories will cost about the same as the parts. Look over the list and see what you will need. The 5 and 10-cent stores carry a variety of good units at low cost.

You Can Boast of It

The only part that the fan will have to make is the coupler unit. Even this may be purchased outright if you wish, and thus save the bother of construction. In case it is purchased, it may look very much different from the one in the photo, Fig. 2, and still work very satisfactorily. However, remember that if you make it yourself, you will have something to boast about.

To make the coupler unit you need two hard rubber or bakelite tubes. Cardboard dipped in hot paraffine will serve very well also. The dimensions are as follows: 4 1/8 inch diameter and 3 inches long for the main coil. See Fig. 3. The tickler coil will be 3 1/4 inches diameter and 1 3/4 long. These dimensions should be followed as closely as possible, but the builder should not feel that a failure will follow deviation. Most of the radio stores will have a coupler unit such as this for about a dollar and a half. Three windings will be required; a primary, a secondary (sec), and a tickler (tick).

Winding Like Photograph

Two of the windings are on the large tube. The primary (pri) will be 1[illegible] turns of number 24 double covered cot-

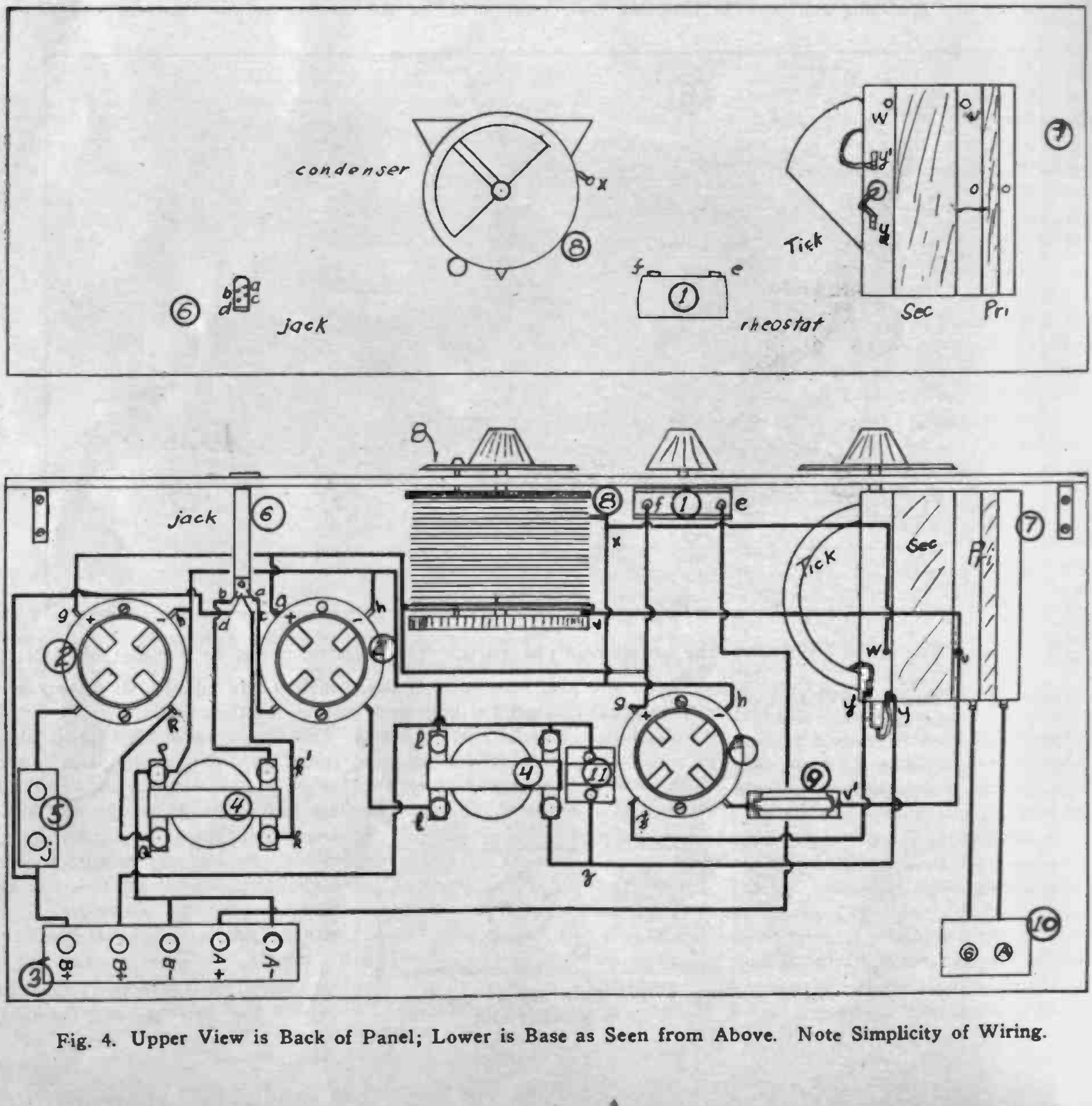

Fig. 4. Upper View is Back of Panel; Lower is Base as Seen from Above. Note Simplicity of Wiring.

ton. (No. 24 dcc.) Start winding with the tube as in the figure, from the right side or the side marked A. Wind up and over away from you until you have wound around 11 times, Fig. 4.

This is called 11 turns. Make both ends of the wire fast to the screws and nuts on the tube, or binding posts as they are called. Wrap tightly so that it will not come undone. One half an inch away wind the secondary with 33 turns No. 24 dcc. Start the wire at U and wind up and over away from as before.

The tickler (movable coil) has 48 turns, but after you have had your set a few days you may find you need only 20 or 30 turns. This is so because vacuum tubes are different and where one might need 50, another will require only 20. However, to be on the safe side, wind at least 40. The idea is, that a tube which is particularly good will usually oscillate quite easily while as it gets old it requires more feed-back action to get it going. Naturally the more turns you have on the tickler the poorer tube you can use and still make it squeal.

Don't Wind Too Many

If the number of turns is reduced too low, then you will not be able to cause oscillation on some of those stations which you may want to hear, while on the other hand, if you have too many turns, you will observe that the distance you must turn the knob for bringing a station in or out will be very small. In that case, of course the adjustment is much more critical, and it requires more skill to tune such a set. A further disadvantage of too many turns is that there is considerably more resistance in the circuit than is necessary and of course this causes extra losses which might otherwise be avoided.

If you see how a coil is wound, it is easier to do one yourself. In the radio stores take a good look at the units known as variometers and vario-couplers. This will help you put your own unit together without much trouble.

Condenser Holes Not Shown

The panel is a 22x7x1/4 inch radion rubber or bakelite panel. Drill the holes in it as per layout plan, Fig. 5. With the condenser will come a template or a piece of paper with the proper markings for the holes. Check up with the panel layout to make sure before drilling.

After the panel has been drilled, wipe off with a cloth and mount it on the base board by means of three small angle irons.

When all the parts have been obtained we are ready to assemble. The instruments are marked in the order that they are put on the panel and base. Fasten on the panel the bradleystat or rheostat and the jack. On the base board go the three sockets, the battery terminal strip, and the two audio frequency transformers, and the loud speaker strip.

For the battery leads use No. 18 bare copper wire covered with spaghetti or round bus bar if you wish a very neat job. The bus bar will call for much more skill, however.

Hooking Up the Jack

The other two prongs, B and C, of the jack are connected to the primary terminals of the second transformer. All of the jack terminals will have to be soldered. The other side of the transformer is the secondary. Q runs to R on the third socket and P is already connected. Finish the wiring of the other transformer as shown in the diagram, Fig. 6.

The coupler and rotary condensers, called the tuning elements, are mounted on the panel next with the parts, 9, the grid leak and condenser, and 10, the antenna strip on the base. The primary wires are clearly shown running to A and G of the antenna strip No. 10.

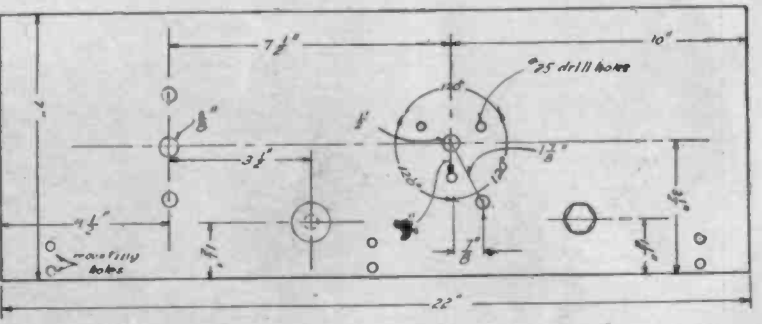

Fig. 5. The Drilling Plan is Complete Except for Holes for Mounting the Condenser.

Test for Filament Circuit

Connect A plus on the battery strip to E on the rheostat. The current goes through this unit to F, from which it runs to the terminals on the sockets marked plus and G. The A minus connects first to P, on the second transformer, then to the terminals marked H or minus on the sockets. This completes the "A" battery circuit, and if you wish, the battery may be connected and the tubes put in the sockets to see if the work is correct.

The tubes should light if the wiring is proper, and turning the rheostat should cause the tubes to vary from full brilliancy to darkness.

The "B" battery leads are run similarly; the B minus being connected to the A minus and so connecting to P, etc. The B plus for detector runs to one side of the first transformer and also to the condenser marked 11. The other B plus (the left one) is hooked up to J on the loud speaker strip and also to D on the jack.

The secondary has two terminals, U and W. From U a wire connects to V and also V'. Connect W to X (the connection of the moving plates) and then to H or a wire leading to H.

Lamp Cord is Used

The tickler has two terminals, Y and Y'. Y is connected to the moving tickler coil by passing a 4-inch piece of lamp cord through the hollow shaft as in the sketch. L connects, externally, to Z which is the common point of one side of condenser 11 and the primary of the first transformer, Y', connects to Z', which on the socket will be marked P for plate terminal. Number 9 is the grid condenser and leak and is connected to the grid terminal of the first socket.

Before you start in, trace over the connections with a red or green pencil so that they will stand out unmistakably. Make the leads straight and turn corners at right angles. Use spaghetti only on the battery wires.

After the set has been built, check over the wiring to make sure it is correct. Then insert the tubes in the sockets and connect the batteries and antenna and ground. The loud speaker runs to the strip No. 5. A pair of phones will do if you have no loud speaker. With your head phones connected to the plug, put the plug in the jack. However, this set will give so much volume that it will be unpleasant to wear the phones except with the distant stations. A loud speaker may be made out of the phones by making paper cones and mounting them in a block of wood to which is clamped the ear phones. Of course, such a speaker is not nearly as good as a regular manufactured one, but will do very well in an emergency.

week you will be an expert with your set.

In conclusion, the author wishes to state that he will be glad to hear from the fans if a self addressed and stamped envelope is enclosed, care of Radio Progress.

How to Build Aerial

Although you may have many friends who will be free with advice on how to put up the antenna, a few additional words may not be amiss. Put up a single wire as high as you can, preferably between two poles over an open plot. The wire should not cross any electric power or telephone lines for safety. The total length of wire from the far end to your

No. 3. 1 Battery terminal strip, 5 binding posts.
No. 4. 2 Audio frequency transformers.
No. 5. 1 Terminal strip, two binding posts.
No. 6. 1 Double circuit jack.
No. 7. 1 Coupler unit (see text).
No. 8. 1 .0005 variable condenser.
No. 9. 1 Grid condenser and leak.
No. 10. 1 Terminal strip, 2 binding posts
No. 12. 1 Plate condenser .002.
1 7x22x1/4 radion rubber panel.
2 3-inch dials with 1/4 inch holes.
3 Angle irons and screws.
1 Baseboard 9x22.
4 Feet spaghetti
6 Feet bus bar or No. 18 copper wire.

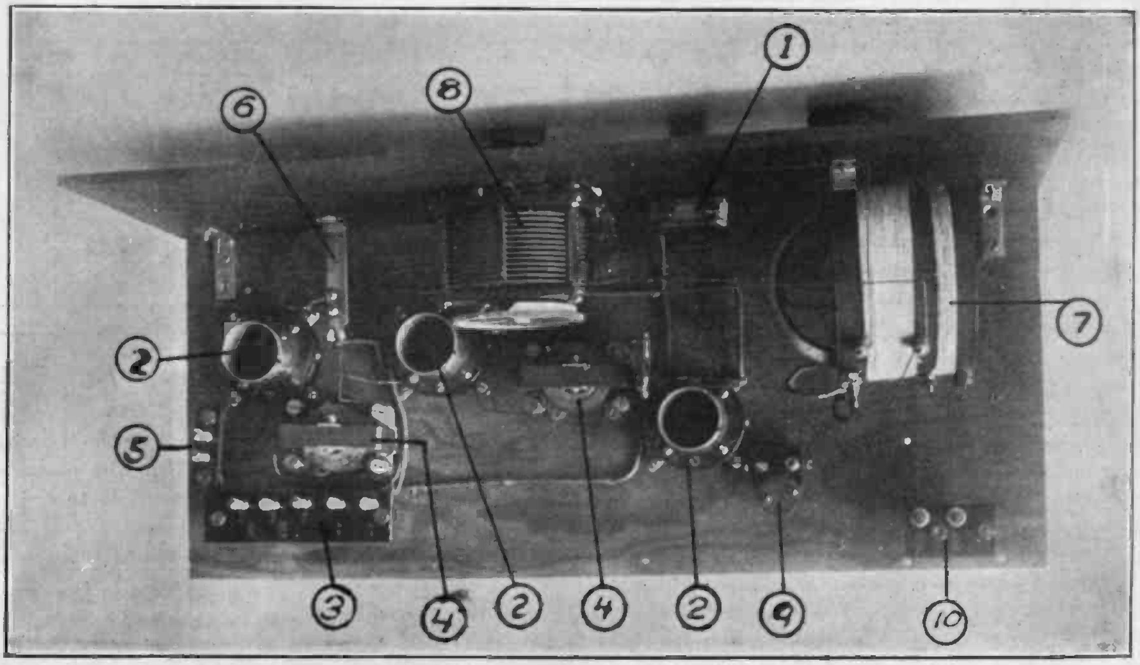

Fig. 6. Top View of Assembled Set. The Wiring is direct and Simple.

How to Become Expert

Now turn the rheostat (No. 1) until your tubes are at proper temperature. Then with the tickler dial at 0 turn your condenser dial to the maximum limit slowly or until a local station is heard. When it comes in, turn over the tickler dial until you hear a squeal and the music becomes mushy. This shows that you have rotated your tickler dial too far. Turn it back a little until the squeal stops and the music becomes perfectly clear. If you now desire to listen to this station, pull out the plug just a little—and presto— the music will come pouring out of your loud speaker. In a

radio (counting the vertical stretch and also the lead inside the house) should not be over 100 feet. The ground wire should run to the nearest cold water pipe, but if your window is on the side that the cellar water pipe is on, you should run a wire down the side of the house into the cellar to the street side of the water meter.

In the following list of parts, the number at the left hand corresponds to the figures given in the circles on the various diagrams:

No. 1. 1 Bradleystat or rheostat, 6 ohms.
No. 2. 3 Type UV-201A sockets.

Accessories

3 Vacuum tubes No 201A.
1 6-volt 40-ampere hour storage battery.
1 45-volt "B" battery.
1 Phone plug.
1 Pair of head phones.
1 loud speaker.

Antenna Requirement

100 Feet aerial wire.
1 lightning arrester.
1 Ground clamp.
20 feet insulated wire, No. 14, for ground.
4 Porcelain wall insulators for ground wire.
2 Aerial insulators.

Broadcasters Have Live Association

Here is One Reason Why You Are Getting Better Programs

By VANCE

THERE are no clubs or associations at Sing Sing. Where everything is prescribed by law, there is no need for guilds or committees to decide on what action to follow.

In radio, however, it is different. There are not very many laws which Congress has passed relating to this subject. The result is that there must be a voluntary association of those interested if we are to have any sort of team work in the operation of our broadcasting. For this reason it is a very good thing that the big sending stations have got together into an association of broadcasters which is a natural organization.

Got Out the Crowd

This association recently held a meeting at Washington, D. C., to consider some of the problems which have come up. There were 237 representatives of this new art in attendance. This is a very large number considering how young the organization is and what distances many members must come for such a getting together. President Elliot was in the chair.

One of the subjects under discussion was in regard to the proposed International Tests to be held the week of January 24, 1926. Many people think that these will be a great boon to radio and it will stimulate interest among those who have not already bought sets. Others, on the contrary, believe that many and perhaps most of those who listen in the United States will be doomed to disappointment. Of course those on the Eastern Coast will have a fair chance of picking up England and the continent when all the United States stations have shut down an hour each evening.

A 3000-Mile Pall

However, those situated farther inland will have considerably more difficulty and many people feel that it will do the art more harm than good to have such tests run. You see those who are not interested will not be able to ignore the occasion since they will not be able to hear anything from their old favorites. Indeed there will be a pall of silence which will settle down from Maine to California and from the Rio Grande to the Great Lakes.

TRY THIS ON YOUR RADIO

Thousands of letters have been received by William N. Stradtmann, Physical Director of the Cincinnati Y. M. C. A., from people who are taking up the morning exercises which will reduce those who are fat and put on weight for the thin ones. These healthful exercises are given at 7:30 in the morning through Station WLW. A group of girls are shown in the studio with the instructor and pianiste.

There was so much difference of opinion in this subject that on the vote in the morning there was a tie. The matter was carried over till the afternoon session when more delegates would be present. At that meeting, the idea was favorably acted upon.

What About "Eveready Hour?"

Another matter of importance was brought up by the National Carbon Company as to whether they should be allowed to have a representative in the meeting. Of course they are responsible for the "Eveready Hour," which is played every Tuesday evening from a dozen or more stations. They took the position that since they were paying for this talent at the stations, they were entitled to be called broadcasters. Of course they own no sending station, and so that was the question. The paragraph of the constitution which covers this point reads:

"Article III, Section 1. Any radio station engaged in broadcasting, or any individual, co-partnership, or corporation associated with radio broadcasting, may become a member of this Association, upon favorable action by the Membership Committee."

That Made it Unanimous

Unanimous recommendation was made to the Membership Committee that favorable action be taken on such applications as the National Carbon Co., Atwater Kent, and other regular broadcasters whose interest in broadcasting is upon a par or greater than that of some owners of stations.

Anybody who can tell what names the public likes, ought to be able to make quite a lot of money. It seems to be pretty hard to predict whether any name which is made up or coined will be used by you and me. For instance, there is the word "kodak." It is so well founded that a good many people call any camera by that name, even though it is made by some other manufacturer than the Eastman Kodak Company. On the other hand, the Eveready people tried to get

Edith Carpenter and Grace Ingram

Chicago's favorite harmony girls, who so successfully entertained thousands of radio fans during the past, are now with Westinghouse Station KYW as exclusive radio artists.

us to adopt the word "Daylo" as a synonym for "flashlight," and it didn't work at all.

Returned to First Love

In the same way about a year ago the Associated Manufacturers of Electrical Supplies voted that the word "broadcast" was not very distinctive for radio, since it was used primarily to describe a farmer sowing seed in a field. Instead they recommended the use of "radiocast." At first you saw a few magazines and papers which used the word, but recently it has been as hard to find as an old 201 tube. In view of this fact, the association unanimously decided to stick to its first love and forget "radiocast."

A committee of ten members was appointed by President Elliot on Legislation and Wave Frequencies to confer, and the following was unanimously adopted:

"Resolved, That it be the sense of the National Association of Broadcasters that in any Congressional legislation, or pending such legislation, the test of the broadcasting privilege be based upon the needs of the public served by the proposed station. The basis should be convenience and necessity combined with fitness and ability to serve, and due consideration should be given to existing stations and the services which they have established. And be it further

"Resolved, That full authority be vested in the Secretary of Commerce to act upon broadcasting license application; that he should be authorized to use such means as he deems proper to ascertain the broadcasting need of the communities in which licenses are sought, with due provisions for court appeal. And be it still further

"Resolved, That we recommend that legislation be proposed to Congress, enacting into law the sense of these resolutions."

May Stir Up Trouble

Of course Secretary Hoover has taken steps to limit the further increase in the number of stations, but such an idea has not yet been enacted by Congress into a law. There is a feeling that if any powerful company should wish to fight the ruling of the Secretary of Commerce, it might be able to stir up trouble which would take a lot of litigation to straighten out. If Congress in the coming session will pass suitable laws to this end, it will prevent any chance of long law suits in this matter.

The biggest matter taken up at this meeting was that of copyright. You probably know that there has been a fight on for the last couple of years between the broadcasters and the society which includes most of the composers and publishers of the popular songs which are released in this country. The composers and publishers have been licensing the various broadcasters to use their songs, but the pay demanded for this service has ranged from a few dollars up to a few thousand depending on what they thought the traffic would bear.

Won't Return the Money

Furthermore, the right has been reserved at any time to withdraw any number from broadcasting which the publishers wish. Thus if Station XYZ should print in its program that the music this evening would start with "Show Me the Way to go Home," it would be quite possible for the publishers' association to send round notice that hereafter they would not allow this song to be sent out over the air, and although XYZ had already paid for the privilege of sending out this song (among others) it would have no redress nor be able to collect back any of the money it had paid for the privilege.

John Frazier

Of KDKA, deevelopment station of the Westinghouse Company, is the world's pioneer and veteran in the installation of outside pick-ups for radio work.

This same condition used to obtain way back when phonographs were young, and at that time composers would charge one company one price and another a different one for making the same records. This was so evidently unjust that Congress passed a law to govern the matter. Since that time manufacturers of phonograph records and piano player rolls all pay the uniform price of two cents apiece for all their reproductions.

The Association of Broadcasters has been trying to get a similar law passed to apply to radio. Some time ago this idea was broached to all the sending stations in this country with a request that they vote on it.

Only Eight Opposed

A report on the copyright ballots received showed that 181 stations had voted in favor of the association's copyright proposal, and eight stations against it. Upon motion made and seconded, the following resolution was unanimously adopted:

"Whereas, It was decided at the last meeting to submit the Association's copyright proposal to all broadcasters in the United States, and

"Whereas, This having been done, and 181 stations having voted favorably and eight stations unfavorably on the Association's copyright proposal; now, therefore be it

"Resolved, That this copyright proposal is declared to be the principle upon which the Association shall seek to settle the copyright matter; and be it further

"Resolved, That a committee of ten be appointed to present a resolution to the Hoover Conference containing the doctrine set forth."

Seventeen on Committee

As a result of this action the Fourth National Radio Conference Committee No. 9 on Copyright, under the Chairmanship of Congressman Wallace H. White, was composed as follows: E. C. Anthony, S. E. Baldwin, A. B. Church, Powel Crosley, Jr., W. E. Harkness, Wm. S. Hedges, Volney D. Hurd, Paul B. Klugh, H. E. Knight, Harry La Mertha, A. S. Lebee, E. F. McDonald, Jr., F. H. Pumphrey, David Sarnoff, C. H. Van Housen, Walter S. Greevy, E. N. Rauland.

Four sessions of this committee were held, during which representatives of the music copyright owners were heard, and answers made by the National Association of Broadcasters. After much argument and oratory, it developed that the copyright owners had no proposals to make which would fit in with the copyright policy adopted by the National Association of Broadcasters, and therefore the committee went into executive session. Congressman White made the following report:

All Interests Were Represented

The relations between copyright owners and the broadcasting interests were discussed by Mr. E. C. Mills, representing the American Society of Composers, Authors and Publishers; by Mr. William J. Brady, representing an association of theatrical producers; by Mr. Paul B. Klugh, executive chairman of the National Association of Broadcasters, and by other members of the Committee.

It was agreed by all interests that the owners of copyrights were entitled to reasonable compensation for the use of their copyrights, and the representatives of the broadcasting interests indicated a complete willingness to pay a reasonable charge for copyrighted numbers used by them.

They Could Not Agree

It appeared, however, that the parties were not able to agree upon the terms and conditions of use of copyrights. The Committee reached the conclusion that no good purpose would be served by undertaking to make a recommendation upon these disputed matters. The Committee, however, considered the principles which should control in the solution of this problem, and its conclusions are embodied in the resolution presented to the conference, a copy of which is attached hereto.

Attention is directed to the fact that this Resolution is applicable in terms only to musical compositions. The Committee did not undertake either in its deliberations or its recommendations to deal with copyrights of literary or dramatic productions nor of press matter. The resolutions adopted were as follows:

Music the Main Part

There can be no continuation of broadcasting unless musical compositions are made available to broadcasters upon a fair, equitable and permanent basis, and an insistent demand from the public requires that music be made the principal part of broadcast entertainment. Practically all of this music is held by copyright proprietors and is not available to broadcasters except on prohibitive and unstable terms.

The broadcasters recognize the right of the copyright proprietors to compensation for the use of their compositions and are willing to pay a fair and equitable maximum fee for each broadcast rendition of each copyright musical number, and they admit that copyright owners should have the sole, complete and entire right to withhold their property if they so desire; but if a copyrighted number is released by the owner to one or more broadcasters, then such number should become available to all broadcasters.

A Threat to Broadcasting

The present conditions threaten the entire broadcasting structure and the continuation and permanence of broadcasting depends upon the solution of this problem, and all attempted solutions through negotiations between the parties having proved unavailing through negotiation; now therefore be it

Resolved, That it is the sense of this conference that the only possible solution lies in the enactment of suitable legislation based upon the above principles, and it is the recommendation of this Conference to the Secretary of Commerce that such legislation be suggested to Congress.

SIXTY-TWO MEN COVER WHOLE UNITED STATES

The annual report of the Department of Commerce which has just come out shows how efficient their men have been. In spite of the small number of inspectors for the whole country radio conditions have been much improved owing to suppressing sources of interference.

On June 30, 1925, there were 15,111 licensed amateur stations as compared with 15,545 the previous year, according to the report. The number of class B stations increased during the year from 54 to 99. During the same period the class A stations increased from 378 to 468. The total expenditures of the radio services for 1925 amounted to $205,238, and the licensing and inspection work was done with a total field force of only 62 men.

On a Diet

"I'd like to see some shirts for my husband. Soft ones, please, the doctor has forbidden him anything starchy."—Los Angeles Herald.

HOW'S THIS PRESENT?

Do you like to find money? Most people do. We are going to tell you how you can find some every month.

Probably you like Radio Progress If you didn't you would not be reading this editorial. So many people are pleased with our magazine that they buy it in large quantities. So we have now reached the point where we can reduce the price.

Broadcast a Nickel

In that case you would naturally expect to pay ten cents a copy. We cannot really afford to put the price down to a nickel, but that is just what we are going to do the first of the year. You see we are depending on you to tell your friends about the remarkable price of such a magazine so that they will buy it in increasing numbers. If you want to continue to get it for five cents, be sure to broadcast the news, and then the increased sales will allow us to retain this low figure.

This reduction will take place starting the first of the year. And here's an idea for you. For a dollar a year you can send subscriptions to many of your friends, whose Christmas presents are now beginning to worry you. Every family who *has* a radio or who *wants* a radio (and who is left out?) will enjoy having a copy of Radio Progress twice a month.

Not as You Expect

The Editorial matter and the size of the issues will not be reduced as you might expect from such a radical cut in price. Instead the growth of circulation which will result will enable us to give you even better and bigger issues than before.

Such a present coming twice a month will be a reminder of you right through the year and will please anyone who has an interest in radio and broadcasting. To make it easy for you to send away subscriptions, we print at the bottom of the page a subscription blank which you may use. Fill this out right away so that there may be no delay in starting the magazines to your friends.

WHY MIDNIGHT

Many people who like dance music are asking why it is that so many of the broadcasting stations wait until the hour from 11 to midnight for putting forth their best efforts along this line.

It is indeed a fact that any station which has both classical and dance music on its program the same evening is quite likely to devote the early hours to the former and reserve the late time for the gayer performance. But there is a good reason for this.

Jazz in Bloom

In fact, we might say that there were two reasons, both good. In the first place, radio is not like the manufacture of gas which can be made all day long and stored in a big tank to be used in the evening. In order to broadcast a good snappy number it must be played at that instant. And you will find that the fun begins in most of the better class night clubs and cabarets after 10 o'clock. When the the-

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atres let out is the time that jazz comes to full bloom.

That means that if you want to hear the most popular orchestras and bands you must necessarily wait until late in the evening before you can shake a foot in time to their syncopated music. Some few may start running at 8 o'clock, but they are not likely to be the most popular ones.

those who will like them best.

It is well known that of those who retire at 10 o'clock the majority *will not* be the youngsters. But Grandma wants to turn in early, and so we must give her the more sedate music, which she wants early in the evening. When the young people get home from their dates will be a good time to start playing the melodies which make

RADIO A ROYAL RECREATION

Lady Diana Manners, who portrays the "Madonna" in "The Miracle," the great mystery play now being given in this country, is an ardent radio fan. She is shown tuning-in with a Trirdyne.

Doing the Charleston

The other reason which is equally good is the difference in musical taste between 16 and 60. Where do you find the young chap or flapper who really appreciates the grand operas? And by the same token, how many grandmothers want to get up on the floor and do the Charleston? If we are to have programs which include both classical and jazz music we naturally fall time them to the habits of their feet itch. And that is another good reason for postponing the dance tunes till later.

SENT TO PRISON

Why do we send criminals to prison? The old idea seems to have been that we wanted to get even with them.

Nowadays everything is done to try to make them normal human beings who will not go wrong again when they are released. That is also the theory of the indeterminate sentence, which gives a man, say from two to four years, depending on his behavior.

In Touch with World

Along these lines radio has had a prominent part. Many of the prison authorities are allowing loud speakers to cheer up the prisoners and keep them in touch with the outside world. In this way the inmates feel that they are still living on earth and have their interest aroused in the life which they expect to take up again when they have finished their time.

Recently there has been another angle in this humanizing process. It is well known that a mischievous boy can often be kept out of trouble by giving him some responsibility and something to do. The same thing applies to the grown-up boys behind the bars. If they get a chance of self expression in a way which those outside can appreciate, there is a big chance that they will profit by it.

Programs by Prisoners

Recently the Eastern State Penitentiary at Philadelphia has allowed the prisoners to do some broadcasting through station WIP. Knowing that they would have the opportunity to get their voices at least outside the walls there has been keen competition among those musically inclined. A number of good singers and instrumental players were selected and for the fifth time the Penitentiary put out a broadcast concert.

Everybody hearing these special programs is naturally touched at the thought that the performers are doing their best to overcome their weakness so that they will not fall before their temptations when they come out. Perhaps that is one reason, as well as the excellence of the music, why there has been such a general response in the way of applause cards.

There is no doubt but the chance to show what they can do and also the large applause received has given a great moral benefit to these men. It is one of the signs of the times and shows in how many ways radio is affecting our civilization.

Coil Calculations

Formulas Which Will Help You Pick Out the Right Winding

By HARRY A. NICKERSON, Boston, Mass.

CAN *you* change a tire when the old one is worn out? You ought to be able to change a coil in your radio set if you find that it is superceded. Or perhaps you will want to try some experiments in picking up the new high frequency (short wave length) vibrations which are being sent out.

The exact formulas for calculating the inductance or electrical weight of a coil are very complicated and hard to work if you want absolute accuracy. However, in a radio set you always have a chance to vary some adjustment like the condenser, and so an exact value to a fraction of a per cent is unnecessary and even foolish. The formulas which are given in this paper are accurate enough for the purpose, although they do not claim to be rigorous.

Electrical Weight of Coil

To start with, the *value* of a coil used in radio is measured in "inductance" or electrical weight. Just as two pounds are twice as much as one pound of avoirdupois, so an inductance of two henries is twice as much as one. The electrical weight of the coil does not depend on its value in pounds. For instance, a coil wound of lead wire would weigh a great deal more than one of copper, but its electrical weight would be exactly the same provided the spacing and size was identical.

The unit of inductance or electrical weight is one henry. However, this value is very large indeed. Just as a mile is too big to measure the size of the ordinary room, and we use 1/5280th of it (one foot) so it is convenient to use a fraction of the henry for ordinary measurements. But instead of dividing it into such a queer figure as 5280, we split it up into 1,000 equal parts, each called a millihenry.

Meet Milli and Micro

Even this value of 1/1000th of a henry is too big for some measurements, and we split the unit into 1,000,000 parts called microhenries. Thus three millihenries equals 3/1000 henry or 3000 microhenries. The abbreviation, "mh," is usually used for millihenry, although some people use it also for the smaller value.

The capacity of a condenser is generally found measured in microfarads (mfd.) or in micromicrofarads (mmfd.), "micro" meaning "one millionth," and "micro-micro" meaning "a millionth of a millionth," (of the *farad*, or unit of capacity.)

In looking up books on the subject of coils you will often find that the figures are recorded in the form of straight line diagrams called "nomograms." These look like thermometer scales and the answer is found by drawing a straight line between two points on the scale. Where the line crosses a third line is the figure you are seeking. Instead of drawing a pencil line it is usually convenient to lay a ruler or even the edge of a piece of paper from point to point to find the intersection.

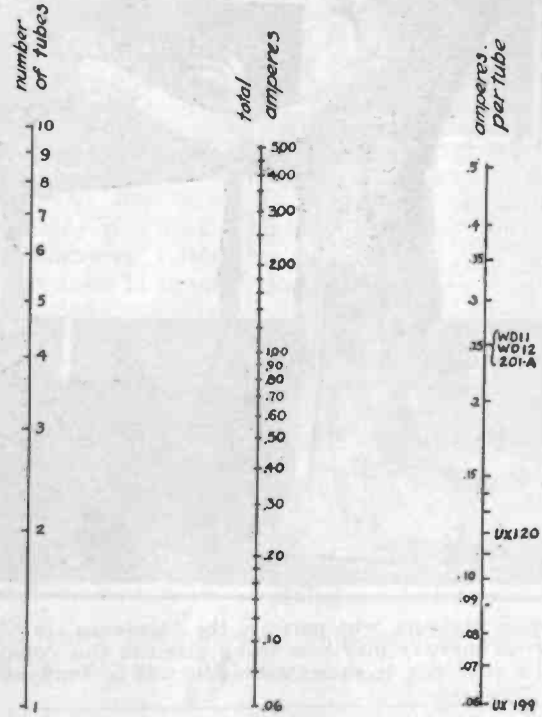

Fig. 1. This is Called a Nomogram. It Will Calculate the Current Your Radio Takes. Lay Ruler Across.

How to Work Thermometers

Thus in Fig. 1 we have a nomogram showing how much current is taken by the filaments of a radio set. The left hand thermometer shows the number of tubes in the set, while the one on the right reads the current per tube. By drawing a line connecting the two points, the total current of the set appears on the middle line. For instance, suppose you have two tubes, style 199, which each take .06 ampere of current. Lay a ruler from 2 on the left to .06 on the right, and you will find that the total current is .12 on the center line.

Among the more elaborate treatments of coil design are: *Prepared Radio Measurements*, by Ralph Batcher, in book form with cloth covers, costing approximately $2.00. This contains a great deal of helpful data, chiefly in the form of nomograms, as just described.

Throw Up Your Hands

A certain amount of time and a preliminary understanding of the directions are required for use of these nomograms, but there is no reason why the average reader should throw up his hands and use that much abused word "too *technical*," when referred to a nomogram. Questions, the answer to which may not be found in this article, may usually be answered in Batcher or in one of the following:

Lefax Radio Handbook. The extensive tables and formulas of Lefax are very valuable possessions. It should be noted in using the tables, as in others, that the outside diameters (including insulation) of magnet wires of different manufacturers may differ somewhat, and that the "homewound" coil as a rule does not contain as many turns to the inch as the "machine wound" coil.

How Much You Don't Know

Radio Instruments and Measurements. (Circular 74 of the Bureau of Standards) This may be procured by sending postal money order (60c) to Supt. of Documents, at the Government Printing Office, Washington, D. C. Formulas for calculation of inductance for rectangular, bank-wound, toroidal wound, and other types of coils are given. Other publications of the Bureau, such as Rosa and Grover's "Formulas and Tables for the Calculation of Mutual and Self Inductance," (Sc. Paper 169, 20c) are along the same lines as Circular 74. If the publications of the Bureau of Standards do nothing else, they are quite likely to make the ordinary radio fan realize how little is his radio knowledge.

Popular Radio (March 1923) article by Raoul J. Hoffman, with nomograms, describes how, having three of the following the fourth may be obtained,—1. Inductance in microhenries, 2. Diameter in inches, 3. Size of wire, 4. Number of turns.

Radio Broadcast (May 1925) and *Radio* (San Francisco, April 1925) also contain monograms where having three of the four factors following, the fourth may be readily computed—1. Inductance in microhenries, 2. Diameter in inches, 3. Size of wire, 4. Number of turns (or length of winding).

The foregoing represent some of the sources of reference, as it were, to be used in solving problems not answered in the tables given hereafter.

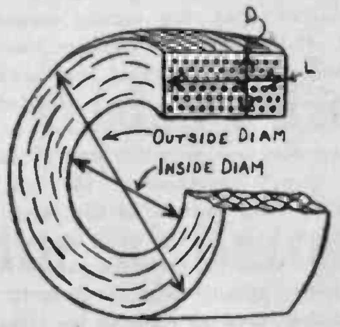

Fig. 2. This Shows the Way to Measure the Coil

Table for Usual Coils

In looking over the size of tube for a winding form as specified in most construction articles on radio, it seems that a three-inch diameter is a fairly average size. Also the specified weight of the coils or inductance usually runs from .200 millihenries (mh.) down to .150 mh. Here is a table showing the amount of wire to be used for various sizes which are common. Both the number of feet and the number of turns on these three-inch tubes are given.

Inductance	.20 mh.		.17 mh.		.15 mh.	
Wire No.	Ft.	Turns	Ft.	Turns	Ft.	Turns
16	53	67	47	60	43	55
18	47	60	43	55	39	50
20	43	55	40	51	36	46
22	40	52	37	48	34	44
24	37	48	35	45	32	42
26	35	45	33	43	31	40

The value of inductance using a diameter of tube slightly different from above may be approximated by using the same number of *feet* specified of the particular size wire, wound on the tube of different diameter.

Finding Turns Per Inch

When winding wire it is well to know how many turns you can get per inch as measured along the tube. Using single cotton covered, we have the following figures:

Size wire No. 18	20.2 turns per inch
20	25.8
22	31.6
24	36.0
26	45.0

In using single layer coils or solenoids it is often desirable to know what the inductance is per inch of length for various windings. Here is a table for single cotton covered wire as wound on 3, 3½ and 4-inch tubes. The wire sizes vary from 18 to 26.

	Wire Size				
Tube Diam.	18	20	22	24	26
3.0 in. ...	.039	.063	.096	.125	.195 mh.
3.5 in. ...	.049	.080	.120	.155	.243 mh.
4.0 in. ...	.059	.096	.145	.187	.291 mh.

Note that in above a change in inductance must be figured for other diameters of single cotton covered wire or for other coverings,—thus D. C. C. would make a decrease in inductance owing to its thicker insulation.

Twice Turns Four Times Weight

In coils with several layers of wire, as shown in Fig. 2, when the axial length is kept constant, then the inductance varies as the *square* of the number of turns. Thus if you wind on double the turns by doubling the number of layers you get not twice, but four times, the number of millihenries. But in single layer coils where the length must vary as the number of turns the inductance goes up only a little bit faster than the number of turns.

Thus for a coil length of two inches we must multiply the above table by 2¾, while if the size is three inches we multiply it by 4¾. This table with the corrections for other lengths will be found of great value for a hurry-up job.

A certain type of coil, similar to a honeycomb, has been given an inductance value by the maker as follows:

.160 mh. for 50 turns.
.350 mh. for 75 turns.
.600 mh. for 100 turns.

But in the writer's experience, the foregoing values of inductance for the average make of honeycomb seem high.

Want to Play Safe

For broadcast reception the usual coil specification, when shunted by a .0005 mfd. condenser, is an inductance of from

.180 to .200 mh., which seems a little too high. This perhaps may be due either to a desire to be "on the safe side" of 550 metres, or to reach ship code on that wave, or because some variables may not quite reach their full rated capacities of .0005 mfd.

Various nomograms and the usual formulas for calculation of inductance give just about .173 mh. as being necessary to tune to 550 metres, and .205 mh. to .600 metres, with a .0005 mfd. condenser. With .00025 mfd., double the foregoing inductances are necessary, to reach 550 and 600 metres,—namely, .340 and .410 mh. Approximately .243 mh. and .285 mh. are necessary when using the usual 17-plate (.00035 mfd.) in shunt.

Look Out for Square Root

If you keep the same coil and use a smaller condenser whose capacity is only half then by thus cutting this capacity to 50% you reduce the maximum wave length you can reach not to 50 but to 71% of its former value. This is because the wave length varies as the square root of the capacity. To be exact not the value of the condenser only but the total capacity of condenser and wiring should be counted.

With the ordinary condenser having semi-circular plates half the wave length range will be found on about one-quarter of the scale. This ratio is exact if the condenser contains all the tuning capacity. However, the effect of wires and connections modifies this slightly. It is this crowding of the scale at the lower end which has caused the development of the straight line wave length models of condenser. With such a unit the wave lengths are equally spaced. But since the Government assigns stations with equal separations of frequencies (not wave lengths) you will still find the stations somewhat crowded at the lower end. The remedy is to use a straight line *frequency* condenser which gives uniform spacing of all stations.

Useful Wire Tables

The following figures were selected from the tables of wire manufacturers as being of special use to broadcast coil design:

In a half pound of magnet wire of double cotton covered and double silk covered insulation:

			Turns in 1 In.	
No.	Ft. D.C.C.	D.S.C.	D.C.C.	D.S.C.
16	61	63	16.7	18.2
18	96	100	19.6	22.3
20	148	158	24.5	27.5
22	231	249	30.0	34.0
24	358	393	35.5	41.5
26	547	617	41.8	50.2

The number of turns used to wind a coil in a certain circuit in order to reach a given minimum frequency (maximum wave-length) with a certain special variable condenser may be figured with great care and apparent accuracy but may not be found correct in practice. It is very difficult, for instance, to determine the effect of antenna, ground, lead in, and "untuned primary" capacities and inductances upon the tuning secondary coil. It is evident, for instance, that the highest frequency (lowest length wave) to which a given inductance shunted by a variable condenser will "tune" is affected not only by what may be called the "pure" inductance of the coil but also by such matters as the capacities between leads to the coil; by the distributed capacity, (between turns of the coil), by capacity between leads to the condenser, between leads to the coil, between grid and filament terminals in tube, and even between coil and ground; and of course, the minimum capacity of the variable condenser itself.

Fitting it to the Band

The fact that a well built coil and shunted .0005 mfd. variable permits a tuning range from say 190 to 600 metres, allows considerable variation in the number of turns permissable in the winding to cover 200-550 metres, as now required for reception of broadcasting. When a 17-plate variable is used, the coil must be more carefully designed. With the 11 or 13-plate, unless the various capacities which go to make up the actual minimum capacity in circuit, (of which capacities of course, the variable condenser minimum is an important one) are kept low and the coil itself is carefully designed, the 200-550 metre band may not be covered.

Naturally the usual tables and data published do not take account of such matters as untuned primaries and antenna capacities as affecting the maximum-minimum of inductances shunted by variable condensers. For the fan who wishes KSD, at St. Louis, at 550 kc. (545 metres) to come in at just about 100 on the condenser tuning dial, when using his particular antenna and associated apparatus, a "cut and try method" is suggested as follows:

Wind on Too Much

When first winding a coil to be used as the tuning inductance for your circuit, wind a few more than the probable number of turns required. Fasten the loose end temporarily, such as by spreading apart the coil winding, say 15 turns from the last turn wound, then inserting the loose end down between the spread-apart turns and through a hole drilled in the tube form on which we will suppose the whole coil is wound.

Let us imagine the coil under test is to be used with a neutrodyne or similar set, as the secondary of a tuned r.f. transformer, or as the secondary winding of a variocoupler in a double circuit regenerative set. Solder a sharp fine-pointed pin to the grid return wire.

This is the one which runs from the secondary of the coil back to the grid or to the potentiometer or "C" battery if used. Make all connections in the set except the grid return wire at the pin, where it connects to the coil. Then put set in operation. Push the pin through the insulation of the wire at different points until the exact point desired is found. If KSD is regarded as the maximum and is audible on the set, the proper location of the pin is an easy matter; if some other station operating below 600 kc. (above 500 metres) can be tuned in, the number of points on the condenser dial necessary to reach KSD can be allowed for, using the known station as the starting point. With the newer straight line frequency type of condensers, it is quite easy to calculate the maximum range, from a known frequency higher than the minimum.

One method of making the "click" test, for location of a particular wave length is as follows: Set the tube in another set oscillating at a known desired wave length. Place the coil under test so the magnetic axis or end of this coil is close up to the magnetic axis of the tuning coil in the oscillating grid circuit. Find the setting of the condenser shunting the coil under test which causes a decided change in tone of the oscillating set, a sort of "hollow" between the distorted peaks of oscillation. This hollow or change of tone is sometimes called a "click" because it comes sometimes abruptly with a click.

Continued on Page 36.

℞ 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. How is the best way to arrange an inside aerial running around the room? Is it better to make a complete loop?

Answer. When running an inside aerial, much depends on the size of the room. In general it is not desirable in such a case to use more than 75 or 100 feet including the lead-in. If the room is a large one, a single turn around the four sides will do, stopping the upper end about one foot from the lead-in. If the room is small, you may do better to take two complete turns around it. In any case, do not solder the upper end of the wire back on itself to make a loop around the room.

In such a case the result is that the incoming radio waves do not circle the room, but go direct by the nearer route to the lead-in, so in that case the length of the wire is largely lost. The separation between the upper and lower turns if two are used, should be at least five or six inches.

Question. There is a rapid tapping noise in my set. What is the probable cause?

Answer. This is probably due to the fact that your grid leak is adjusted for too high a megohm resistance. The negative electrons which strike the grid cannot leak off fast enough, and as a result block the tube and stop it working. This is an opportunity for the piled up charge to be conducted away through this resistance and then the tube starts oscillating again. This, in turn, blocks the tube and this action is repeated over and over again for perhaps several times each second. Whenever the tube starts and stops oscillating, it makes a little click in the receiver, and this repeated over and over again rapidly gives the knocking noises which is the one you probably hear.

The remedy is to adjust for lower leak resistance if you have a variable unit, or to substitute a cartridge with the lower resistance if you use the fixed type. Of course in an extreme case, the grid lead may be open circuited, which gives practically an infinitely high value of grid leak.

Question. What is the ordinary polarity of the jack used in a radio set?

Answer. With some types of loud speaker it makes no difference which terminal is connected with the plus and which the minus of the "B" battery. However, others will work very much better with the correct polarity. It is customary to attach the positive lead of the speaker to the long shank of the phone plug, and the negative to the tip. It is easy to remember this by the fact that a plus sign (+) is considerably bigger than a minus (—) and the big sign is connected to the big piece of metal. Of course, the jack must be hooked up to the "B" battery so that it corresponds with the plug as just outlined. All manufacturers, who are careful of details, observe this conventional arrangement and so with them a loud speaker may be plugged in correctly on any set.

COIL CALCULATIONS

Continued from Page 34.

Dead End Weakens Coil

The actual inductance of say a 50-turn untapped coil is less than that of 50 turns tapped off say a 60-turn coil, due to the action of the 10-turn "dead-end" on the 50-turn portion. This fact should be borne in mind when making the "click" test.

If you wish to calculate the inductance of a single layer coil one of the formulas giving approximate results is as follows:

$$L = K \times L \times D^2 \times N^2$$

In this formula L is the inductance in microhenries which you remember is the thousandth part of a millihenry. To convert your answer to millihenries you must divide it by 1,000. D is the diameter of the coil in inches. N is the number of turns per inch, (not the total number of turns) L is the length of the winding in inches. K is a constant which depends on the dimensions of the coil. By dividing the diameter by the length you may substitute in the following table to obtain K.

Diam. / Length	K	Diam. / Length	K
1/20	.025	2	.013
½	.021	3	.011
1	.017	4	.009
1½	.015		

This formula will be found very useful since dimensions are in *inches* rather than *centimeters*, thus offering advantages over the usual so-called "Nagaoka" formula which has dimensions in centimeters.

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.
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O....1200-250- 500
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
KFGC—Louisiana State Univ., Baton Rouge, La..........1120-268- 100
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- 225
KFKU—University of Kansas, Lawrence, Kans..........1090-275- 500
KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb...1040-288-2000
KFLR—University of New Mexico, Albuquerque, N. Mex.1180-254- 100
KFLV—Swedish Evangalical 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
KFMX—Carleton College, Northfield, Minn.......... 890-337- 500
KFNF—Henry Field Seed Co., Shenandoah, Iowa.........1130-266- 500
KFOA—Rhodes Dept. Store, Seattle, Wash.......... 660-454-1000
KFON—Echophone Radio Shop, Long Beach, Cal....... 1290-233- 100
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
KFPG—K. M. Turner Radio Corp., Los Angeles, Cal....1260-238- 500
KFPR—Los Angeles County Forestry, Los Angeles, Cal...1300-231- 500
KFPY—Symons Investment Co., Spokane, Wash..........1130-266- 100
KFQB—Searchlight Publishing Co., Fort Worth, Texas...1140-263- 150
KFQU—W. E. Riker, Holy City, Calif..........1380-217- 100
KFRB—Hall Bros., Beeville, Texas..........1210-248- 250
KFRU—Stephens College, Columbia, Mo.......... 600-500- 500
KFSG—Echo Park Evangelistic Asso., Los Angeles, Cal...1090-275- 500
KFUM—W. D. Corley, Colorado Springs, Colo..........1240-242- 100
KFUO—Concordia Seminary, St. Louis, Mo.......... 550-545- 500
KFUT—University of Utah, Salt Lake City, Utah.......1150-261- 100
KFVE—Film Corporation of America, St. Louis, Mo.....1250-240- 500
KFVW—Airfan Radio Corporation, San Diego, Cal.......1220-246- 500
KFWA—Browning Bros. Co., Ogden, Utah..........1150-261- 100
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
KGB—Tacoma Daily Ledger, Tacoma, Wash..........1200-250- 100
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
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

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

KSAC—Kansas State Agric. College.......... 880-341- 500
KSD—Post-Dispatch, St. Louis, Mo.......... 550-545- 750
KSL—The Radio Service Corp., Salt Lake City, Utah....1000-300-1000
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.......... 800-375- 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
WAAF—Chicago Daily Drovers Journal, Chicago, Ill.....1080-278- 200
WAAM—I. R. Nelson Co., Neark, N. J..........1140-263- 500
WAAW—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., Medf'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
WBAO—James Millikin University, Decatur, Ill..........1110-270- 100
WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex. 630-476-1500
WBAV—Erner & Hopkins, Columbus, Ohio..........1020-294- 500
WBBL—Grace Covenant Church, Richmond, Va..........1310-229- 150
WBBR—People's Pulpit Assoc., Rossville, N. Y..........1100-273- 500
WBCN—Foster & McDonnell, Chicago, Ill..........1130-266- 500
WBES—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
WCAH—Entrekin Electric Co., Columbus, O..........1130-266- 500
WCAJ—Nebraska Wesleyan Univ., Univ. Place, Nebr....1180-254- 500
WCAL—St. Olaf College, Northfield, Minn.......... 890-337- 500
WCAO—A. A. & A. S. Brager, Baltimore, Md..........1090-275- 100
WCAP—Cheaspeake & 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
WCEE—Liberty Weekly, Elgin, Ill..........1090-275-1000
WCLS—H. M. Couch, Joliet, Ill..........1400-214- 150
WCSH—Congress Square Hotel Co., Portland, Me.......1170-256- 500
WCUW—Clark University, Worcester, Mass..........1260-238- 250
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 College, Winter Park, Fla..........1250-240- 100
WDBR—Tremont Temple Baptist Church, Boston, Mass.1150-261- 100
WDCH—Dartmouth College, Hanover, N. H..........1170-256- 100
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, Columbia, Ohio..........1020-294- 500
WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio... 770-389- 750
WEAU—Davidson Bros. Co., Sioux City, Iowa..........1090-275- 100

Station	K.C.	W.L.	W.P.
WEBC—Walter C. Bridges, Superior, Wis.	1240	242	100
WEBH—Edgewater Beach Hotel Co., Chicago, Ill.	810	370	1000
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
WFBI—Galvin Radio Supply Co., Camden, N. J.	1270	236	250
WFBL—Onondoga Hotel, Syracuse, N. Y.	1190	252	100
WFBM—Merchant Heat & Light Co., Indianapolis, Ind.	1120	268	250
WFBR—Fifth Infantry, Maryland N. G., Baltimore, Md.	1180	254	100
WFDF—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
WFRL—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
WGBQ—Stout Institute, Menomonie, Wis.	1280	234	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—Coyne Electrical School, Oak Park, Ill.	1200	250	500
WGHB—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 Techonology, Atlanta, Ga.	1110	270	500
WGY—General Electric Co., Schenectady, N. Y.	790	380	5000
WHA—University of Wisconsin, Madison, Wis.	560	535	750
WHAD—Marquette Univ. and Mil. Jour., Mil., Wis.	1090	275	500
WHAG—University of Cincinnati, Cincinnati, O.	1290	233	100
WHAM—University of Rochester, Rochester, N. Y.	1080	278	100
WHAP—William H. Taylor Finance Corp., Brooklyn, N. Y.	1250	250	100
WHAR—Seaside Hotel, Atlantic City, N. J.	1090	275	500
WHAS—Courier Journal & Louisville Times	750	400	500
WHAT—George W. Young, Minneapolis, Minn.	1140	263	500
WHAV—Wilmington Elec. Specity 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	570	526	5000
WHT—Radiophone Broadcasting Corporation, Deerfield, Ill.	1260	238	1500
WIAD—Howard R. Miller, Philadelphia, Pa.	1200	250	100
WIAS—Home Electric Co., Burlington, Iowa	1180	254	100
WIBA—The Capital Times Studio, Madison, Wisc.	1270	236	100
WIBC—L. M. Tate Post No. 39, V.F.W. St.Petersburg, Fla.	1350	222	100
WIBO—Nelson Brothers, Chicago, Ill.	1330	226	1000
WIBW—L. L. Dill, Logansport, Ind.	1360	220	100
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
WJAK—Clifford L. White, Greentown, Ind.	1180	254	100
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
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. J.	660	454	1000
WKAA—H. F. Paar, Cedar Rapids, Iowa	1080	278	500
WKAF—WKAF Broadcasting Co., Milwaukee, Wis.	1150	261	250
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
WLAL—First Christian Church, Tulsa, Okla.	1200	250	150
WLB—University of Minnesota, Minneapolis, Minn.	1080	278	500
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 / 5000
WLWL—Mis. Soc. of St. Paul the Apostle, New York	1040	288	1000
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
WMBC—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
WNAB—Shepard Stores, Boston, Mass.	1200	250	100
WNAC—Shepard Stores, Boston, Mass.	1070	280	500
WNAD—University of Oklahoma, Norman, Okla.	1180	254	250
WNAP—Wittenberg College, Springfield, Ohio	1090	275	100
WNAT—Lennig Bros. Co., Philadephia, Pa.	1200	250	100
WNBH—New Bedfrod Hotel, New Bedford, Mass.	1210	248	250
WNJ—Radio Shop of Newark, Newark, N. J.	1290	233	100
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
WOI—Iowa State College, Ames, Iowa	1110	270	750
WOK—Neutrowound 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
WPCC—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., Parkesburg, 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
WRAK—Economy Light Co., Escanaba, Mich.	1170	256	100
WRAM—Lombard College, Galesburg, Ill.	1230	244	100
WRAV—Antioch College, Yellow Springs, Ohio	1140	263	1000
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	100
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.	1150	261	350
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	5000
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., Nasbville, Tenn.	1060	283	1000
WSMK—S. M. K. Radio Corp., Dayton, Ohio	1090	275	500
WSOE—School of Eng'rng 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
WTAT—Edison Illum'ting Co., Boston, Mass., (portable)	1230	244	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	266	500
WWJ—Detroit News, Detroit, Mich.	850	353	1000
WWL—Loyala University, New Orleans, La.	1090	275	100

*Additions and corrections.

Start the New Year Right With These

Many broadcasting stations have a slogan of their own. One of the very up-to-date studios will be described and photographs given of some of its well-known personalities. See **"Southern Gateway of New England,"** by Riley, in our next issue.

We are finding a great deal of interest displayed in the New Fast Waves which are now getting to be all the rage. One of the chief advantages of them is that Old Man Static does not seem to disturb them much. However, you do not see very many articles telling how to experiment with this new development. If you want to keep up with the times see what Rados says in **"Experimenting on Very Fast Waves."**

You can't play the piano unless you know how. Many people think that they can tune in distant stations without any instruction. Such fans will be surprised when they read Palmer's **"Hints on Sharp Tuning."**

Harvey, the well-known cartoonist, has been drawing funny radio strips for us for a long time. You will be surprised to see what a bright and witty style he has when it comes to writing. His **"The Izzy A. Nutt Family"** will provoke a laugh even from a loud speaker.

Marks has recently been studying one of the most popular hook-ups for selectivity which has been built by fans. It already has worked so well that it seems unlikely that it could be made any better. But improvements have been found and these are described in a construction article, **"A Modified Roberts Hook-Up."**

"Five 'Genes' in One Station"—That seems a funny title for a radio article. Yet Vance has been able to give a very readable account of an extraordinary coincidence which has happened at one of the popular studios.

The theory of loud speakers is still being developed. Many of those on the market are now very good in the upper ranges and others are equally efficient at the lower part of the scale. But what we want is one which will take either a high or low note and reproduce them both with equal volume. How this is being done in a new development is described by Connet in **"A Soprano-Bass Loud Speaker."**

One of the most extraordinary developments in radio will help to prevent fires in ships at sea. It has many other uses like testing automobile headlights. This will be described in detail in our January first issue by Taylor in **"The New Electric Eye."**