August 1, 1925
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RADIO PROGRESS

"Always Abreast of the Times"

In This Issue

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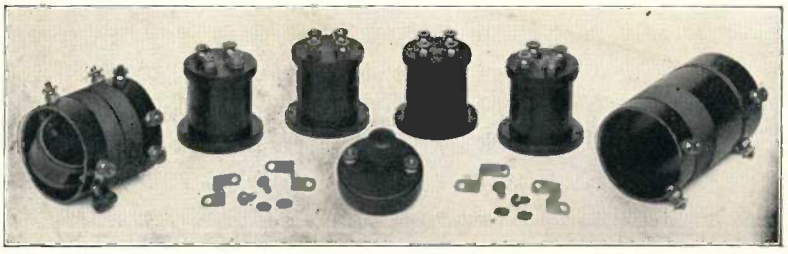

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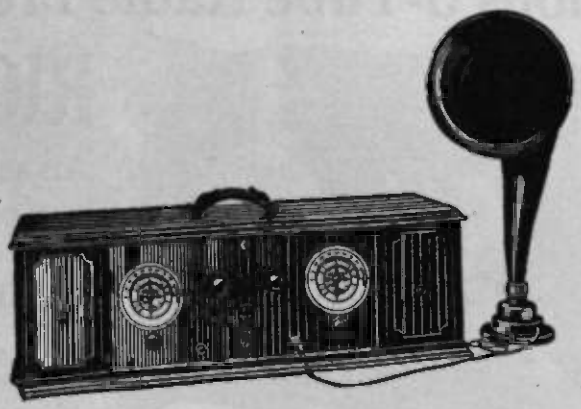

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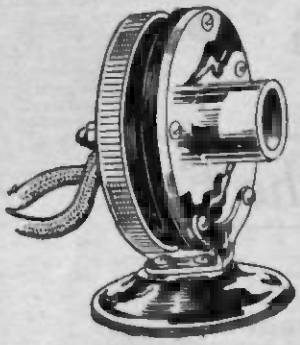

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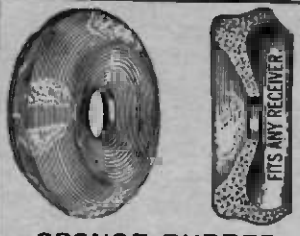

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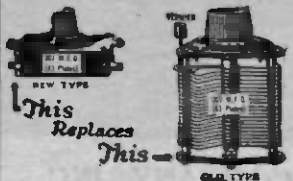

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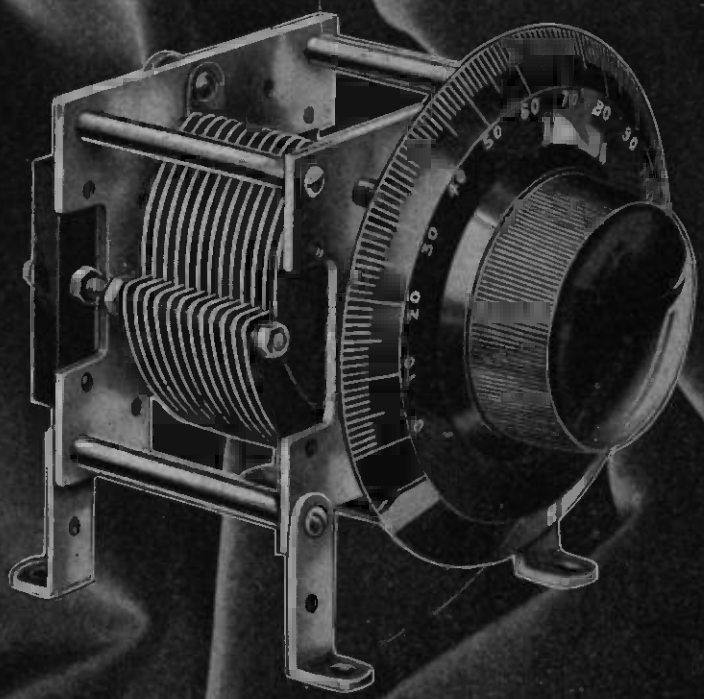

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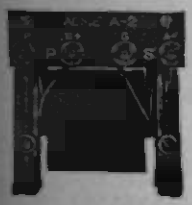

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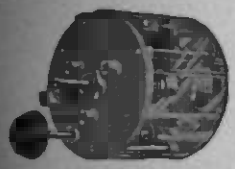

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RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 2 Number 10

Contents for

AUGUST 1, 1925

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Stand By, Please, for Our Next Issue

You know how dependent ships are on radio if there is an accident at sea. But a much more common use of this science is made for the benefit of the passengers every day. A daily sheet is published giving the world news for the benefit of those on the vessel. This is described in the August 15th number by Vance in **"A Radio Newspaper on Shipboard."**

Of course any set **must** have aerial, detector, condensers, etc. What is the most valuable accessory outside these absolute essentials? It is probably an instrument for measuring wave frequency and length, dial position for stations, value of condensers, coils and resistance. **"Build Your Own Radio Meter"** by Rados will explain not only how to use such a device but how to make it.

It is always interesting to see how the other fellow does it. In Germany sending stations and systems have developed different lines from ours. McClatchie has studied the situation abroad and gives us the benefit of his experience in **"German Broadcasting Not Like Ours."**

Much has been written about reducing static in the summer time, although a great many of the articles don't mean much. We have a write-up by the eminent authority, Goldsmith, which gives some real facts—**"Shaving Static From Your Signals."**

How does radio work on top of a high mountain? Do the broadcasting waves penetrate to the bottom of the Grand Canyon? Palmer made a trip across the continent to find out some of these facts and has described them in **"Peak and Canyon Trip With Radio."**

As a government experiment with high speed (short) waves it looks as if the broadcast range might be further extended to include a broader band of waves. This will make it desirable to have a set which is not limited to a short range. Smith's article **"A New Type of All Wave Set"** gives the building details of a receiver which will pick up everything.

The lightning arrester is very necessary at this time of year. It is also required by the insurance companies. It sometimes, however, has a very bad effect on your radio set. How this occurs and why is told by Taylor in **"Watch Your Lightning Arrester."**

RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 2, No. 10 AUGUST 1, 1925 15c PER COPY, $3.00 PER YEAR

Why Some Waves are Hard to Lose

It May or May Not Be the Fault of Your Set

By HORACE V. S. TAYLOR

YOU have probably heard of persons who would strain their ears for hours at a keyhole to be able to listen to a conversation they weren't supposed to hear. But no radio fan can be called an intentional eavesdropper.

Many a time our sets will pick up a program from some station that we don't want to get and the numbers from the fainter broadcasts are smothered. Do you remember the famous statesman who was approached by a man selling a course of memory training. He would not buy because he said he wanted to be taught not how to remember but how to forget.

Learning to Forget

In the same way with over a hundred class B stations any one of which can be heard over half the United States, it isn't so much a question of how to pick up good programs as it is to lose the ones which you have and don't want. Anyone living within 10 or 15 miles of a powerful sending station will realize how much easier it is to pick up a big list of distant stations on the nights when the local is silent.

Of course this is one of the main reasons why a station is hard to tune out. It is the power in the wave striking your aerial which counts. This strength is made up with two considerations. The first one is that of the original power at the sending station and the second is how far away from you that station lies. Fig. 1 shows this idea; at the left is seen a large class B sending station which is located 50 miles away from your radio set. At the right is a small class A station which is only 10 miles distant.

Distance Cuts Them Down

Of course the waves from the big broadcaster are much more powerful when they come from the aerial than those from the small, and this is indicated by the size of the waves as shown in the sketch. However, owing to the big distance which the left hand waves must travel they are reduced to a small fraction of what they were at the start. Naturally the same sort of action goes on at the right, but owing to the fact that distance is so much less in this case the reduction is also not nearly so noticeable.

From this you can see that if the spacing of two stations happens to be adjusted exactly right for their amounts of power then your radio receiver will pick them up with the same loudness although they are not at all alike to listeners who may be located in the local town of each transmitter. The point here is that it is the size (volume) of the wave *at your aerial* which determines how loud the music sounds.

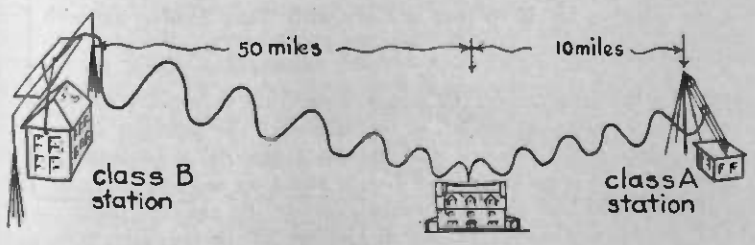

Fig. 1. A Big "B" Station Far Away May Give Same Wave as Small "A" Sender Near By

Dial Like Line of Soldiers

It is naturally the *powerful* wave in your aerial which is difficult to tune out. Such a signal can be heard over a broad band of numbers on your tuning dial. In this respect it is like a company of soldiers. Fig. 2 shows a line of men standing side by side. In front is the captain talking to his aid. They speak in low tones or a whisper with the result that only the men nearest them can hear what they say. Later on they start talking in their natural voices and so it follows that they are heard over a much wider range. But when the captain shouts an order the entire company is able to pick it up. This corresponds exactly to the numbers on your dial.

Fig. 2. Loud Waves Cover More Degrees on Dial Than Soft Ones Do

You may wonder why a set which is able to tune out a certain station so that

it cannot be heard at all when 100 miles away is picked up so loudly at, say, 25 miles. Perhaps the waves are four times as powerful as they were at the greater distance but four times nothing is nothing and so you might expect that you would still be able to tune out the unwanted program at the shorter distance.

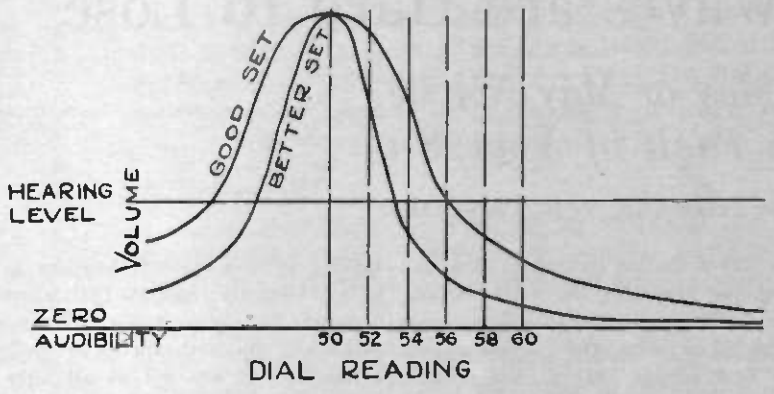

Fig. 3. The Better Set is Much Softer When Thrown Slightly Out of Tune. At 53 it Disappears

No Station Really Tuned Out

The reason is that no station is ever tuned out to *absolute zero*. If you bring a station in at, say, 50, on your main dial, and then you turn to 52, (see Fig. 3), it naturally is not so loud. The upper curve, which represents a good average set, will have fallen off in loudness quite a great deal. The better set, which is the lower curve, will have reduced the volume still more, owing to its greater selectivity. Notice that the volume of the better set has been cut to half what it was when tuned in exactly.

Here a point should be made. The volume, as recorded, is not that of sound which you *hear*, but tones as actually given off by the phones or loud speaker. You no doubt know that there are a great many noises which are so faint that your ears do not pick them up, whereas those of a dog will hear them clearly. Another breed of dog, with still sharper hearing, will be able to catch even fainter sounds. And so it goes. It requires a certain amount of vibration (which is often called the "threshold" value) in the air to make our ears respond and our brains realize that there is any noise at all.

How Hearing Level Counts

This hearing level is indicated in Fig. 3. When the volume rises above this line our ears pick up the program, but when it drops below, we do not know there is anything going on. Although turning the dial to 52 has cut the actual volume (as measured from the top of the curve to the zero line) down to half, it has reduced the part which is actually heard and which is shown above the hearing level to about one-quarter.

Comparing these two different sets you will see that although they are equally loud at 50 when they are in tune with the incoming wave still one is twice as selective as the other. The better one has the offending station reduced to the hearing level (zero loudness) at 53 on the dial, whereas the other radio must be turned to 56 before it suppresses the interference. Of course the same effect appears at the left of the resonate point (50) although this is not shown to avoid complicating our diagram. One set will hear the interference from 47 to 53 a distance of six divisions, while the other will pick it up from 44 to 56, or 12 divisions.

How Tube Differs from Spark

Another reason for difficulty in tuning out a wave is caused by the action of old style ship stations. They used a spark transmitter instead of a tube for sending out the vibrations in the ether. Fig. 4 shows the difference. A is a continuance wave as produced by a vacuum tube oscillator. B is a series of impulses given out by a spark gap. Suppose you wanted to know how to tune to these signals. In this diagram it is easier to measure wave length than frequency. How could you go about it? If these diagrams are drawn to scale it is only necessary to get out your ruler and measure the distance L, which when multiplied by the scale ratio will give you the answer.

But of course you recall that the waves these days are quite close together in frequency, and for exact tuning you must know the wave length pretty accurately. An easy way to do this in the case of Fig 4-A is to lay off ten vibrations as shown and then measure this length. Then by dividing by ten you will get a very accurate figure for L. When you attempt to try the same scheme at B you find it can't be done. Each wave has died out so fast that you cannot measure ten of them at once.

How the Coil Measures Wave

Of course in your receiving set your tuning coil and condenser do not pull out of their pocket a foot rule or even a meter rule to measure the wave length. However, the principle is very similar and a continuous oscillation like A can be tuned by coil and condenser quite accurately. On the other hand, the oscillations of B are very broadly tuned which is another way of saying that it is impossible to get any great amount

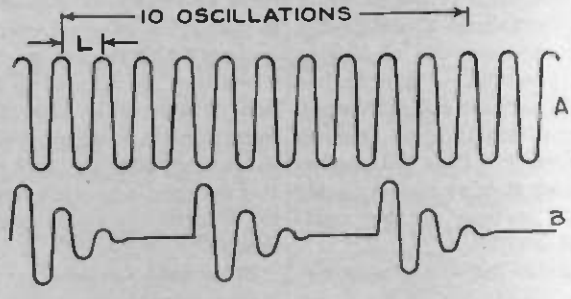

Fig. 4. Tuning for 10 Waves is Easy with Tube Sender, but with Spark It Can't Be Done

of certainty in the measurement of their wave length or vibration speed whether you use a ruler or a radio tuner to get the answer.

Because of this action the loudness of the signal as obtained by rotating the dial would be as shown in Fig. 5. At A would appear the curve of the continuous wave while B shows the tuning for the spark set. A few divisions will get rid of the one while the other persists over a good share of the entire tuning range.

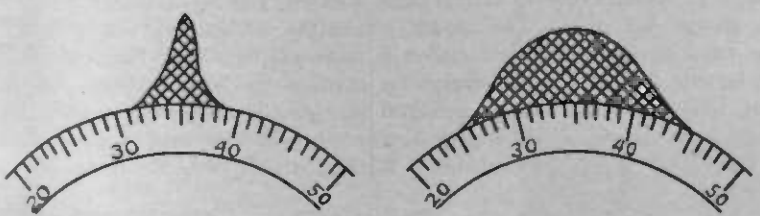

Fig. 5. The Shaded Area Shows Loudness of a Station As the Dial is Turned. The Sharp Tuning is at Left

What Note Is Explosion?

In a spark set, the quicker the waves are damped out to zero, and so the shorter the wave trains last, the harder it is to get rid of their interference by tuning. Another way of looking at it is this. If you have a certain amount of energy in the form of a continuous tone like that given out by an organ, it is easy to tell what pitch the note is. Perhaps you are not able to name it, but at least you can whistle or sing the same note yourself. If, instead of a continuous sound, the same amount of energy is gathered up into one sharp, short noise, it will be like an explosion and then you can not tell what tone it is.

In radio a similar thing occurs when you get a stroke of lightning in the vicinity of your aerial. You hear a short, sharp snap, which your set will pick up no matter where the tuning dial is set. The trouble is that the coils and condensers cannot tell what the pitch of that lightning shock corresponds to and so no matter how the dial is turned, the set brings in the noise. A spark set, of course, is not nearly as bad, but follows the same general idea.

Shifting Between High and Low

Another kind of wave which is quite unsatisfactory from the tuning proposition is shown in Fig. 6. This represents a form of vibration, in which the frequency or wave length is not constant. Notice that at L the wave starts out at a comparatively low vibration speed or large wave length. As time goes on, the vibrations speed up as at H. A little later they again drop to their former low speed, L, and then once more go in high again. This action may continue indefinitely. Now, if your receiver happens to be tuned to a frequency like L, it will pick up at least half the wave. Also the same is true of frequency, H, and indeed anything between. This naturally gives a very broad wave, which will be heard over a large part of your dial.

You may wonder how such broadcasting can be given out. Of course, there are a number of places in the sending station where slight changes will cause a slight difference in frequency. For instance, one of them is in the tuning condensers. If the plates are not perfectly rigid and stiff, they will vibrate at times as the building shakes slightly or as the attracting action of the electrical charges on their surfaces varies. Another cause of such irregularity is owing to the swinging of the aerial. The tuning of this part of the system depends on the distance from the wire to ground and as it sways back and forth in the breeze, as shown in the end view (Fig. 7), the effective height, H, will be smallest when the wire is straight down and greatest when out at the end of the swing. This constant shift will cause a corresponding change in the capacity to ground, and this will result in a wave which is hard to tune out.

A Family of Harmonics

One more kind of trouble is fairly frequent in a broadcasting station, and this is the sending of harmonics. Harmonics are defined as waves of different frequencies which are sent off at the same time. The fundamental is the lowest tone or you might say the keynote. This is also sometimes known as the first harmonic. The second harmonic is a vibration which goes just twice as fast, and so is one octave above the fundamental. The third harmonic goes three times as fast, etc., up the scale as far as you like. The numbers above the fifteenth are usually so small that they do not matter.

A broadcasting station which is supposed to send out a certain frequency of say 1,000 kc. may transmit other speeds of vibration at the same time. Of course, if the difference is great enough, the unwanted waves will lie outside the broadcasting range. However, it sometimes happens that two waves of nearly the same kilocycles will be transmitted from a sending aerial. In that case the resultant wave will be broadly tuned or hard to get rid of. Fig. 8 shows two waves which differ by only a slight amount. One may be assumed as having 1,000,000 vibrations per second (1,000 kc.), while the other is perhaps going at 970,000 (970 kc). Of course, neither one is a direct harmonic of the other in this case since they are not multiples of each other. To make the drawing one wave is shown slightly louder (more volume) than the other, but this of course has no effect on the vibration speed (kilocycles).

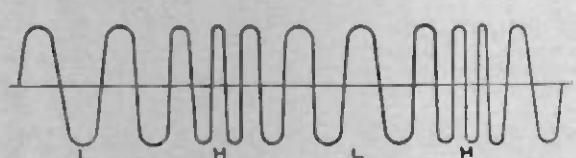

Fig. 6. A Swinging Aerial May Cause a Wave to Change its Speed as Shown

Double Speed Harmonic Bad

Such a wave will be picked up in the dials probably all the way from the 970 to the 1,000 kc. positions. Naturally, such a broad band will cause interference, and cannot be easily lost. It may not even be the same aerial which is sending the extra vibration. Ship sta-

tions sending on 500 kc. (600 meters) have a second harmonic at 1,000 kc. (300 meters) and such a wave is apt to be fairly strong unless suppressed by a filter in the sending station. Many code messages around powerful shore stations

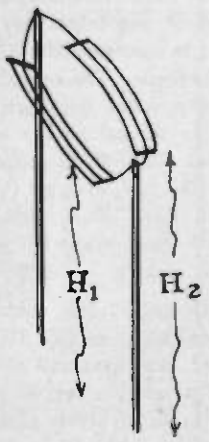

Fig. 7. The Principle of Wave Shift with Swinging Aerial

are picked up on this double frequency wave, if care has not been taken to use good sending apparatus.

It will be seen that practically all of these troubles of broad tuned waves are difficulties which are caused by something wrong at the sending station end. In such a case the broadcast listener cannot adjust his set to get rid of the particular trouble. The best he can do is to report any cases of broad tuning to the radio inspector for investigation. However, before doing so, he should make sure that the cause of the lack of selectivity is not due to the nearness or power of the individual broadcaster. In such an event of course, it is no one's fault, and the listener is simply out of luck.

Biggest Stations on the Farm

It is on account of this condition that the government requires the super power broadcasters of over 3,000 watts to be located at least twenty or thirty miles out of the big cities. The theory is that those living inside this radius will not be able to use their sets except for local reception when such a powerful sender is on the air. If the station were in the limits of a large community, it would mean that the number of people interfered with would be very great. Out in the country those living nearby the aerial will be just as much bothered, but as the number of such inhabitants is small, the principle of the greatest good to the greatest number requires that they suffer some inconveniences so that the rest of the citizens of the United States may profit.

Of course, this discussion does not mean that the listener can do nothing. If you have a good set, any form of interference which has not been noted will bother you considerable less than if you have a poor and non-selective outfit. And if you are troubled even with a good set, then by installing a still better one the conflict between different stations will be still further reduced. With most of the large stations now on the air, the Government Inspection Department maintains such a close watch on the output that there is not much chance of their putting a very bad wave on the air. This implies that the majority of cases of interference can be cured by the listener by getting better equipment.

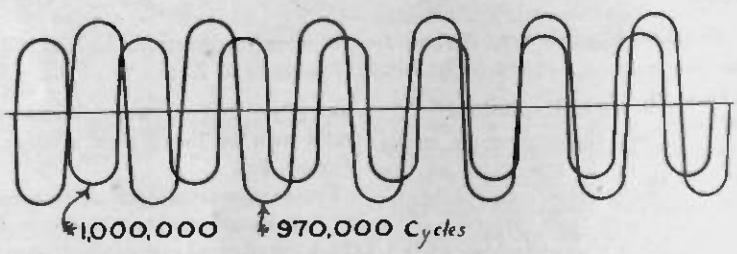

Fig. 8. Two Waves of Almost the Same Speed Will Give Very Broad Tuning if From Same Station

"Oh Fudge," Says Tuba Man

"The ill wind that blows nobody any good" was probably the one which carried off the hat of the tuba player of the Silvertown Orchestra during a recent trip to Boston. A casual announcement of the loss was made by Phillips Carlin, the announcer of the orchestra playing each Thursday from WEAF and a chain of eleven other stations.

A few weeks later he received a package from Boston. Inside was a straw hat, somewhat small for the tuba player, but filled to the brim with delicious home made fudge from the "Xmas Club," a group of four women, who during their meeting every Thursday evening to make presents for the coming holiday, listen regularly to the Silvertown Orchestra through WEEI. Rumor has it that hats are now being lost right and left by the other musicians.

The Women's Hour from WJZ

This Was Started as a Way of Broadcasting Broadway

By GOLDA M. GOLDMAN

ABOUT three years ago a very delightful little lady with as much sparkle in her disposition as there is in her red hair, had an inspiration which she thought could be used by Station WJZ. That was in the days when WJZ was tucked away in a corner of the old Westinghouse building in Newark.

Bertha Broadcasts Broadway

Her idea was that she could "broadcast Broadway" for the listeners-in who could not go to the theatre. Because the idea was a good one, Mr. Poponoe, director of the station, gave her a place on the program, and so Bertha Brainard (see Fig. 1) made her unseen bow to the radio world. Since then she has become a regular part of the studio forces and when WJZ moved to the Aeolian Hall Building in New York and was transferred to the auspices of the Radio Corporation of America, Miss Brainard proved to be one of the force who could not be dispensed with nor replaced.

To-day she occupies an advanced position as Assistant Program Director. One of her pet enterprises is the conduct of the "Women's Hour," which has become a recognized broadcasting institution. For one magic hour every day from ten to eleven in the morning, all the waves emanating from Aeolian Hall are aimed at the women of the home—your home. Miss Brainard has put much time and thought upon this period and the result is a program of widely diversified interests, taking in practically every phase of household activity and helping to solve nearly every question which confronts the housewife and mother.

Everyone Her Own Decorator

For the woman who is chiefly interested in making home a place more attractive to the aesthetic sense, we have a series of talks called the "Home Beautiful" group. In this Dorothy Ethel Walsh, a free lance writer and interior decorator, talks on color and color harmony, the use of chintz, etc., in the average home. Miss Walsh has been a regular feature on the WJZ program for three years, and thousands of homes today which are being furnished on an average income are the more attractive because of her helpful talks.

Would you like to do something with that window space, this jardiniere, or that tiny back yard? In a series of talks on "The Little Back Yard," Frances Duncan, Garden Editor of Delineator, tells you what to plant in the small space which is at your disposal, how to start it, and how to make it thrive.

Fig 1. Miss Bertha Brainard Invented the Women's Hour

How to be Healthy at Home

Perhaps your problem is one of health. Today every mother realizes that something can be done about the delicate health of her child and the proud possessor of robust children knows that they can be kept so. These folks listen in to the "Speakers' Health Service," through which Mr. Isaac Galston, specialist on child and adult health

gives information. The talks are presented under his supervision and are given by specialists in the particular subject so that they are absolutely reliable.

Of course, the greatest problem of the home is to be found in the kitchen. Therefore, it is not surprising that the most popular feature of this Women's Hour is the daily talk given by Mrs. Julian Heath (Fig. 2), the founder and President of the National Housewives' League. Mrs. Heath, who has been editor of the House Magazine and Chairman of the Home Education Department of the Federation of Women's Clubs of the city, says that the housewife of today must keep abreast of modern developments if she is to conduct her home in an efficient manner.

Fig. 2 Mrs. Julian Heath, Who is Head of Housewives' League

Foods That Favor Finances

The daily program divides itself into different parts. The first one is called the "Daily Housewives' Ticker" which is a market report of prices. This she follows with a discussion of outstanding fluctuations in price with special reference to seasonable commodities. The third step is a dinner menu fitting the market and using especially those products which are cheapest that day. Last, but not least, she gives the recipes in order to carry out the menu successfully. The results of this talk are sometimes amusing and sometimes pathetic. For instance one woman writes, "My husband says I have an entirely different disposition since I am cooking from 'the little black box'." (Does that mean better or worse?)

A rather pathetic story is that of a crippled boy of fourteen or fifteen years of age who is confined to his home. Since his mother and brothers work, he keeps house. Daily he listens in to Mrs. Heath's broadcasting and follows her dinner suggestions. He prepares as much of the meal as possible, and when the older boys come home they put the food on the table. One of the most interesting of Mrs. Heath's activities this year was an apple pie contest held in the Grand Ball Room of the Waldorf-Astoria. Three hundred pies were submitted and the winner was awarded a silver pie dish and server.

Broadcasting a Dumb Pig

Mrs. Heath is not the only one on the WJZ program who talks about food. The Meat Council of New York is represented by John Cutting who talks on such topics as "What to give the child besides a spanking." Once Mr. Cutting in order to make his talk realistic, brought a pig to the studio and endeavored to put him on the air. When piggy refused to do his stuff, his tail was tweaked so that his squeals might be heard by the listeners-in.

Talks are also given by the Good Housekeeping Institution which are of practical value and include such topics as "How to Group the Day's Work," "How to Save Steps in the Kitchen," etc.

When it comes to the question of planning for the summer months or "Keeping Up with the Joneses" socially, we have instructions by the Associate Editor of Vogue, Mrs. Franchesca Van der Kley, who reads from her own book of etiquette.

Picking Out the Right Job

A very valuable series of talks are those by Helen Hoerle on the subject "The Right Job for Your Daughter." Miss Hoerle is a specialist in vocational training and her program includes information on the possible fields of endeavor open to women, the training necessary for each, as well as health and personality requirements and probable remuneration.

If you would be "high brow," you may keep abreast of art progress and exhibitions by listening to Mrs. Augusta Owen Patterson, Art Editor of "Town and Country." She covers painting, sculpture, tapestry, etc. Since clothes are supposed to make the woman, "The Shoppers' Guide," by Mrs. Pauline Peck, is found to be of great service. Every Monday morning Mrs. Peck will tell you what the outstanding bargains in clothes are. If you are out of town and wish to buy, you may write to her and she will purchase for you at the regular retail price, and if you live in town and would like to have her go with you when you purchase, she will do that also.

Beating Paris on Style

A daily and important feature is that conducted by Mrs. Sara Fuertes Hitchcock, who is on the staff of one of the largest trade newspapers, "Women's Wear." There she conducts a column on possible purchases and the analysis of advertising copy. At WJZ her talks cover cable fashions from Paris. Because of her trade affiliations, she is able to predict styles ahead of time, and the

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House Cleaning a Radio Set

How to Meet the Hot Weather Needs of Your Radio Receiver

By W. GOULDEN, Commercial Engineer, Radio Corporation of America

YOU have doubtless heard the story of the man who was seen sitting disconsolately on the front steps with all his goods and furniture strewn around him. "Too bad, you're evicted, I suppose," said his friend. "No," he replied sadly, "It's the boss housecleaning."

You know this must be done every spring or summer in your own home, but do you realize that your radio set should have the same attention? There are a great many different things which go wrong with a set and although each one is small, still the result is to reduce its efficiency.

Has It These Diseases?

If you are an average radio "fan," your receiving set has gone through some 600 or 800 hours of service since last it received any real attention. Since you overhauled the set last fall, the vacuum tubes have been burning over 600 hours. The batteries, especially the "B" variety, have probably been delivering current over a long period. The antenna wire and its joints have stood out in the weather, subject to the wear and tear of the elements, as well as the corrosive effects of coal smoke. The soldered connections and binding post screws of the receiving set have had plenty of jars and rattles to shake them loose. The condenser plates and other parts have been accumulating dust and dirt and moisture, tending to introduce leakage paths and noises. The rheostat and switch members have become loosened. And so it goes.

Fault finding in radio should begin at home. When the receiving set fails to function in accordance with fond expectations or past experience, it must not be assumed that all broadcasting stations have suddenly cut their power in two, or that Dame Nature has conspired to ruin our radio entertainment. There are four primary causes of poor reception; (1) tubes that have been abused either electrically or mechanically, (2) batteries, (3) faulty condition of set, and (4) weather conditions. As often as not, the falling off in the strength of signals and the increasing noises which do so much to mar the programs, are due to conditions within the long used set itself. Of course, there is such a thing as static; true, weather conditions have much to do with the radio "transparency" of space, so to speak; granted, some days are better than others for radio reception, but weather conditions are not always to blame for poor reception.

Fig. 1. Here is One Reason Why You Need to Keep Your Set Clean in Summer

No Trip Without Overhauling

It must be remembered that summer time radio is ushered in after the average receiving set has gone through a long session of steady use, and is very much in need of replacements and general overhauling. Therefore, just as the average motorist would not think of starting his motoring season without going over his engine and body and tires

THE WOMEN'S HOUR

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funny thing is that her predictions come true. The talks are arranged for her by Eleanor Gunn and other representatives of "Women's Wear" who are fashion experts. The main idea of these talks is to develop in American women a point of view in regard to the suitability of clothes which they are supposed to wear on certain occasions. For this reason, Mrs. Hitchcock reports what women of society wear at different types of functions so that other women may adopt those ideas to their own social occasions.

Last, but not least, comes Mr. Roger B. Whitman, who is connected with the building magazines. He will inspire you to build your own home by telling you what to build and how to make the building possible.

So you find that there is not much that Miss Bertha Brainard has overlooked in the conduct of the "Women's Hour."

to be sure of satisfactory operation during the hard Summer-time use of his car, so the average radio "fan" should put his receiving set in tip-top shape for the same Summer period when its efficient operation will bring joys and thrills.

Radio house cleaning starts with the wave pick-up system, which is usually in the form of an antenna and a ground connection. Of course, a superheterodyne or other style of receiver which uses a loop, needs no attention on the aerial and ground. Such a form of set is really portable, as shown in Fig. 1. It can be put down in an instant on the beach, and setting-up exercises run off to its signals every morning. The only trouble with the wave collecting part of such a set is that which comes from a loose connection, and that is usually easily found.

Trees Trap Part of Power

But with the conventional antenna, summer-time conditions are apt to introduce new factors which must be met. Thus the aerial that has been giving excellent service all winter may require certain alterations with the approach of warm weather, when nearby trees and shrubbery take on foliage. The absorption factor increases with the appearance of the leaves, so that the antenna, good as it may have proved during the winter and early spring, now requires more clearance above trees and shrubbery to provide the same efficiency as heretofore.

Again, the aerial masts may be bent over as the result of long exposure, and the antenna supporting ropes may be stretched, so that the wires have a pronounced sag that lowers the effective height. Of course, this reduces the amount of energy taken from the air. Besides this, there is the serious objection that a slack wire will sway easily in the wind (Fig. 2), and this changes the capacity to ground and so the wave frequency (length) to which the set is tuned. You hear about it because the music keeps fading in and out as the wire swings.

Lead-in wires, heretofore free and clear of trees and shrubs and walls, may now be touching objects which provide a direct path to the ground for the elusive radio currents. All these things should be watched for in going over the antenna.

Take Off Its Coat in Summer

Then there is the question of wear and tear. The antenna wire, exposed to the elements and the corrosive action of the sulphur fumes of coal smoke, becomes a poorer conductor as time goes on. Indeed, the high resistance coating, which forms on antenna wires where there has been much corrosion, is apt to reduce the efficiency to some extent. Fastidious radio fans change their antenna wire at least once a year, although this is not essential to good results.

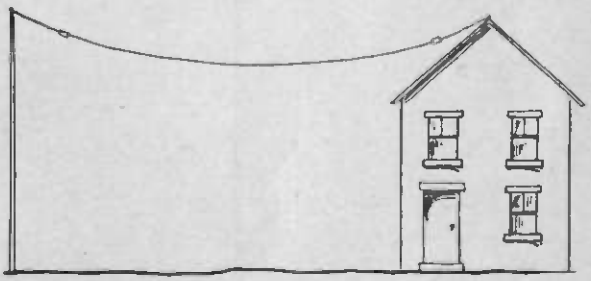


Fig. 2. With This Construction Your Signals Will Sometimes Fade

The main features are the joints, for if they have not been soldered, they are bound to become corroded in time and form high-resistance links in the wave-collecting circuit, greatly reducing the efficiency of the set. The joints of the antenna, from the wire itself to the lead-in and right down to the aerial binding post on the receiver, should be carefully examined. It may be best, even if there are no visible signs of corrosion, to undo each unsoldered joint, scrape the wires clean with emery cloth or sand paper, and make new connections. Of course, soldered joints are best, but if the unsoldered joints are tightly made and then wrapped with electrician's friction tape, they will remain satisfactory for a long while.

Don't Let Current Follow Soot

While going over the aerial system, the insulators should be examined, since these are apt to accumulate a coating of dirt or soot with the result that a conducting path is formed for the leakage of the high frequency radio currents. The insulators should be cleaned. If unglazed insulators have been in use, they should be replaced with the glazed kind.

The ground connection is next to be examined. Often, due to the difference in the metals of the water pipe and the ground clamp (or wire wrapped around the pipe) electrolytic action has set in with the result that the metals in contact are quite corroded, forming a high resistance ground connection. Rather than overlook a serious handicap in this direction, it is best to remove the ground clamp or wire, clean it and the waterpipe with sandpaper, and make a new ground connection with clean, bright surfaces. If another type of ground is used, it should be examined and good connections ensured by soldering the wire to the ground clamp.

Pipe Cleaner for Condenser

While the average radio receiving set is more or less fool-proof, constant use must necessarily bring about certain changes. First of all, there is the matter of dust and dirt—apparently insignificant, but really a factor that counts in achieving topnotch efficiency. Dust and dirt are apt to accumulate moisture, in which event serious leakage is introduced in the radio set with an accompaniment of troublesome noises. Especially is this true in the case of dust and dirt accumulating between the plates of the variable condensers. For dusting the radio receiver, a soft brush, preferably camel's hair, should be used, of such size as to permit of getting into the tight places and corners. A pipe cleaner will do very nicely for cleaning in between the variable condenser plates.

Then there is the matter of contacts and joints. If the variable condensers are not provided with flexible "pig-tails" or coiled spring connections, and if noise is noticed as they are turned, it is well to take them apart and clean the points of contact with fine emery cloth. But be very careful that you do not leave any of the emery imbedded in the soft aluminum or brass. The grains are so hard that they sometimes dig their way into the metal surface, and then remain and tear the part which comes next to

them. Sandpaper is better in this respect as the little particles are not hard enough to become imbedded in the metal. If flexible connections are used, these should be examined to make sure they are unbroken.

Tighten Your Arms

Binding posts should be examined. Screws and nuts must be turned up tight to make good connections with the wiring. Look over the jacks for loose connections. Switch members should be inspected to make certain that good contacts are made and that the various parts are properly tightened. Examine the rheostat arms to ensure proper contact between the movable spring and the resistance wire winding. In fact, the radio receiver should be overhauled as much for mechanical details as for electrical.

Joints, soldered and otherwise, are a prolific source of trouble, especially in the home-made variety of receiver. In the case of soldered joints, unless the work has been done with rosin-core solder, or has been carefully wiped after soldering, they may become corroded. Again, flux which has been only wiped off after the soldering job tends to spread to the panel and out to adjoining parts, forming high-resistance leaks which become more evident with the advent of warm and damp weather. All traces of flux should be removed by cleaning the soldered parts with gasoline or alcohol. A still better plan, of course, is to have the metals so clean before soldering that you do not need any flux to make the solder stick. If both pieces to be joined are well tinned, you will find that no outside help of any kind is needed to make the solder bite.

How to Find the Breaks

Broken joints may be located while the receiver is in actual use, by tapping or moving each joint in turn and listening for noises in the head phones. Movable parts can be tested in the same way, by manipulating them.

The wear and tear of radio reception falls heaviest on the batteries. The "A" variety, which operates the filaments of the vacuum tubes, may require recharging or replacement, depending upon whether it is of the storage or dry type. The "B" batteries, having gone through several months of service, are probably pretty well exhausted, even though they still operate the radio receiver with fair volume. A good rule to follow is this: Try out the pressure of each block of "B" battery with a volt meter, and when the pressure has fallen to three-quarters of its rating it is time to throw that unit away.

Be a Battery Booster

In the case of the storage battery, radio spring house cleaning involves an examination of the cells. The lugs and straps of the battery may be partially corroded, and dirt has perhaps accumulated between them, thus establishing a partial short-circuit which, while insignificant so far as the battery itself is concerned, is a fertile source of noise in the receiver. The vent caps should be removed and the battery electrolyte tested for specific gravity and also for water level. Add distilled water if necessary and the battery should be recharged if the hydrometer reading is low. If the battery has been allowed to run down nearly empty, it is best to send it to a recharging station for a good "boost" after which it can be recharged when necessary with the usual home recharger.

Dry cells are usually tested by an ammeter which has a scale running up to 35 or 40 amperes. By connecting this right across the terminals, you get a direct circuit through the instrument. A new cell will read around 30 amperes. Of course, the meter should be removed just as soon as the reading is obtained, as otherwise the current is wasted.

Some people prefer to use a volt meter for testing. In this case, turn all the tubes on to full brightness. Then measure the pressure of each individual cell with a low reading volt meter. When new, 1½ volts will be shown. But when the cell is on its last legs, the hand will not go above one volt. Even this is too low for working a WD-11 or WD-12 tube, as either of these requires 1.1 volts.

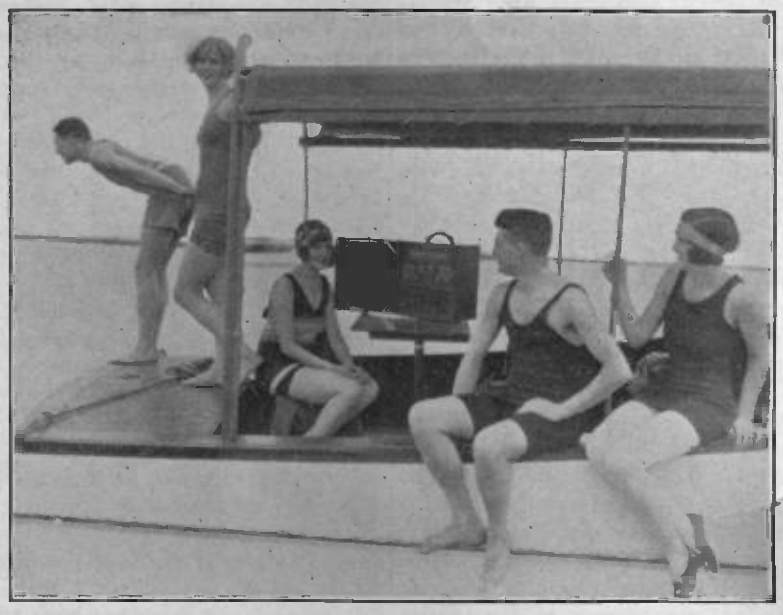


Fig. 3. A Portable Using Loop May be Set up Where There is no Room for Antenna

When to Change the "C"

If a "C" battery is used, its chief aim in life is to reduce the current out of the "B" battery. Since a half a dollar invested here will save several dollars in "B's," it is poor economy to keep the "C" too long. If you get a good make it is well to change this unit twice a year, while if you buy a cheap style, then every few months should see a new one.

Next we come to the tubes, which have more to do with results than any other component of the receiving set. Unless the tubes have been abused by too high filament voltage, four or five months of steady use should by no means wear them out. Radiotrons,

Continued on Next Page

BROADCASTING BEING STRANGLED

Some of the Dangers Which Sending Stations Must Face

By POWELL CROSLEY

(Editor's Note): This is taken from a speech delivered at the Annual Convention of the Radio Manufacturers' Association in session at Atlantic City early in July. In the interest of fairness to both sides we immediately wrote to the Society of Composers, Authors and Publishers, New York, asking them to explain their side of the argument. We have not heard from them in reply.)

I CONGRATULATE the Radio Manufacturers' Association upon its activities during its short existence—on the rapid strides which it has made in the accomplishment of a real organization.

I need not enumerate the several things so vital to radio which have been already done. The doing of them has demonstrated the ability to tackle any problem and bring it to a satisfactory conclusion. I, therefore, am taking the liberty of presenting to the organization a most vital problem of our industry.

What Radio is Founded on

You are perhaps familiar with our broadcasting. We have from the very beginning appreciated that our radio business, in fact, all radio business, is founded upon this basis. Were there no broadcasting there would be no use for receiving sets.

From the experience of the Crosley Radio Corporation in the broadcasting field I feel that I can speak on this subject, and it is with due thought, and positive assurance that I now state to you the entire fabric of our industry, its very life blood and being, is being threatened by a situation which is now gnawing at the very roots of our existence.

I cannot impress upon you too emphatically the danger which confronts us. I am calling upon the Radio Manufacturers' Association, believing that it is the means whereby steps can be taken immediately to prevent a catastrophe. I refer to the attitude of the Society of Composers, Authors and Publishers. The Society refuses to grant licenses to broadcast the music controlled by it for any substantial period of years, and most of its license contracts are for one year only. The Society commands to a surprisingly large extent the performance rights in most modern music. Thus it has come to a position where, if it wishes to exercise its power, all radio broadcasters are practically subject to its demands.

A Very Serious Situation

You know something of the history of the controversy between the broadcasters and the Society, but I feel sure that none of you here have more than the faintest conception of the seriousness of the situation.

Many of you know in a general way of the suit that was filed against the Crosley Corporation for broadcasting a certain popular number. We fought this suit because we felt and still feel, that the copyright law of 1919 did not consider broadcasting because there was no such thing in existence at that time that, therefore, the law could not cover and does not cover this phase. We have never taken the attitude that the holder of a copyright should not have proper control over his own music—that he should not receive a reasonable compensation for broadcasting his composition, providing all broadcasters are treated alike.

Congress Fixes Record Prices

Congress has said that if a holder of a copyright grants the right to one maker of phonograph records or music roll manufacturer to reproduce a number, then this same right shall be given to all such manufacturers at the *same rate*, actually specified by Congress. We would have no quarrel if such an arrangement were made effective in the case of broadcasting.

The Society of Composers, Authors and Publishers, which controls the copyright rights of a large number of publishers and composers, is arbitrarily setting one figure for one broadcasting station and an entirely different figure for another. The title of the copyright of each individual piece seems to be well vested in the individual publisher—all dealings, however, must be carried on with the Society.

HOUSECLEANING SET

Continued from Previous Page

properly used, have a life of over a thousand hours, but when excessive filament voltage is applied, the process of boiling the electrons out of the filament and hurling them across the vacuum to the plate, is pushed beyond safe limits, and the tube may become paralyzed, so to speak. As viewed by the eye, the tube does not appear to be damaged, since it lights in the usual manner. However, it fails to deliver the normal output expected of it, and the results suffer in consequence.

Take Your Radio with You

As a final word, don't forget your faithful set this summer. You will get a lot of entertainment out of it whether you stay at home or go away on a vacation. If you have a really portable outfit as shown in Fig. 3, you will have no end of enjoyment whether you are on board a yacht or camping way up on the mountains. The increase in power of the large broadcasting stations will reach all parts of America, so that you will get good programs no matter where you go.

A Case for Supreme Court

The suit against us was brought by one of the members of this Society. The lower court held in our favor. The Circuit Court of Appeals reversed the District Court and ordered the case back for trial. We are now carrying the case to the Supreme Court.

In the meantime, it is the belief of the Society that they can collect $250.00 every time we play one of their numbers. It is needless to say that we are not playing any of their pieces, excepting in a few instances where the orchestra or entertainers have received special permission from the Society to broadcast.

It is not our desire to continue this fight. It would have been much easier for us to have made a settlement with the Society. They have offered, as a basis of settlement, that we might make our peace by paying $9,000.00 damages and $3,000.00 per year, notwithstanding the fact that WEAF of the American Telephone and Telegraph Company were at that time paying only $2,500.00 per year—the largest contribution of any broadcaster.

Olcott Vail, Concert Violinist, and leader of the Olcott Vail Trio which broadcasts from Station WJY, every Sunday evening at 8:30.

Plus $20.00 an Hour

In addition to $3000.00 per year we would have to pay $20.00 an hour additional whenever the name of a hotel, any individual or corporation providing the entertainment was mentioned. The amount of $9,000.00 damages and $3,000.00 per year was afterwards reduced to approximately $3,000.00 damages and $1,000.00 per year; $1,000.00 per year being exceeded by only one other broadcaster—WEAF. It was expected that we would pay the $20.00 per hour additional where the name of any other concern or individual was mentioned. This arrangement could only be made for one year, with the frank statement that it was expected the tax would be raised as rapidly as the traffic would bear it.

Many broadcasters have paid $250.00 or $300.00 for a license, feeling that this was much easier than to fight, but little realizing that they were putting their heads into a noose by the acceptance of a situation whereby the rate could be increased at will by an organization determined to exact as much revenue as possible.

We Are Not Making Money

Now, gentlemen, very few broadcasting stations are operating with any direct profit. Some handle indirect advertising for revenue, but our income from this source would not pay even for the management of the studio. We have a large investment in broadcasting equipment—whether it is profitable for us to broadcast is a question; whether the good will created by a broadcasting station justifies its continued existence is merely a matter of opinion. No one can check the results.

If all broadcasting stations face an additional expenditure of $5,000.00 per year, and more, how many of these stations will continue to exist? Imagine the feelings of a man who appreciates the seriousness of this situation, playing a gambling game in which no limits are set—where the more he pays the more he will have to pay—and you will appreciate, perhaps, how bad the situation is.

What Are the Remedies?

Now what remedies do we suggest? First, the appointment of a committee to investigate thoroughly the status of the Society of Composers, Authors and Publishers as a monopoly.

Second, I suggest that a second committee be appointed to investigate the present situation in Congress. There are certain bills pending there which have been presented by Senator Dill in behalf of the broadcasters, and I understand another bill or bills have been also offered by the Society. These should be carefully investigated by this second committee, which should confer, perhaps, with committees of other organizations, with a view to agreeing upon a bill to present to the next Congress.

My suggestion in regard to this Legislation is that broadcasting royalties should be under the control of Congress just the same as are the royalities applying to phonograph records and music rolls.

Let Each Number Cost $1.00

I suggest that a charge of 50 cents, or perhaps $1.00 per performance might fairly be levied upon all broadcasters providing they are given the right to play a number. The sum should be definitely determined and should be arranged for all time to come. In other words, radio broadcasting should have a well recognized status.

Please remember, gentlemen, that this is not a personal fight of my own, although I have a very vital personal interest in it. I am looking at, and I hope that you will see the big picture of the danger to the very foundation of our industry—radio broadcasting.

The Tallest Tower

A broadcasting tower is under construction near Berlin, Germany, 1,049 feet high, which is slightly more than the Eiffel Tower at Paris. The tower will be used as an observatory as well.

Crystal Set is Wave Trap

How to Build a Unit Which Will Work With Any Kind of Radio

By HARRY A. NICKERSON, Boston, Mass.

(Editor's Note:—This is the second and concluding part of this article. The first, which appeared in our last July 15 issue, explained how to build a crystal receiver which is unusually loud and selective.)

IN the first half we had just reached the point of winding the coils. The following is suggested as an excellent method for winding any layer wound coil by hand:

1. Figure out the length of wire necessary. (The length of each turn is 3 1/7 × the diameter of the coil form.)

2. Unwind about three feet more than this length and fasten the wire spool and remaining wire to some fixed object in an open space long enough so that the wire necessary to wind the coil may be stretched out in a straight line.

3. Fasten the loose end into holes in the tubing as a start of the secondary wiring, at the end, away from the future primary winding.

4. Stretch the wire somewhat. (Unless pretty well stretched, there is a tendency for the wire after it is wound to loosen up.)

5. Start winding in either direction as convenient, with the moving part of the wire on top in plain sight, turning the tube form over and over and walking in toward the fixed portion of the magnet wire, "reeling it in," as it were, upon the tube. It goes without saying that the wire must be kept free from "kinks" and the turns wound close together without irregular crevices between turns.

How to Wind a Space

If one seeks ultra-efficiency he may try spacing the turns. This may be done by winding another wire along with the secondary "S" winding; when the coil is finished, then unwrap and remove the extra wire. Another method is to wind the secondary turns fairly close together about as usual, but before they are fastened at the finishing end, force between each turn and the next ordinary heavy twine or string. This string may be removed later, after the turns have been properly spaced, provided the wire turns were properly and tightly wound on the tube.

If the primary is tapped, it is suggested that the space winding method should not be used in preparing it, but that the turns be wound close together. It is too difficult to make a good job of a tapped and spaced winding. Another

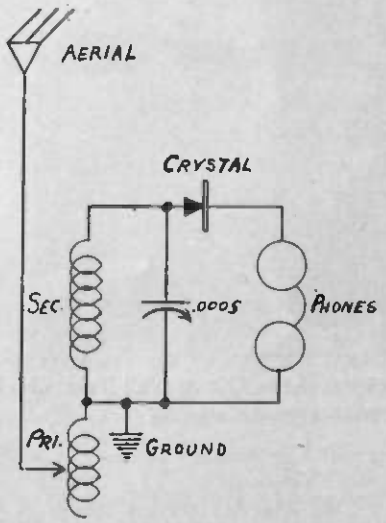


Fig. 2. (Reprint from First Part) Hook-up of Crystal Set

point to look out for is the condenser. If you do not happen to have a .0005 mfd. unit and you want to use another size then the number of turns in coil "S" must be changed to correspond. For instance, if you are going to employ a .00025 mfd. condenser then the number of turns in the "S" coil should be increased about 40% over what you need with the larger sized unit. This increased number of turns cannot be predicted exactly as the inductance or electrical weight of the coil increases a lot faster than the number of turns and the way it varies depends on what kind and shape of coil you use.

The Trouble With Enamel

Using fine wire close together will slightly decrease the number of turns required for "S," while spacing the turns (whatever the size) will require a greater number than when wound closely side by side. The use of a 3-inch tube results in a rather long and slender coil, when using larger sizes of wire, such as No. 18, while the 4-inch tube makes a somewhat more symmetrical coil. The use of enamel wire, without silk or cotton covering, is not advised, unless the turns are carefully spaced. Great care should be taken that the insulation is not injured on magnet wire; if one turn should touch another at a bare spot, it would short circuit and ruin the coil.

The operation of the set, as has been described, is quite simple. High speed (short wave) stations are heard on the lower settings of the condenser dial, and low speed waves on higher settings. Increases in volume or selectivity, sometimes both, are had by adjustment of the primary "P" taps, in case such taps are provided. If it is desired to omit the taps entirely, about 30 turns in "P" may be tried. If this does not give the desired selectivity, try inserting a small value of fixed mica condenser in the aerial circuit, as say .0001 mfd. or slightly larger. A value of .0005 mfd. instead of .0001 mfd. may increase the volume on some waves.

Making Long Waves Loud

Greater volume is generally had on slow (long) waves by connecting the aerial direct to the bottom turn of "P" in Fig. 2, or to one side of a small fixed condenser, the other side of which is connected to the bottom turn of the "S" winding.

A word or two about the adjustment of the coupling between the primary and secondary (Fig. 3) is worth while. There is a certain setting or distance apart of the tube which gives the loudest results. It may seem strange that when the coils are pushed closer together that the volume falls off, but if the set is well made that result will follow. The selectivity improves with decreased coupling no matter what the spacing.

Fig. 4 illustrates these effects. The horizontal line represents distance between the two coils, or coupling. Space up and down means selectivity for one curve and volume for the other. Notice that as the coils are pulled farther apart volume at first gets louder and louder until it reaches a maximum at "M" and then it begins to fall off again.

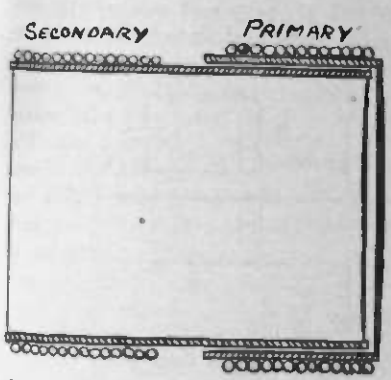


Fig. 3. (Reprint) Details of Adjustment for Selectivity

A separation of the two windings which amounts to anywhere between the values "A" and "B" will give signals about equally loud.

The Coils a Mile Away

Notice that the selectivity keeps increasing the farther apart we make the windings. Looked at from this point alone, we should move the primary a yard or a mile away from the secondary. This really would be an advantage as regards to sharpness of tuning, but of course it would not be practical as the loudness of the signal drops so low that it can not be heard when the coils are separated by more than a few inches.

As already noted, anywhere from "A" to "B" will get about equally loud music. However, at "B" notice the selectivity is at least 50% more than at "A." This shows us that the best setting for coupling is to have the coil as far apart as possible without causing real decrease in the loudness. The set will then be in an adjustment which gives loud results and which is quite selective.

Condenser Avoids the Coil

In mounting the variable condenser in Flg. 2, it should be located several inches or more away from the side of the tube, but not inside the winding or at the end. Mounting it inside the tube would probably appreciably decrease both the volume and selectivity, as the insertion of the metal inside the field as it is called, of the coil, results in some losses, just as though a part of the energy that works the telephones had been removed from the circuit before this energy had affected the phones at all.

The reason for this loss is that any metal which is cut by the magnetic field or lines of force from the winding has induced in it an alternating voltage. Indeed it is this voltage which is used in transformers. Since the condenser plates would be affected in this way they would have circulating or eddy currents which would keep flowing through the metal parts of the condenser. Such currents would not help the radio at all, as they never get outside of the plates. All the energy which they carried would be lost in the form of heat. By locating the unit outside of the magnetic field this loss is avoided.

What Kind of Terminals

A panel, although not required, will offer a means for mounting the variable condenser firmly in place; but unless some standard size cabinet is to be used, the panel need be only just large enough to mount on it the variable condenser. Binding posts with engraved caps and slotted posts are convenient for the insertion of phone tips. Some crystal detector stands and variable condensers are so constructed that the phone tips might be held under Fahnestock clips (special type of binding posts), the clips being fastened, one to the proper terminal on the stand, and one to the condenser stator binding post. The binding posts for the phones may also be mounted on the wooden baseboard or if a regular full size panel is used, the posts may be placed on that panel. A jack may be added, also, of course, instead of binding posts, for phones.

You Have Most of These

List of parts for this set:

Antenna-ground outfit, consisting of the usual arrester, antenna and ground wire, porcelain insulators and knobs.

Panel.

Baseboard.

Tubing, about 3 inches outside diameter, six inches long (see article).

Mounting screws or brackets for support of tubing.

One-half pound D. S. C. or D. C. C. magnet wire (size as determined).

Four binding posts (antenna, ground, two phones).

Crystal detector and stand or fixed detector with mounting.

.001 Mfd. mica fixed condenser.

.0005 Mfd. (21 or 23 plate) variable condenser.

Head set.

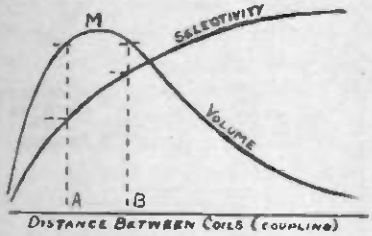


Fig. 4. Selectivity But not Volume Increases with Distance of Coils

Spring clip (or switch lever with switch points) to take advantage of a "tapped primary," if such be used.

Crystal Set is a Trap

When not in use as a crystal set, the fixed coupler with variable condenser can by itself be employed as a very efficient wave trap or filter in order to reduce interference found with tube sets. If so used, it is highly essential that the coil be wound to give as low losses as possible, and spaced winding with number 18 wire is suggested. The variable condenser should also be chosen of low-loss type. With this type of wave trap, improvement in selectivity may be had with reasonably good single circuit sets, when the wave trap is connected as shown in Fig. 5. With this method of connection, a particular unwanted station can be either eliminated or at least considerably lessened in interference.

With the parallel wave trap connection, Fig. 6, one particular station can be tuned for with the trap and receiver, so that other stations are filtered out. The

parallel connection generally gives more complete filtering out of interference, but is rather hard to operate, since some experience is necessary before just the right settings are mastered. When used as a wave trap the connection between "P" and "S" is omitted.

How to Tell the Single

The method of connection of the trap when used with other than the single circuit tuner is not shown. Unless the set with which the trap is used is a single circuit tuner, the combination will not be much of an improvement. If the user has any doubt as to just what sort of a tuner is incorporated in his particular set, the wave trap may be tried out by placing the end of the "S" winding so its axis (center line drawn through the opening in the tube at right angles to direction of the wire winding) coin-

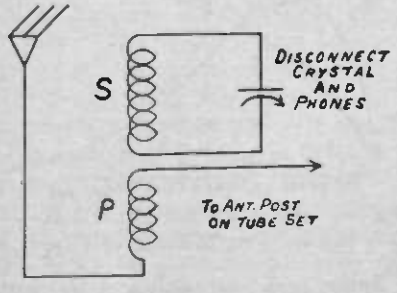


Fig. 5. Series Connection of Set Used as a Wave Trap

cides with the axis of the tuning coil in the set. Usually the tuning coil in the set is placed at the extreme left hand side.

The tuning coil of the set and the wave trap coils are then said to be "inductively coupled," and just as we see a magnet attracting a piece of iron from a distance, there is a magnetic effect between the two coils which results in the transfer of radio frequency electric energy from one to the other, and which permits the trapping of the undesired interfering signal. The filtering effect of this particular method of coupling the wave trap to the tuning coil of the set may not be as satisfactory as some other method, however, such as is shown in the sketches of series and parallel connection. The same fixed coupler with its associated variable condenser may also be used as a wave meter, but that is not within the scope of the present article.

Long Distance on Crystal

While the crystal set is usually limited to reception within a radius of about 25 miles of a broadcasting station, it should be borne in mind that until the last few years, practically all reception on board ship was on a crystal, and under favorable conditions distances approaching those covered with a tube set have been reached. In Dorchester, Mass., a crystal set made from parts purchased principally at a 10-cent store permitted reception of Davenport, Iowa, on one never-to-be-forgotten night; (Editor's note—This was probably reradiated from a nearby powerful tube set) and a Boston station five miles distant could be heard downstairs from a cheap pair of head phones lying upstairs on the table. This was using a "loose coupler" hook-up and of course without any tube for audio amplification.

Using audio amplification, a signal too faint for the human ear to detect until amplified with the tube may be heard. With audio amplification, it should rather be expected when a good location, aerial, ground, phones, crystal, and a set built according to the specifications of this article are also used, that stations within a radius of a hundred miles will sometimes be audible. Even without amplification, late in the evening, the higher powered stations that "come in" well on tube sets from distances within a few hundred miles should be heard faintly on this little crystal set occasionally (perhaps reradiated). This particular design of crystal set offers some advantages over the "loose-coupler type" in that the variable condenser setting may be logged, so that stations once heard can be relocated on the same setting of the variable, providing the same primary tap be used. This will be found of great advantage in hunting for distance, since the "place to hunt" can be more definitely determined.

What Resistance for Crystal?

Little data seems to have been published on the relative resistances of crystals. One crystal may seem to make the set "tune" more broadly than any other, but this broadness of tuning is generally explainable on the well-known fact that the louder a station is heard, the broader it seems to tune, relative to other stations. On the other hand, the resistance of the crystal which is placed in the phone circuit of the tuner in Fig. 2 will have some effect on the broadness of tuning of that circuit.

With 25 feet of antenna about 30 feet high, a long ground lead, about 40 turns of No. 24 D. C. C. on 3 1/4 inch tube for "P" and 42 turns for "S," WEEI (five miles distant from the Fig. 2 set of the writer) operates a small loud speaker so that music is audible say 20 feet from the horn.

Looks Like Perpetual Motion

Inasmuch as one can "go off and leave it running" without thought of exhausting batteries or tubes, to return and hear the broadcast again whenever the station is operating, the little crystal set gives one a rather uncanny feeling, a sort of "perpetual motion" thought.

In conclusion, at least a 125-foot an-

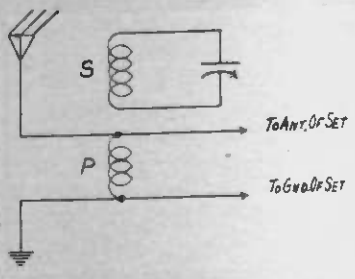


Fig. 6. Parallel Connection of Trap

tenna is necessary for real volume with the crystal set described in Fig. 2. This means straight away distance in the clear, away from trees and buildings and well up from the ground. The set will work with an antenna as short as 60 feet, but the volume is greatly reduced. For those who live more than 15 miles from a broadcast station, 175 feet or even more of antenna should be used for maximum results, although this length may not be so desirable for those who live near several local stations of high power, because so long an antenna makes the tuning less selective.

Write in Your Results

If you follow directions in making and operating this crystal radio, and if you have a really good location for your aerial on the grounds, you will get very good results. In the interest of advancing crystal set practice, drop a line to the Editor as to what success you have had.

LOCALS THAT CAN'T BE HEARD

New System May Do Away With Interference Between Stations

An Interview by E. F. W. ALEXANDERSON, Chief Consulting Engineer Radio Corporation of America

WHAT is the biggest problem now in radio? Some would say static. However there are a good many nights, even in summertime, when weather conditions do not bother you.

Among city dwellers, at any rate, the biggest question is how to get rid of interference between stations. If your city has one or more sending stations, then you will not be able to cut through them and pull in all the outside programs which you might otherwise enjoy.

After They All Say "Good-night"

Of course, if your radio set is good enough, you can get pretty close to the

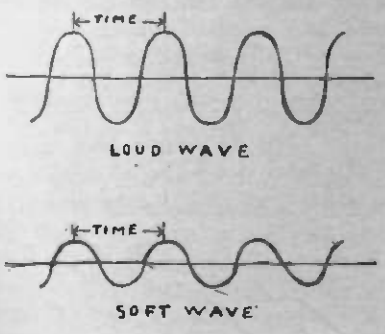


Fig. 1. These Waves Have Same Frequency But Different Loudness

local wave without being disturbed. The better the set the narrower the band over which the local is picked up. However, even with the most expensive sets, you will find that the long distance work in large cities is done mostly after the nearby stations have signed off for the night.

The reason is that a small amount of energy is picked up by every receiver from a powerful nearby station even though it is not quite in tune. Of course, this amount is reduced as much as possible by the proper design of the set. If a system could be devised which still further would reduce this unwanted local power, appearing in the tuner, it would have a very marked effect on reducing interference. It is this problem that many research laboratories, including the Radio Corporation, have been working on for years.

In order to understand this question we must know something about the way a radio wave is conducted through space, or propagated, as it is called.

Research Develops New Idea

Our knowledge of the laws of wave propagation is as yet very incomplete and much more research must be done of both a theoretical and practical nature before we can expect to have a full understanding of radio transmission. Such research work is being systematically done by the Radio Corporation and several important discoveries have been made which throw a new light on the subject. The new knowledge will undoubtedly influence the future art of practical radio, and I shall attempt to make a forecast of the developments which we have reason to expect.

When the first wireless experiments were performed, the waves were recognized as having only two characteristics. The first of these was loudness, or volume. This is shown in Fig. 1. Notice that the two waves are timed just alike. However, the amplitude, or up and down height of one is considerably greater than that of the other, which means that it is louder.

Vibration Speed Basis of Tuning

The second characteristic, it was found, is the frequency. This corresponds to the wave length. Fig. 2 shows two waves—the upper being a slow vibration at 600 kilocycles (500 meters) while the lower is 1000 kc. (300 meters). They both have the same height, and so are both of the same volume. Until tuning was first tried, the loudness was the only characteristic recognized, but it was found very shortly, that the speed of vibration, which could be detected by tuning, was very important. This, of course, is the method used now-a-days in separating the different sending stations.

With spark stations a third characteristic of the wave is the decrement. This means the rate at which the vibration dies out. Modern broadcasting stations, however, send out a continuous wave, which has no decrement at all.

The next great development in radio was transoceanic telegraphy. Transmitters producing waves with a decrement became obsolete, but a new characteristic of discrimination was intro-

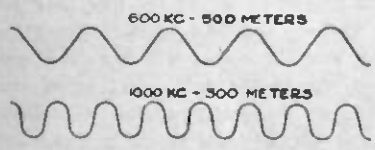


Fig. 2. These Are Equally Loud, But Top is Slower (Lower Frequency).

duced, the *direction* of the wave motion. This is the quality which is used by loop radio sets in separating two stations on the same wave. If they both happen to come from the same direction, the case is hopeless, but if one has a different bearing from the other, then by rotating the loop so that the axis of its winding points towards the unwanted station, its signals will fade out while those from the other sender will still be heard.

How Sound Waves Reach the Ear

On opening up the high speed (short wave) field of radio, we now find a fourth quality—polarizing of the vibrations. This refers to the direction in which the undulations move. There is no such thing in air for sound, as in that case little particles of air do not shake up and down as the waves travel along the ground, although such a drawing is

often made. Instead of this they crowd together and then separate again. Fig. 3 shows such an effect, as a sound wave travels from a bell to your ear. The little dots represent particles of air. Notice they are crowded together into a dense mass and a little farther on, separated wide apart. This is repeated all the way along the path at A. An instant later the particles are spaced as at B since the wave motion has traveled along. Here you will see that the regions of dense population have moved along to the right.

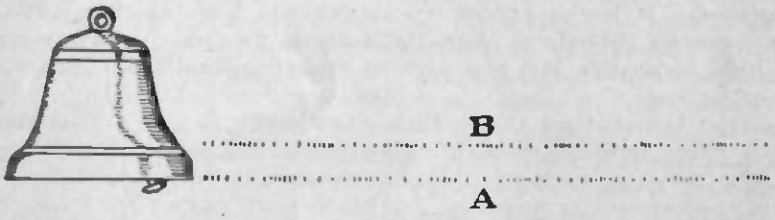


Fig. 3. Sound Waves Do Not Vibrate Up and Down, But Are a Bunching of the Air Particles

A vibration which is at right angles to the direction of its travel, on the other hand, can be polarized. The waves of the ocean are always up and down no matter which way the vibration is going. A clothes line may also be shaken with an up and down motion, and the waves will run from your hand out to the pole. Instead of that, however, you may shake the clothes line to the left and right, in which case the wave will move just as fast along the line, but the vibration will be sidewise, instead of up and down.

Polarizing a Clothes Line

Fig. 4 makes this plainer. At V we have a pair of ropes, which are being shaken up and down, and so the wave motion is as illustrated. At H are two more ropes, but these go back and forth sidewise in a *horizontal* direction. As far as the waves are concerned they run along the clothes line no matter which way the end is shaken. However, the ones at the left are polarized in the vertical plane, while those at the right are polarized in a horizontal plane.

Looking at the motion endwise, as in Fig. 5, we notice that when the oscillations take place in a single direction (in a plane) a single straight line will show the motion. Thus V is the vertical shaking and H the horizontal. But if instead of a regular oscillation you should shake the end of the rope back and forth and up and down in all directions, as shown at the right of Fig. 5, you would get a vibration which was not polarized.

What It Does to Light Rays

As you no doubt know, light is a vibration in the ether like the waves shown in Fig. 4, except that they oscillate in all possible ways as the right hand sketch of Fig. 5. By running ordinary light through a special optical instrument, called a polarizer, all the rays may be swung into the same plane. Polarized light has several unexpected effects. It will make all sorts of rainbow colors when passed through certain crystals, and it can also be used to show lines of stretch and strain in transparent objects, like glass and celluloid. More will be said about polarizing of radio waves in a few moments.

The great problems in radio are interference, static, and fading. The trend of the radio art in the past has been determined by improvements that have been made in overcoming these difficulties. The practical solution of these problems to-day are: directional reception for reduction of static, continuous waves to minimize interference, and the use of especially slow or quite fast waves to minimize fading. The future answer to these problems may be different. At least we have reason to think that the new knowledge which we have gained regarding wave travel will furnish us additional methods of discriminating between signals and disturbances. Wave polarization will undoubtedly be one of the important factors in this new development.

Radio is Slow Light Wave

A radio wave is of the same nature as the light wave, only with a much slower speed of vibration. The current theory of light radiation is based on the assumption that oscillations take place in all directions at right angles to the direction of propagation (Fig. 5, right). These waves may be rearranged into oscillations polarized in two planes at right angles to each other (Fig. 4), and one of these two components may then actually be suppressed if we so desire.

In radio practice we have so far been in the habit of neglecting the possibility of polarizing the waves, although some of the earliest writers mention such possibilities. Fleming notes two patent specifications by Alessandro Artour of 1902 and 1903 which are based on a theory of wave polarization. Our generally accepted formulas for radiation take into account only the radiation from vertically oscillating currents, and receiving systems of the usual type are responsive only to *vertical* oscillations.

Like Raisin in a Jelly

This habit of thinking of radio waves as existing only in the vertical plane has probably grown up as a result of the fact that horizontal electrical oscillations cannot take place close to the ground where all ordinary observations are made. This can be understood by referring again to the ocean. Waves caused by the motion of the water shak-

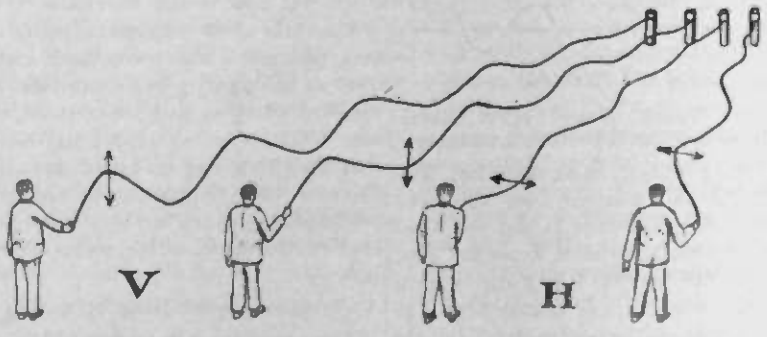


Fig. 4. Two Men Shake the Clothes Lines Up and Down (Vertical), the Others Back and Forth (Horizontal)

ing up and down are familiar to everybody. How would you get the water to make waves by vibrating sidewise to the left and right? If you lived inside a tremendous dish of jelly you could shake a raisin in it back and forth horizontally, and it would make the whole jelly wiggle the same way. Right at the surface, however, the motion has a tendency to become at right angles, or up and down.

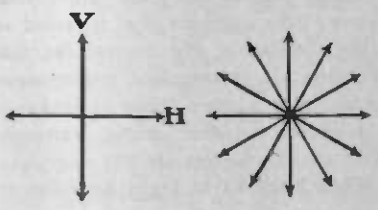


Fig. 5. Polarized Waves May be Horizontal or Vertical, but Most Waves Are in All Directions.

An airplane with a trailing antenna can radiate as well as receive horizontally polarized waves, just like the bowl of jelly. In the *length* direction of such an airplane antenna, the radiated oscillations are vertically polarized, but in the directions at right angles to the antenna the radiation is horizontally polarized.

Much Weaker Near By

Systematic tests that have been conducted with radiation and reception of horizontally polarized waves have proven that this type of radiation is very useful for communication. It has been found that the wave gradually changes its plane of polarization so that a signal which has been transmitted by a horizontally polarized wave can be very well received with ordinary instruments at points distant for the transmitting station. In the neighborhood of the station on the other hand, these signals are very much weaker than signals transmitted from an ordinary station of equal power. The new wave has thus the advantage of creating less interference.

Fig. 6 shows this better. A horizontal aerial or any other radiator which gives horizontally polarized waves is shown sending out vibrations in the horizontal plane only. As they go off into space, they gradually turn as just explained, and some distance away have swung entirely into the vertical plane. As we just saw, the ordinary vertical aerial picks up only the waves which vibrate up and down or in its own plane. The near aerial N, which is located in the midst of the horizontal waves, will not respond to the broadcasting, even though tuned exactly to the right frequency.

Sounds Good When Far Away

On the other hand the distant station D, which is far enough away so that the waves have turned over, will be received just as loudly as any ordinary broadcasting station. If there were another sending station near D, then the latter would not be effected by its *local*, whereas receiver N would pick up this far away sender when it could not hear its own local. The problem of interference would then be solved.

Our principal problems in radio communication are as just mentioned—interference, static, and fading. A brief analysis of these problems as we see them to-day will show that wave polarization is an important factor that should be taken into account.

The greatest advance in overcoming interference between different radio stations was made when continuous waves were generally adopted. Further improvement is gained by the use of directive reception. It is possible to go still further in avoidance of interference by use of directive or beam transmission. In fact the experimental work, which led to the development of the system of polarized waves, was originally undertaken in order to study methods of directive transmission.

Polarizing Will Reduce Trouble

The next step towards suppression of interference is to utilize the new discriminating characteristic that has been found in wave polarization. Selectivity by polarization can then be combined with the already known advantages of selectivity for direction.

A horizontally polarized radiator sends out waves which gradually shift their plane of polarization (Fig. 6). Receivers adjusted for vertically polarized waves do not respond to these waves until this shift has taken place. An area of immunity or a shadow is thus created around the station and this is just the area in which the interference from an ordinary station is most objectionable. We may picture such a station as a spray fountain which throws the water over a wide area, whereas there is a space in the neighborhood of the fountain where comparatively little spray falls.

Static Not Like Signal

The history of our efforts to reduce static divides itself up into two periods. Each of these was dominated by a working theory. According to the first, static is a disturbance which, in its nature, is quite different from a signal. It was pictured as a rapid succession of shocks without any definite wave length. It was therefore assumed that the static could be separated from the signal by some electric filtering device or wave trap, and many such filters were invented. The net result ultimately obtainable from any of these wave traps is the same, and the process resolves itself into a highly selective tuning. The super-heterodyne method of reception is an example of such a highly developed wave filter. It was found, however, that even the best

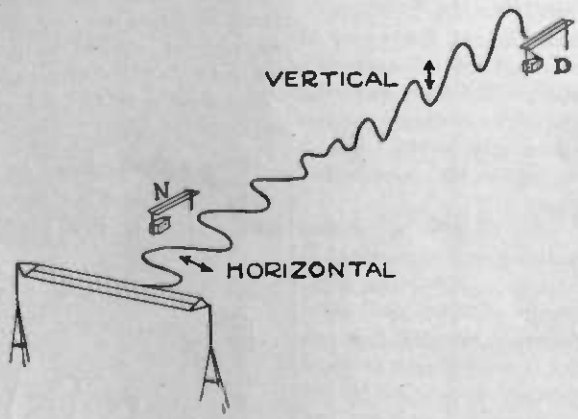
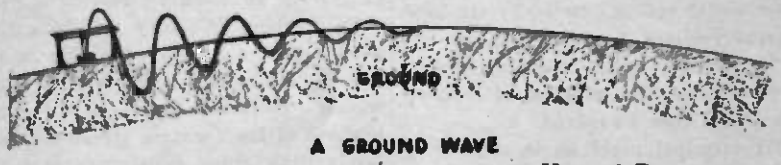


Fig. 6. It is Found That the Plane of Polarized Waves Keeps Turning

methods of filtering leave a residual of static, which in wave characteristics so closely resembles the signal that it cannot be separated by any further such process.

The second working theory for reduction of static gives a physical picture of static as a wave motion of the same character as the signal. The disturbing waves come in from all directions, but the signal arrives from only one. A new characteristic of discrimination was thus found in the *direction* of the motion. The system of reception used by the Radio Corporation for its code messages is based on this principle. It responds to waves only from one direction and excludes waves from all others; 90 per cent. of the disturbances are effectively eliminated in this way.



A GROUND WAVE

Fig. 7. The Earth Wave is Always Straight Up and Down (Polarized Vertically)

Polarizing Out the Noise

In the polarization of the wave, we have now found another characteristic or discrimination. The most favorable condition for reception is thus a receiver which is sensitive only in the plane of polarization in which the outside disturbance is least.

There are three kinds of fading which are particularly noticeable in radio communication. First, the great variation between daylight and darkness. This difference between day and night intensities is insignificant at wave speeds less than 30 kilocycles (10,000 meters) and becomes greater and greater at shorter wave lengths until a critical wave length is reached around 6,000 kc. (50 meters) where the law seems to reverse itself with the result that daylight transmission at 10,000 kc. (30 meters) is practically the same as during darkness. This effect is not yet understood.

The second type of fading is the sharp decrease of signal strength, which is usually observed around sunrise and sunset. This fading is pronounced on the slow waves as well as on the fast ones.

The third type of fading is the periodic variation in signal intensity which is particularly noticeable on broadcast waves. The time of variation, which in each instance is fairly regular, varies from periods of several seconds or even minutes down to intervals so short that the variation becomes an audible frequency modulation which distorts the signal. It is the third of these types of fading which is particularly interesting from the point of view of wave polarizing.

It has been found that a wave proceeds from a radiator in corkscrew fashion with continual changing in its plane of polarization. A horizontally polarized wave of forty to fifty meters has been found to get about 20 to 30 degrees shift in each distance of ten miles. It has also been observed that the most severe phenomena of fading from broadcast stations take place at a distance of about 100 miles. Herein, we may find an explanation and also possibly a cure for the phenomena of periodic fading.

Turned Upside Down in 100 Miles

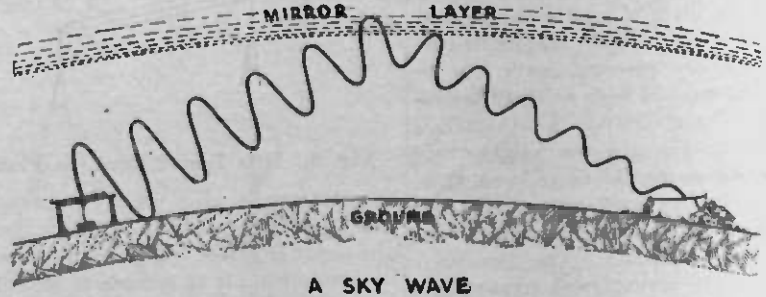
The waves sent out from an ordinary station are of two kinds, the *earth bound wave*, (Fig. 7), which is guided by the proximity of the conducting earth, and the *space* wave or high angle radiation, (Fig. 8), which is guided by refraction in an ionized layer (the Heaviside layer) in the upper atmosphere. Slow wave telegraphy depends largely upon the earth wave. Fast wave long distance communication depends entirely upon the space wave. Broadcast reception depends upon the earth bound wave for nearby stations and space wave for distant stations.

At a distance of about 100 miles the earth bound is of about the same strength as the space wave. We have found by experiment that the space wave from a 6,000 kc. (50 meter) station twists its plane of polarization about 20 degrees every ten miles. From this we may conclude that it would acquire a twist of 180 degrees in 60 to 90 miles. It is therefore reasonable to assume that a space wave emitted from a broadcast station might acquire a twist of 180 degrees in 100 miles.

When Two Waves Fight Each Other

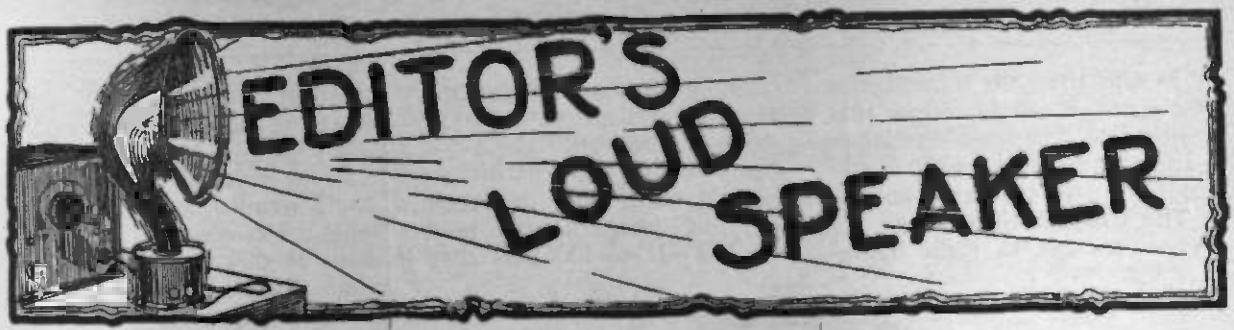
The earth bound wave, on the other hand, proceeding from the same station, will maintain its vertical plane of polarization due to the proximity and guidance of the earth. The earth and the space wave may thus arrive 180 degrees out of step (phase) and cancel each other. If all conditions were constant we should thus have a permanent dead spot of reception, such as is sometimes observed. Variations of the conditions which control polarization will, however, cause the signal to fade intermittently.

From this reasoning it might be expected that these phenomena would repeat themselves again at a distance of 300 miles from the station, where the plane of polarization has twisted another 360 degrees. At that distance, however, the earth bound wave has been so largely absorbed that there is not much of it left compared with the space wave, and therefore it cannot produce phenomena of interference. Much will undoubtedly become known in the next few years which will enable us to predict more accurately these phenomena.



A SKY WAVE

Fig. 8. The Space Wave Changes Its Direction as Shown in Fig. 6



FALLING INTO LINE

Have you ever risen in a meeting and proposed a motion that a certain thing be done? Then you sat down amid absolute silence. Nobody got up to second your motion, and you felt a little smaller than nothing at all.

And then when all hope was lost someone else arose and seconded your motion. Right away you felt that you would *not* have to have your head examined after all, and that if your idea was good enough to appeal to another person, then it was worth fighting for. And as like as not with this encouragement you were able to put your motion through.

And We Were Jim

That is something like the way we have felt for the last year in regard to wave length and frequency. As far as we know, we have been the only publication which has used frequency in discussing radio rather than wave length. Our reason for doing this will appear shortly. However, they were all out of step but Jim, and we were Jim. Just about as we were considering giving up the fight to change all other magazines and newspapers of the United States to our way of thinking, we find in the August number of "Radio Broadcast" a statement by Professor Morecroft, that hereafter that magazine will standardize on frequency instead of wave length.

While we make no claim that we have been the one to convert that magazine, we do feel that the fact that another has swung into line with us is an intimation of how the trend will go. There is a great deal of inertía in people's minds and we all resemble the Chinese to some extent in our respect not only for our ancestors, but also for the old ideas. However, the new idea is so much better than the old that there is no doubt now that sooner or later the world will be converted.

Monsieur Jean Vallier, Famous Basso of Paris Opera, who sang the "Marsellaise" in Bastille Day Program from Station WJZ. His French listeners nearly smashed their instruments in their enthusiasm.

Commuting to Work

At the risk of wearying our readers, we will mention again what the advantages are of this change. Frequency is easy to understand. If you commute from the country to your work in the morning and go back at night, you have a frequency of one cycle per day. If, however, you live near enough to town so that you go back home for lunch at noon, then your frequency is two cycles per day. What would your wave length be in that case? It does not mean the distance actually travelled.

You know that the distance does not have anything to do with the wave length from the fact that you pick up 300-meter stations a thousand miles away. The same is true with 400-meter broadcasters, and 500, too. Get some friend of yours who thinks he understands wave lengths to figure out what would be meant in the case just mentioned.

If you have a short line or shuttle trolley in your town connecting two longer lines it takes perhaps five minutes for a round trip. Then it has a frequency of twelve per hour.

A Palm Leaf Fan

On a hot day you take a palm leaf and fan yourself a hundred times (cycles) a minute. But a big insect's wings fan up and down 100 cycles a *second*. All this is clear enough, isn't it? But again ask your smart friend what the wave length of these vibrations would be.

When we get to notes in music again it is clear what is meant. If a phonograph needle shakes the diaphragm back and forth 1024 times per second, we have the note of high C. You may think that here the wave length can be measured by observing the spacing of the hills and valleys on the record, but this is not so. You can see that this idea is wrong because if we should speed up the disk so that it turned twice as

fast at the time the record was being made, it would follow that the hills would be spaced twice as far apart and yet the 1024 cycles would still give the same note.

The Broadcasting Range

When we get to radio vibrations they go so fast that the cycles are never measured per hour, or even per minute, but always the number of complete oscillations which occur in one second. The broadcasting range runs from about 600,000 cycles (or for convenience dropping the thousands, and calling it 600 kilocycles) to about 1400 kc.

Again this idea of vibrations per second is quite clear to anyone's mind, but where do the meters come in? It so happens that if you divide the number 300,000 by the kc., you get an answer which represents the meters wave length. Thus 600 kc. corresponds to 500 meters, or 1,000 kc. is equivalent of 300 meters. But who is there short of a laboratory engineer who has much idea of what the meters wave length actually means?

From this it follows that a small number of meters represents a fast vibration speed, while many meters mean a slow speed. Since the waves are assigned by the government at every ten kc. throughout the range, it is easy to remember the wave speed as expressed this way. When converted to meters, however, the lengths all end in decimals, which makes them hard to remember.

Jump Over the Range

Besides this, while the kc. runs up in even tens throughout the range, the wave length in meters jump all around. In some cases two stations with adjacent waves will be separated by two or three meters, while others may have a difference of seven or eight meters. In every case, as already explained, the difference in kilocycles is exactly ten.

For all these reasons (as well as for some engineering causes) we have been using frequencies as standard, followed in parenthesis by the meters for those who are not yet familiar with the change. If you like this idea, as you probably will when you get accustomed to it, a letter to your local newspaper may help to swing them into line.

William Van Hoogstraten, Conductor of the New York Philharmonic Orchestra, whose stadium concerts are a tri-weekly feature throughout the East. Altho the music is high class, it seems to appeal to everybody.

TALK ABOUT NERVE

An enthusiastic listener to the Goldman Band Concerts broadcast from WEAF and a chain of stations has cited the "Hallelujah Chorus" from Handel's "Messiah," which was played recently by the band, as the plainest case of plagiarism he had ever heard. "Why, it's a direct steal from 'Yes, We Have No Bananas'," he protested.

STATIONS STILL INCREASE

For the month of July the radio division of the Department of Commerce reports that while 23 broadcasters folded up their tents and hung the To-let sign in the window there were 27 others who first saw the light of day. That means that there are four more on the air than there were a month ago. No one is pleased at this except the stations themselves.

Four Speeds for Schenectady

Here is Your Chance to Try Out Several Different Waves

By VANCE

YOU hear so much these days about high speed vibrations and short wave lengths. But many fans do not like to try them out, because in the first place they do not know how to go about it, and in the second, they don't know which waves to pick up, even if the apparatus is made.

However, this article is not so much about *how* to build a high frequency, low wave set, as it is to point out in what way such a radio can be used. There are several stations at present broadcasting on these waves. For instance, the Westinghouse Company at East Pittsburg has been experimenting for over a year and is getting very good results. They are not, however, following a definite schedule, and it is not possible to tell beforehand just when they may be picked up.

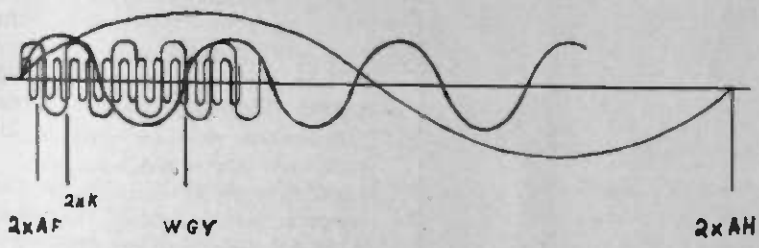


Fig. 1. Four Waves, All Going at Once, Come from the Transmitters of Schenectady. Their Relative Frequency and Length Are Shown Here

In a general way, almost any ordinary set can be made to pick up high speed (short length) waves by cutting down the condensers and coils in the set. Probably the easiest way, if you have a set using 23 or 45-plate condensers, is to disconnect each of these units and in its place substitute one which has five plates. Then the coils should be removed and others having about one-third the number of turns should be substituted.

How to Double the Speed

Remember in this connection that if you wish to increase the frequency to double, which is the same thing as cutting the wave length down to half, you must reduce both capacity *and* inductance to half or else the product must be reduced to one-quarter. Since there is quite a bit of leakage capacity in your set between wires, which can not be reduced, it follows that the condenser capacity must be cut to considerably less than half in order that the total quantity shall go down in this proportion.

A Quartette that Keeps Together

The General Electric Company, however, has gone on a definite program which contains four different waves. All of this quartette are going at the same time, and so if you look up the concerts in the daily paper and find Schenectady down as WGY at 790 kc. (379.5 meters) you will know that the other three waves are also running at the same time.

This will be a great advantage for equipments in the field of radio, since they are in this way afforded an opportunity of comparing the same program under similar conditions except for differences in power and frequency.

Evening programs of the General Electric Company's Eastern station are now going out on four channels as follows:

Call Letters	Frequency Per Second	Wave Length
2XAH	1800 kc.	1660 meters
WGY	790 kc.	379.5 meters
2XK	2750 kc.	109 meters
2XAF	7900 kc.	38 meters

What the Call Letters Mean

Of course, the second one in the column, WGY, is most popular, as it falls about in the middle of the regular broadcasting band. If you are not satisfied with this one, you can get either higher or lower ones by adjusting your set to fit. The difference in the series of call letters is caused by the fact that the series starting with a "W" shows that the station is a regular broadcaster, while those starting with a numeral (2 in this case), shows that it is not in regular entertainment service, but is an amateur station located in one of the regular radio districts (second) of the United States. The fact that the number is followed by the letter "X" further tells us that the station is an experimental one. The rest of the signature is entirely arbitrary like the letters in the call of a broadcasting station.

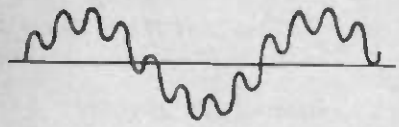


Fig. 2. When Two Waves Go Together, They Add Like This. Here, One is Eight Times as Fast as the other.

Some idea of the way these compare in speed and length may be obtained from Fig. 1. This shows the four waves which are going out together at the same time. Notice that 2XAF is the high speed short wave, which vibrates at 7900 kc. (7,900,000 oscillations per second). 2XK is a much slower wave, as it shakes up and down only 2750 kilo-

cycles per second. Then comes our old friend WGY at 790 kc., and last the sluggish wave of 2XAH, which changes its mind only 180 thousand times per second.

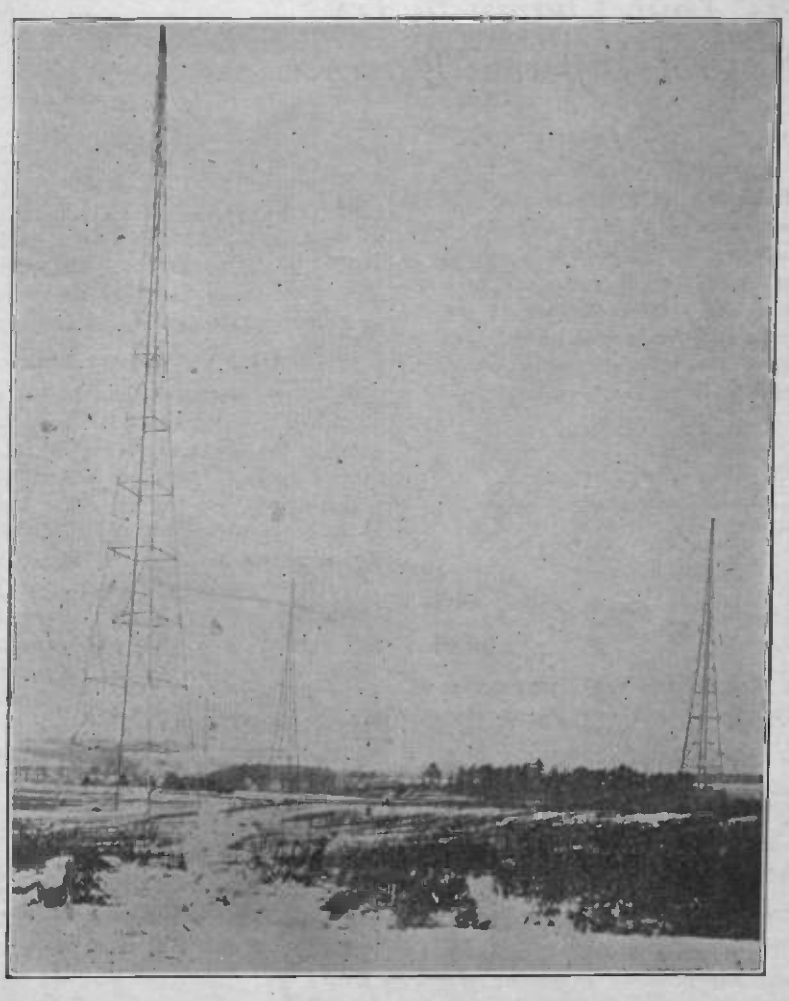


Fig. 3. Three Steel Masts Tower Above the Laboratory Lot. They are 300 Feet High

Like a Mixed Quartette

You may wonder how all four waves can be going at once without interfering with each other. In this respect, it is just like a quartette singing from the stage—the soprano has a high pitched voice, which means that her notes contain a high number of vibrations per second. An instant later the alto joins in with a lower tone. Does this mean that you can no longer hear the soprano? Not at all—her music is just as clear as before, but has the accompaniment added to it.

If you have a phonograph record made of the two, you will find that both vibrations show up very clearly, although one appears more as a ripple on the other as shown in Fig. 2. Then the tenor chimes in with a still lower tone, and following him, the bass. Although they are all singing simultaneously, anyone with a musical ear can pick out the separate note that each one is singing. It is the same thing in radio. Although all four vibrations are going together, a sensitive radio set is able to pick out any one of them to the total exclusion of the rest. Indeed, it is much easier to separate waves like these which differ so much in the kilocycles, than it is to keep apart those in the ordinary broadcast range when their frequencies are much closer together.

Ringing All the Changes

In broadcasting on higher and lower wave speeds than those provided in the band assigned by the government to broadcasting stations, the radio engineers are pursuing an exhaustive research into the problem of transmission under all conditions of service, daylight and dark, summer and winter, under various degrees of power and with a variety of antenna arrangements.

Radio fans who are equipped to receive these higher and lower waves, are asked to report to the engineers on their reception with particular reference to quality, fading, and strength of signal on the different waves. For example, if the signal on 7900 kc. (38 meter wavelength) rides through clearly while the 790 kc. (379.5 meters) signal of WGY is blasted by static or smothered by fading, the engineers will be very much interested in knowing about it. Your report may become an important factor to them in solving some of the many perplexing problems of radio transmission.

54 Acres of Broadcasting

Stations 2XAF, 2XK, and 2XAH are located at the transmission laboratory of the General Electric Company, three

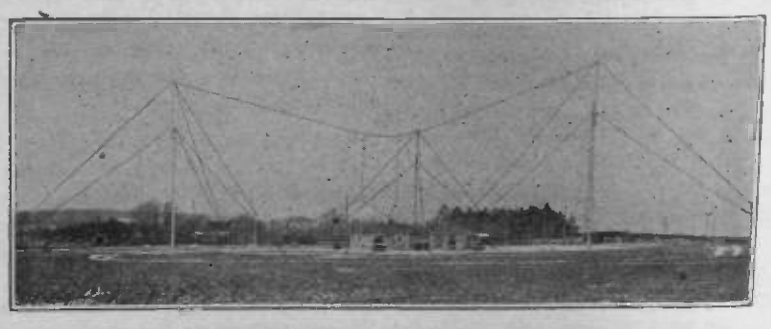


Fig. 4. Wooden Masts Must be Used for the High Speed Waves, as Shown Here

miles from the City of Schenectady. This 54-acre tract contains a total of thirteen buildings, five of which are used to house transmitting equipment, four for power machinery, and the remaining four contain the tuning coils for the antenna systems.

Fig. 5. This Power Plant Furnishes the Energy for All the Laboratories and Transmitters

The antenna structures, which are visible many miles outside of the city, include three masts 300 feet high (Fig. 3), arranged in the form of a triangle. From these masts almost any type of antenna may be strung capable of operation between 500 kc. (600 meters) and 100 kc. (3,000 meters).

Owing to the extreme height of these towers, the higher frequency vibrations cannot be transmitted from them. The lead-in alone running to the top of the masts would be long enough to slow the oscillation speed down to about 500 kc. For higher speed work, a shorter antenna post is needed. This is supplied by a fourth steel tower, 150 feet high, which may be connected by a short aerial to any of the trio of masts for work on waves in the broadcasting range. In addition to the four steel towers, there are several wooden masts for antennas working on high speed waves to 20,000 kc. (See Fig. 4).

The largest of the thirteen buildings is constructed of steel and brick, and contains the main power plant. Space is provided for two additional transmitters. A good view of this appears in Fig. 5.

A Dark Room is Needed

The power plant includes a number of high-powered rectifiers for converting the alternating current supply into a direct current source with a maximum pressure of 30,000 volts. In addition to the rectifiers, there are direct current and alternating current machines for filament energy, biasing the filaments, and for low powered amplifier operation. The space alloted for the two transmitters is sufficient for equipment rated at a maximum of from 50 to 100 kilowatts. The power building also includes a dark room for the development of oscillograms, and a fully equipped storage battery plant. Here also is located a central pumping system which provides circulating water for all transmitters. This water supply is used for the water-cooled power tubes.

With all this equipment at your disposal, it will really pay you to try some experiments in picking up these high speed waves this summer. They have already been received a good many times in Europe, and even as far off as Africa.

"Banner" Made Him Choke

Reports of distant reception of these special broadcasting waves are already coming in, indicating that they are getting distance in spite of warm weather and the accompanying static. Irvin N. Reeves, living in London, England, reports under date of June 19, that he has been listening to the 2XAF signals on 7900 kc. (38 meters) "nearly every night, and they have been coming through in great shape." He recently listened to the music of the U. S. Marines, broadcast through WRC from Washington, D. C., and the concluding number, "The Star Spangled Banner," made him "choke up."

"Now for the sake of Americans abroad," writes Mr. Reeves, "please don't abandon the high speed broadcasting. It comes through with a punch, and the daylight on this end does not seem to affect it. This morning at 5:15, the organ recital was still coming in fine, and it was bright daylight."

If you try your luck on these broadcasts, you will undoubtedly be pleased. RADIO PROGRESS will be glad to hear from you as to the outcome of your experiments.

Fun For Fans

You Ought to with Some

Con: "The radio will never take the place of newspapers."

Denser: "Why?"

Con: "You can't start a fire with a radio set."—*Science and Invention.*

A Joke on the Cop

Cop on Shore: "I'm going to arrest you when come out of there."

Man in Water: "Ha-ha! I'm not coming out. I'm committing suicide."—*Arogwan.*

But Not a Radio Fan

Flap: "Where you going?"

Deb: "Out for a ride with Jack. Do I need a coat?"

"I should say not. You'll need a fan."—*Colgate Banter.*

He Came with His Trunks

"I liked that fellow you were with last night, so I asked him to dinner this evening," said the merchant to his daughter. "I told him to drop round in his business clothes."

"Oh, father!" said the girl, "he's a swimming instructor,"—*Good Hardware.*

Coming Out Even

Sandy: "Hoo is it, Jock, that ye mak sic an enairmous profit off yer potatoes when ye gie a special price to each freend?"

Jock: "Well, I tak a half-crown off the price because he's a freend o' mine; then I tak ten pounds off the hundred weight because I'm a freend o' his."—*London Opinion.*

American Radio Relay League

NEWS FROM BAY OF FUNDY

Amateur wireless is already fulfilling its mission as the only link between the Navy-MacMillan expedition to the far north and the homeland. Member stations of the American Radio Relay League in Alabama, Illinois, New York and Pennsylvania have already communicated with WNP, radio station of the Bowdoin, flagship of the expedition, and the valuable data on reception which is sent back through the air to John L. Reinartz, operator of the station, is expected to help clear up the difficulties which beset the last MacMillan expedition.

WNP began work on June 17, the day the Peary sailed from Boston to join the Bowdoin at Wiscasset, Me., and contact was made with two stations. J. W. Newman of Mobile, Ala., operating station 5AOM, carried on a conversation with WNP for forty-five minutes. The same day, WNP at Wiscasset, talked with E. H. Conklin of Evanston, Ill., operating station 9DBF.

Thunderstorm Upsets Plans

At 6 p. m., Eastern Standard Time, on the sailing day, WNP was heard by several stations trying to get a station in the first radio inspection district (New England). This effort was unsuccessful due to a sharp thunderstorm then in progress over a large part of the area.

At 6:15 the same day, with the two ships on the way along the coast, Mr. Reinartz carried on a conversation with 8CYI, a Rochester, N. Y., station owned by Hertzberg Brothers. The operator at 8CYI reported WNP with terrific strength that faded frequently, giving rise to the idea that the Bowdoin was rolling considerably. This conversation continued until 6:47 p. m.

Fred Link, operator of station 3BVA at York, Pa., talked with Reinartz from 3 until 3:30, Eastern Standard Time, the same day at which time the exploration ships were reported 330 miles off Monhegan Island, crossing the Bay of Fundy. Link reports the signals of WNP as coming in loud but with some unsteadiness. The results were such, however, that Link expects to be in daily communication with the Bowdoin.

QUAKE FAILS TO WRECK RADIO

To Brandon Wentworth, Jr., and Graham George of Santa Barbara, the former an official relay operator of the American Radio Relay League, fell the duty of first linking the stricken city with the outside world after the disastrous earthquake that shook the entire neighborhood.

The first news telling the world without of the city's plight; the first reassuring messages to friends on the outside; the first call for Naval aid in guarding against vandals were the work of Wentworth and George.

When the trembler hit the city, bisecting buildings, paralyzing the power system, laying waste the water works and cutting off Santa Barbara from the rest of the world, these two youthful radio enthusiasts, like all others lost their home stations in the general collapse of higher structures.

The Key to the S. O. S.

Undeterred by the loss of their own equipment, the two young men made post haste to the radio store of Bolton and Jones where materials were available for the use of those who knew how. Wentworth and George knew how. Within an hour of the first shock, they had assembled a three-inch spark coil, a rotary gap, twelve volt battery and a key for transmission of an SOS.

An undamaged superheterodyne receiver from the store stock took care of the reception and the busy pair of radio men immediately started sending out their SOS. The tanker H M Story, Station KDVV, and the tug Peacock, Station KDKY, were the first two to pick up the calls. The tug acted as relay station in the call for naval aid and in sending out the news of the disaster. The emergency station continued its work until other communication was restored.

RADIO INTERFERENCE SMALL IN TORONTO

Toronto, according to members of the local Vigilance Committee, which takes care of reducing radio interference, is fortunate in that there is practically no interference from amateur radio telegraph stations. Despite the fact that there are twenty or more transmitters working in the city, only one complaint has been registered against interference by these stations. This matter was cleared up and the local committee was practically forced to suspend operations, because the nature of interference complaints against power leaks, X-ray and violet ray machines was such that the committee lacked power to operate.

Photos of Fanatic Fans

Perhaps He Files His Messages in the Same Way

First 50,000 Watt Sending Station

Laboratory Report on Fading Tests Real Superpower Transmitting

By RADIO PROGRESS LABORATORY DIRECTOR

AT midnight, Eastern Standard Time, and running for an hour into early Sunday morning, July 26, the first real super power station was on the air.

This is the new transmitter of WGY, the General Electric Company at Schenectady. It has a rating of 50 kilowatts or 60,000 watts, which is just 100 times as big as the majority of the high powered stations in the United States, as they have a rating of 500 watts. It is 25 times as big as the regular station of WGY, with its 2,000 watt transmitter.

Steps 500 Watts High

You will remember that it was only recently that the Department of Commerce allowed any station to use more than 1,000 watts in an aerial. A few months ago, Secretary Hoover announced that they would permit further increases of power in steps of 500 watts each, and these would perhaps be allowed to pile up until a total maximum of 5,000 watts was obtained. Several stations took immediate advantage of this permission and increased to the first step of 1,500. The Government further let it be known that stations would not necessarily be treated alike, but that each one would be judged on its own merits as to whether still more power might be used.

As the 1,500 output seemed to be a success, the limit was raised to 2,000. This was so promising that the far seeing Department of Commerce decided that in a few cases the intervening steps might be omitted and the full allowed power of 5,000 watts might be put immediately into the aerial. Station WLW, Cincinnati, immediately availed itself of the privilege and KDKA, East Pittsburg, also at times used this same value.

When Everything is Shut

This has not worked out for a long enough time to give the radio fans through the country sufficient time to find out whether the disadvantages of jamming the smaller stations are great enough to outweigh the advantages. However, Secretary Hoover is a broad gauge engineer, and so the General Electric Company was given very special permission to try out real super-power as already explained of 50,000 watts, provided they used it at a time when practically all surrounding stations were shut down.

As the cities of the East where the sending aerial is located are largely on Daylight Saving Time, you will realize that the time from one until two o'clock on a Sunday morning is not likely to cause interference to very many people.

Entertainment Not Entertaining

It so happens that Providence, where the laboratories of RADIO PROGRESS are located, lies at such a distance from Schenectady that ordinarily Station WGY fades very badly. This bother occurs so much even in winter time, that it is not at all popular in these parts. During the summer, no one thinks of tuning in to WGY for entertainment, as it is far from entertaining. The signals fade continuously even under conditions of minimum static, and it is hopeless to try to get any enjoyment at all from them.

It should be understood that this is no criticism of Station WGY. The fault lies not at the sending end, but in the receiving conditions at this particular location and distance. Nor is it the fault of any one style of radio set, as all makes are affected about the same.

Here is the report taken from the log of the laboratories starting at 1 a. m. Daylight Saving Time, Sunday morning, July 26.

Static Every Two Seconds

The weather was poor. A gentle rain fell intermittently. During the entire evening there had been more than ordinary amount of static. Crashes repeated themselves at an average of about every two seconds. At 1 o'clock the announcement came on that the station was transmitting on its experimental license with 50,000 watts on its usual wave of 790 kc. (379.5 meters.)

Following the announcement various pieces of music were played and then a short address was given by Mr. Rice, the head of the broadcasting at this station. Then the musical program was again resumed.

The station had been logged just before it signed off at midnight an hour before on its customary 2,000 watts. It is very difficult to guage the relative loudness of sounds by the ear, but the laboratory observer estimated that the volume sounded about five times as loud on the new output as it did on the old. The actual ratio of power was 25 times as much, so the apparent loudness as estimated varied as the square root of the power.

Announcer Not So Good

The enunciation was perfect and left nothing to be desired. When Mr. Rice spoke he was much more intelligible and his voice was considerably louder than the voice of the announcer. The former compared very favorably with the volume of the musical pieces, but the announcer was not nearly as easily heard as was the music.

Fading was quite marked, although it was not nearly as bad as it had been on the usual wave an hour before. *Before* midnight when the signals faded, they dropped apparently quite a bit below audibility, so that the time during which the station could be heard at all on the loud speaker of a sensitive three-tube regenerative set was considerably less than the time when the volume was loud enough to be understood. As a result the announcements which were

made at that time were almost unintelligible.

Could Be Heard When Faded

After one o'clock, although the fading persisted, the signals were loud most of the time for perhaps two or three minutes at a time and then they dropped fairly rapidly to a minimum which could still be barely heard, and which lasted for ten to twenty seconds. A record was made of when the signals were loud and when soft. It was found immediately that no particular time could be noticed for the loudest value, since this held constant as explained for several minutes. The times of minimum loudness, when the station faded are as noted below, (hours, minutes and seconds):

1:15:40
1:18:00
1:22:08
1:23:30
1:27:30
1:30:50

The test for fading was discontinued at this point since the above data is enough to show the general form of its period.

A rather interesting fact was noted in regard to tuning the wave. This receiving set can easily detect a change of 0.2 (2/10) of a kilocycle in wave frequeney. During the test there was an apparent shift of 0.8 kc. in the wave from the time of start until the finish. As an indoor aerial was used which could not sway and as the set has been frequently tested for constancy, it seems unlikely that this change in wave speed was internal in the receiving set. Of course, however, it is possible that it was the radio which shifted rather than the incoming wave.

Results of This Test

The laboratory drew the conclusion from this test that such an increase in power output, not only brought the signal level considerably above the static level even on a night with bad receiving conditions, but it also reduced the fading in a location where the latter is very bad to a point where the entertainment from that station could be enjoyed.

It is suggested that to get the best results from fading tests of this nature, it would be an advantage for the announcer to give the exact time several times during the sending period in order that various listeners could all set their watches exactly alike. Only in this way could comparative tests of the times of fading be made.

POLICE COURT ON THE AIR

As a means of educating the public in traffic laws, particularly as applied to the operation of motor cars, WGY, the Schenectady station of the General Electric Company, recently offered "A Night in Magistrate's Court."

The cast of this three-act tragedy, with a moral in every act, consisted of the Schenectady police magistrate, chief of police, court attendants, policemen, counsel and three prisoners. Each act of the tense realistic production was a complete story in itself, and each pointed the same moral—the hazard of breaking traffic laws where the police are alert.

"Good Morning, Judge"—"Fine"

Those of us who have said, "Good Morning, Judge," after stopping on the wrong side of the street, or parking without lights, perhaps enjoyed the re-enactment of an unpleasant scene. Those who have yet to learn the inner workings of a magistrate's court probably found this drama educational, and if the warning is remembered, this production meant a saving in fines.

Three violations of traffic laws were tried before the magistrate. Court procedure was re-enacted as faithfully as those who are engaged in the job every day could make it. The offenders were represented by counsel. Arraignments were made on a charge of operating a car while intoxicated, of reckless driving, and of speeding. At the conclusion of each action, Magistrate Charles F. Fryer gave a short dissertation on the law covering the particular case.

If the broadcasting of these traffic cases proves of sufficient interest and value, it is proposed to present other actions, from time to time. Each will illustrate some phase of the various laws and ordinances which govern traffic on state highways and city streets.

WHO WON THE BALL GAME?

After several weeks of research and experimenting, the staff of Station WJZ has worked out a program for the broadcasting of news of interest to the followers of the world of sport which they think will meet with the hearty approval of all. Finding a time which would dovetail in with all other broadcasting and still be at an hour which was suitable to the listeners was not at all easy, but finally the following schedule was adhered to by that station throughout the season, unless some exceptional event makes a slight variation necessary in which case due notice of it will be given:

On week-days, baseball scores of the major leagues will be given inning by inning every half hour, from the hours of four to six o'clock in the afternoon. The first report will be made to the radio audience at four o'clock, the next at four-thirty, etc., until six, when the last afternoon report will be made. At eight o'clock each week-day evening, (with the exception that on Tuesday it is 7:55) a sporting final report will be sent out which will include a summary of the baseball scores for the day, results of all races at local and other prominent tracks and other big sporting events. On Sundays, the series of baseball scores given in the afternoon will be omitted, but the sporting final will be broadcast as usual at eight o'clock.

Rx 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. Is it possible to add an amplifier to a crystal set?

Answer. Yes, it gives very good results to make this combination. The crystal is quite clear and is not much affected by static. The amplifier will increase the volume so much that a loud speaker can be operated. One step is enough to work a horn in an ordinary room provided the crystal set gives loud signals on the phones. Of course, the combination will not pull in outside stations as only the locals will be picked up by the crystal itself. The amplifier makes louder the program which the crystal feeds it and does not play any music of its own.

Question. Some of the new sets are coming through with wooden panels. How can this be reconciled with the directions to use nothing but bakelite or hard rubber?

Answer. To be sure a fine insulator must be employed at this point if the panel supports any live radio apparatus. In the sets which use a wood panel you will find that no high frequency equipment depends on this support for insulation. If a variable condenser is fastened to the panel, with the rotor grounded and a metal shield to prevent body capacity located between the panel and the condenser frame, then of course there is no need of an insulator to support the unit. In such a case the panel will carry no current at all, even if it should happen to be a very poor insulator. All current which might flow into it has already been drained off to the ground through the shield and rotor. This construction is standard practice and the material of which the panel is made, whether bakelite, wood or even metal, makes no difference at all.

If a coil or switch is also mounted on the panel, then such units should really be well insulated in themselves and not require the added dielectric value of bakelite. You can easily see from these considerations that in many of the modern sets which have good insulation in the various units themselves, there is no need of adding the extra effect of a well insulated panel. In such sets if a wooden front seems to harmonize better with the cabinet design by all means use it.

Question. How often does a Neutrodyne set have to be re-balanced?

Answer. Such a receiver should not require re-balancing at all as a general thing. The idea of the adjustment is to compensate or neutralize the internal capacity of the radio frequency tubes. This capacity is the condenser action between the grid and the plate of a tube. Its value depends on the size of these units and the distance between them.

A few years ago the vacuum bulbs were not made by automatic machinery and the result was that the spacing of these two elements varied quite a bit between one unit and another. This resulted in internal capacities which were not always the same. With modern machinery, however, the spacing is kept constant and so the capacity is alike. When you have neutralized the set for one tube you may change to another without effecting the adjustment.

But if you have balanced the set for five-volt storage battery bulbs and decide to change over to dry cell operation with three-volt tubes then you will find that your set is apt to squeal because it oscillates, since the new capacity is quite different from the old. In that case you must neutralize the set over again with the new tubes in place.

Question. Many of the new sets seem to be omitting the dials and using a pointer instead. Why is this change made?

Answer. It is largely a question of taste. Some people prefer the appearance of one and some the other. However, there is one positive advantage of the pointer. It arises from the fact that it is natural for a right handed person to turn a handle to the right to increase the reading. That is why dials are often made with the zero at the right and the 100 at the left. If such a dial is set at say 50 then you turn it to the right to bring it up to 60.

This seems natural enough but the great objection to such a system of numbers is that they run backwards instead of forwards. That is instead of reading 8, 9, 10, 11, we see 11, 10, 9, 8. Half a division beyond the 8 is not 8½ but 7½. This is so awkward that this type is disappearing.

Question. I have a vernier dial on my tuning condenser but it does not seem to give a smooth adjustment of waves. What is the trouble?

Answer. This is a rather common occurence but it is not the fault of the vernier dial. Many of the condensers have a slight amount of looseness between the rotor shaft and its bearings. If this shaft is moved sidewise or up and down it rocks the rotor plates slightly and this changes their spacing inside the stator plates with the result that the capacity of the unit varies.

There may be only one or two thousandths of an inch looseness in the bearings but this is enough to cause a distinct shift in the capacity of the condenser. The vernier dial in turning a few degrees is intended to change the capacity by a very small amount—in fact, so small that the change caused by the bearing looseness as just described may be considerably greater. When you start adjusting the vernier knob you are bound to move the shaft back and forth a little, if it is loose and in such a case the capacity will vary in a way which is not smooth but has sudden changes in a very erratic manner.

Of course, the remedy is to use a condenser in which the bearings have no play or looseness. The style with a cone bearing gets rid of this trouble and is adjustable for wear.

Question. Is there any special way that the aerial and ground should be brought to a receiving set?

Answer. The exact way these wires run is not very important provided you escape two different pitfalls. One of these which is seen fairly often is the mistake of bringing in the aerial lead-in close to some of the other wires. This is wrong as the high frequency radio wave will leak off to the other wire by capacity action and so reduce the signal strength. Such sets as the Atwater Kent which use a large cable with all leads bunched together are careful to exclude the aerial wire from this assembly. The ground and battery wires, however, may all be cabled with advantage.

The other error is bringing in the aerial over the top across to the front of the receiver. Such a location is very apt to bring it fairly close to some of the grounded wires inside the set. An additional bad effect is found in the pronounced body capacity which will very likely result if the lead-in is placed near where your hands must be to operate the controls. The best way of locating the aerial is to have it come directly from the rear of the set at the end where it is to be connected.

Question. There is a steady crackle in my receiver most of the time. What is probably the cause?

Answer. It is most likely something coming in from outside. The probability is that there is a direct current motor near you and owing to a poor commutator or defective brushes it is sparkling badly. That makes it a little broadcasting station on its own hook. Try disconnecting aerial and ground to see if the sound is changed. If not, then your trouble lies inside the set most likely in the grid of the detector tube.

Question. How can I tell if my tubes are oscillating or not?

Answer. If you have a single circuit set you will get a squeal from an oscillating tube if you tune to a radio wave coming in from the air. This squeal is caused by the action of one wave on the other and is never obtained from one vibration alone. If you find that you are getting a whistle as you turn your tuning knob then the thing to do is to cut down on the regeneration by turning down your tickler. This will suppress the oscillation.

If you have a set using radio frequency amplification then oscillation is much harder to locate and to suppress. It is usually discovered as the result of a sort of mushiness of tone, although sometimes it will show up as a squeal. To prevent such an oscillation you may use a neutralizing condenser as in a neutrodyne or some form of resistance which will damp out the objectionable vibration.

Question. Is it worthwhile using a vernier rheostat for sharp tuning?

Answer. Properly speaking the rheostat is not used for tuning at all. You may vary the volume of sound by its means but this is poor practice since it introduces a certain amount of distortion. In some sets which are not well built the rheostat is needed to control oscillations. In such a case a vernier unit might perhaps have some slight advantage. Naturally the real way to accomplish this result is to rebuild the set so that the rheostat is required only to adjust the supply voltage to the correct value for the filament.

Question. What is meant by "Neutrodyne Style" of receiver?

Answer. This set uses three control dials which operate condensers to tune the grid circuits in two stages of radio frequency and the detector. In a real neutrodyne there are a pair of neutrodones used to neutralize the grid circuits of the two steps. That is what makes this receiver different from others. If you leave them out it merely becomes a tuned radio frequency hook-up. Since it resembles the well known set in tuning dials and general appearance, it is sometimes called "neutrodyne style."

Question. What size of coils should be used to pick up Arlington time signals direct on a three-coil honey comb set?

Answer. Of course, you should really use a long aerial to get this station. However, if you have the customary aerial of 100 to 150 feet, then a 200 turn primary would be about right. A smaller coil will match with a longer aerial. The secondary should use 250 turns with a .0005 condenser. The tickler may require as many as 300 turns to make the set oscillate. If this is not sufficient you may go higher, but a better way is to reduce some of the resistance in the coil and then this size will be big enough.

DOUBLE STATION AT WLW

The Crosley Radio Corporation's super-power station, WLW, is now listed by the Department of Commerce as an experimental station in addition to its regular broadcast license, which permits the use of five-kilowatt transmission. The call letters are 8XAL, and will be heard from time to time as the occasion requires.

This new license permits the Crosley station to conduct experiments for the development of the science of radio communication or apparatus. This will allow experiments with wave speeds between 1,500 and 300 kc. (200 and 1,000 meters), during the hours before 11:30 in the morning and after 12:00 midnight.

Biltmore Master Reflex

We wish to announce our

Model V1 Master Reflex Receiver

which we are about to place on the market.

It has taken more than a year of constant improvement on one of the most popular reflex circuits which has ever been designed to develop this receiver.

And we have been well repaid for our efforts. We have completed this six tube machine, a set extreme in sensitiveness and excellent in selectivity.

But most important of all, the receiver is perfect in tone! We will compare it with any standard receiver, and guarantee that it wins the opinion of all who hear, that it has the finest tone of any receiver manufactured.

If your dealer is not yet supplied, we shall gladly fill your order direct, and if you are within a reasonable distance of Boston, we shall be pleased to have the receiver installed and demonstrated in your own home, and to your own satisfaction.

MODEL V1 $115

DEALERS ARE REQUESTED TO WRITE

Please mention RADIO PROGRESS

THE BILTMORE RADIO COMPANY

BOSTON 30 MASS.

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

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

	K.C.	W.L.	W.P.
KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburg, Pa.	970-	309-	1000
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O.	1200-	250-	500
KDZB—Frank E. Siefert, Bakersfield, Cal.	1430-	210-	500
*KFAB—Nebraska Buick Auto Co., Lincoln, Neb.	880-	341-	500
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz.	1100-	273-	100
KFAE—State College of Washington	860-	349-	500
KFAF—Western Radio Corp., Denver, Colo.	1080-	278-	500
KFAJ—University of Colorado, Boulder, Colo.	1150-	261-	100
*KFAU—Boise High School, Boise, Idaho	1080-	278-	500
KFBK—Kimball Upson Co., Sacramento, Cal.	1210-	248-	100
KFCF—Frank A. Moore, Walla Walla, Wash.	1170-	256-	100
KFDM—Magnolia Petroleum Co., Beaumont, Tex.	950-	316-	500
KFDX—First Baptist Church, Shreveport, La.	1200-	250-	100
KFDY—S. Dak. Ste. Col. Ag. & Mech. Arts, Br'kngs., S. D.	1100-	273-	100
*KFEQ—Scroggin, & Co. Bank, Oak, Nebr.	1120-	268-	500
KFFV—Graceland College, Lamoni, Iowa	1200-	250-	100
KFGC—Louisiana State Univ., Baton Rouge, La.	1120-	268-	100
KFGD—Oklahoma College for Women, Chickasha, Okla.	1190-	252-	200
KFGH—Leland Stanford Junior Univ., Stanford Univ., Cal.	1110-	270-	500
KFGX—First Presbyterian Church, Orange, Texas	1200-	250-	500
KFI—Earl C. Anthony, Los Angeles, Cal.	640-	469-	2000
KFIF—Benson Polytechnic Institute, Portland, Ore.	1210-	248-	100
*KFIO—North Central High School, Spokane, Wash.	1130-	266-	100
KFIQ—First Methodist Church, Yakima, Wash.	1170-	256-	100
*KFIZ—Daily Com'lth & Wis. R. S'les, Inc., Fondulac, Wis.	1100-	273-	100
KFJF—National Radio Mfg. Co., Oklahoma, Okla.	1150-	261-	225
KFJM—University of No. Dak., Grand Forks, No. Dak.	1080-	278-	100
KFKQ—Conway Radio Laboratories, Conway, Ark.	1200-	250-	100
KFKU—University of Kansas, Lawrence, Kas	1090-	275-	100
KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb.	1040-	288-	2000
KFLR—University of New Mexico, Albuquerque, N. Mex.	1180-	254-	200
KFLV—Swedish 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-	500
KFMR—Morningside College, Sioux City, Iowa	1150-	261-	100
KFMX—Carleton College, Northfield, Minn.	890-	337-	750
KFNF—Henry Field Seed Co., Shenandoah, Iowa	1130-	266-	500
KFOA—Rhodes Dept. Store, Seattle, Wash.	660-	454-	500
KFOC—First Christian Church, Whittier, Cal.	1270-	236-	100
KFON—Echophone Radio Shop, Long Beach, Cal.	1290-	233-	100
KFOO—Latter Day Saints Univ., Salt Lake City, Utah	1270-	236-	250
*KFOR—David City Tire & Electric Co., David City, Neb.	1330-	226-	100
KFOX—Technical High School, Omaha, Nebr.	1210-	248-	100
KFPG—Oliver S. Garretson, Los Angeles, Cal.	1260-	238-	100
KFPR—Los Angeles County Forestry, Los Angeles, Cal.	1300-	231-	500
KFPY—Symons Investment Co., Spokane, Wash.	1130-	266-	100
KFQA—The Principa, St. Louis, Mo.	1150-	261-	100
KFQB—Searchlight Publishing Co., Fort Worth, Texas	1140-	263-	150
KFQC—Kidd Brothers Radio Shop, Taft, Cal.	1300-	231-	100
KFQU—W. E. Riker, Holy City, Calif.	1350-	222-	100
*KFQZ—Taft Products Co., Hollywood, Calif.	1330-	226-	250
KFRB—Hall Bros., Beeville, Texas	1210-	248-	250
KFRU—Etherical Radio Co., Bristow, Okla.	760-	395-	500
KFSG—Echo Park Evangelistic Asso., Los Angeles, Cal.	1090-	275-	500
*KFUM—W. D. Pyle, Colorado Springs, Colo.	1240-	242-	100
KFUO—Concordia Seminary, St. Louis, Mo.	550-	545-	500
KFUT—University of Utah, Salt Lake City, Utah.	1150-	261-	100
KFVE—Film Corporation of America, St. Louis, Mo.	1250-	240-	500
KFVJ—First Baptist Church, San Jose, Cal.	1330-	226-	500
KFVK—Sacramento Chamber of Com., Sacramento, Cal.	1210-	248-	500
KFVW—Airfan Radio Corporation, San Diego, Cal.	1220-	246-	500
KFWA—Browning Bros. Co., Ogden, Utah	1150-	261-	500
KFWB—Warner Bros. Pictures, Inc., Hollywood, Cal.	1190-	252-	500
KFWD—Arkansas Light & Power Co., Arkadelphia, Ark.	1130-	266-	500
KFWH—F. Wellington Morse, Jr., Chico, Cal.	1180-	254-	100
KFWI—Radio Entertainments, Inc., So. San Fran., Cal.	1360-	220-	500
*KFWO—Lawrence Mott, Avalon, California	1420-	211-	250
KGO—General Electric Co., Oakland, Cal.	830-	361-	2000
KGU—Marion A. Mulrony, Honolulu, Hawaii	1110-	270-	500
KGW—Portland Morning Oregonian, Portland, Ore.	610-	491-	500
KHJ—Times-Mirror Co., Los Angeles, Cal.	740-	405-	500
KHQ—Excelsior Motorcycle & Bicycle Co., Seattle, Wash.	1100-	273-	100
KLS—Warner Bros. Radio Supplies Co., Oakland, Cal.	1240-	242-	250
KLX—Tribune Publishing Co., Oakland, Cal.	590-	509-	500
KLZ—Reynolds Radio Co., Denver, Colo.	1130-	266-	250
KMO—Love Electric Co., Tacoma, Wash.	1200-	250-	100
KNX—Los Angeles Express, Los Angeles, Cal.	890-	337-	500
KOA—General Electric Co., Denver, Colo.	930-	322-	2000
KOB—New Mexico Col. of Agriculture, State Col., N. Mex.	860-	349-	750
*KOIL—Monarch Manufacturing Co., Council Bluffs, Ia.	1080-	278-	500
KOP—Detroit Police Dept., Detroit, Mich.	1080-	278-	500
KPO—Hale Bros., San Francisco, Cal.	700-	428-	500
KPRC—Houston Printing Co., Houston, Texas	1010-	297-	500
*KQP—Apple City Radio Club, Hood River, Ore.	1110-	270-	100
KQV—Double-Hill Electric Co., Pittsburg, Pa.	1090-	275-	500
KSAC—Kansas State Agric. College	880-	341-	500

	K.C.	W.L.	W.P.
KSD—Post-Dispatch, St. Louis, Mo.	550-	545-	750
KSL—The Radio Service Corp., Salt Lake City, Utah	1000-	300-	1000
KTCL—American Radio Tel. Co., Inc., Seattle, Wash.	980-	310-	1000
KTHS—New Arlington Hotel Co., Hot Springs, Ark.	800-	375-	500
KTW—First Presbyterian Church, Seattle, Wash.	660-	454-	750
KUO—Examiner Printing Co., San Francisco, Cal.	1220-	246-	150
KUOM—State Univ. of Montana, Missoula, Mont.	1230-	244-	250
KWKC—Wilson Duncan Studios, Kansas City, Mo.	1270-	236-	100
KWWG—City of Brownsville, Brownsville, Texas	1080-	278-	500
KWKH—W. G. Paterson, Shreveport, La.	1110-	273-	250
KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill.	560-	535-	1500
KZKZ—Electrical Supply Co., Manila, P. I.	1110-	270-	100
KZM—Preston D. Allen, Oakland, Cal.	1240-	242-	100
KZRQ—Far Eastern Radio, Manila, P. I.	1350-	222-	500
WAAB—Valdemar Jensen, New Orleans, La.	1120-	268-	100
WAAC—Tulane University, New Orleans, La.	1090-	275-	100
WAAF—Chicago Daily Drovers Journal, Chicago, Ill.	1080-	278-	200
WAAM—I. R. Nelson Co., Newark, N. J.	1140-	263-	250
WAAW—Omaha Grain Exchange, Omaha, Neb.	1080-	278-	500
WABA—Lake Forest University, Lake Forest, Ill.	1320-	227-	200
WABI—Bangor Hydro-Electric Co., Bangor, Me.	1250-	240-	100
WABN—Ott Radio (Inc.), La Crosse, Wis.	1230-	244-	500
WABO—Lake Avenue Baptist Church, Rochester, N. Y.	1080-	278-	100
*WABX—Henry B. Joy, Mount Clemens, Mich.	1220-	246-	150
WADC—Allen Theatre, Akron, O.	1160-	258-	100
*WAFD—Arbert B. Parfet Co., Port Huron, Mich.	1170-	256-	500
WAHG—A. H. Grebe Co., Richmond Hill, N. Y.	950-	316-	500
WAMD—Hubbard & Co., Minneapolis, Minn.	1230-	244-	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-	1000
*WBAX—John H. Stenger, Jr., Wilkes-Barre, Pa.	1170-	256-	100
WBAY—Erner & Hopkins Co., Columbus, Ohio	1020-	293-	500
WBBG—Irving Vermilya, Mattapoisett, Mass.	1210-	248-	100
WBBL—Grace Covenant Church, Richmond, Va.	1310-	220-	100
WBBM—Atlas Investment Co., Chicago, Ill.	1330-	226-	1500
*WBBP—Petoskey High School, Petoskey, Mich.	1260-	238-	200
WBBR—People's Pulpit Assoc., Rossville, N. Y.	1100-	273-	500
WBES—Bliss Electrical School, Takoma Park, Md.	1350-	222-	100
WBOQ—A. H. Grebe Co., Richmond Hill, N. Y.	1270-	236-	100
WBT—Southern Radio Corp., Charlotte, N. C.	1090-	275-	250
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass.	900-	331-	2000
WCAC—Connecticut Agric. College, Mansfield, Conn.	1090-	275-	500
WCAD—St. Lawrence University, Canton, N. Y.	1140-	263-	250
WCAE—Kaufmann & Baer Co., Pittsburg, Pa.	650-	461-	500
WCAG—Clyde R. Randall, New Orleans, La.	1130-	226-	200
WCAH—Entrekin Electric Co., Columbus, O.	1130-	266-	500
WCAJ—Nebraska Wesleyan University, Univ. Place, Nebr.	1180-	275-	100
WCAL—St. Olaf College, Northfield, Minn.	890-	337-	500
WCAO—Kranz-Smith, Baltimore, Md.	1090-	275-	100
WCAP—Chesapeake & Potomac Tel. Co., Wash., D. C.	640-	469-	500
WCAR—Southern Radio Corp. of Texas, San Antonio, Tex.	1140-	263-	100
WCAU—Durham & Co., Philadelphia, Pa.	1080-	278-	500
WCAX—University of Vermont, Burlington, Vt.	1200-	250-	100
WCAY—Milwaukee Civic Br'dcstng Asso., Milwaukee, Wis.	1130-	266-	250
WCBC—University of Michigan, Ann Arbor, Mich.	1310-	229-	200
WCBD—Wilbur G. Voliva, Zion, Ill.	870-	345-	2000
WCBN—Foster & McDonnell, Chicago, Ill.	1130-	266-	500
*WCBQ—First Baptist Church, Nashville, Tenn.	1270-	236-	100
*WCCO—Washburn Crosby Co., Mfnneapolis, Minn.	720-	416-	5000
*WCEE—Charles E. Erbstein, Elgin, Ill.	1090-	275-	1000
WCM—Texas Markets & Warehouse Dept., Austin, Tex.	1120-	268-	250
WCN—Foster & McDonnell, Chicago, Ill.	1130-	266-	500
*WCSH—Congress Square Hotel Co., Portland, Me.	1170-	256-	500
WCTS—C. T. Sherer Co., Worcester, Mass.	1120-	268-	500
WCUW—Clark University, Worcester, Mass.	1260-	238-	250
WCX—Detroit Free Press, Detroit, Mich.	580-	517-	500
WDAE—Tampa Daily News, Tampa, Fla.	1100-	273-	250
WDAG—J. Laurence Martin, Amarillo, Tex.	1140-	263-	100
WDBE—Gilham-Schoen Electric Co., Atlanta, Ga.	1080-	278-	100
WDBK—M. F. Brox Radio Store, Cleveland, O.	1320-	227-	100
WDBO—Rollins College, Winter Park, Fla.	1250-	240-	100
WDBR—Tremont Temple Baptist Church, Boston, Mass.	1150-	261-	100
WDBY—North Shore Congregational Church, Chicago, Ill.	1160-	258-	500
WDWF—Dutee W. Flint, Cranston, R. I.	680-	441-	500
WDZ—James L. Bush, Tuscola, Ill.	1080-	278-	100
WEAA—Frank D. Fallain, Flint, Mich.	1280-	234-	100
*WEAF—American Tel & Tel Co., New York, N. Y.	610-	492-	3000
*WEAH—Hotel Lassen (Rigby-Gray H. Co.), Wichita, Kas.	1120-	268-	100
WEAI—Cornell University, Ithaca, N. Y.	1180-	254-	500
WEAJ—University of So. Dakota, Vermilion, So. Dak.	1080-	278-	100
WEAM—Borough of North Plainfield, No. Plainfield, N. J.	1150-	261-	250
WEAN—Shepard Co., Providence, R. I.	1110-	270-	250
WEAO—Ohio State University, Columbia, Ohio.	1020-	294-	500
WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio.	770-	389-	1000
WEAU—Davidson Bros. Co., Sioux City, Iowa.	1090-	275-	100
WEAL—Iris Theater, Houston, Tex.	1110-	270-	500
*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

The Heart of Your Radio Set

A Grid Leak is essential on every set. There are few sets made which wouldn't be improved by the use of a Variable Grid Leak.

Even the set makers admit that.

But those makers say—"Show us a good Variable Grid Leak,"—because they know that most of the variables on the market have been a failure.

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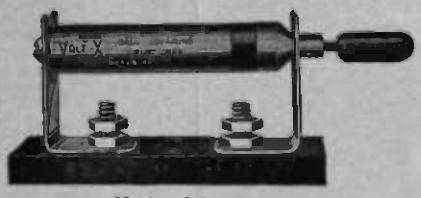

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If you are not satisfied, return it and get your money back

This GRID LEAK is made by an organization which has been handling delicate electrical instruments for years. We know what it means to build accurately and substantially. We KNOW that this GRID LEAK is as nearly perfect as human hands and precise machinery can make it —we're glad to have you try it with the knowledge that if it doesn't do what we claim for it, your money will be refunded.

Clip the coupon, and send it in with $1.00—a grid leak will be mailed at once.

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NAME. . . . . .

ADDRESS. . . . . .

	K.C.	W.L.	W.P.
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 Corporation, Chicago, Ill.	1130-266		100
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
*WFBK—Dartmouth College, Hanover, N. H.	1170-256		200
WFBL—Onondoga Hotel, Syracuse, N. Y.	1190-252		100
WFBM—Merchant Heat & Light Co., Indianapolis, Ind.	1120-268		250
WFBR—Filth Infantry, Maryland N. G., Baltimore, Md.	1180-254		100
WFBY—U. S. Army 5th Corps Area, Ft. Benj. Har'son, Ind.	1160-258		100
WFI—Strawbridge & Clothier, Philadelphia, Pa.	760-395		500
WFKB—Francis K. Bridgman, Chicago, Ill.	1380-217		100
WGAQ—W. G. Paterson, Shreveport, La.	1110-273		250
WGAZ—South Bend Tribune, South Bend, Ind.	1090-275		250
WGBA—Jones Electric & Radio Mfg. Co., Baltimore, Md.	1180-254		100
WGBB—Harry H. Carman, Freeport, N. Y.	1240-244		100
*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 Finance Co., Miami, Fla.	780-384		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
*WGHP—Geo. H. Phelps, Detroit, Mich.	1110-270		500
WGMU—A.H.Grebe&Co.,Inc.(portable),Richmond Hill,N.Y.	1270-236		100
WGPH—George Harrison Phelphs, Inc., Detroit, Mich.	1110-270		500
WGN—The Tribune, Chicago, Ill.	810-370		1000
WGR—Federal Telephone Mfg. Corp., Buffalo, N. Y.	940-319		750
WGS—Georgia School of Technology, Atlanta, Ga.	1110 270		500
WGY—General Electric Co., Schenectady, N. Y.	790-380		2000
WHA—University of Wisconsin, Madison, Wis.	560-535		750
*WHAD—Marquette Univ. and Mil. Jour., Mil., Wis.	1000-275		500
WHAG—University of Cincinnati, Cincinnati, O.	1290-233		100
WHAM—University of Rochester, Rochester, N. Y.	1080-278		100
WHAP—William H. Taylor Finance Corp., Brooklyn, N. Y.	1250-250		100
WHAR—Seaside Hotel, Atlantic City, N. J.	1090-275		500
WHAS—Courier Journal & Louisville Times	750-400		500
*WHAT—George W. Young, Minneapolis, Minn.	1140-263		500
WHAV—Wilmington Electric Specity Co., Wilmington, Del.	1130-266		100
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y.	790-380		500
WHB—Sweeney School Co., Kansas City, Mo.	820-366		500
WHBF—Beardsley Specialty Co., Rock Island, Ill.	1350-222		100
WHBH—Culver Military Academy, Culver, Ind.	1350-222		100
WHBP—Johnstown Automobile Co., Johnstown, Pa.	1170-256		100
WHBW—D. R. Kienzle, Philadelphia, Pa.	1390-216		100
WHDI—Wm. Hood Dunwoody I. Inst., Minneapolis, Minn.	1080-278		500
WHEC—Hickson Electric Co., Inc., Rochester, N. Y.	1160-258		100
WHK—Radiovox Co., Cleveland, O.	1100-273		250
WHN—George Schubel, New York, N. Y.	830-361		500
WHO—Bankers Life Co., Des Moines, Iowa	570-526		500
WHT—Radiophone Broadcasting Corporation, Deerfield, Ill.	1260-238		1500
WIAD—Howard R. Miller, Philadelphia, Pa.	1200-250		100
WIAK—Journal-Stockman Co., Omaha, Nebr.	1080-278		250
WIAS—Home Electric Co., Burlington, Iowa	1180-254		100
WIBA—The Capital Times Studio, Madison, Wisc.	1270-236		100
WIBC—L. M. Tate Post No. 39, V.F.W. St.Petersburg, Fla.	1350-222		100
WIBF—S. P. Miller Activities, Wheatland, Wisc.	1300-231		500
WIBK—University of the City of Toledo, Toledo, O	1460-205		100
WIBL—McDonald Radio Co., Joliet, Ill. (Portable)	1390-215		250
WIBO—Nelson Brothers, Chicago, Ill.	1330-226		500
WIL—St. Louis Star, Benson Radio Co., St. Louis, Mo.	1100-273		250
WIP—Gimbel Bros., Philadelphia, Pa.	590-508		500
WJAD—Jackson's Radio Eng. Laboratories, Waco, Texas.	850-353		500
WJAG—Norfolk Daily News, Norfolk, Nebr.	1110-270		250
WJAK—Clifford L. White, Greentown, Ind.	1180-254		100
*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., Chicago, Ill. (portable)	1120-268		100
WJBC—Hummer Furniture Co., La Salle, Ill.	1280-234		100
WJBD—Ash'and Broadcasting Committee, Ashland, Wisc.	1290-233		100
WJBI—H. M. Couch, Joliet, Ill.	1400-214		100
WJJ—Supreme Lodge L. O. Moose, Mooseheart, Ill.	990-303		500
WJY—Radio Corporation of America, New York, N. Y.	740-405		1000
WJZ—Radio Corporation of America, New York, N. J.	660-454		1000
WKAQ—Radio Corporation of Porto Rico, San Juan, P. R.	880-341		500
WKAR—Michigan Agric. Col., E. Lansing, Mich.	1050-286		750
WKBG—C. L. Carrell (portable), Chicago, Ill.	1390-216		100
WKRC—Kodel Radio Corp., Cincinnati, O.	710-422		1000
WKY—WKY Radio Shop, Oklahoma, Okla	1090-275		100
WLAL—First Christian Church, Tulsa, Okla.	1200-250		150
*WLB—University of Minnesota, Minneapolis, Minn.	1080-278		500
WLBL—Wisconsin Dept. of Markets, Stevens Point, Wis.	1080-278		500
WLIT—Lit Bros., Philadelphia, Pa.	760-395		500
WLS—Sears, Roebuck Co., Chicago, Ill.	870-345		500

*Additions and corrections.

	K.C.	W.L.	W.P.
WLTS—Lane Technical High School, Chicago, Ill.	1160-258		100
WLW—Crosley Radio Corp., Harrison, O.	710-422		{5000 500
WMAC—Clive B. Meredith, Cazenovia, N. Y.	1090-275		100
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833-360		500
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833-360		100
WMAK—Norton Laboratories, Lockport, N. Y.	1130-466		500
WMAQ—Chicago Daily News, Chicago, Ill.	670-448		500
WMAY—Kingshighway Presbyterian Church, St. Louis, Mo.	1210-248		100
*WMAZ—Mercer University, Macon, Ga.	1150-261		500
WMBB—American Bond & Mortgage Co., Chicago, Ill.	1200-250		500
WMBF—Fleetwood Hotel, Miami Beach, Fla.	780-384		500
WMC—Commercial Appeal, Memphis, Tenn.	600-500		500
WMCA—Greeley Square Hotel Co., New York, N. Y.	880-341		500
WNAB—Shepard Stores, Boston, Mass.	1200-250		100
WNAC—Shepard Stores, Boston, Mass.	1070-280		500
WNAD—University of Oklahoma, Norman, Okla.	1180-254		250
WNAP—Wittenberg College, Springfield, Ohio.	1210-248		100
WNAT—Lennig Bros. Co., Philadelphia, Pa.	1200-250		100
WNAV—People's Tel. & Tel. Co., Knoxville, Tenn.	1290-233		500
WNAX—Dakota Radio Apparatus Co., Yankton, S. Dak.	1230-244		100
WNJ—Radio Shop of Newark, Newark, N. J.	1290-233		100
WNYC—City of New York, New York, N. Y.	570-526		1000
WOAI—Southern Equipment Co., San Antonio, Texas.	760-395		1000
WOAN—James D. Vaughn, Lawrenceburg, Tenn.	1060-283		500
WOAW—Woodmen of the World, Omaha, Nebr.	570-526		1000
*WOC—Palmer School of Chiropractic, Davenport, Iowa.	620-484		5000
WOI—Iowa State College, Ames, Iowa.	1110-270		500
WOO—John Wanamaker, Philadelphia, Pa.	590-508		500
WOQ—Unity School of Christianity, Kansas City, Mo.	1080-278		500
WOR—L. Bamberger & Co., Newark, N. J.	740-405		500
WORD—People's Pulpit Association, Batavia, Ill.	1090-275		2000
WOS—Missouri State Marketing Bureau, Jefferson City, Mo.	680-441		500
WOWL—Owl Battery Co., New Orleans, La.	1110-270		100
WOWO—Main Auto Supply Co., Fort Wayne, Ind.	1320-227		500
WPAJ—Doolittle Radio Corporation, New Haven, Conn.	1120-268		100
WPG—Municipality of Atlantic City, Atlantic City, N. J.	1000-300		500
WPSC—Pennsylvania State College, State College, Pa.	1150-261		500
WQAA—Horace A. Beale, Jr., Parkesburg, Pa.	1360-220		500
WQAC—Gish Radio Service, Amarillo, Tex.	1280-234		100
WQAM—Electrical Equipment Co., Miami, Fla.	1120-268		100
WQAN—Scranton Times, Scranton, Pa.	833-360		100
WQAO—Calvary Baptist Church, New York, N. Y.	833-360		100
WQAS—Prince-Walter Co., Lowell, Mass.	1190-252		100
WQJ—Calumet Rainbow Broadcasting Co., Chicago, Ill.	670-448		500
WRAA—Rice Institute, Houston, Tex.	1170-256		100
WRAF—The Radio Club, Laporte, Ind.	1340-224		100
WRAK—Economy Light Co., Escanaba, Mich.	1170-256		100
WRAM—Lombard College, Galesburg, Ill.	1230-244		100
WRAV—Antioch College, Yellow Springs, Ohio.	1140-263		100
WRAX—Flexon's Garage, Gloucester City, N. J.	1120-268		250
WRBC—Immanuel Lutheran Church, Valparaiso, Ind.	1080-278		500
WRC—Radio Corporation of America, Washington, D. C.	640-469		1000
WREO—Reo Motor Car Co., Lansing, Mich.	1050-286		500
WRK—Doron Bros. Electrical Co., Hamilton, O.	1110-270		200
WRM—University of Illinois, Urbana, Ill.	1100-273		500
WRNY—Experimenter Publishing Co., New York, N. Y.	1160-258		500
WRR—Dallas Police & Fire Dept., Dallas, Tex.	1150-261		350
WRW—Tarrytown Radio Research Labs., Tarrytown, N. Y.	1100-273		500
WSAC—Clemson Agric. Col., Clemson College, S. C.	890-337		500
WSAG—Gospel Tabernacle, St. Petersburg, Fla.	1130-266		250
WSAI—United States Playing Card Co., Mason, O.	920-326		500
WSAJ—Grove City College, Grove City, Pa.	1310-229		250
*WSAN—Allentown Call Publishing Co., Allentown, Pa.	1310-229		100
WSAR—Doughty & Welch Electric Co., Fall River, Mass.	1180-254		100
*WSAV—Clifford W. Vick Radio Const. Co., Houston, Tex.	1210-248		100
WSB—Atlanta Journal, Atlanta, Ga.	700-428		500
WSBC—World Battery Co., Chicago, Ill.	1430-210		200
*WSBF—Stix, Baer & Fuller, St. Louis, Mo.	1100-273		100
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
WSMK—S. M. K. Radio Corp., Dayton, Ohio.	1090-275		500
WSOE—School of Engi'rng of Milwaukee, Milwaukee, Wis.	1220-246		100
WSRO—Radio Co., Hamilton, Ohio.	620-483		100
WSUI—State University of Iowa, Iowa City, Iowa.	620-484		500
WSY—Alabama Polytechnic Institute, Auburn, Ala.	1200-250		500
WTAB—Fall River Daily Herald Pub. Co., Fall R'vr, Mass.	1130-266		100
WTAC—Penn. Traffic Co., Johnstown, Pa.	1430-210		100
*WTAM—Willard Storage Battery Co., Cleveland O.	770-389		2500
WTAQ—S. H. Van Gorden & Son, Osseo, Wis.	1180-254		100
WTAR—Reliance Electric Co., Norfolk, Va.	1150-261		100
*WTAS—Charles E. Erbstein, Elgin Ill.	990-302		1500
WTAT—Edison Illum'ting Co., Boston, Mass. (portable)	1230-302		100
WTAW—Agric. & Mech. Col. of Texas, Col. Station, Tex.	1110-270		250
WTHS—Flint Senior High School, Flint, Mich.	1370-219		250
WTIC—Travelers Insurance Co., Hartford, Conn.	860-349		500
WWAD—Wright & Wright, Philadelphia, Pa.	1200-250		100
WWAE—Lawrence J. Crowley, Plainfield, Ill.	1240-242		500
WWAO—Michigan College of Mines, Houghton, Mich.	1140-263		250
WWI—Ford Motor Co., Dearborn, Mich.	1130-266		500
WWJ—Detroit News, Detroit, Mich.	850-353		500
WWL—Loyala University, New Orleans, La.	1090-275		100