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RADIO PROGRESS

"Always Abreast of the Times"

In This Issue

What About the Ether?
By HORACE V. S. TAYLOR

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This Speaker Can't be Overloaded

Non-Squealing RF Amplifier

The Myth of Summer Lightning

Follow Fast Waves to the Pole

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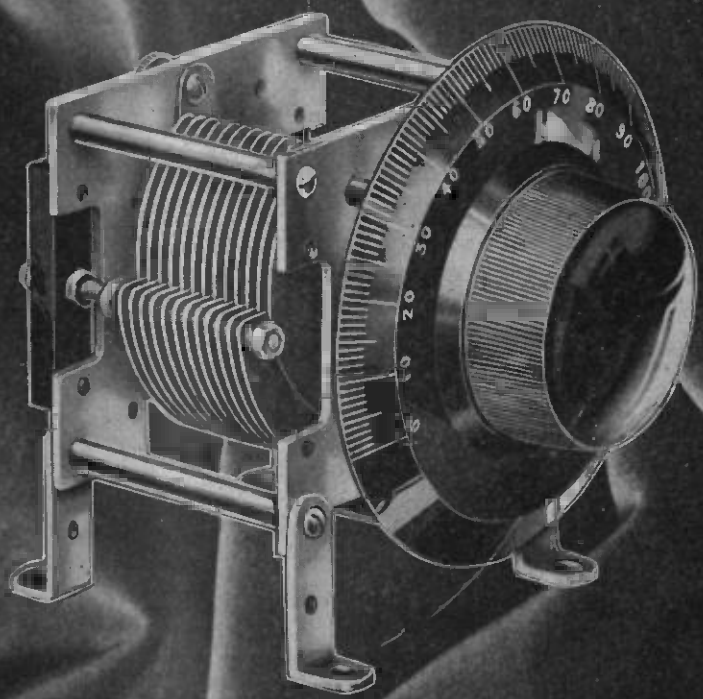

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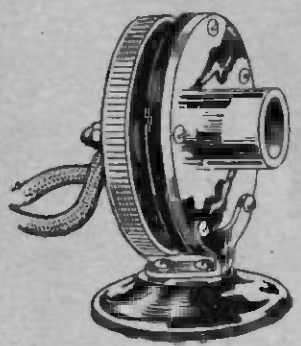

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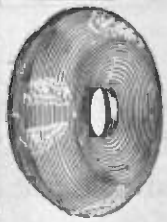

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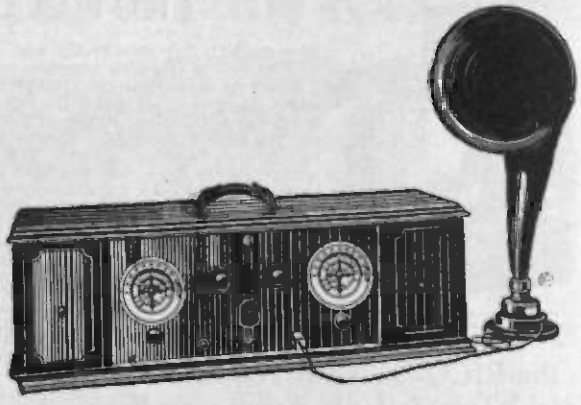

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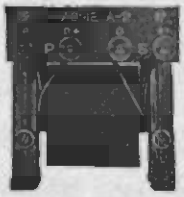

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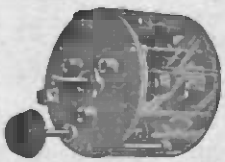

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RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 2 Number 8

Contents for

JULY 1, 1925

	PAGE
WHAT ABOUT THE ETHER?	9
AMERICAN RADIO RELAY LEAGUE	12
THIS SPEAKER CAN'T BE OVERLOADED	13
THE MYTH OF SUMMER LIGHTNING	16
NON-SQUEALING R. F. AMPLIFIER	19
UNCLE BILL A WBZ STAR IN FOUR MONTHS	22
A CONSTELLATION OF THREE	23
EDITOR'S LOUD SPEAKER:	
THE RADIO REVOLUTION	25
CELEBRATING BY AIR	25
RADIO COSTS BEAT ELECTRICITY	26
BROADCASTING FROM A BELFRY	27
GAMBY—DANCING SONGBIRD	29
FOLLOW FAST WAVES TO THE POLE	31
NEW PRODUCTS OF UNUSUAL INTEREST	34
DR. RADIO PRESCRIBES	36
U. S. BROADCASTING STATIONS	38

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These articles will make you forget the heat in the middle of July

Many people at this time of year do not care so much for distant stations, as they find their locals give very good performances. In that case a crystal set has some advantages over a tube—that is, if you have a modern one. The style that sells for $1.98 is hardly to be called a first-class receiver. To build one yourself does not cost much and you can do a good job if you follow the theory and instructions in **"Building an Up-to-Date Crystal Set,"** by Nickerson.

You often read about Bakelite panels, sockets, and the like. This substance is almost ideal from a radio point of view. It is not as easy to make it as it is to use it, however. If you are at all interested in the parts you use and why they are better read, **"Bakelite—How Made and Molded,"** an interview by Brown.

When you hear one of those faint, far-off stations, if you happen to have a suitable table you can find out how many miles away it is. Sometimes the tables do not include the cities you have picked up. Again, when talking of places in Europe it is difficult to find how far the waves must travel. An ordinary map will not do at all, as it is not corrected for distance, but only for direction. In **"Measuring the World for Radio,"** by Vance, is included a map of the world and a description of how to find the distance to any city immediately.

Microphone fright is a well-known disease in the broadcasting station. But the Mike itself is not such a dangerous piece of apparatus. Have you ever seen what is inside the cover? Arnold takes one apart for you and tells you what each piece is for in **"What is Inside a Microphone."**

Some local stations are tuned out fairly easy, while others with no more watt power can be heard all over the dials. What makes this difference, and is it an advantage or disadvantage to far-away listeners? All this is explained, with illustrations, by Taylor in **"Why Some Waves Are Hard to Lose."**

The subject of shielding a condenser is not clear in many people's minds. Some think it is an advantage, while others say it should never be done. A great deal of talk on this subject is incorrect. If you want to know the truth of the matter, read **"Shielding Your Condensers,"** by Marx.

RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 2, No. 8 JULY 1, 1925 15c PER COPY, $3:00 PER YEAR

What About the Ether?

New Experiments On This Jelly in Which We Live

By HORACE V. S. TAYLOR

DID you know that we are all living in a jelly? That is about the best word to describe the ether as it is thought of by scientists and engineers—that is, those who believe in it. There are some who deny its existence, however.

You may think of it as a jelly for this reason. When a little piece of it is moved aside in any way, it tries to return again, just as would happen if you pushed on a raisin, which had been molded into a big dish of jello. This is different you can see from the air, as the latter, when moved by a fan, does not try to get back where it started from.

Tapping Waves in Gelatine

The next time you have gelatine for dessert try tapping the surface gently with your spoon. You will see that it makes a sort of ripple, which moves to the edge of the dish very rapidly. It is a surface wave very similar to that which you will find on a lake (Fig. 1) when you drop a stone in it. This wave in either case rushes rapidly away from the place where it was started and extends in all directions until it reaches the boundary.

Here is an interesting thing to observe. Although the wave moves out in all directions, the little particles of water travel only up and down. The corks, shown in Fig. 1 are floating on the top of the lake and they do not move towards the shore at all. They merely bob up and down. It is because each one follows the motion of the one next to it in a regular way that we have a wave motion being transferred across the lake.

Living in Ocean of Ether

Inside the mass of gelatine, we may have a similar vibration going on, but of course, it is hard to start it in the dish of dessert, as we have no way of getting inside. But we do live on the inside of this vast ocean of ether, which is thought to fill all space. And it is easy for us to start a vibration of its

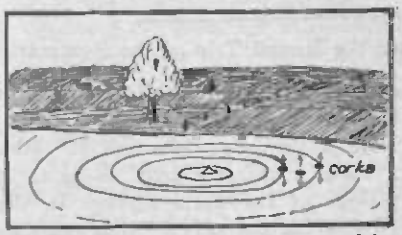

Fig. 1. Waves Run to Shore, Altho Corks Bob Up and Down.

particles. That's what lightning does far away when it causes the noises you know as static. Even the passing trolley car, which happens to arc at its wire, knows how to set the ether in motion. That is why you hear all these things in your radio set.

This brings us to the question of why we think there is an ether. Looking again at Fig. 1, suppose we should tell you that a second after we drop the stone in the water the corks would begin to bob around, but that there was no water there to carry the motion. You would probably think we were crazy. When you speak about a vibration, it is naturally assumed that there must be something there to move back and forth. It is hard to believe that a piece of nothing will shake so hard that it will carry the radio waves from the broadcasting station to your aerial. So it was largely a matter of common sense which first caused the scientists to believe there must be something to vibrate and they called it "ether."

Obeyed All the Laws

This same substance is what is supposed to carry light waves, and it is often called "lumeniferous." "Lumen" in Latin means light, and "ferous" bearing. Indeed the laws of light and radio waves seemed to check up perfectly with the conception of the ether for a great many years.

Finally, however, an experiment was performed by Professors Michelson and Morley, which seemed to prove that the ether did not exist. If this substance does fill all the space in the universe, then the earth must be travelling through it and if we can find any way of telling whether the world is flowing through some substance the way a boat travels through the water, then of course, its existence will be proved. If we doubt whether the vessel is in motion, we can throw some thing overboard and see if it floats by. But unfortunately, that can not be done with ether, since it is so light and thin that it has in theory practically no pressure at all on heavy pieces of matter.

Delaying the Round Trip

There is a way that we can check up on this ether drift, as it is called. This

is the scheme developed by the two professors just mentioned. It is a fact that when you travel to a place and back again, if there is any current along the path it always slows down the time of your round trip. It may seem at first glance that when you go *with* the stream it will help you as much as it hinders when you go *against* it, but such is not the case. Fig. 2 will make this plainer.

A man in a rowboat starts to row along the river to a stake three miles away and then back again so that the finish is at the same place. If the stream has no current at all, then he will get back quicker than if a current

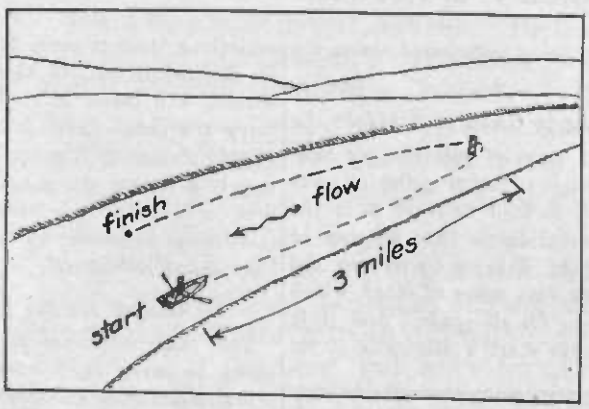

Fig. 2. The River Current Slows Down the Round Trip of the Boatman.

flows in the river. To prove this let us say that he rows three miles an hour. The trip out in that case when the river is perfectly calm will take one hour and the trip back another hour, making a total of two hours. This is the fastest time in which the journey can be accomplished.

He Drops 40 Minutes

Now, let us assume that the river starts to run with a current of 1½ miles an hour. Since he passes through the water at three miles an hour, and it goes down stream 1½ miles, his total gain up stream will be 3—1½, which equals 1½ miles an hour as the answer for the ground he covers. It will then take him two hours to get as far as the stake. On the down trip, the current will help him and his total rate of travel will be 3+1½, or 4½ miles in an hour. To cover the three miles then will take him 40 minutes. His total time for the round trip is then two hours up plus forty minutes down, or a total of 2 2/3 hours. Comparing this with the two hours, which it took when there was no flow, we see that the current in the river has hindered him considerably.

If the river should now increase to three miles an hour, he would have to row at top speed (3 miles an hour) just to stay still on the surface of the water, and he could then row forever and ever before he reached the stake. Another way to think of this is that the current flow helps as much on the return trip as it hinders on the trip out, but since the river is acting a lot *longer* time when opposing, it gets in much more of its deadly work in the one direction, with the result that a net loss in time occurs.

When light flows through the ether, if there is an ether drift, owing to the passage of the world through it, then by shooting the rays off into space and back again, they will loose more time when going against the drift than they gain when flowing with it showing a loss for the whole trip.

However, light goes so fast that a single trip back and forth is hardly enough to show much difference. Instead, as shown in Fig. 3, we make use of two mirrors, which reflect the light one way and then the other a number of times. Fig. 3 shows two such complete journeys, but in practice this may be extended up to a dozen times without any trouble.

Timing a Light Ray

When you realize that radio and light both travel at the astounding rate of 186,000 miles per second, you will see that no stop watch could time the motion, even though the beam of light were reflected back and forth from mirror to mirror a great many times. How then can we tell whether the rays are slowed up in their trip, and thus prove the presence of an ether current along the path. The way it is done is to send out two rays from the same candle at right angles to each other. One pathway is turned along the direction in which the ether stream is supposed to be moving, and the other at right angles to that. The one at right angles is not affected at all by the current, while the pathway up and down the stream will take longer as has already been shown. By comparing the time over the two paths, you know right away that if one is slower than the other it lies along the lines of flow.

In order to tell whether one beam arrives before the other, use is made of the fact that when two wave motions are in step they add, but when out of step they subtract. This principle is called "interference." The two beams of light, when they come back on their final journey, are passed through a lens to bring them to the same spot on a screen or telescope. If they both arrive

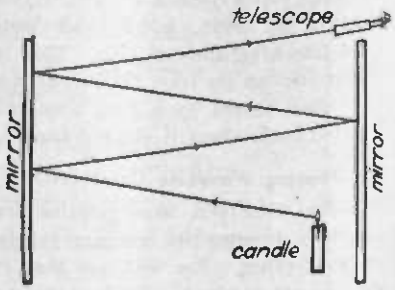

Fig. 3. By Using Two Mirrors, Ray of Light is Reflected Several Times.

at exactly the same instant, the two beams will add together and give uniform white light, but if one is ahead of the other, even though it may be infinitesimal, it will cause the rays to break up into alternate light and dark bands. The spacing apart of these bands is a measure of how much one ray arrives before the other one.

Two Soldiers in a Race

This whole idea can be grasped easier by referring to Fig. 4. We have a city block with the streets running at right angles, north and south for some, and east and west for the others. Two

soldiers start at the corner, and each walks exactly a block, then around a traffic man at the next intersection and back again to the finish. Let us assume that the men ordinarily walk at the same speed. As they start together and go the same distance you would naturally expect them to arrive at the finish together.

This will be the case provided that there is no wind blowing. However, let us assume that there is a west wind blowing towards the east as shown. This

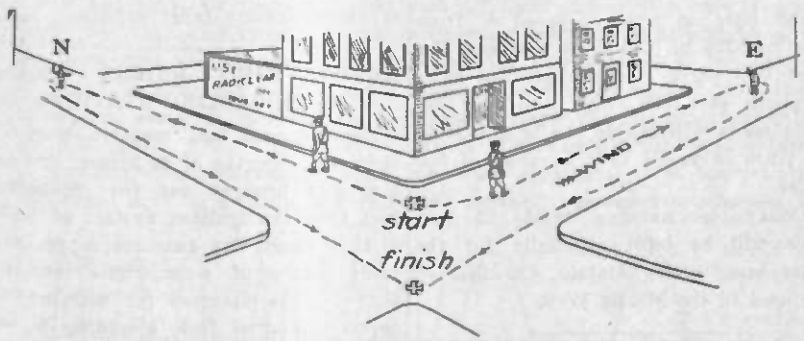

Fig. 4. The Harder the Wind Blows, the More the E Soldier Falls Out of Step with the N Soldier.

will not affect the soldier who is walking north and south, as it is directly at right angles to his path. The other chap, however, tells an entirely different story. On his out stretch he finds the wind at his back and it helps him along so that he walks faster than his partner. After he turns the corner into the home stretch, he feels the wind directly in his face, and as he is now walking slower than before the effect of the wind will last longer on the return than it did on the first lap of his trip. That is, his total time will be longer than before, just as was explained in Fig. 2.

Why He Fell Out of Step

Since the two soldiers started together and one of them was delayed on account of the wind current, he will arrive at the finish a little later than the one who was not delayed. If each man takes the same length of step then, although they were together at the start, they will be out of step at the finish. If the wind was very feeble, the two men will vary only slightly in their step, but if we find that the east and west soldier is badly out of step with the north and south man at the finish, we can tell right away that it must have been a pretty strong wind. We also know that the direction of the air current must have been along the way *he* walked, as he is the slow man.

Of course we can *see* the current in a river as it takes down bits of bark and dirt, and we can *feel* the direction of the wind as it blows in our faces. When it comes to radio waves through the ether or an ether drift, as the world ploughs through it in space, we can not appreciate the presence or direction of this substance. We can, however, make use of this slowing up in one direction of the rays of light as compared with their speed at right angles.

A Surprise for the Professors

Of course at the start it was unknown in which direction the ether drifted, as the whole solar system, sun, world, planets, and all is known to be travelling through space. Professors Michelson and Morley built a very elaborate piece of apparatus with the two paths for the beam of light to be reflected back and forth from the mirrors and mounted the whole thing on a turn table, which could be swung around to all points the compass. They expected that when pointed in *some* direction, one ray would be retarded, while at right angles to that the other would be slowed down, while half way between both beams of light would be equally affected, and so arrive at the same instant. To their surprise no such affect could be noted—both beams arrived *at the same instant*, no matter how the apparatus was pointed.

This classical experiment was tried at all times of the year and by different observers, and all got the same results—that it *nothing at all*. This apparently proved either that there was no ether at all, or that the earth dragged it along with it so that there was no draught, as it might be called, or else that light travelled at the same speed relative to an observer no matter how fast the observer himself moved.

It was on this experiment that Professor Einstein founded his Theory of Relativity. This theory is quite mathematical when worked out in full and is difficult to grasp. However, its basis rested squarely on this experiment with the ether drift and the negative results obtained from it.

A Bad Jolt for Relativity

Now comes along a jolt. Professor Dayton C. Miller of the Case School of Applied Science, has tried this same experiment going way up on a hill and finds that *there is a slowing* down of one of the rays as proved by the fact that he gets light and dark bands instead of

Continued on Page 30

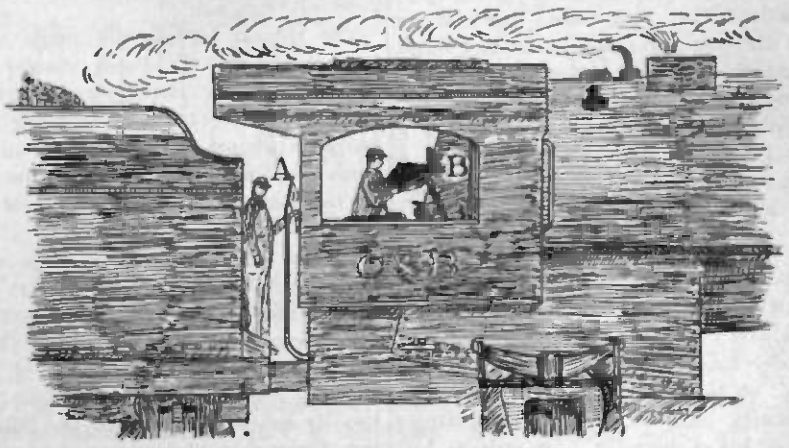

Fig. 5. The Fireman at A Finds There is No Breeze, but the Engineer at B Proves Otherwise.

American Radio Relay League

VIGILANCE COMMITTEES ARE ON THE JOB

Vigilance Committees designed to reduce radio interference, according to plans put forth by the American Radio Relay League, have scored real successes in a number of communities throughout the country. The wide variety of causes of this interference, according to reports made to League headquarters here, have proved a revelation to many radio fans.

In Danville, California, for instance, there was widespread interference and the Vigilance Committee was called in by a number of irate listeners. Investigation proved that the commutator on a motor in an ice cream parlor refrigerator was sparking with fatal results, as far as radio reception was concerned.

In another California city, a commercial station working on the other side of the Pacific was so powerful it made trouble for broadcast listeners. The matter was turned over to governmental agencies as beyond the control of the Vigilance Committee.

But there is one trouble that balks the best efforts of every Vigilance Committee; it appears when a complaint is made that regenerative sets in the neighborhood are setting up a wealth of interference. Obviously this does not come within the province of the committee.

It is not always easy to find the focus of trouble. For instance, a difficulty in Oakland that still causes much worry to the committee is a violet ray outfit that thus far has defied detection. A simple remedy is planned for this, when located. A radio frequency choke will be inserted in the ground lead with a consequent removal of the present undesirable noise on lower wave lengths.

FROM BOOZE TO BROADCAST

A rum runner confiscated off the Atlantic coast has been purchased by Clarence E. Ogden, president of the Kodel Radio Corporation. It will be used on the Ohio River for broadcasting concerts, boat races and other features from towns between New Orleans and Pittsburgh.

The boat is a 37-foot cabin cruiser, equipped with a galley, sleeping accommodations for 12 persons, and carries a powerful engine. When captured, the yacht was laden with liquor, which (according to reports), has been entirely removed.

Wishing to experiment with high speed waves, application will be made for a license to operate a 20 to 30-watt transmitter on a wave speed of from 7500 to 3750 kc. (40 to 80 meters.) The boat will carry storage batteries sufficient to give 700 volts, and four 10-watt tubes will enable the broadcasting of voice or music over a range of 500 miles.

Collapsible antenna masts 25 feet high will be built especially for the river broadcasting station, the first of its kind in the Middle West.

OLD MUSIC REALLY UP TO DATE

Music of two centuries ago, it seems, is in reality quite similar in detail to the popular tunes which now predominate in our dance halls.

This was definitely proved one Saturday night recently by the Brock Sisters, popular harmony singers of broadcasting station WHT, Chicago. These beautiful and harmonious sisters demonstrated that music of to-day is like music of two centuries ago, when several radio listeners wrote to the station and asked for selections over two hundred years old.

The request for the old music was turned over to the Brock Sisters to work up, and on delving through music files they discovered that by changing the tempo of almost any of the old tunes music that would be an instantaneous hit in a theatre or dance hall would be the result.

To prove their contention, Julia and Ruth Brock wrote lyrics for several arrangements dating back two hundred and twenty years ago, and sang them from station WHT. The names of the numbers sung by them were intentionally not announced, and the following three days brought over twelve hundred letters asking the names of the new popular songs they had sung and requesting information as to who the publisher was.

"This should prove to some of these old fogies that sit around and long for 'those wonderful selections of centuries ago' and deride the popular style of music that they are not quite as educated in musical history as they think they are," said Julia Brock, the elder of these famous radio artists.

HENRY FORD BUILDS 1,000,000 BROADCASTING STATIONS

Experimental and research work on short wavelengths of 20 meters and below, has brought out the interesting fact that the ignition system of many of the present day automobiles generate radio waves of considerable intensity that can be detected for distances of several hundred feet, according to experts in a radio laboratory.

The auto therefore enters the radio broadcasting field and seems to bid fair toward making itself heard even though the operator doesn't always seem to have complete knowledge of his program. This fact has been brought out with considerable emphasis. a number of times when the operator at 9XH has been in the midst of 20 meter reception from some distant point with excellent success until some representative of the flivver family insisted on parking one of the Auto Radio Broadcasters at the curb with the motor running. The music has the same tonal qualities as is characteristic of the hum of the four coil vibrators with an accompaniment of considerable clicking and scratching noises.

CROSLEY NOW AT FULL STRENGTH

The Crosley Radio Corporation's superpower broadcasting station, WLW, is now using its full strength of 5000 watts. Permission was given to this station following a number of successful experimental tests to ascertain if it would cause interferenee to radio fans in greater Cincinnati. No difficulty in tuning out the station was reported, due to the fact that it is located about 25 miles away from Cincinnati.

This Speaker Can't be Overloaded

Although It Has No Horn It Talks and Sings

An Interview from C. W. RICE and E. W. KELLOGG.

WHAT is the worst fault of an ordinary loud speaker? Perhaps that it is too big? Or that it is ugly looking? No, the chief trouble is that it does not treat all its friends alike. By "friends" we mean the electric waves or vibrations which it is supposed to change into sound.

The medium speed vibrations, which are the usual note on a piano, are well looked after. The high notes, on the other hand, are rather badly treated, and as for the low ones, the usual speaker cuts them almost dead. Fig. 1 shows a curve of the waves fed to a speaker. Notice first the medium tones, then a high pitch, followed by a low one. The up and down height of these curves shows that they all have the same intensity or loudness.

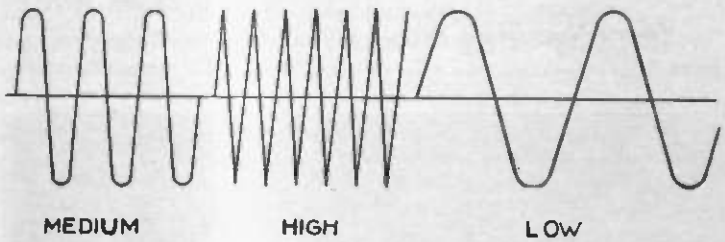

Fig. 1. Here Are Curves of Three Different Tones Fed to Loud Speaker. Notice They Are All of Same Loudness (Height).

What It Did to Low Note

Now look at Fig. 2, and see what the speaker has done to them in changing them over into sound. The wave of medium tone has come out with just as much intensity as it had when it went in. The high tone is reduced in loudness quite a lot. And then look at the low note. You nearly have to put on your glasses to see it. It is this surpressing of the high and low speed vibrations which gives the effect called "distortion."

For a long while radio engineers have been trying to find some type of speaker which will treat them all alike. Success has now apparently been reached after experimenting for several years.

Faithful reproduction of the deepest organ notes and the highest violin harmonies, without the distortion and other defects of the usual radio loud speaker, has been accomplished in the hornless loud speaker, developed by Chester W. Rice and Edward W. Kellogg, of the research laboratory of the General Electric Company, for the Radio Corporation of America. This apparatus was demonstrated at the spring convention of the American Institute of Electrical Engineers at St. Louis.

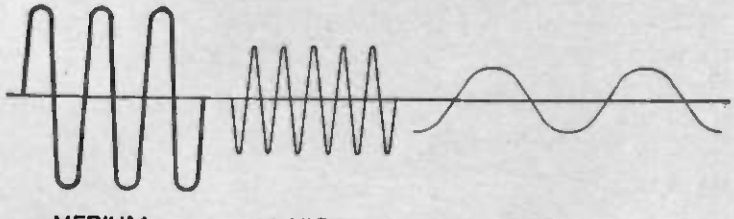

Fig. 2. How Most Speakers Treat the Tones of Fig. 1. Only Medium Pitch is Reproduced in Full—Others Very Soft.

What An Octave Is

Each octave up the scale means that there are twice as many oscillations per second as before. Thus Middle C is 256 vibrations per second, while C, an octave higher, is 512 cycles. The next octave is 1,024, etc., up to the limit of audibility at about 10,000 cycles per second.

Sound is, of course, produced by vibrations which are sent through the air as pulsations. The more vibrations per second, the higher will be the pitch of the sound.

In the usual telephone receiver, Fig. 3, the sound is produced by vibrations of a metal diaphragm, which is affected by the varying strength of an electromagnet behind it. This type of receiver is satisfactory for earphones, since the air gap between the diaphragm and your ear drum, through which distance the sound vibrations must travel, is small, and so diaphragm vibrations of small amplitude are sufficient. For loud speaker operation, however, the telephone unit must be more powerful and must generally be coupled with a horn, as already explained. It will usually be found that such an arrangement will not reproduce both high and low notes with the same volume, and it is ordinarily the low notes which present the most trouble.

Loud Speaker An Air Pump

To radiate low notes more effectively, there must be more air moved with each swing of the diaphragm. The loud speaker may be thought of as an air pump. If an air pump which will give a large movement of air with each stroke is desired, a large piston area and a long

stroke should be used. The telephone receiver type of speaker is not suited to the purpose of obtaining a long stroke for two reasons.

In the first place the air gap between magnets and disk is so small—a few thousands of an inch—that when a powerful current from the amplifiers is fed in, the movement of the disk may be so great that it strikes the pole pieces. This causes a very harsh, rattling noise. Secondly, since the diaphragm must be very flexible and bend easily, it is somewhat unstable and not stiff enough always to hold itself rigidly in position. Sometimes it will snap over to the mag-

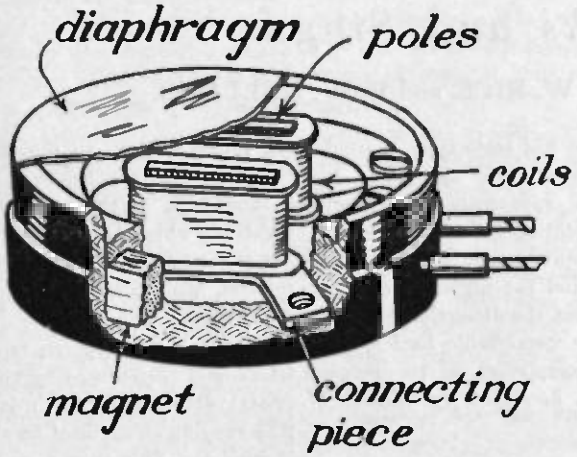

Fig. 3. There is Not Room for Diaphragm to Vibrate Very Hard Without Striking Pole Pieces.

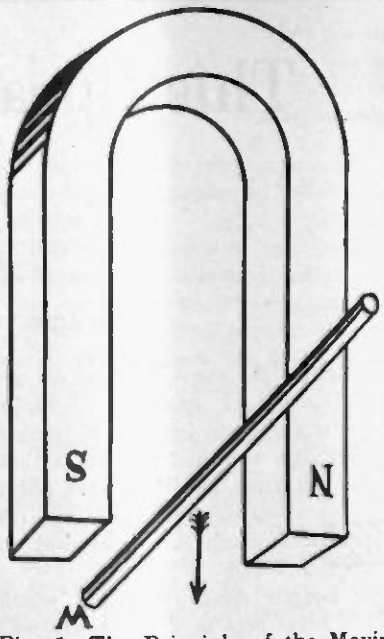

Fig. 5. The Principle of the Moving Coil is Shown Here.

Fig. 4. A View of the Two Authors with the New Speaker They Have Developed. The Diaphragm is a Paper Cone.

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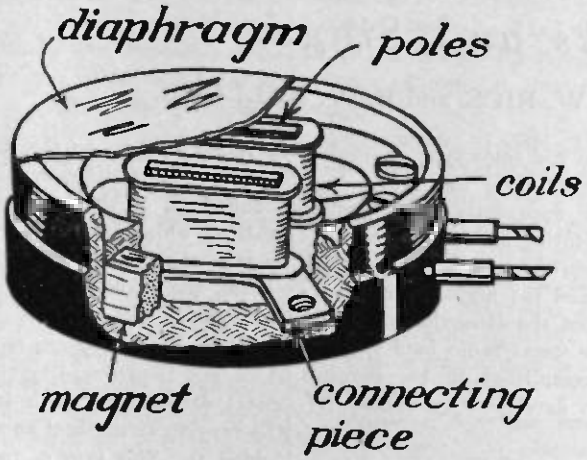

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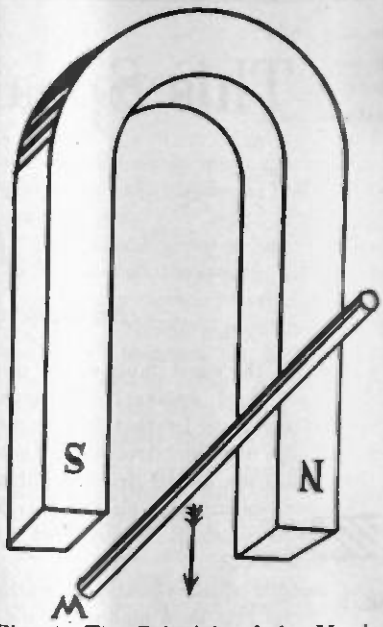

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nets and stick there. Of course the air gap may be increased to remedy these two troubles, but in that case this extra resistance in the magnetic circuit, or "reluctance," as it is called, cuts down the amount of magnetism very considerably and so reduces the sensitiveness of the speaker.

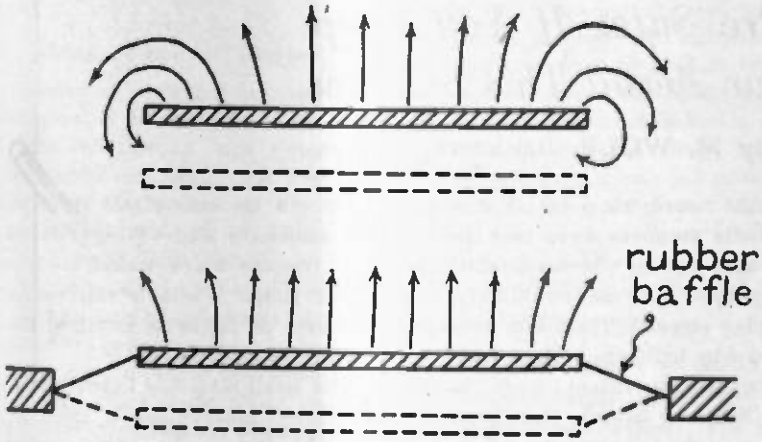


Fig. 6. Without a Baffle, the Air Near Ends of Dish Will Swirl Around Behind it. Rubber Ring Prevents It.

Drives Through Moving Coil

The new type of speaker does not use a disk vibrating in front of the electro magnet. Instead, the familiar moving coil type of drive is employed. A photograph of this unit complete is shown in Fig. 4. It is being demonstrated by the authors of this article. At our left is Mr. Rice holding the speaker, while Mr. Kellogg is looking on.

Here is the principle on which the device works. If a copper wire, "W," Fig. 5, is placed between the poles of a magnet, "NS," of course no motion will take place. However, as soon as current flows through W it immediately tries to move, either up or down, depending on which direction the current flows. If the wire has an alternating current running through it, then the wire will oscillate up and down keeping time with the alternations of the electricity. This same idea is employed in an electric motor where this phenomenon causes the armature to rotate. In the loud speaker, by attaching the diaphragm by a thread to the wire, it is made to vibrate in step with the wire.

A Diaphragm of Paper

The wire is wound into a coil, and since it moves *parallel* to the faces of the magnet poles instead of *toward* and away from them, there is no limit to the distance it can move. The varying currents from the radio set are passed through an amplifier to the moving coil. The strength of the magnetic force on the coil of copper wire varies with the current, and the coil is thus caused to vibrate. The moving coil is attached to the diaphragm, a paper cone about six inches in diameter.

An important feature of the loud speaker is the baffle board which surrounds the diaphragm and which serves as the front of the cabinet. The baffle does not itself radiate sound, but it prevents air from circulating between the front and back of the diaphragm. This action is better explained in Fig. 6. Here we see a flat diaphragm, which has suddenly moved up from the position shown in the dotted lines. This motion is supposed to start an air wave going, which will reach our ears to form a sound. The center part of the disk will send out such an air wave, but at the edges observe how the little air particles swish around the ends and flow into the space which has just been passed over during the motion. Such currents of course, have no use at all in giving out music.

Air Can't Flow Into Vacuum

In the lower part of Fig. 6, the rub-

Continued on Page 21

Fig. 7. The Rubber Baffle Around the Edge of Diaphragm is Seen in This Picture.

The Myth of Summer Lightning

You Are Safer If You Keep Up Your Aerial This Summer

By M. WOLF, Baltimore

SOMETIME ago in our radio era somebody told the world that it was dangerous to operate a radio set during the summer time because of the very frequent occurrence of lightning storms.

As sure as the seasons roll by some people are taken in by this erroneous idea especially at this time of the year. This notion is a pure myth, founded most likely in ignorance. It is extremely desirable, therefore, to explain

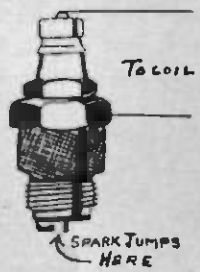


Fig. 1. It is a Miniature Flash of Lightning Which Fires the Gas.

the entire subject of lightning as it is related to radio broadcast reception, and at the same time to explode this myth.

Sometimes Winter Lightning

Of course this feeling towards lightning is at its height during the summer period. Yet it is a fact that lightning storms may occur during all seasons of the year although no mention is made of them except in the summer season. And the fact that they happen during other seasons of the year without harm or injury to radios or operators should convince anyone that receivers and listeners are not special subjects of persecution of the gods of lightning.

Three big radio summers have passed and yet we have seen no lists of radio calamities brought on by lightning. In fact, the records show that houses having radio antennas have been immune from such damage whereas dwellings not so equipped have suffered injury from lightning storms. There is a very good reason why buildings with aerials are to a considerable extent more immune from lightning hazards than houses not so equipped, and this reason will be brought out in the course of this article.

Lightning Across Spark Plug

What is this thing called lightning anyway? How does it occur? Most everybody has seen an electric spark. When an electric switch opens a circuit, a small spark is usually seen to pass or jump across the break for an instant. Another well known case is in the spark plug Fig. 1, which ignites the gasoline in your automobile engine. Here the gap exists all the time and a fairly high voltage is needed to jump it.

The ordinary spark coil gives a pressure of about 5000 volts at the coil terminals. This will jump about ¼ of an inch under ordinary conditions of temperature and pressure. When in the cylinder, however, the compression reduces very greatly the distance which the voltage will break down. That is why the spark plug points are set so there is a gap of 1/32 of an inch or less between them. The exact distance which a spark will span depends quite a lot on the shape of the terminals or electrodes. It is much harder for the current to jump between two large balls than it is between two sharp points. In fact, it takes roughly twice the pressure required in the case of the needle points.

How Strong is Lightning?

A flash of lighting is just such a current jumping across a break only on a very much larger and grander scale. In the case of the spark jumping across the plug we know that there is a voltage which makes the electric spark jump. Where is this voltage in the case of lightning and how does it originate? Let us see.

The small schoolboy knows that when lightning takes place a cloud is involved in the process. Clouds are formed by evaporation of water in large quantities. As the evaporated water rises in

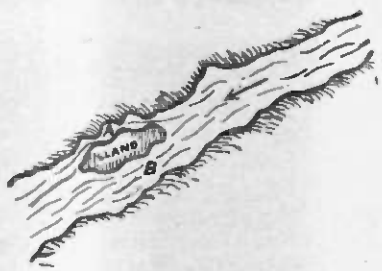


Fig. 2. The Current Flow in a River Obeys the Laws of Electricity.

the atmosphere it sooner or later reaches a point where the air is much colder, and so it starts to condense just as steam will collect in drops of water on a cold plate held before a tea kettle nozzle.

It has been found that to start this condensing action it is always necessary to have some object which the water vapor can use as a start for a drop of liquid. In the case of the tea kettle just mentioned, it was the plate on which the water condensed. When a cloud forms up in the air there is a nucleus for each drop as it starts forming, and this is oftentimes a tiny speck of dust. However, it has been found that a charged particle of air works

very well for this purpose. The air particle may get its charge from friction or from the action of the sun's rays. Uncharged air will not condense water vapors.

Adding Billions of Charges

The action of the vapor in condensing itself gives off a charge of electricity. The amount of it on each globule of water is extremely small. But the large white clouds that you see in the upper atmosphere are made up of billions and billions of small water globules, and the electric charge which therefore piles up on the cloud becomes greater and greater until really enormous magnitudes are reached. As a result of this great electric charge which accumulates on the cloud, there is established a tremendous voltage between the cloud and any other body near it, as, for example, between

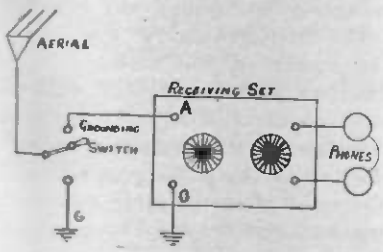


Fig. 3. This Switch Will Prevent Tube Damage in Thunder Storm.

the cloud and the earth, or between the cloud and another cloud.

Now the voltage which accumulates on a cloud cannot increase indefinitely, for the same reason that you cannot stretch a rubber band more than a certain amount. When a child pulls a rubber elastic at both ends he finds to his great glee that it stretches, and the more he pulls the longer it grows. But suddenly it snaps and there is no longer a whole rubber band. The tension in the elastic becomes so great that it must give and so it breaks. In the same way when the voltage on the cloud increases, the electric tension becomes greater and greater between the cloud and the objects near it. A huge spark leaps from the cloud to the earth, or to another cloud. This spark is lightning and it has relieved the enormous electric tension on it.

The pressure will keep on increasing until the air insulation around it can no longer stand the strain. Advantage may be taken of this fact to protect buildings and other structures from the ravages of the thunder storm. The lightning rod is an illustration of this. Such a rod extends to some height above the topmost point of a building and as it is metallic it attracts the lightning to strike to it. Since the rod is run directly to the ground the discharge travels to earth where no harm is done. It will be apparent that what happens here is that a path of very low resistance is offered to the stroke, and that the object of the rod is to divert the lightning from points where great harm may be done, as the buildings, etc., to points where no damage occurs.

Like Water Round an Island

Lightning is unlike the ordinary electric current in one respect. The latter divides between various paths in such a way that the greatest current goes through the least resistance. However, some current flows even through the highest resistance. It is like a stream of water in that regard. Suppose we have (Fig. 2) a river with an island in it quite near one shore. There is only a tiny passage at A, while at B the channel is wide and deep. You might think that all the water would take the easy path through B, but if you check up on it you will find that there is a small current through A, no matter how little the latter may be.

The rule for this, which is called Ohms Law, is that if one path is ten times as easy as the other, then ten times as much current will flow through it, or if it happens to be 1,000 times as easy, the current ratio will be 1,000 to one. Notice that in each case, however, some fraction of the total amount goes through the hard passage.

When Flash Seems to Divide

When lightning strikes, the first shock through the air makes its path quite conducting, while the surrounding air has practically infinite resistance. The result is that all the current flows through the one path. If you watch a thunder storm in progress you will sometimes see apparently that the lightning divides, but in such cases it is a second or third stroke following immediately after the first, which has carved out another path through the atmosphere.

Now what is the bearing of this on radio? People who like to raise scares say that the presence of the antenna invites lightning to strike the house on which it is located. A knowledge of the simple principles mentioned above conclusively disproves any such assertion. As between a dwelling with no antenna and no lightning protection, and a house with an aerial properly grounded, the latter is far less likely to be hit by lightning than the former. For the antenna behaves exactly as the lightning rod explained in the previous paragraph, —it offers a very low resistance path for the lightning discharge which is run to earth by means of the ground wire and no harm is done.

Discharging the Charge

Even a more important action of the lightning rod is to *prevent* the direct

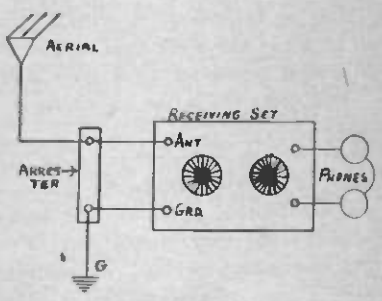


Fig. 4. The Fire Insurance Companies Require an Arrester Like This.

stroke from ever happening. If the thunderstorm takes place on a dark night, you will oftentimes see a glow or corona from the sharp points projecting above the roof. What happens is this. An electric charge is induced by the clouds in the points below them, and since electricity easily flows off from a point, the charge which has gathered there flows up into the cloud and neutralizes the one above it. This action is so powerful that it is rare for a direct stroke of lightning to occur in the neighborhood of a house properly protected. It is a case of an ounce of prevention as well as a pound of cure.

Instances have been known to occur where, of two adjacent houses, one which has an aerial and the other which has not, the one without the antenna suffered a lightning stroke, whereas the house with it was untouched. That such is most likely to be the case must be evident from a knowledge of the action of the

lightning rod; and *the antenna well grounded is a lightning rod.*

How About the Telephone?

Why should the antenna be more susceptible to lightning strokes than other things anyway? It is not. The aerial is simply a wire leading into an electrical instrument located inside the house. Well, so is a telephone wire. The latter comes from the outside into an electrical instrument similar to a radio set inside the house. Yet we do not see any hue and cry raised against the telephone for attracting lightning. The answer is that it does not attract it any more than anything else. In fact, less, because, like the antenna, it is protected by being well grounded. Telegraph wires, and power wires also, come from the outside to the inside of the house, yet these are not more subject to lightning because of it. There is no logic at all in the myth that an antenna will attract lightning. Far from doing so, it protects the house on which it is installed.

However, the antenna must be well built. It should always be grounded when not in use. This is best accomplished by the very simple way of using a grounding switch. An ordinary porcelain base 30-ampere switch of the single pole double throw type is quite satisfactory. The method of using this is shown in Fig. 3, with all necessary connections. The middle post of the switch is connected to the lead-in of the aerial. The top terminal of the unit is connected in the regular manner to the antenna post of the receiving set. The bottom post is connected to ground.

When the switch is thrown up, the antenna lead-in will be connected directly to the receiving set for use, and reception is done in the normal way. When the set is not in use the grounding switch is thrown down, and this connects the antenna directly to the ground, as may be seen from Fig. 3. In other words the switch converts the antenna into a lighting rod when the radio set is not working, and the house on which the aerial is erected has the full protection which a lightning rod affords. Such a switch may be purchased in any electrical store for about 25 to 40 cents.

Small Gap in Arrestor

The same protection may be had while receiving or using the radio set by means of a simple device called a lightning arrestor. There are a number of units of this sort on the market, but whatever device is used it should be one approved by the Board of Fire Underwriters. Most of these arrestors consist of a small gap formed by two metal rods separated from one another by a small distance. Often this gap is in a vacuum. The two terminals are connected as in Fig. 4.

The behavior of this is as follows. The tiny gap in the lightning arrestor is seen to be connected across the antenna and ground posts of the receiving set. But this gap offers a tremendous resistance to radio currents which therefore flow through the receiver rather than through the arrestor. However, a lightning discharge behaves exactly opposite to this. The discharge is an entirely different sort of animal from a radio current and it flows very easily through this device. It therefore goes through the arrestor while you are receiving. In other words the lightning arrestor serves to by-pass or divert the lightning discharges away from the radio receiver.

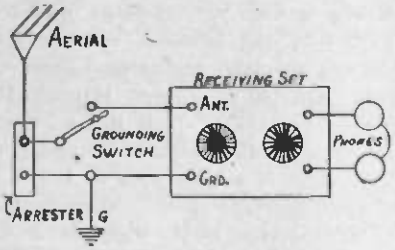


Fig. 5. Complete Protection Combines Figs. 3 and 4, Like This.

Using Switch Also

In general, if the arrestor is used alone, sufficient and ample protection is afforded against lightning by it. Both arrestor and lightning switch may be used in conjunction with one another, as shown in Fig. 5, which is self-explanatory after the above account of the action of both devices.

All of this, we repeat, is on the assumption that lightning is coming after you. But there is no reason why lightning should pick on you. The number of strokes doing damage is extremely small, considering the number of lightning flashes which there are each year. Railroad accidents, subway accidents, and so on, occur each year, yet one would not think of therefore stopping from riding in the subway or railroad. For they are extremely rare, considering the number of railroad and subway trips that are made each year. A certain amount of common sense is applied by the public in these cases, and the same thing should hold true for radio and lightning. There is no conspiracy between lightning and radio. So those of you who are contemplating the installation of radio sets this summer may go ahead and do so with the feeling that you are protecting yourselves from the dangers of lighting even more than if you were having an ordinary telephone installed in your house.

BROADCASTING A FIRE

Station KYW, Chicago, just a few evenings ago, broadcast a great fire from the actual scene of the conflagration, from a spot so close that burning embers were falling on the roof where the emergency microphone was installed.

The "Midnight Revue" was ending in the studio of the Chicago Evening American in Hearst Square, when news came of the $2,000,000.00 fire at the Rosenbaum grain elevators. Before the show ended the public was told of the blaze, and given the early reports that had been received by The Herald and Examiner.

Immediately after signing off, the program manager of the Hearst Square studio, and the chief announcer rushed to the scene of the fire. A location was selected on the top of a nearby building and within a few minutes the radio world was getting the first hand story over a hastily laid out microphone hook-up.

Two fire engines were puffing and snorting right below in the street. A big fire tug had just swung across the river and directed two streams into the fire. The air was filled with steam, smoke and burning embers. All of the noises, and a word picture of the scene, was passed on to the radio listeners.

PHYSICIAN FOR FANS

And now we have the radio physician. Once a week from WGY, at Schenectady, Dr. C. W. Woodall is giving a short talk on first aid. He doesn't attempt to prescribe for individual cases, but he does give advice which may be of great value in an emergency, and the response from listeners indicates that his efforts are meeting with success.

A Non-Squealing RF Amplifier

Saves "B" Battery and Increases Range by Resistance

By HARRY J. MARX

DO you like to buy "B" batteries? Most people don't, yet it often happens that the cost of the plate current supply is the biggest item of expense in running a radio.

Of course, a "C" battery helps quite a bit in cutting down current consumption from the "B." If, however, you can save even more by further changes in your set, it is well worth while. Besides this, the type and design of many circuits makes the use of "C" batteries impractical on the radio frequency side. But it is on radio frequency amplifiers that the maximum economy of battery current consumption is possible.

Do Not Kill Your Volume

Another problem,—does your neutrodyne refuse to neutralize? Or are you having trouble in controlling oscillation in your tuned radio frequency stages? If so, then you will be interested in an efficient method of controlling your tubes, without affecting the selectivity or killing the volume. In addition, this scheme eliminates those complicated back-of-the-panel adjustments. One knob on your panel permits you to control oscillation over the entire wave length range. Not only will it take care of all this, but it will enable you to operate your set at maximum volume with a minimum plate current.

The author has operated a loud speaker through a four-tube receiver (201-A tubes) and the *total* plate current of all four tubes was as low as two milliamperes, and the volume was sufficient to be heard all through a five-room apartment. Most sets use two or three milliamperes per tube, so you can see that this is a startling reduction.

Not only this, but the quality of reception is decidedly improved because of the lack of forcing your tubes by means of high plate potentials.

Harmony in Steam Whistle

The tendency of a tube to oscillate in one of the radio frequency stages is often due to excessive plate energy. This feeds back to the grid and starts trouble. When you force a sound making device to too high an output, the tone is apt to be changed. Have you ever noticed that when the steam whistle is blown on a factory, it starts with rather a low note and as the valve is opened wider, thus giving it more steam pressure, the tone not only gets louder, but also changes. Sometimes the note will be an octave or two higher than when it started. This high pitch is called a harmonic.

The same thing occurs with a vacuum tube when the output is greater than what was intended. This is sometimes made use of, however. The "second harmonic" superheterodyne built by the Radio Corporation employs this tendency of the tube to supply higher frequency oscillations. In this way the controls on the oscillator of this set do not interfere with the tuning adjustments. But with any ordinary radio the presence of these harmonics is not only a waste of energy, but also the cause of squeals and noise.

Besides all this, when the tubes are forced they draw too much current from the plate batteries. Reduce this energy and you can stop the feedback. If you can control the reduction, you can master tube oscillation.

Why Grid Resistance is Bad

Adding enough resistance in the grid circuit will stop the oscillation, but it also destroys volume and reduces selectivity. Why not add it in the plate circuit? The question is asked, "Isn't this just as bad?" Let us see. Fig. 1 shows a single step of RF amplification. The input to the grid comes from the secondary of the RF transformer, while the output from the plate threads the primary of the next transformer and so through the "B" battery to the filament.

Notice the two high resistance rheostats RG in the grid circuit and RP in the plate. Why isn't one just as bad as the other in reducing the selectivity and volume of the amplifier? The big difference is this. The grid resistance, being in series with the grid, carries all the current, which flows to this terminal. Such a resistance, while preventing the set from oscillating, at the same time makes the set very badly tuned.

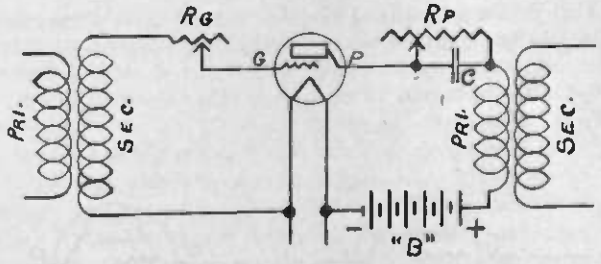


Fig. 1. Principle of Resistance in Grid or Plate to Control Oscillations. One is Wrong, Other Right.

Radio Waves Skip Resistance

Resistance RP from the plate circuit may at first sight look like the same proposition. But notice this big difference. By-pass condenser C is bridged across the terminals of this variable resistance. This has such a high value of capacity (.5 mfd.) that all the high frequency radio current flows through it as a dead short circuit on RP. That is why it does not broaden the tuning to any extent. The direct current from the "B" battery of course cannot flow through a condenser, no matter how

large, and so it is forced to use RP in getting to the plate. In that way its value is cut down by adjustment, until the best results are obtained.

If this by-pass condenser does so much good in the plate circuit, you may wonder why not use it as a by-pass on the resistance on the grid side of the tube. There is one serious objection to this

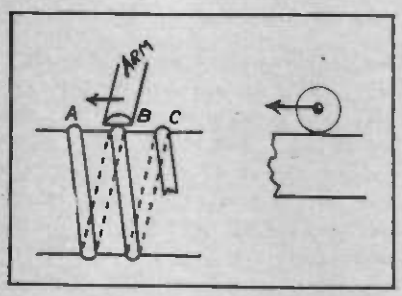


Fig. 2. Why a Wound Resistance is Not as Good as a Solid One.

plan. If the condenser is located on the grid side, then it will by-pass all the radio frequency and so the tuning will not be affected. However, in this case the rheostat has had no effect at all because no direct current flows in the grid circuit. For that reason a by-passed resistance in the grid is useless.

In controlling the energy of the plate circuits, a variable resistance simply cuts down the voltage actually applied to the plates of the tubes. In reducing this plate voltage, the current drawn from the "B" batteries is likewise lowered. In this manner economy of operation becomes another advantage of this addition to tuned RF amplifiers.

There are, however, a number of essential factors to be considered in using this method of control. A wire-wound resistance has some inductive value owing to the fact that the wire is in the shape of a coil. In varying the resistance, naturally the inductive value would be altered. This would introduce into the plate line a closed circuit (resistanee with by-pass condenser), which would have a wave length of its own, thus absorbing power from the normal circuit and reducing the volume of the set. Therefore a non-inductive variable resistance must be used.

Another requirement is that the resistance range must be great enough to reduce the voltage and control oscillation at the lowest wave length to which the set will tune. This value will be about 200,000 ohms.

Must Have a Zero Setting

The last requirement is that the resistance can be reduced to zero. For very high wave lengths, it may be necessary to maintain maximum plate potential. The variable resistance should therefore have a range from 0 to 200,000 ohms.

There is available a non-inductive variable resistance known as the "Centralab Radiohm," which has no wire-wound resistor. Contact is made upon a resistor consisting of graphite strip, by a patented rolling circular disc. This insures noiseless operation of the set and eliminates all troubles from loose turns of fine wire. It also permits adjustment of resistance without steps as in the wire-wound type and gives the finest setting desired.

You can see from Fig. 2 that a wire-wound resistance, with turns, A, B, C, is bound to give irregular action as the contaet arm is slid over it. As shown, the contact is made on wire B, but as the arm is moved to the left, sooner or later it will touch A, at which instant the entire turn, AB, will be cut out of the circuit. On the other hand, a roller, sliding on a smooth, high resistance strip, as shown at the right, will have its ohm value varied quite smoothly.

Look Out for Audio Wires

The illustration, Fig. 3, shows the

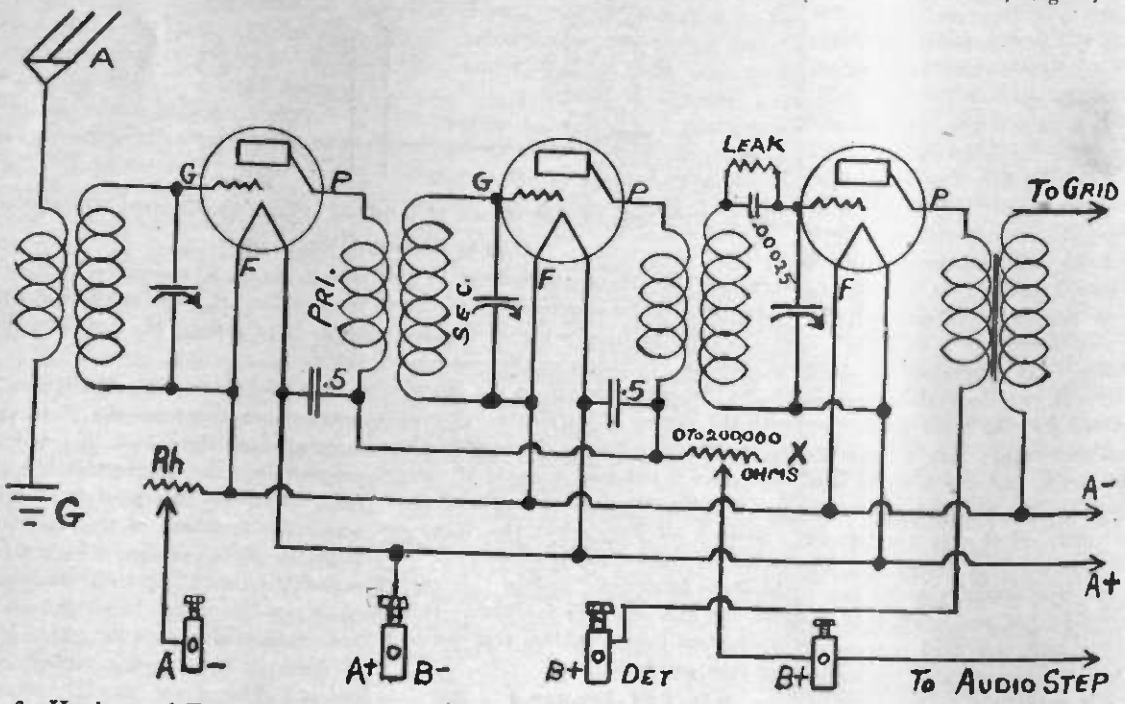


Fig. 3. Hook-up of Two-Stage R. F. Amplifier with Control of Oscillation Located in Resistance, X. This Also Saves "B" Current.

proper method of using the radiohm in a tuned radio frequency amplifier. One point is of special importance,—the resistance should not be connected so as to be in series with the audio frequency plate circuits. A separate lead from the B+AMP binding post is indicated to the audio stages. The "B" terminal of the radio frequency transformers should be connected to the one side of the Radiohm. The other side is connected to the B+AMP post. The Radiohm can be mounted in any convenient place on the front panel.

The use of two 0.5 microfarad by-pass condensers is recommended for the reasons already given. Make sure they are a good quality. Instead of just by-passing across the variable resistance, it has been found advantageous to by-pass across the "B" battery also. Why make the radio frequency currents force their way through the internal resistance of the "B" batteries? Connect each by-pass condenser with the shortest possible leads between the B terminal of the transformer and the A+ terminal on the tube socket.

Used with All Coils

The circuit diagram is not intended to show any new or complete hook-up. Its purpose is to indicate the proper connection for the by-pass condensers and the Radiohm. It is immaterial whether the radio frequency transformers are of the single layer tubular type, spiderweb coils, or any low loss type of winding.

A single rheostat is indicated for all tubes, but this is immaterial. Likewise any small changes in circuit details will not affect the operation of the hook-up.

If you have a neutrodyne circuit which will not neutralize, or any other form of balancing device, this method of control can be added, and the difficulties usually eliminated. Even in superheterodynes it can often be used.

Undoubtedly the action of the set will be clear, but a few words will be given explaining the hook-up. The radio frequency waves come into the primary of the tuner and go direct to ground. Although a non-adjustable primary is shown, of course this may be variable as to its turns. The secondary of the tuner is paralleled by the variable condenser and the combination delivers the waves to the grid of the first step.

Direct Current Leaves the A. C.

The output from the plate, after going through the primary of the RF transformer divides. The AC waves use the by-pass condenser to get back to the filament while the direct current must flow through rheostat X on its way from the "B" battery. The secondary of the transformer repeats the action to the second tube.

The third bulb is the detector, as can be seen from its grid condenser and leak. Its output is taken by the first stage of audio frequency amplification, although the tube for this is not shown. The single rheostat, X, it will be seen controls the plates of both RF tubes. The 2.5 mfd. by-pass condensers prevent the broadening of the tuning by rheostat X in the way already described.

THIS SPEAKER CAN'T BE OVERLOADED

Continued from Page 15

ber baffle in the shape of a ring is fastened both to diaphragm and to the large hole in the panel of the cabinet. Although there is a partial vacuum behind the diaphragm, just as before, this does not do the air at the edges any good, since the latter is prevented from darting around by the sheet of rubber. Instead, its motion must be out into the room where it will please our ears in the form of music.

It is the use of a baffle which makes it possible to dispense with a horn without sacrificing the radiation of the deeper tones. The edge of the paper cone or diaphragm is attached to the baffle by means of very thin rubber, as shown in Fig. 7. As a result of this extremely flexible support, the diaphragm resonance corresponds to a tone so low that it can hardly be heard, as it is so near the lowest audible limit.

Crystal Detector on Speaker

The cabinet contains, in addition to the speaker itself, a rectifier and amplifier, power for the operation of which is taken from the alternating current lighting circuit. The amplification in the model exhibited at St. Louis is sufficient so that, in the case of local stations, very clear loud speaker reproduction can be obtained even from a crystal, provided the latter gives clear headphone reception. It is important that the amplifier used with the new speaker be designed to have plenty of capacity, since the extension of the range of response of the loud speaker to higher and lower tones makes defects in the remainder of the system more noticeable, particularly roughness and blasting due to overworked amplifiers.

Tests of the hornless speaker show that its use is advantageous for all kinds of radio reception—for talks, solos, orchestral and band music, and group singing. In the research laboratory there have been set up loud speakers of many designs, so arranged that by a throw of a switch it is an easy matter to obtain comparisons, as well as a series of tests for any one type.

Will Send Hisses and Hums

Of course, these tests are conducted for investigating the speakers, and since radio transmission itself introduces such factors as static and fading, and frequently gives rise to serious distortion, a special sending set has been installed in one room. The most nearly perfect type of telephone transmitter known, namely a "condenser" transmitter, is used in sending signals to the amplifier and loud speakers in the adjoining room. The difference in quality of reproduction of the different units is at once apparent to the listener. Low musical tones which shatter and blast, or which are produced only as overtones by the horn speaker, are reproduced with fidelity by the new apparatus. Voices sound natural, and such high frequencies as the letter S, or a hiss, likewise are true. Even a 60-cycle hum, low in the audibility scale, is reproduced accurately. Horn speakers fail at much high frequencies.

Many experiences connected with testing and demonstrating loud speakers of the type we have described are of interest. The possession of such an instrument in which distortion is minimized, and whose response covers such a wide frequency range, transfers the interest of the broadcast listener from "fishing" for distant stations to that of trying to find the best program among the nearby high grade broadcasting stations, and to enjoy the music or speeches themselves.

$5.00 Before You Start

The Government of Guatemala levies a charge of $5 for the installation of a receiving set, but there is no charge for operation.

Uncle Bill a WBZ Star in Four Months

Can You Locate Sweet Meadows, His Home Town?

SO you know Uncle Bill of Sweet Meadows? Few radio entertainers have achieved such wonderful success in radio broadcasting as one of the feature characters of Westinghouse Station, WBZ, who has been entertaining the vast radio audience during the past few months by his style of humor and wit. Considering the short time that this character has been on the air, his rapid rise to stardom and his wide-spread popularity throughout New England, Canada and the more distant places is all the more remarkable.

Uncle Bill first started broadcasting February 18, 1925, and since that date he has been a regular Wednesday evening feature of WBZ programs. As far as we know, he is the only radio character of his kind, and his style is inimitable. His first broadcast made a tremendous hit and his popularity has increased with every appearance through his amusing anecdotes of country life and characters, and the recital of homely but appealing old-time Yankee philosophy.

As the possessor of a very pleasing voice which lends itself very well to broadcasting, Uncle Bill also entertains the listeners by songs of long ago, with those beautiful melodies found in the old-time favorites, in addition to writing and composing selections for the sole entertainment of his "neighbors" scattered throughout the North American continent. He has also written many verses on rural life in Sweet Meadows. These contain that Yankee philosophy which adds so much to his interesting and amusing entertainment which has been received with so much favor by the radio listeners.

Is It Real or Imaginary?

Sweet Meadows, the little New Hampshire town which furnishes the setting for Uncle Bill's anecdotes, cannot be found on any map. But this little town which contains the country store, the old hitching post, the meeting hall, and his rural associates and companions seems to be real. In fact, it is so much alive in his broadcasts that many listeners have written to the broadcasting station asking where they can find this country village, famous through the medium of radio, so interesting and rich in rural characters. Although his style is unusual to-day, Uncle Bill recalls to mind Sam W. Foss, that famous old New England poet, and Eugene Field, because the quality of his work and style compares favorably with the treasures these two noted poets have left with us.

What is Uncle Bill's real name? Sh—that is a secret. His modesty will not permit WBZ to disclose his true identity, but this character knows life as few people ever do. Typically Yankee, "Uncle Bill's" ancestors settled in New England, where he now makes his home, nearly three hundred years ago. He has been in almost every walk of life, from a cowboy on the plains up to a guide among the Rocky Mountains. He has found the Fountain of Youth and keeps young by not letting bitterness creep into his heart, and it is the waters from this fountain that Uncle Bill tries to give to his "neighbors" during his regular Wednesday evening broadcasts.

He Draws a Tremendous Mail

The huge amount of mail which he receives every week further proves the universal popularity of the Sage of Sweet Meadows, and the countless hundreds of letters he receives after each broadcast are postmarked from all parts of the United States and Canada. Young and old, robust and shut-ins, all write to Uncle Bill and many of these correspondents have resorted to poetry, as the only means of expressing their true appreciation and sentiment for this popular character.

Fig. 1. Uncle Bill Has His Audience Guessing Where Sweet Meadows Is Located.

A Constellation of Three

Broadway Favorites Who Have Now Taken to Broadcasting

By GOLDA M. GOLDMAN

THREE little ladies who are accustomed to shining brightly and separately on Broadway shone together for a while at the Hotel McAlpin Station, WMCA, one night last May.

First came Betty Pierce, that siren of "White Cargo," who as "Tandeleyo" has captivated the hearts of half of male Broadway. (The other half have not yet had the opportunity to see her.) From the charm and precision with which she nightly accomplishes this feat, one would hardly have expected Betty to be nervous; but not even the knowledge of how captivating she looked in a stunning red costume saved her from fright at the sight of "Mike." The nervousness soon wore off, and Betty told the listening kiddies how much she sympathized with their Saturday night troubles, for not the least of her labors consists of scrubbing herself free of paint eight times weekly as she removes her make-up.

Dreams Ahead

To everyone's surprise the little charmer turned serious for a few minutes and read her listeners-in a poem entitled "Dreams Ahead." Between you and me, however, although there is no question that her ambitions are real, and that her dreams will materialize, she will probably laugh her way through the world to her goal, rather than achieve her ambitions by treating the matter too seriously.

The second little star was a decided contrast to the dark fascination of Tandeleyo. She was Katherine Revner, a little blond beauty now starring in that melodrama, "The Rat." This winsome little lady made her initial appearance

Fig. 1. Some Say That Broadway Favorites Are Jealous and Will Not Associate with Each Other. Here Are Three Headliners Who Broadcast Together.

on the stage at the ripe age of seven, when she played "Titania" in "A Midsummer Night's Dream." Then she played all the princes and pages that could be found in literature.

From Denver, Colorado, as a starting point, she toured the west with a repertoire, but the lure of the Eastern States brought her to New York accompanied by her mother and grandmother. Stock claimed her for a while and finally we find her playing with Marjorie Rambeau in the "Valley of Content." A week after the play opened she was offered the lead in "The Rat," and was released from the "Valley" to accept the engagement.

Threw It Across the Room

She is an optimist, this blonde Katherine, and thinks life is pretty good. Perhaps that is because of a lesson she learned when she was just a child playing in stock, and which even before reaching twenty she has made a definite part of her philosophy. "There was a leading man," she says, "who had what he called temperament, and what of course was really temper. At every rehearsal he would fling his part across the stage, and then of course, had to walk over and pick it up. To me that was so silly that I resolved then and there that I was never going to develop temperament."

Katherine's listeners-in, by the way, were probably surprised to find the little lady of the melodrama, singing "Katinka," the song hit of the "Chauve Souris," in *French*. It happens that her hobby is the cultivation of her voice. You may also look for her in the movies, for she has appeared for Griffith, Paramount, etc.

Does She Look Nineteen?

The tiniest, but not the least scintillating of this constellation of stars is little Nydia Westman of "Pigs." Nydia says she is nineteen, but she looks like a schoolgirl of sixteen. She is without exception the simplest, most natural little body to be found on the interesting side of the footlights of Broadway. She is an old-timer in the broadcasting game, as she has already appeared at WOR, where she played the ukelele, and as she says "told a short history of her life."

Nydia is also blonde, which perhaps accounts for some of her youthful appearance. Maybe you will like her quaint little story as she stood before the microphone with her "uke."

"I am going to sing you some old songs," she explained, "and I want to tell you why I haven't been able to learn any new ones. I've been taking care of the 'Pigs' over at the Little Theatre, and it keeps me busy. You see, we have to treat them very well. First we used to feed them bran, but after we had fed them that for some time they struck. They said they were tired of bran, so we began to feed them lettuce instead. They ate that cheerfully for a few weeks, and then they struck again, so we said, 'Well, what do you want now?' and they answered, 'We want some mayonnaise'."

A Talented Family

Nydia gets her quiet air of self-possession from the fact that she has practically grown up on the stage, as her entire family—father, mother, sister, and brother—used to appear together in vaudeville sketches. For two and a half years she starred in "Lightnin'" on the road and then was with May Irwin in "On the Hiring Line." Nineteen finds her a full-fledged star. Her hobby seems to be singing to her ukelele, but perhaps we should consider her concluding words to the unseen audience:

"I want you to understand that I danced as I sang each of these songs, and I dance beautifully."

Of course you may believe her if you want to.

A SOCIETY FOR THE PREVENTION OF CRUELTY TO FANS

It Aims

To prohibit "Katherina" being sung more than once per week.

To punish very severely all announcers who address audiences as "Folks."

To furnish listeners-in with free sleeping powders for use just preceding any election.

To prohibit the publication of pictures in radio magazines of "the smallest radio receiver in existence."

To suppress all stories by DX fans.

To prohibit the use of the word "Kiddies" by bed-time story tellers.

To insure seven years of hard labor to writers referring to fans as "Phans."

To strangle all announcers who give a trick pronunciation to their stations and city.—Crosley Radio.

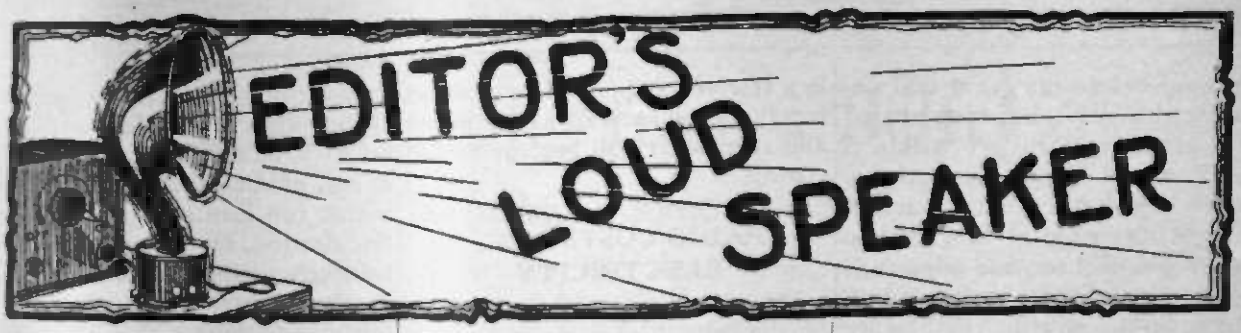
HOW HIGH IS YOUR STATE?

Every state in the country now has at least one broadcasting station. The highest ten have each at least nineteen. Here is the list arranged according to numbers for the leading ten and then alphabetically.

California	46
Pennsylvania	34
Texas	32
Illinois	31
New York	29
Ohio	29
Missouri	25
Washington	23
Iowa	20
Nebraska	19
Alabama	3
Arizona	3
Arkansas	7
Colorado	13
Connecticut	2
Delaware	1
District of Columbia	4
Florida	7
Georgia	5
Idaho	5
Massachusetts	17
Michigan	14
Missouri	5
Montana	7
Nevada	1
New Hampshire	3
New Jersey	15
New Mexico	2
North Carolina	2
North Dakota	6
Oklahoma	11
Oregon	14
Rhode Island	7
South Carolina	2
South Dakota	4
Tennessee	10
Utah	5
Vermont	2
Virginia	5
West Virginia	2
Wisconsin	13
Wyoming	1
Hawaii	2
Porto Rico	1

Pending Patents Choke Office

There are more than 2,000 applications for radio patents now pending at the United States Patent Office in Washington.



THE RADIO REVOLUTION

You hear it now on every hand—the talk of a revolution in radio. We certainly hope that one is coming but don't expect to see it. A revolution naturally means a big change of some kind and radio is already so good that a change of any great size would make it perfect or a little better.

However, there is very small chance of anything so startling happening. You see the laws of electricity are so well known by this time that there is not much doubt about how our present apparatus will act under any condition. Naturally we cannot make any predictions about new materials or unusual devices.

An Olden Prophet

Suppose in the days of the crystal set some prophet had foretold that radio had developed about as far as it could. Vacuum tubes in those days were of course unknown. Such a prophet might have said that the laws of the crystal were well developed and that it was easy to sit down and figure out how much power would be needed to send a signal a distance of 25, or 50, or 5000 miles. He might have continued that increases in the watts of sending stations would broaden the range and that improvements in hook-ups might increase selectivity but such minor detailed improvement were all that could be looked for.

And then the vacuum tube was invented which at that time did revolutionize radio. Yet our prophet was quite right in his predictions if he were careful enough to do as we have done—that is, say that there will not be any startling advance until some new material or some unusual device is discovered.

Nothing Startling in Three Years

Although the improvements in radio have been going on rapidly for the last two or three years, notice that they are nearly all refinements. Take the most expensive set which you can buy at the present time which sells for over $400.00 and compare its performance with the single tube, home-made outfit, put together by a skilful amateur of three years ago.

Under favorable conditions he was able to get 1500 to 2000 miles. At the present time the most up-to-date set is occasionally able to pick up 3000 miles, although with no regularity. You can hardly call this a revolution—the doubling of the range by using six or eight times as many tubes and at a cost of ten times as much. Of course, the new sets look a lot better and are considerably more selective. They are also easier to control, and use less battery current.

An Auto Revolution?

What we are getting at is this. The chap who thinks that a revolution in automobiles is just ahead of us will probably wait quite a while before he sees a radical change. And any one who thinks that some new circuit or hook-up is going to increase the range of the receiving set by a large proportion is also doomed to disappointment.

All the big manufacturers assure us that they have nothing concealed up their sleeves at the present time in the way of radical changes. To be sure we do not have the complete confidence in their truthfulness, which we perhaps might have. It has sometimes happened that a big concern will deny a thing up and down and then later show that their left hand did not know what their right hand was doing. But it is hard to keep all hints of new developments out of the press, and so relying more on the undercurrent of news which circulates among writers than on the assurances of the large companies we feel safe in predicting that nothing startling will happen for at least a year or until some new materials are discovered.

CELEBRATING BY AIR

The well-known Fourth of July is with us again, and the druggists are laying in an extra lot of iodine and absorbent cotton. Does your plan for the day run something like this?

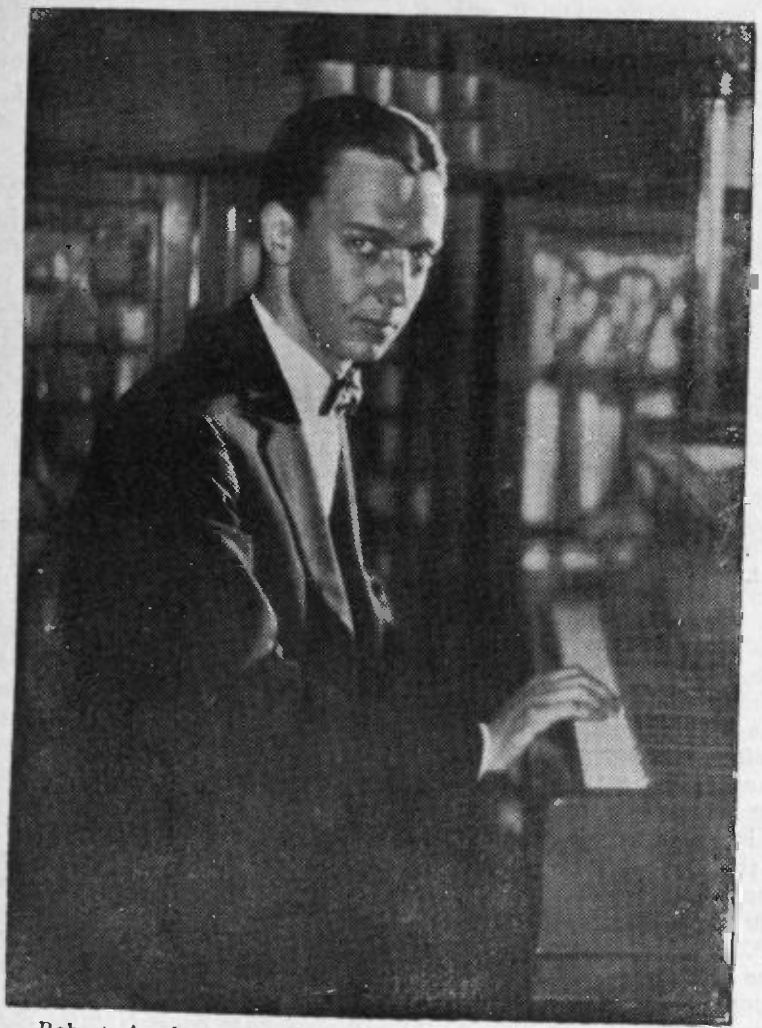
In the morning wake up at six o'clock through the efforts of your young son, who is anxious to touch off a few packs of fire crackers. By noon most of the fire crackers have gone to glory, and during the afternoon you take a trip somewhere. In the evening come the fireworks and the speeches. Here is where radio shines. It used to be that if any good speakers were announced for the celebration, it was necessary to attend in person if you wanted to know what was going on. In these days most of the good speeches are put on the air by enterprising sending stations, and by putting the loud speaker on the porch you can set off rockets with one hand while you tune in to the flow of eloquence with the other.

Art Beats Nature

A little while ago at a large open-air gathering, we arrived

an hour before the event was announced to start, but even at that it was difficult to get within a few hundred feet of the platform. After listening for quite a while, we got disgusted at hearing two words out of three, and adjourned to our home, where we turned on the radio set and for the balance of the performance were able to hear every word easily.

There is no doubt about it. If you want to hear a program to the best advantage, the only thing to do nowadays is to stay at home. Of course, if you want to get the excitement of the crowd, and see the fun as well as hear it, that is another matter. Perhaps in a few years we shall have radio for the eyes as well as the ears, and then what will become of the crowds?



Robert Armbruster, the distinguished young American pianist who is broadcasting a series of piano recitals from WJZ. The letters from fans prove they like his style.

RADIO COSTS BEAT ELECTRICITY

Here is an interesting sidelight on the growth of radio. Although it has been going for only three or four years, its cost to the average family exceeds, or at least equals, what is paid for electric current. The electric light companies find that the average home bill per month is about $2.50. Of course, many families pay less than this. If you run nothing electrical but the lights in your house, then it is doubtful if the bills will be much over $1.00 or so a month. It is the appliances of one kind or another which run into money. An electric flatiron, for instance, will use as much current as twenty lamps of the ordinary size (25 watts) burning together.

If you accidentally leave your cellar light on for ten hours overnight, you probably feel that you have wasted nearly a day's pay, but just think—one-half hour of your flatiron will cost you just as much as ten hours of the electric light. This should not be thought of as an argument against the flatiron, but in favor of using all the lights you need. What with electric fans and toasters, and washing machines, many households pay $3.00 and $4.00 a month to the central station, and this brings up the average to $2.50 as just mentioned.

Costs Same to Run Set

It is probable that, considering tube renewals and batteries, the ordinary radio set costs about this same figure. The 45-volt "B" battery sells for around $3.00 and $4.00 and needs renewing every few months, depending of course, on how much use is made of the set. Then there are the "A" batteries The dry cells are worth 40 cents apiece, or if you have a storage battery instead, it costs 50 or 60 cents plus charges for a rental battery to take its place while being charged. The tubes, which list for about $3.00, will often times last a year, but then when you consider how many are burned out through wrong connections, you will find the average life is considerably less.

The best estimate made through a survey of the industry shows a cost of about $2.50 per month for operating a radio set. It certainly is remarkable that so new an industry can take its place beside an old one in the amount which we are all willing to pay for its operation.

Broadcasting from a Belfry

By OLIVER D. ARNOLD

YOU have all heard of the chap who claimed that a banjo was not a musical instrument. Some people class church chimes in the same way. Indeed, if you stand too close to the belfry, it is oftentimes hard to realize how clear and sweet the music is as heard by listeners farther away. It all seems to be a terrible jangle and discord to the nearby hearer.

That is one of the troubles in broadcasting these instruments. Where are you going to put the microphone? If it is in or near the tower, then the same jangling or discord will go out on the air as will be heard by your own ears at that location. If you could tie a captive balloon a few hundred feet away and on a level with the tower, that would make a very good pick-up position.

Traffic Cop Mixes With Bells

Down on the ground it is not so good. Outside noises are sure to enter into the broadcasting and mar the effect. An example of this occurred on a sleety day last winter, when broadcasting the chimes of Trinity Church on Broadway, at the head of Wall Street. The church authorities would not allow an engineer to risk his neck by venturing out on the icy roof of the church to place a microphone, and therefore the "pick up" was made from the church yard below. As a result, whenever traffic changed direction at the junction of Broadway and Wall St., the radio audience was informed by the blasts of the officer's whistle, which was clearly audible above the peal of the chimes. "Draw over to the curb, there" was heard above the Christmas carols, as an offending driver started to run by the signal of a traffic cop.

A Sunday morning does not seem complete somehow without the sound of church bells wafting through the balmy air. With this in mind, Station WJZ has been supplying the radio audience with such an atmosphere for their Sunday mornings. Starting at 10:45 each Sunday, the new chimes of Grace Church, Episcopal, have been broadcast, and this will continue to be a regular feature. The chimes of Grace Church are considered to be one of the most complete sets on this side of the Atlantic. They were just recently installed and made their radio debut on Easter morning, when the first note played on them was broadcast by WJZ of New York and WGY of Schenectady.

Now 20 in the Set

Nearly a year ago the eleven old bells in the belfry of Grace Church were removed to the foundry of the Meneely Bell Co., in Troy, to be recast into new and better form. Nine bells were added to secure a set of twenty chromatically attuned, and Grace Church now claims to have the largest set of bells in New York and one of the most musical on the air.

The large bell, seen on the right of Fig. 1, of the Grace Church chime weighs over two tons, the others being graduated proportionately with the result that the smallest bell tips the beam at about 300 pounds. The composition used in the manufacture of the bells is 78 parts of new Lake Superior copper and 22 parts of new block tin. Experience has shown that these two metals alone produce the best ringing alloy, even silver being too soft a metal for such purpose.

How the Bells Are Played

The keyboard, or console, which the musician uses to play the chimes, is located on the ground floor. As the ringer presses the keys, an electric contact is made, which allows current to flow through a long wire reaching into the action room. A relay, which is operated by this current, admits compressed air through a valve to a cylinder and piston. The piston operates the hammer which strikes the bell. This is shown in idea in our sketch, Fig. 2.

It is hard for anyone to play a musical instrument, if he is stone deaf. That is what the bell ringer would apparently be if located several stories away in the heavy stone belfry, as he would not be able to hear at all well the notes which he was playing. To remedy this condition a speaking tube is run from the belfry down to the keyboard. By fixing the upper end of this tube in the proper place, it is possible for the player to

Fig. 1. These Are Some of the Bells You Hear Broadcast. The One on the Right Weighs Over 4,000 Lbs.

hear the tones of the big chimes practically on the instant they sound forth.

Mike and Musician Hear Alike

It is possible by proper design to put the microphone near the end of this speaking tube. Proper proportion of length and diameter reduces the volume of sound down to a point where an ordinary microphone can handle it. This has the great advantage that the music going out on the air would sound exactly like what the musician himself hears, and he would naturally broadcast the kind of performance which he himself likes to hear.

In locating the upper end of the speaking tube, or if the microphone itself is to be installed in a belfry, then the position of this unit must be decided on with the greatest care. In the chimes in the tower of Grace Church, the largest bell weighs over 4000 lbs., and has a diameter at the mouth of about five feet. It can be readily seen that any mechanism made to ring a bell of such size and weight must make some noise in operating, and to the sensitive microphone such a noise is amplified until it sounds like peals of thunder. Furthermore, the terrific crash caused by the huge hammer striking the side of the bell momentarily paralyzes a diaphragm that is located too close to the point of impact, and results in blasting. On the other hand, if the microphone is placed too far from the bell tower, extraneous noises enter into the broadcasting, as just explained.

Can Even Play National Anthem

The Grace Church set of bells have a range in chromatic scale from B-flat, through 1 2/3 octaves, to F. With this range the ringer may play "The Star Spangled Banner," which is beyond the range of most chimes. During the war they were unable to play the national anthem because of the limited range of the old chimes.

In some cases, owing to the arrangement of the big bells, and the small space in which they are squeezed together, it is impossible to find a spot in the belfry which can be used as a pick-up position for the microphone. Such a case was found when it was proposed to broadcast the chimes from the Metropolitan Life Insurance Tower. You will remember that it is from here that Arthur Bagley is conducting his tower health exercises through Station WEAF, New York.

In order to get all the tones equally loud it was expected to use four microphones. It was discovered that they could not be placed closer than fifty feet away from the bells for the sound would register too loudly. Four units suspended out in the air fifty feet away would have worked well, but who would hold them up. This obviously was not a practical method.

The Problem Was Solved

The solution of this problem was hit upon by Mr. John C. Knight, a vice-president of the Company, who has in his charge the huge Metropolitan Building, which houses 8,500 workers, and the tower, which shelters several hundred more. He secured a set of small

Continued on Page 30

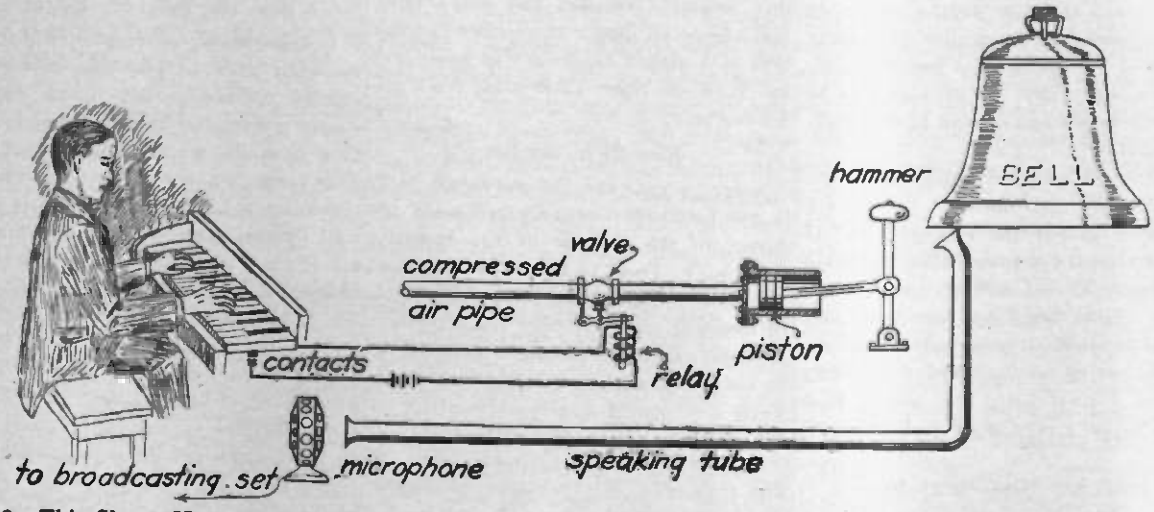


Fig. 2. This Shows How the Bells Are Rung from the Keyboard, and Also How the Microphone is Placed so it Picks up Just What the Musician Hears

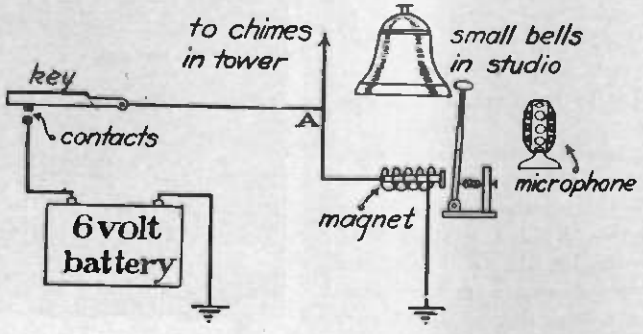


Fig. 3. The Junior Edition of Chimes Is Used in the Metropolitan Tower to Do the Broadcasting.

Gamby--Dancing Songbird

She Proves That a Bright Girl Can Also be Pretty

An Interview by VANCE

WHEN some one mentions a Roxy concert, what do you think of first? Some undoubtedly bring to mind the jovial conductor of the Capitol Theatre in New York. To others a fine Sunday evening's entertainment is thought of. Or perhaps you immediately recall the movies at the Capitol itself.

A great many radio fans, however, will think first of all of Gamby. Of course, if you want to give her a more dignified title it is Maria Gambarelli, but no one who has fallen in love with her calls her anything but "Gamby." If you take a look at her picture, Fig. 1, you will see one reason why it is so easy to do said falling.

What it is to be Popular

As she is one of the most popular members of Roxy's gang, it is not surprising that many would-be visitors are disappointed in not being able to see her. And when you consider that modesty is also one of her qualities, you will realize how hard it was to get an interview with this demure damsel. In fact, we were kept waiting for nearly two weeks before we were able to get in a word edgewise. She had been rehearsing for such a large ballet this last week, that she has even had to refuse to see her dressmaker, and I leave it to you girls if that isn't some busy.

To start with, Gamby was born in the year ——Oh, we are not allowed to tell that after all. But to continue in her own words.

"As a very little girl I was so attached to dancing that mother, my one great inspiration, took me to the Metropolitan Ballet School, where, after I had practiced very hard for a while, I was entered in the ballet and was finally engaged as a solo dancer."

The Thrill of a Lifetime

As was just remarked, Gamby is quite modest and she did not mention what a wonderful success she made at this

Fig. 1. Everybody in the East and Many in the West Know Who "Gamby" Is

school. Her star, serving as a model for her dancing, was the great Pavlowa who was then the reigning favorite at the Hippodrome. Imagine her surprise and thrill when Pavlowa herself offered Gamby the chance to be with her throughout her New York engagements. That was one of the big days in her life.

It certainly looks pretty soft to a tired business man to drop in of an evening and see the stars float over the stage floor as they seem to drift through their graceful dances. Anyone who has the gift like Gamby, certainly would never need to *work* at her art. That is, anyone would think so judging by her performance, but such an opinion is all wrong. She is one of the hardest workers on the stage. During the entire time she was dancing solos with Pavlowa, she was hard at work every morning with Maestro Albertieri, the famous ballet master of the Metropolitan.

However, doing fancy steps alone, was not enough for such an ambitious girl.

She Breaks Into Vaudeville

"My next venture," she said "was into a different field, that of vaudeville with Theodore Kosloff as his Prima Ballerina. After many and varied experiences in the realm of dancing, and although but a few years had elapsed since leaving the Metropolitan Opera House, I was engaged to appear at the Capitol Theatre as Prima Ballerina for ten weeks; and indeed the ten weeks have never ended for I am still there."

Here we murmured the heartfelt hope that instead it would be ten decades. But let her go on with her story.

"After I had been dancing at the Capitol for a while, working extremely hard in an effort to attain the success which I desired, I was appointed Ballet Mistress and Prima Ballerina of this marvelous organization which meant creating and putting on the ballets. I now engage and train from ten to eighteen people each week, besides doing all the important solo dancing. Although it gives me little chance for recreation, yet because of my great interest in the work, I really enjoy it."

Wouldn't You Do it, Too?

She is not the only one who likes this work. The dancers under her find that she has such a sympathetic nature, and above all, such a sense of humor, that it is easy to learn from her. If we ever lose our job of interviewer, we shall take the first train to New York and apply for a position as pupil in her school.

Perhaps you have liked the Sunday evening performances as given out through WEAF, New York, and seven other stations. Maybe even you have written in about them. If you did you have given Gamby another little thrill of pleasure. As she explains it. "The weekly radio broadcasting from the Capitol Theatre has been a source of great delight and inspiration to me, because of the kindly and generous response of the radio fans. I hope some day that they will be able to broadcast the dance; until that time the only means of entertaining my radio friends is by singing (or at least that is what some people call it); Roxie says 'As a singer, you are an excellent dancer'."

How Gamby Got Her Start

How does one start a career of broadcasting? If you mean to go into this line as a career, we do not advise doing the way she did. "My first attempt at broadcasting," she explained, "was very unexpected and flustered me considerably. It is quite some time ago that I secretly went up to the broadcasting room and taking a little bit of a stool, I went into an obscure corner and enjoyed all that the artists were doing. Suddenly, like a "bolt from the blue," I heard Roxie say, 'Well there's little Gamby; come here Gamby.' Needless to say, I turned from pink to red and from red to scarlet when I realized that I was discovered. Although I can't remember what I did that first night on the radio, the fans seemed to like it, and from that time on, I broadcast regularly from the Capitol Studio, singing little Italian songs and reciting cute little poems. Playing announcer of the stations is one of the things I like doing best."

These Italian patter songs, as they are called, are quite different from anything else ever heard on the radio. They go so fast that we never have been able to translate them, but judging from the way Gamby sings them, they must be full of sparkle and humour. If an Italian tenor as he intones grand opera is represented by a heavy soup, then we should say that Gamby represented the ice cream, and personally, we prefer the ice cream.

Three Guesses Which it Is

One must actually see this dancer to realize her charms. Many fans feel they would change places with Roxy any evening, and indeed our friend Roxy himself does not seem to be oblivious to this member of his Gang. If we were given three guesses which one of his troupe was his favorite, all three of our guesses would be alike.

Having achieved the pinnacle of art, partly by natural grace and largely by hard work, Gamby is not willing to take the credit herself. She explains that her success is really due to another. "I feel," she says, "that no account of my career would be complete without mentioning my mother's part in it, and to her goes the credit of any success which I may have attained. She always impressed on me that to be an artist means to be a hard worker and that the road to success is not an easy one. Although my mother never flattered me, she encouraged and helped me with constructive criticism and made me realize that there is always lots more to be learned."

Unfortunately, our picture of Gamby is dull and cold, and does not do justice to the life and sparkle which she always has. Also the quality of humor which is so apt to be missing in such graceful dancers is what strikes one first in her case. Beauty—brightness—ballet in five letters—Gamby.

WHAT ABOUT THE ETHER?

Continued from Page 11

uniform illumination on his screen. On the hills around Cleveland, he was able to measure a speed of more than one mile per second, and at the height of the Mt. Wilson Observatory, the ether drifted by at the rate of six miles per second.

All the experiments before had been performed on the plains as no one had apparently taken the trouble to repeat the tests on a mountain. The idea is very much like that shown in Fig. 5. Suppose we have a train of cars which may be running along the track. We will assume that we can not see the motion or hear the wind whistle by, just as we can not tell about the ether from our senses. The fireman wants to find out whether the train is in motion

Continued on Page 32

Follow Fast Waves to the Pole

By JOHN L. REINARTZ

WE are off to the Pole. If we get there it will be like standing in the center of a merry-go-round and watching it spin. Only, of course, since it takes the world a whole day to turn around once, the motion is so slow that we shan't know the Pole except by careful calculations in astronomy.

This trip will have a special grip on the imagination of radio fans particularly those who know the code. One of the big objects of this party is to find out how well the high speed (short length) waves will be able to penetrate through daylight. If they work as well as they seem to promise, it may make a big change in the wave assignments in the broadcasting stations.

Better Than First Trip

This will be the second time that Dr. MacMillan takes radio with him to the North Pole area, and its application this trip differs from the first in that fast waves will be used,—over 7,500 kilocycles per second (40 meters). The equipment will be capable of working down to 500 kc., but it is expected that 7,500 kc. will be the slowest wave that will get through the Arctic daylight to the States. We may even have to double this vibration speed in order to keep the traffic going after the ships arrive at Etah.

The expedition got away to a good start on June 17, from the Boston Navy Yard. It sails (see Fig. 1) under the direction of Commanders Donald B. MacMillan, famous scientist and Arctic explorer; E. F. McDonald, Jr., President of the National Association of Broadcasters, and in charge of radio; Commander R. E. Byrd of the U. S. Navy, in charge of cruising aeroplanes.

The entire personnel of twenty-eight men, the largest party ever to explore the polar region, comprises scientists from the National Geographic Society, United States Navy officers and men, and radio engineers, including the author, inventor of the Zenith-Reinartz short wave circuit which promises to revolutionize daylight radio reception.

A $30,000 Equipment

Briefly the expedition is made up of two vessels—the S. S. Bowdoin (MacMillan's veteran ship) and the S. S. Peary. As part of the equipment, the S. S. Peary will carry three monster sea-going aeroplanes consigned to the expedition by the United States Government, and also over $30,000 worth of the latest government instruments for making both still and motion picture records and charting and mapping devices with special equipment for operating at an altitude of 10,000 feet.

With so distinguished a party on board, the expedition has taken every precaution for the safety of its personnel. In addition to firearms, ammunition, clothing, food and other provisions for self protection, each ship and plane is equipped with radio apparatus, making possible communication between the S. S. Bowdoin and the Peary, and the main base to be established at Etah, and the advance base of the flyers to be stationed at Cape Thomas Hubbard, (the most northerly point in the world.)

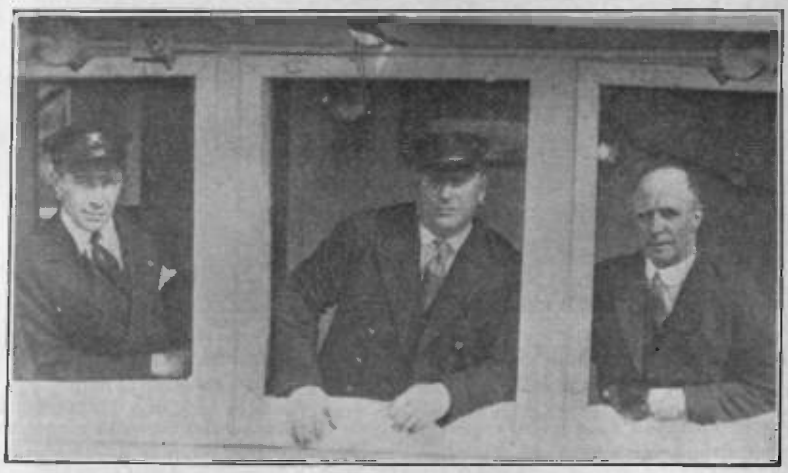


Fig. 1. The Pilot House is Decorated with Commander McDonald (left), Captain Steele, and Commander MacMillian, Who Heads the Expedition

A Ton of Grain for Pigeons

Nobody knows just what 24-hour daylight and the Northern Lights will do to high speed radio waves. To be absolutely sure that the expedition will not get out of touch with civilization, a large flock of carrier pigeons has been taken on board. This is something like the candle you keep in your cellar to supply light if the electric power should ever happen to go off. To feed this colony of birds will require more than a ton of grain. Fig. 2 shows part of this feed as it is being carried on board the S. S. Peary.

An appeal by the operator in charge of communication during this trip is being made to his fellow amateurs through the publications of the United States. The previous response for cooperation, especially during the period when fast wave reflection needed investigation, was so great that the writer has not yet been able to answer properly and thank the many recording amateurs for their very valuable reports. It is hoped that they will find some compensation in the publication of their portion of the work in the radio magazines, and it is hoped that some really valuable information will be obtained on the action of these waves in the area of no darkness for six months of the year.

Wood is Hard Boiled

A few words about the transmitting and receiving equipment may be interesting. The transmitter is specially designed, each part being accessible with-

out having to remove any other part to get at it. The frame is of wood, boiled in paraffine wax, as this combination proved its worth during the writer's fast wave experiments.

Both telegraph code and voice will be used as an experiment, and it is hoped they will get through. Preliminary tests indicate that they will. Three sources of power will be available, 500 cycles A. C., and two sources of D. C. at 2,500 volts, supplied by two 1 K. W. generators driven by 32-volt motors. There will be two sets of 32-volt, 240 ampere hour storage batteries, a charging generator and an auxiliary gasoline engine driven generator of 7½ horse power.

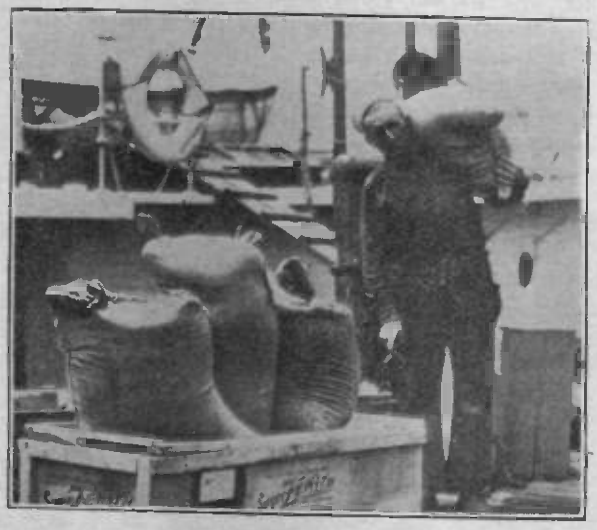


Fig. 2. Fast Wave Radio is So New That Carrier Pigeons Are Thought More Reliable. Here is More Than a Ton of Grain to Feed Them.

A Collapsible Antenna

The receiving sets will be capable of receiving all waves from 30,000,000 vibrations per second down (ten meters). The receiver is the writer's old standby, the Zenith-Reinartz circuit built especially for the expedition by the Zenith Radio Corporation's Laboratories, as are the transmitters and the airplane sets. These embody the circuits of the larger sets, except that both transmitter and receiver are in the same cabinet. When the planes are in flight, the antenna will consist of a wire stretched from the wing to tail, but when not in flight, a fifteen foot collapsible navy mast will be used.

A trial test at the Great Lakes Naval Station has given range of better than 450 miles, but with this equipment engine ignition interference during flight is still bad. It is hoped that experiments now under way will lessen that trouble.

The antenna on the Bowdoin and the Peary will consist of a single wire, thirty or forty feet high. No counterpoise will be used, as the ground is formed by plates on the ship's bottom.

Here is the Working Schedule

Tentative schedules for transmission are 12:00 noon to 3:00 P. M., 6:00 P. M. to 9:00 P. M., and 12:00 midnight to 3:00 A. M. As the expedition continues northward, the amateur sending station which gives the best response will be chosen, it being kept in mind at all times that all districts of the States and Canada are to be worked. No one person or district will be favored night after night, and as a matter of fact, the dispatches for the National Geographic Society will not be given to the same person twice unless it is necessary. Instead, the writer will endeavor to work as many U. S. States and Provinces of Canada as he can, throwing in Europe and Australia for good measure. Talking with Schnell on board the U. S. S. Seattle will be one of his ambitions.

Now remember, the success or failure of the radio portion of this expedition will rest with the amateurs, and whatever the writer will be able to accomplish in the radio field will be entirely through the co-operation of the "hams" and he stands or falls down with them. Let's go.

WHAT ABOUT THE ETHER?

Continued from Page 30

or not by holding out a flag and seeing whether it is effected by the wind. He holds it out as shown in the cut at "A" and notices that there is no breeze at all to make it stand out, and so concludes that the train is stationary.

The Engineer Knows Better

The engineer, however, happens to notice that the fireman is down *between* the engine and the tender and so the air is being dragged right along with the train. Of course, the pennant does not feel the breeze in such a position. So the engineer sticks his flag out the window, where it will catch the sweep of the breeze if there is one, and immediately it stands right out, showing the presence of the air current at "B."

It seems that the ether sticks pretty close to the earth, and so when the light ray experiment is tried on the plains, it is just like the fireman testing for the wind behind the engine. Professor Miller has acted like the engineer, and by trying the experiment over again up on a mountain he has got out into the current and so finds the ether is flowing by the earth.

What does this prove? In the first place it seems to be quite conclusive that there must be an ether because when you see a sign blown over, you are pretty sure that there is a wind. In the second place, it makes it rather rough sledding for the Relativity Theory since this was the starting point for Einstein's argument. He may be able to modify his ideas in some way so as to take account of this fact, but until he is heard from further, it may be well to accept Relativity with a grain of salt.

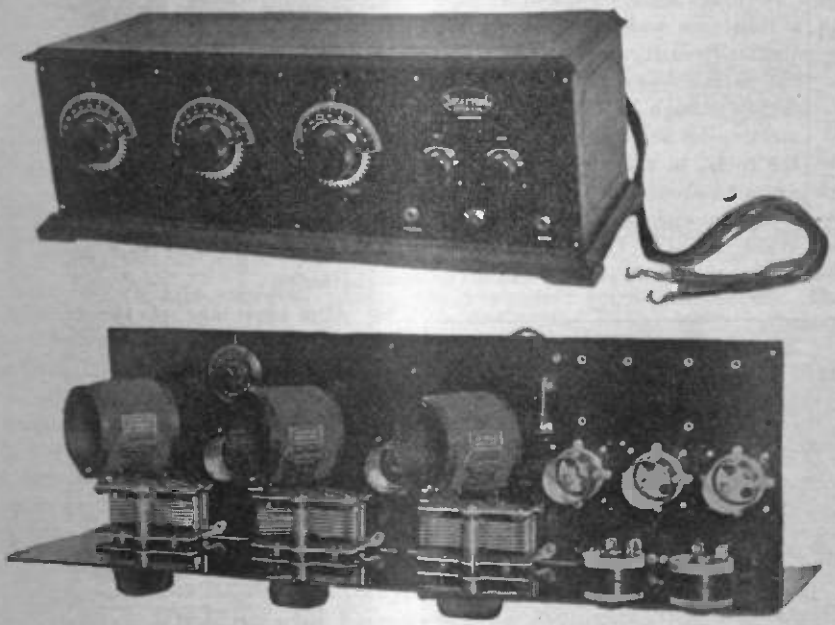
What About the Eclipse?

The deflection of light rays around the sun at the time of the eclipse worked out just as Einstein had predicted, but this effect can be accounted for just as well by the constants of the ether which is now proved to exist.

Further experiments are under way along these lines, and when a conclusion has finally been reached, it will undoubtedly help considerably in clearing up some of the mysteries of fading and the night effect on radio transmission.

Selectrol Super-Five

ENGLAND, SCOTLAND, SPAIN HEARD ON LOUD SPEAKER



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A NOVEL CHARGING RESISTANCE

Various chargers on the market for filling up your "B" use a series resistance. This is because the current supplied to the battery must be kept to very low values, somewhere round a quarter or even one-tenth of an ampere. If the charger were connected directly to the battery without some means of cutting down the input the plates would be ruined by the heavy current which would result.

Many of these chargers use an electric light bulb for this service. It makes a very good resistance too, but has some disadvantages. In the first place, it is often times not easy to get the right size for charging the battery you want. Another trouble is that the ordinary lamp has a tungsten filament, and this changes its resistance tremendously as it warms up. It is not at all unusual for a Tungsten filament to have ten or twelve times the resistance when hot that it did when starting cold. When charging a "B" battery, it will have some intermediate value, but this changes quite a lot, as the current through it varies.

Carbon Goes the Other Way

A carbon light, on the other hand, has a resistance which is much nearer constant. Even it varies through a two to one ratio, however. The peculiarity of carbon though is this. Unlike all the metals, the hot resistance is *lower* than the cold. In the carbon bulb it usually drops to about half.

To get around these troubles, the Ward Leonard Company has built a special resistance called a radio Vitrohm.

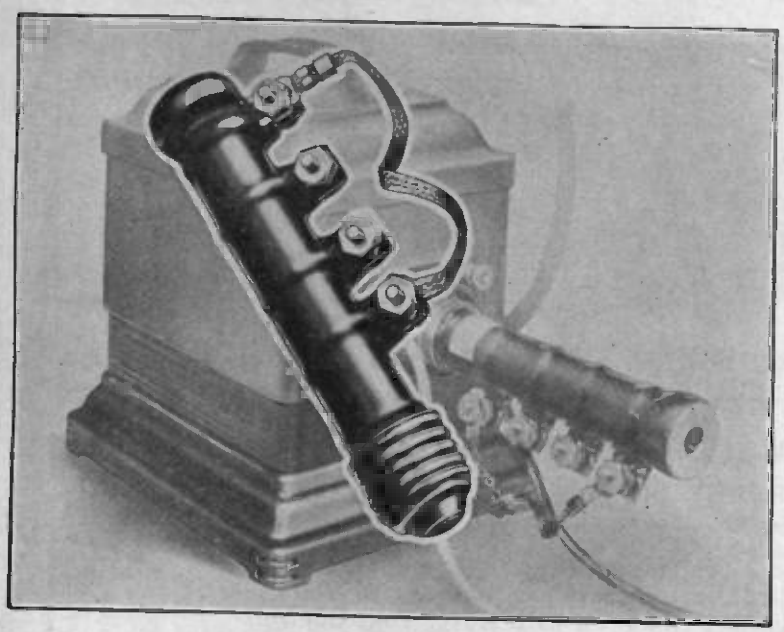

Fig. 1. An Enamelled Resistance Which is Better Than Lamps for "B" Battery Charging.

Our photograph, Fig. 1, shows this in the foreground, while at the back is seen a Tungar charger with the unit inserted in place. The lamp socket comes as part of the standard equipment, and is already to receive the resistance.

This resistor is so designed with variable taps that it can be used to take the place of lamps of 25, 40, 60, or 75 watt sizes, so this one unit replaces four bulbs. Unlike the rather fragile lamps, this resistor is so sturdy as to be practically unbreakable, being enamelled with a glassy coating over a strong porcelain form that is wound with resistance wire.

Changing Charging Rate

The four contact lugs are calibrated and indexed, so that by changing the positive selector lead from one contact to another, the battery or a series of batteries can be charged at any one of five different rates; one rate being for "A" batteries, and four rates for "B" batteries.

One advantage of this flexibility is that it becomes a very simple matter to deliver the ideal "taper" charge to a battery, starting at a high charging rate and after a few hours tapering off at a lower rate. "B" batteries of various plate sizes can be charged at the rate specified by the battery maker, by simply connecting across the proper taps on the resistor unit.

MUSIC ALWAYS MISSING

One of the first applications of the wireless telephone to everyday commercial use is being made by the American Express Company for communication between its offices at Athens and Piraeus, in Greece. Piraeus, the seaport and business district of Athens, with which it used to be connected by the famous "Long Walls," is about seven miles distant from the parent city, and the American Express uses the radio to supplement the regular wire telephone system for quick communication, especially on exchange quotations, between the two offices.

A girl operator at either end is kept busy practically all day long transmitting or writing down the messages. In order to make communication possible in both directions, of course, a transmitting as well as a receiving set is required at each end. The receivers used are of the four-tube type, but are permanently tuned to receive only the opposite transmitting sets.

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Black	$5.00	$4.80	$3.50	$4.00	$5.00	$3.50	$3.50	$5.50	$4.50	$4.50
Mahogany	6.00	5.70	4.00	4.50	6.00	4.00	4.00	6.50	5.50	5.50
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STANDARD SIZE PLAIN RADIO PANELS

INSULINE Frieze Finish

Size Thickness	List Price
7"x10", 3/16" each	$1.10
7"x12", 3/16" each	1.30
7"x14", 3/16" each	1.50
7"x18", 3/16" each	1.90
7"x21", 3/16" each	2.20
7"x24", 3/16" each	2.50
7"x26", 3/16" each	2.80
7"x28", 3/16" each	3.30
7"x30", 3/16" each	3.50
7"x36", 3/16" each	4.30

INSULINE Mahogany

Size Thickness	List Price
7"x10", 3/16" each	$1.20
7"x12", 3/16" each	1.60
7"x14", 3/16" each	1.80
7"x18", 3/16" each	2.40
7"x21", 3/16" each	2.80
7"x24", 3/16" each	3.20
7"x26", 3/16" each	3.50
7"x28", 3/16" each	4.00
7"x30", 3/16" each	4.50
7"x36", 3/16" each	5.00

INSULINE Black Panels

Size Thickness	List Price
7"x10", 3/16" each	$.95
7"x12", 3/16" each	1.20
7"x14", 3/16" each	1.40
7"x18", 3/16" each	1.70
7"x21", 3/16" each	2.00
7"x24", 3/16" each	2.30
7"x26", 3/16" each	2.50
7"x28", 3/16" each	2.90
7"x30", 3/16" each	3.30
7"x36", 3/16" each	4.00

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. Why is a doughnut coil more efficient than other types:

Answer. The doughnut coil is more efficient than the other styles because the magnetic effect goes around in a circle and then closes back on itself. In that way, if we have a coil, say four inches around, then four inches is the total length which the magnetism has to travel. On the other hand, with an ordinary coil, the magnetic lines of force, after threading the center four inches, must curve outside and around and then back again for a total of some nine or ten inches. These magnetic lines always make closed circles you remember and the farther they have to travel the weaker they are for a given number of ampere turns.

Another advantage of such a coil is the fact that none of the magnetism leaks outside to disturb other pieces of apparatus and this very largely reduces the tendency of the set to oscillate or squeal.

Question. Give directions for winding two doughnut coils to be tuned by a multiple condenser.

Answer. It is rather difficult at the present time to get suitable winding forms for such coils. The number of turns depend very largely on the size of the core. In general, the cross section of the ring itself should be one to two inches in diameter and the hole in the center about two inches.

The primary will consist of from five to fifteen turns of No. 22 dcc wire. The smaller number of turns gives greater selectivity and the larger amount more volume. The secondary should have 40 to 60 turns of the same size of wire regularly spaced around the ring. Tuning is by means of a .00025 (11-plate) condenser. These values will give you the average to aim at, but you may find that for your particular set you will want to omit a few of the secondary turns. This you can easily tell by the fact that in such a case most of the broadcasting stations will be brought in with the condenser almost entirely out of mesh (low values of capacity).

Question. What is meant by a "Standard Length Aerial?"

Answer. The term, "Standard Length Aerial" is applied rather loosely to an aerial 75 to 100 feet long.

Question. What do the colors mean on the cords of a head phone set?

Answer. They are used as tracers to show which cord is which. Ordinarily no attention need be paid to them. Sometimes, when the phones appear to be open circuited, it is an advantage to know which conductor is which, so as to test out the cord to see if it is broken. The tip which is red at one end is red at the phones, and the same way with the black or green. One short piece of some other color runs only from phone to phone to complete the circuit of the two in series.

Question. What is the advantage of the vertical "B" battery?

Answer. It is only a question of saving space. Some sets are built with a battery compartment, which naturally cannot be very roomy owing to the restricted space inside the cabinet. If it is designed to take one of these vertical units you will find that the ordinary type will not fit in well.

The cell arrangement in this style is very compact, but usually the intermediate leads from 16½ to 22 volts are omitted as there is not room for them.

Question. Some hook-ups recently showed a variable condenser connected to the grid of the detector tube. Why is not a fixed grid condenser used instead?

Answer. There is no real advantage of having a variable unit at this place. A value of .00025 is right for all styles of tubes and circuits. This value may be halved or doubled without noticing any real change in the operation of the set. Of course, as this capacity is shifted you will find that the tuning changes, but in such cases it can be brought to the proper value by a slight shift in your main controls. Where a variable grid condenser is indicated, we recommend substituting a fixed unit in its place.

Question. My set howls badly when the loud speaker terminals are touched with the fingers. What causes this effect?

Answer. The most likely reason is this—if the secondary of the tuning coil or the "A" battery is not grounded it leaves the tubes at a potential above the ground. When you touch the terminals you change this potential, and if the set includes two steps of audio amplification, it is apt to be thrown out of balance. The remedy is to ground the "A" battery or the tuning coil.

The Heart of Your Radio Set

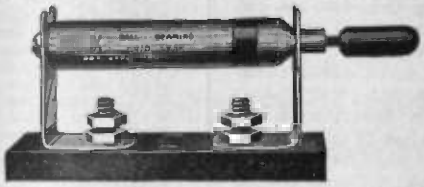
A Grid Leak is essential on every set. There are few sets made which wouldn't be improved by the use of a Variable Grid Leak.

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.

Right now -- we're showing them

Buy It



Try It

Volt-X Ball-Bearing
Variable Grid Leak

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.

BURTON & ROGERS MFG. CO.

755 Boylston St. Boston, Mass.

Please send me one of your VOLT-X VARIABLE GRID LEAKS.

I enclose $1.00 with the understanding that this merchandise is guaranteed to give satisfaction, or may be returned.

NAME. . . . . . .

ADDRESS. . . . . . .

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

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

	K.C.	W.L.	W.P.
KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburg, Pa.	970-	309-	1000
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O.	1200-	250-	500
KDYL—Newhouse Hotel, Salt Lake City, Utah	900-	333-	500
KDZB—Frank E. Siefert, Bakersfield, Cal.	1430-	210-	500
KFAB—Nebraska Buick Auto Co., Lincoln, Neb.	1250-	240-	200
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz.	1100-	273-	100
KFAE—State College of Washington	860-	349-	500
KFAF—Western Radio Corp., Denver, Colo.	1080-	278-	500
KFAJ—University of Colorado, Boulder, Colo.	1150-	261-	100
KFAU—Boise High School, Boise, Idaho	1090-	275-	500
KFBK—Kimball Upson Co., Sacramento, Cal.	1210-	248-	100
KFCF—Frank A. Moore, Walla Walla, Wash.	1170-	256-	100
KFDM—Magnolia Petroleum Co., Beaumont, Tex.	950-	316-	500
KFDX—First Baptist Church, Shreveport, La.	1200-	250-	100
KFDY—S. Dak. Ste. Col. Ag. & Mech. Arts, Br'kngs., S. Dak.	1100-	273-	100
KFEQ—Scroggin & Co. Bank, Oak, Nebr.	1120-	268-	100
KFFV—Graceland College, Lamoni, Iowa	1200-	250-	100
KFGC—Louisiana State Univ., Baton Rouge, La.	1120-	268-	100
KFGD—Oklahoma College for Women, Chickasha, Okla.	1190-	252-	200
KFGH—Leland Stanford Junior Univ., Stanford Univ., Cal.	1110-	270-	500
*KFGX—First Presbyterian Church, Orange, Texas	1200-	250-	500
KFI—Earl C. Anthony, Los Angeles, Cal.	640-	469-	2000
KFIF—Benson Polytechnic Institute, Portland, Ore.	1210-	248-	100
KFIQ—First Methodist Church, Yakima, Wash.	1170-	256-	100
KFIZ—Daily Com'lth & Seifert Rad. Corp., Fondulac, Wis.	1100-	273-	100
KFJF—National Radio Mfg. Co., Oklahoma, Okla.	1150-	261-	225
KFJM—University of No. Dak., Grand Forks, No. Dak.	1080-	278-	100
KFKB—Brinkley-Jones Hosp. Assoc., Milford, Kans.	1100-	273-	500
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
KFMT—George W. Young, Minneapolis, Minn.	1140-	263-	100
KFMX—Carleton College, Northfield, Minn.	890-	337-	750
KFNF—Henry Field Seed Co., Shenandoah, Iowa	1130-	266-	500
KFOA—Rhodes Dept. Store, Seattle, Wash.	660-	454-	500
KFQC—First Christian Church, Whittier, Cal.	1270-	236-	100
KFON—Echophone Radio Shop, Long Beach, Cal.	1290-	233-	100
*KFOO—Latter Day Saints Univ., Salt Lake City, Utah.	1270-	236-	250
KFOX—Technical High School, Omaha, Nebr.	1210-	248-	100
KFPG—Oliver S. Garretson, Los Angeles, Cal.	1260-	238-	100
KFPR—Los Angeles County Forestry, Los Angeles, Cal.	1300-	231-	500
KFPY—Symons Investment Co., Spokane, Wash.	1130-	266-	100
KFQA—The Principa, St. Louis, Mo.	1150-	261	100
*KFQB—Searchlight Publishing Co., Fort Worth, Texas.	1140-	263-	150
KFQC—Kidd Brothers Radio Shop, Taft, Cal.	1300-	231-	100
KFQU—W. E. Riker, Holy City, Calif.	1350-	222-	100
KFQZ—Taft Radio Co., Hollywood, Calif.	1330-	226-	250
KFRB—Hall Bros., Beeville, Texas	1210-	248-	250
KFRU—Etherical Radio Co., Bristow, Okla.	760-	395-	500
KFSG—Echo Park Evangelistic Asso., Los Angeles, Calif.	1090-	275-	500
KFUM—W. D. Corley, Colorado Springs, Colo.	1240-	242-	100
KFUO—Concordia Seminary, St. Louis, Mo.	550-	545-	500
KFUT—University of Utah, Salt Lake City, Utah	1150-	261-	100
KFVE—Film Corporation of America, St. Louis Mo.	1250-	240-	500
KFVJ—First Baptist Church, San Jose, Cal.	1330-	226-	500
KFVK—Sacramento Chamber of Com., Sacramento, Cal.	1210-	248-	500
*KFVW—Airfan Radio Corporation, San Diego, Cal.	1220-	246-	500
KFWA—Browning Bros. Co., Ogden, Utah	1150-	261-	500
KFWB—Warner Bros. Pictures, Inc., Hollywood, Cal.	1190-	252-	500
KFWD—Arkansas Light & Power Co., Arkadelphia, Ark.	1130-	266-	500
KFWF—St. Louis Truth Center, St. Louis, Mo.	1400-	214-	250
KFWH—F. Wellington Morse, Jr., Chico, Cal.	1180-	254-	100
KGO—General Electric Co., Oakland, Cal.	830-	361-	2000
KGU—Marion A. Mulrony, Honolulu, Hawaii	1110-	270-	500
KGW—Portland Morning Oregonian, Portland, Ore.	610-	491-	500
KHJ—Times-Mirror Co., Los Angeles, Cal.	740-	405-	500
KHQ—Excelsior Motorcycle & Bicycle Co., Seattle, Wash.	1100-	273-	100
KJR—Northwest Radio Service Co., Seattle, Wash.	780-	384-	1000
KJS—Bible Institute of Los Angeles, Los Angeles, Cal.	1020-	294-	750
KLDS—Reorg. Church of Jesus Christ of Latter Day Sts., Ind., Mo.	1120-	268-	250
KLS—Warner Bros. Radio Supplies Co., Oakland, Calif.	1240-	242-	250
KLX—Tribune Publishing Co., Oakland, Calif.	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
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
KQV—Doubleday-Hill Electric Co., Pittsburg, Pa.	1090-	275-	500
KSAC—Kansas State Agric. College	880-	341-	500
KSD—Post-Dispatch, St. Louis, Mo.	550-	545-	750
KSL—The Radio Service Corp., Salt Lake City, Utah.	1000-	300-	1000
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.	1250-	244-	500
WABO—Lake Avenue Baptist Church, Rochester, N. Y.	1080-	278-	100
WABX—Henry B. Joy, Mount Clemens, Mich.	1220-	246-	500
WADC—Allen Theatre, Akron, O.	1160-	258-	100
WAFD—Albert B. Parfet Co., Port Huron, Mich.	1170-	256-	250
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.	1090-	275-	100
WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex.	630-	476-	1000
WBAY—Erner & Hopkins Co., Columbus, Ohio	1020-	293-	500
*WBBG—Irving Vermilya, Mattapoisett, Mass.	1210-	248-	100
WBBL—Grace Covenant Church, Richmond, Va.	1310-	229-	100
WBBM—Atlas Investment Co., Chicago, Ill.	1330-	226-	200
WBBP—Petoskey High School, Petoskey, Mich.	1260-	238-	100
WBBR—People's Pulpit Assoc., Rossville, N. Y.	1100-	273-	500
WBES—Bliss Electrical School, Takoma Park, Md.	1350-	222-	100
WCBN—Foster & McDonnell, Chicago, Ill.	1130-	266-	500
WBOQ—A. H. Grebe Co., Richmond Hill, N. Y.	1270-	236-	100
WBT—Southern Radio Corp., Charlotte, N. C.	1090-	275-	250
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass.	900-	331-	2000
*WCAC—Connecticut Agric College, Mansfield, Conn.	1090-	275-	500
WCAD—St. Lawrence University, Canton, N. Y.	1140-	263-	250
WCAE—Kaufmann & Baer Co., Pittsburg, Pa.	650-	461-	500
WCAG—Clyde R. Randall, New Orleans, La.	1130-	226-	200
*WCAH—Entrekin Electric Co., Columbus, O.	1130-	266-	500
WCAJ—Nebraska Wesleyan University, Univ. Place, Nebr.	1180-	275-	100
WCAL—St. Olaf College, Northfield, Minn.	890-	337-	500
WCAO—Kranz-Smith, Baltimore, Md.	1090-	275-	100
WCAP—Cheaspeake & 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 Assoc., Milwaukee, Wis.	1130-	266-	250
WCBC—University of Michigan, Ann Arbor, Mich.	1310-	229-	100
*WCBD—Wilbur G. Voliva, Zion, Ill.	870-	345-	2000
WCBI—Nicoll, Duncan & Rush, Bemis, Tenn.	1250-	240-	150
WCCO—Washburn Crosby Co., Minneapolis, Minn.	720-	416-	1500
WCEE—Charles E. Erbstein, Elgin, Ill.	1090-	275-	500
WCK—Stix, Baer & Fuller Dry Goods Co., St. Louis, Mo.	1100-	273-	100
WCM—Texas Markets & Warehouse Dept., Austin, Tex.	1120-	268-	250
WCN—Foster & McDonnell, Chicago, Ill.	1130-	266-	500
*WCTS—C. T. Sherer Co., Worcester, Mass.	1120-	268-	500
WCUW—Clark University, Worcester, Mass.	1260-	238-	250
WCX—Detroit Free Press, Detroit, Mich.	580-	517-	500

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.

	K.C.	W.L.	W.P.
WDAE—Tampa Daily News, Tampa, Fla.	1100-273-		250
WDAG—J. Laurence Martin, Amarillo, Tex.	1140-263-		100
WDBE—Gilham-Schoen Electric Co., Atlanta, Ga.	1080-278-		100
WDBK—M. F. Broz Radio Store, Cleveland, O.	1320-227-		100
*WDBO—Rollins College, Winter Park, Fla.	1250-240-		100
WDBR—Tremont Temple Baptist Church, Boston, Mass.	1150-261-		100
WDBY—North Shore Congregational Church, Chicago, Ill.	1160-258-		500
WDWF—Dutee W. Flint, Cranston, R. I.	680-441-		500
WDZ—James L. Bush, Tuscola, Ill.	1080-278-		100
WEAA—Frank D. Fallain, Flint, Mich.	1280-234-		100
WEAF—American Tel. & Tel. Co., New York, N. Y.	610-492-2500		
WEAH—Wichita Board of Trade, Wichita, Kas.	1120-268-		100
WEAI—Cornell University, Ithaca, N. Y.	1180-254-		500
WEAJ—University of So. Dakota, Vermillion, 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, Columbus, Ohio.	1020-294-		500
WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio.	770-389-1000		
WEAU—Davidson Bros. Co., Sioux City, Iowa.	1090-275-		100
WEAY—Iris Theater, Houston, Tex.	1110-270-		500
WEBH—Edgewater Beach Hotel Co., Chicago, Ill.	810-370-1000		
WEBJ—Third Avenue Railway Co., New York, N. Y.	1100-273-		500
WEBL—Radio Corp. of America, United States (portable).	1330-226-		100
WEBM—Radio Corp. of America, United States (portable).	1330-226-		100
WEBW—Beloit College, Beloit, Wis.	1120-268-		500
WEEI—Edison Electric Illuminating Co., Boston, Mass.	630-476-		500
WEMC—Emmanuel Missionary Col., Berrien Springs, Mich.	1050-286-		500
WEW—St. Louis University, St. Louis, Mo.	1210-248-		100
WFAA—Dallas News & Dallas Journal, Dallas, Tex.	630-476-		500
WFAV—University of Nebraska, Lincoln, Neb.	1090-275-		500
WFBB—Eureka College, Eureka, Ill.	1250-240-		100
WFBG—William F. Gable Co., Altoona, Pa.	1080-278-		100
WFBH—Concourse Radio Corp., New York, N. Y.	1100-273-		500
WFBI—Galvin Radio Supply Co.	1270-236-		100
WFBK—Dartmouth College, Hanover, N. H.	1170-256-		100
WFBL—Onondoga Hotel, Syracuse, N. Y.	1190-252-		100
WFBM—Merchant Heat & Light Co., Indianapolis, Ind.	1120-268-		250
WFBR—Fifth Infantry Maryland N. G., Baltimore, Md.	1180-254-		100
WFBY—U. S. Army 5th Corps Area, Ft. Benj. Har'sn. Ind.	1160-258-		100
WFI—Strawbridge & Clothier, Philadelphia, Pa.	760-395-		500
WFKB—Francis K. Bridgman, Chicago, Ill.	1380-217-		100
WGAQ—W. G. Paterson, Shreveport, La.	1110-273-		250
WGAZ—South Bend Tribune, South Bend, Ind.	1090-275-		250
WGBA—Jones Electric & Radio Mfg. Co., Baltimore, Md.	1180-254-		100
WGBB—Harry H. Carman, Freeport, N. Y.	1240-244-		100
*WGBQ—Stout Institute, Menomonie, Wis.	1280-234-		100
WGBS—Gimbel Bros., New York	950-316-		500
*WGBX—University of Maine, Orono, Me.	1190-252-		100
*WGCP—D. W. May, Newark, N. J.	1190-252-		500
WGES—Coyne Electrical School, Oak Park, Ill.	1200-250-		500
*WGPH—George Harrison Phelps, Inc., Detroit, Mich.	1110-270-		500
WGN—The Tribune, Chicago, Ill.	810-370-1000		
WGR—Federal Telephone Mfg. Corp., Buffalo, N. Y.	940-319-		750
WGS—Georgia School of Technology, Atlanta, Ga.	1110-270-		500
WGY—General Electric Co., Schenectady, N. Y.	790-380-2000		
WHA—University of Wisconsin, Madison, Wis.	560-535-		750
WHAD—Marquette University, Milwaukee, Wis.	1000-275-		500
WHAG—University of Cincinnati, Cincinnati, O.	1290-233-		100
WHAM—University of Rochester, Rochester, N. Y.	1080-278-		100
WHAP—William H. Taylor Finance Corp., Brooklyn, N. Y.	1250-250-		100
WHAR—Seaside Hotel, Atlantic City, N. J.	1090-275-		500
WHAS—Courier Journal & Louisville Times.	750-400-		500
WHAV—Wilmington Electric Specity Co., Wilmington, Del.	1130-266-		100
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y.	790-380-		500
WHB—Sweeney School Co., Kansas City, Mo.	820-366-		500
WHBF—Beardsley Specialty Co., Rock Island, Ill.	1350-222-		100
WHBH—Culver Military Academy, Culver, Ind.	1550-222-		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., Minneapls, Minn.	1080-278-		500
WHEC—Hickson Electric Co., Inc., Rochester, N. Y.	1160-258-		100
WHK—Radiovox Co., Cleveland, O.	1100-273-		250
WHN—George Schubel, New York, N. Y.	830-361-		500
WHO—Bankers Life Co., Des Moines, Iowa.	570-526-		500
WHT—Radiophone Broadcasting Corporation, Deerfield, Ill.	1260-238-1500		
WIAD—Howard R. Miller, Philadelphia, Pa.	1200-250-		100
WIAK—Journal-Stockman Co., Omaha, Nebr.	1080-278-		250
WIAS—Home Electric Co., Burlington, Iowa.	1180-254-		100
WIBA—The Capital Times Studio, Madison, Wisc.	1270-236-		100
WIBC—L. M. Tate Post No 39, V. F. W. St Petersburg, Fla.	1350-222-		100
WIBF—S. P. Miller Activities, Wheatland, Wisc.	1300-231-		500
WIBK—University of the City of Toledo, Toledo, O.	1460-205-		100
WIBL—McDonald Radio Co., Joliet, Ill. (Portable)	1390-215-		250
*WIBO—Nelson Brothers, Chicago, Ill.	1330-226-		500
WIL—St. Louis Star, Benson Radio Co., St. Louis, Mo.	1100-273-		250
WIP—Gimbel Bros., Philadelphia, Pa.	590-508-		500
WJAD—Jackson's Radio Eng. Laboratories, Waco, Texas.	850-353-		500
WJAG—Norfolk Daily News, Norfolk, Nebr.	1110-270-		250
*WJAK—Clifford L. White, Greentown, Ind.	1180-254-		100
WJAR—The Outlet Co., Providence, R. I.	920-326-		500
WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa.	1090-275-		500
WJAZ—Zenith Radio Corp., Chicago, Ill. (portable)	1120-268-		100
WJBC—Hummer Furniture Co., La Salle, Ill.	1280-234-		100
WJBD—Ashland Broadcasting Committee, Ashland, Wisc.	1290-233-		100
WJBI—H. M. Couch, Joliet, Ill.	1400-214-		100
WJJ—Supreme Lodge L. O. Moose, Mooseheart, Ill.	990-303-		500
WJY—Radio Corporation of America, New York, N. Y.	740-405-1000		
WJZ—Radio Corporation of America, New York, N. Y.	660-454-1000		

*Additions and corrections.

	K.C.	W.L.	W.P.
WKAQ—Radio Corporation of Porto Rico, San Juan, P. R.	880-341-		500
WKAR—Michigan Agric. Col., E. Lansing, Mich.	1050-286-		750
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
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
WLW—Crosley Radio Corp., Harrison, O.	710-422-5000		
WLW—Crosley Radio Corporation, Harrison, O.	710-422-		500
WMAC—Clive B. Meredith, Cazenovia, N. Y.	1090-275-		100
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833-360-		500
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833-360-		100
WMAK—Norton Laboratories, Lockport, N. Y.	1130-466-		500
WMAQ—Chicago Daily News, Chicago, Ill.	670-448-		500
WMAY—Kingshighway Presbyterian Church, St. Louis, Mo.	1210-248-		100
WMAZ—Mercer University, Macon, Ga.	1150-261-		100
*WMBB—American Bond & Mortgage Co., Chicago, Ill.	1200-250-		500
WMBF—Fleetwood Hotel, Miami Beach, Fla.	780-384-		500
WMC—Commercial Appeal, Memphis, Tenn.	600-500-		500
WMCA—Greeley Square Hotel Co., New York N. Y.	880-341-		500
WNAB—Shepard Stores, Boston, Mass.	1200-250-		100
WNAC—Shepard Stores, Boston, Mass.	1070-280-		500
WNAD—University of Oklahoma, Norman, Okla.	1180-254-		250
WNAP—Wittenberg College, Springfield, Ohio.	1210-248-		100
WNAT—Lennig Bros. Co., 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.	620-484-2000		
WOI—Iowa State College, Ames, Iowa.	1110-270-		500
WOO—John Wanamaker, Philadelphia, Pa.	590-508-		500
WOQ—Unity School of Christianity, Kansas City, Mo.	1080-278-		500
WOR—L. Bamberger & Co., Newark, N. J.	740-405-		500
WORD—People's Pulpit Association, Batavia, Ill.	1090-275-2000		
WOS—Missouri State Marketing Bureau, Jefferson City, Mo.	680-441-		500
WOWL—Owl Battery Co., New Orleans, La.	1110-270-		100
WPAJ—Doolittle Radio Corporation, New Haven, Conn.	1120-268-		100
WPG—Municipality of Atlantic City, Atlantic City, N. J.	1000-300-		500
WPSC—Pennsylvania State College, State College, Pa.	1150-261-		500
WQAA—Horace A. Beale, Jr., Parkesburg, Pa.	1360-220-		500
WQAC—Gish Radio Service, Amarillo, Tex.	1280-234-		100
WQAM—Electrical Equipment Co., Miami, Fla.	1120-268-		100
WQAN—Scranton Times, Scranton, Pa.	1200-250-		100
WQAO—Calvary Baptist Church, New York, N. Y.	833-360-		100
WQAS—Prince-Walter Co., Lowell, Mass.	1190-252-		100
WQJ—Calumet Rainbow Broadcasting Co., Chicago, Ill.	670-448-		500
WRAA—Rice Institute, Houston, Tex.	1170-256-		100
WRAF—The Radio Club, Laporte, Ind.	1340-224-		100
WRAK—Economy Light Co., Escanaba, Mich.	1170-256-		100
WRAM—Lombard College, Galesburg, Ill.	1230-244-		100
WRAV—Antioch College, Yellow Springs, Ohio.	1140-263-		100
*WRAX—Flexon's Garage, Gloucester City, N. J.	1120-268-		250
WRBC—Immanuel Lutheran Church, Valparaiso, Ind.	1080-278-		500
WRC—Radio Corporation of America, Washington, D. C.	640-469-1000		
WREO—Reo Motor Car Co., Lansing, Mich.	1050-286-		500
WRK—Doron Bros. Electrical Co., Hamilton, O.	1110-270-		200
WRM—University of Illinois, Urbana, Ill.	1100-273-		500
*WRNY—Experimenter Publishing Co., New York, N. Y.	1160-258-		500
WRR—Dallas Police & Fire Dept., Dallas, Tex.	1150-261-		350
WRW—Tarrytown Radio Research Laboratories.	1100-273-		500
WSAB—S. E. Missouri State Tech's Col., Cape Gir'du Mo.	1090-275-		100
WSAC—Clemson Agric. Col., Clemson College, S. C.	890-337-		500
WSAD—J. A. Foster Co., Providence, R. I.	1170-256-		100
*WSAG—Gospel Tabernacle, St. Petersburg, Fla.	1130-266-		250
WSAI—United States Playing Card Co., Mason, O.	920-326-		500
WSAJ—Grove City College, Grove City, Pa.	1310-229-		250
WSAR—Doughty & Welch Electric Co., Fall River, Mass.	1180-254-		100
WSAV—Clifford W. Vick Radio Const. Co., Houston, Tex.	833-360-		100
WSB—Atlanta Journal, Atlanta, Ga.	700-428-		500
*WSDA—The City Temple, New York, N. Y.	1140-263-		250
WSMB—Saenger A'm't 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.	1490-210-		100
WTAM—Willard Storage Battery Co., Cleveland, O.	770-389-1500		
*WTAQ—S. H. Van Gorden & Son, Osseo, Wis.	1180-254-		100
WTAR—Reliance Electric Co., Norfolk, Va.	1150-261-		100
WTAS—Charles E. Erbstein, Elgin, Ill.	990-302-1000		
WTAT—Edison Illum'ting Co., Boston, Mass., (portable)	1230-302-		100
WTAW—Agric. & Mech. Col. of Texas, Col. Station, Tex.	1110-270-		250
WTHS—Flint Senior High School, Flint, Mich.	1370-219-		250
WTIC—Travelers Insurance Co., Hartford, Conn.	860-349-		500
WWAD—Wright & Wright, Philadelphia, Pa.	1200-250-		100
*WWAE—Lawrence J. Crowley, Plainfield, Ill.	1240-242-		500
WWAO—Michigan College of Mines, Houghton, Mich.	1140-263-		250
WWI—Ford Motor Co., Dearborn, Mich.	1130-266-		500
WWJ—Detroit News, Detroit, Mich.	850-353-		500
WWL—Loyala University, New Orleans, La.	1090-275-		100