RADIO PROGRESS

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How Much Wire on Your Tuner?
By HORACE V. S. TAYLOR
Putting Up a First-Class Aerial
What Do You Mean by Modulation?
Rolls Royce Tubes Can't be Bought
A Sharp Super-Selector Circuit
Radio on the Job as Nurse

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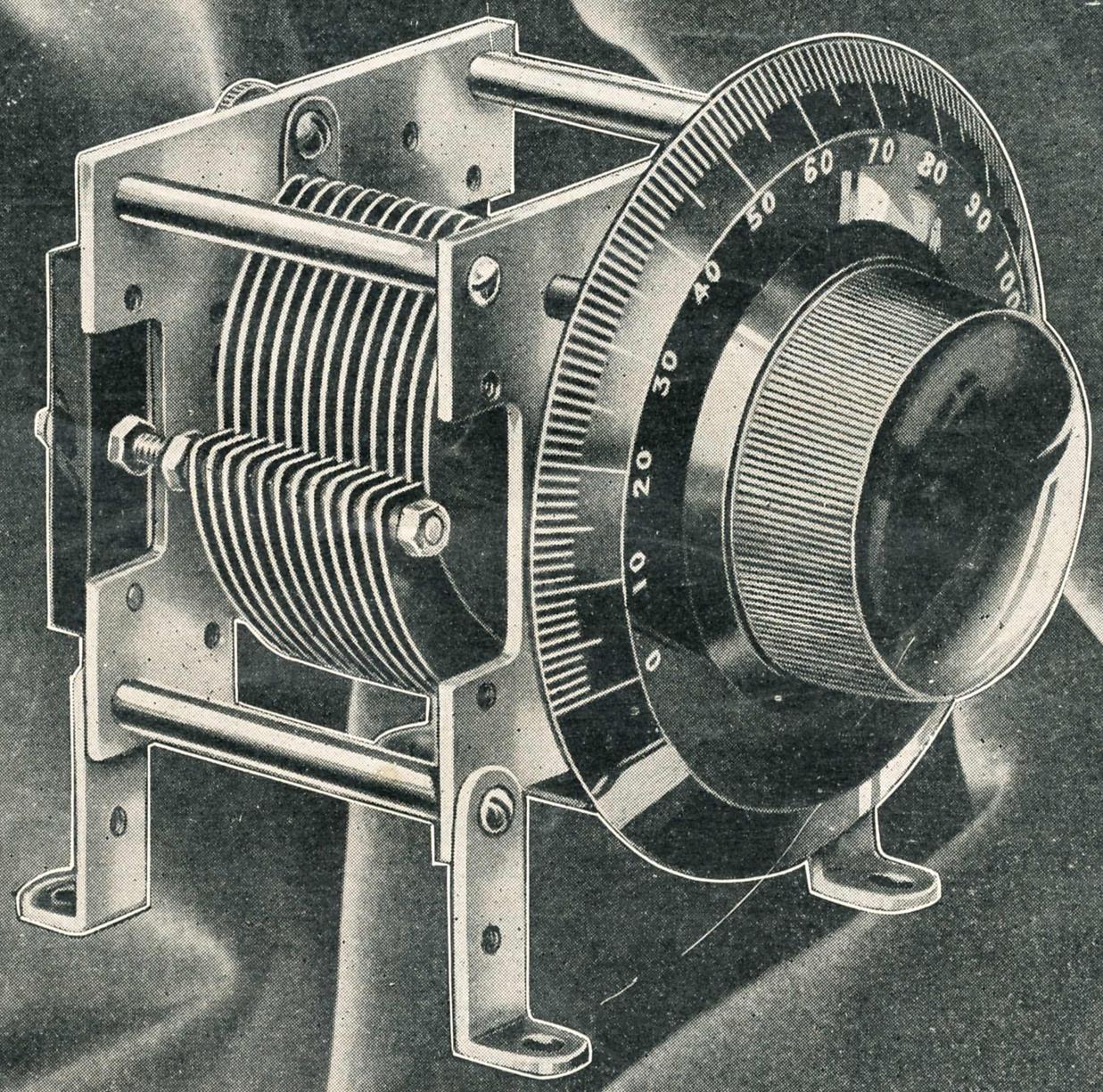

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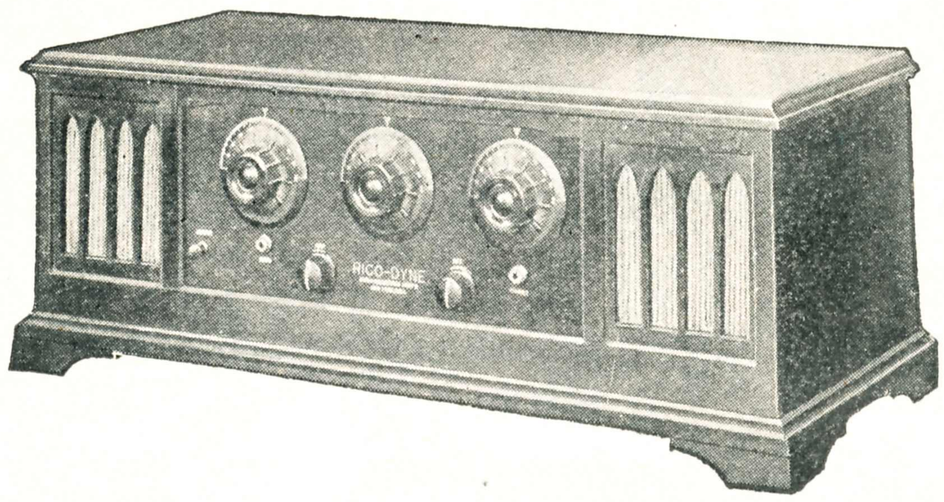

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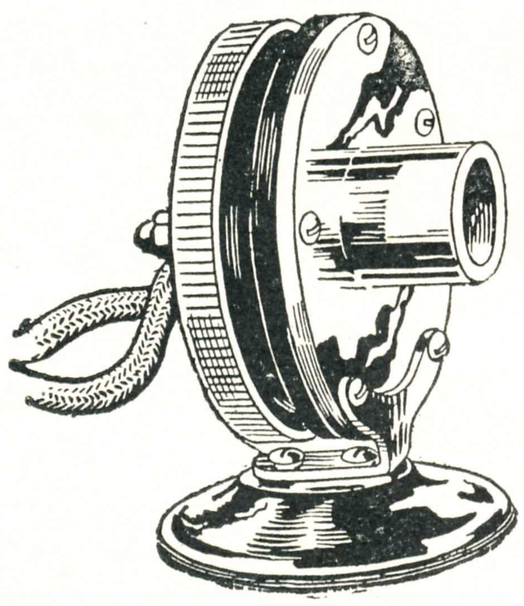

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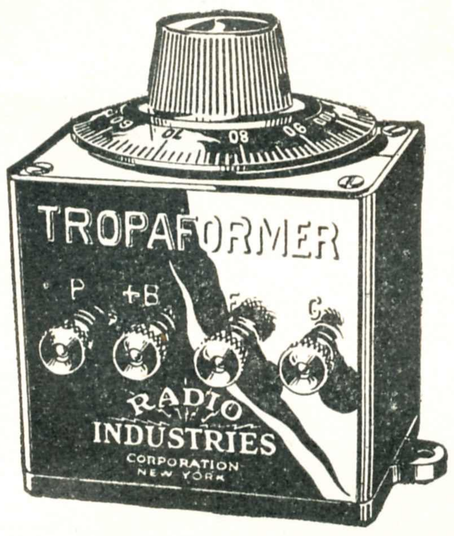

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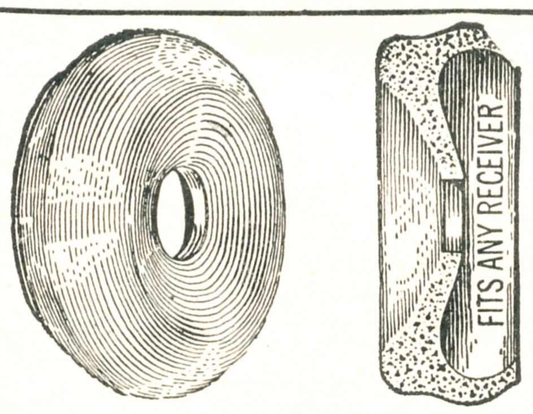

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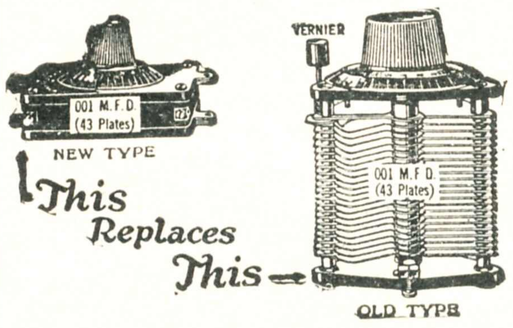

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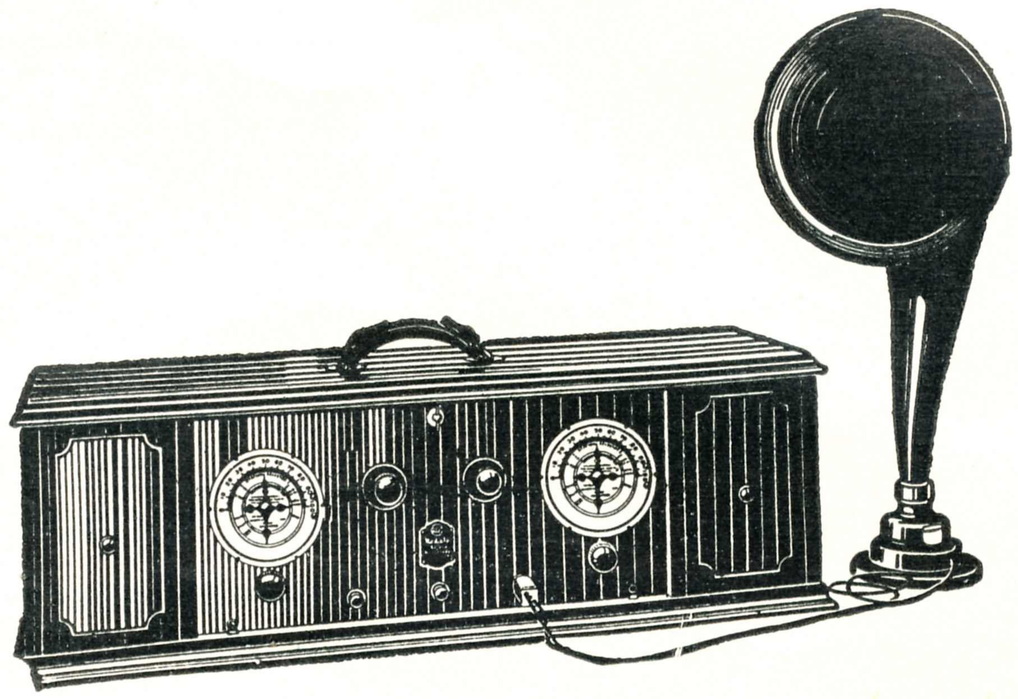

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And Not One of Them Solicited

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"We like RADIO PROGRESS, but don't see enough of it!" H. S. FRAINE, of Doubleday, Page & Co., N. Y.

"Your magazine gives so much on the fundamentals of radio that I have decided to subscribe for it. Most people depend on this magazine to keep them instructed on the subject about which the publication deals. Very few buy books. I appreciate it very much and hope it will grow large." DR. J. S. CANTRELL, Proprietor Snowwhite Eggfarm, Carthage, Mo.

"I like RADIO PROGRESS because its articles are clear and concise, especially those of H. V. S. Taylor." A. A. CONSTEIN, Ph. G., D. D. S., Upper Sandusky, Ohio.

"RADIO PROGRESS is the most interesting radio magazine I have yet seen, and strikes a happy medium between being too technical and ignoring technical explanation altogether. May 'you live long and prosper.'" (Dr.) M. S. DELAND, State Hospital, Topeka, Kan.

"Your magazine has a very pleasing presentation of its subjects without too much technicality, and understandable." A. J. WERTZEL, Vice. Pres. United States National Bank, Superior, Wis.

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"I like your magazine very much and hope you will keep up the good work in publishing such clean cut articles." E. T. LEWIS, Baltimore, Md.

"Interest in your progressive little magazine as well as the desire to obtain the special hook-up number of Jan. 15th has prompted me to enclose," etc. CORLISS GALLOGLY, Alden, Minn.

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"While your magazine may not have the bulk of some of your contemporaries the subject matter is excellent, being clearly written and accurate." E. J. WAGNER, Chicago.

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RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 2 Number 16

Contents for

NOVEMBER 1, 1925

PAGE

HOW MUCH WIRE ON YOUR TUNER 9
AMERICAN RADIO RELAY LEAGUE 12
A SHARP SUPER SELECTOR CIRCUIT 13
NEW STYLES IN SWITCHBOARDS 16
ROLLS-ROYCE TUBES CAN'T BE BOUGHT 19
A SMALL STATION WITH A BIG VOICE 20
PUTTING UP A FIRST-CLASS AERIAL 23
PORTRAITS OF POPULAR PERFORMERS 26
RADIO ON THE JOB AS NURSE 27
EDITOR'S LOUD SPEAKER:
A JAIL SENTENCE 29
FOILING THE EARTHQUAKE 29
MAKING IT ALL MOLASSES 30
WHAT DO YOU MEAN BY MODULATION? 31
RADIO HAS WOODEN ANNIVERSARY 34
DR. RADIO PRESCRIBES 35
U. S. BROADCASTING STATIONS 38

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Selections from Our Next Issue

It takes a pretty smart man to be a prophet and still have honor when the time of the predictions come around. One radio engineer has had an unusual chance to observe the line of development of the art and has written quite extensively about it in various radio publications. The article by Laing, **"Looking Ahead,"** shows such good common sense in predicting the future that we feel he is right in his estimates.

Remember that old song, "Red Hot Mamma?" It is not only the songs coming in over the radio that are "hot." Some of the apparatus runs at such high temperatures that it must be cooled by a stream of water. Photographs of this equipment and a write-up of how it is done appears in **"Water Cooled Radio,"** by Little.

There have been shows and shows. Many visitors at the radio expositions have been bewildered by the very magnitude of the exhibits which dazzle their eyes. When we have an observer like Connet, we can pick out the essential parts and get a great deal of satisfaction out of recalling what we have seen. Read, **"I'm Glad I Saw the Show."**

Two years ago the radio sets had anywhere from twelve to sixteen handles to operate. Now the average number is down to two or three. Why can't we have every set work by a single knob? Some of the difficulties and the ways they are being overcome is described by Taylor in **"Inventing a One-Child Control."**

Does radio affect your sleep? Some think it does and others deny it. One way in which it certainly has a bearing is developed by Cole in **"Open Windows—Sleep—Radios."**

We are getting down deeper and deeper into what the world is built of and it is radio that is revealing many secrets. You would naturally think that an atom was safe in its private life. But just read, **"Eavesdropping on an Electron,"** by Professor Wold.

Perhaps you think you know what you want. However, many people are influenced to some extent by knowing what other folks like. When it comes to radios, aerials, batteries, loud speakers, and various other devices, it is interesting to know how the rest of the world has made its choice. A large survey was recently made and the results are released in **"What Others Like in Radio."**

If you like to build sets yourself, here is something a little out of the ordinary. Marx has designed a superheterodyne with only one tuning dial. A good construction article appears in, **"A One-Control Superhet."**

The Two Outstanding Parts In Radio !

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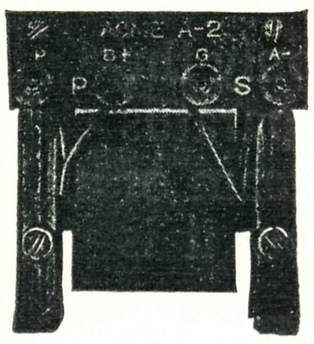
QUALITY and distance are what a radio set must give. To insure Quality, amplification without distortion is essential. And to insure Distance, low losses are essential. That is radio in a nutshell.

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

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



Acme A-2 Audio Frequency Amplifying Transformer

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

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

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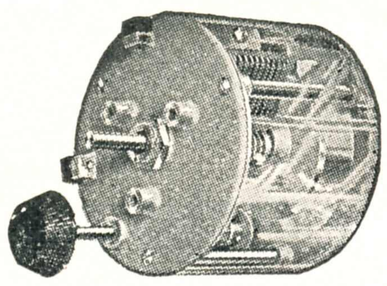

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RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 2, No. 16 NOVEMBER 1, 1925 15c PER COPY, $3.00 PER YEAR

How Much Wire on Your Tuner?

Perhaps Your Condenser Also May be the Wrong Size

By HORACE V. S. TAYLOR

DID you ever go to a dance with pumps that were one size too small? If so, you have a good understanding of the fact that parts which don't fit will still work, but will not give best results.

When it comes to a radio set the parts in the tuner may not be really right, and yet will be able to bring in the stations fairly well. However, if a slight change were made the radio would be a lot more satisfactory. The method of checking up on the sizes of your coils and condensers will now be explained.

Are They Crowded Together?

When properly designed the tuner will bring in stations practically all over the dial from near the zero up to almost the 100 degree mark. Perhaps they may be somewhat crowded at the lower end. If this is the case it is because you are not using the straight line frequency breed of condenser. This was discussed in our last (October 15) issue. However, the style of the condenser does not affect its maximum capacity nor the number of turns which should be in the coil to match it.

This question of size is very much like that of the scale of a map. If you want to see how far it is from San Francisco to Chicago or New York, you must look at a map with about 1,000 miles to the inch. On the other hand, if you want to find Main Street on the city map, a scale of half a mile to the inch is about right. It all depends on how much ground you want to cover.

Map Helped the Oil Man

It is something like the experience an oil man had in China. One of the native boys wanted to work in his office, but it was some miles away from the ancestral home. The parents on this account would not let the boy live so far away from them. However, the oil man secured a map showing the two towns and pointed out to the father and mother that they were only half an inch apart. They were quite surprised and explained that they had not realized their son was to travel only such a short distance, and so gave their consent.

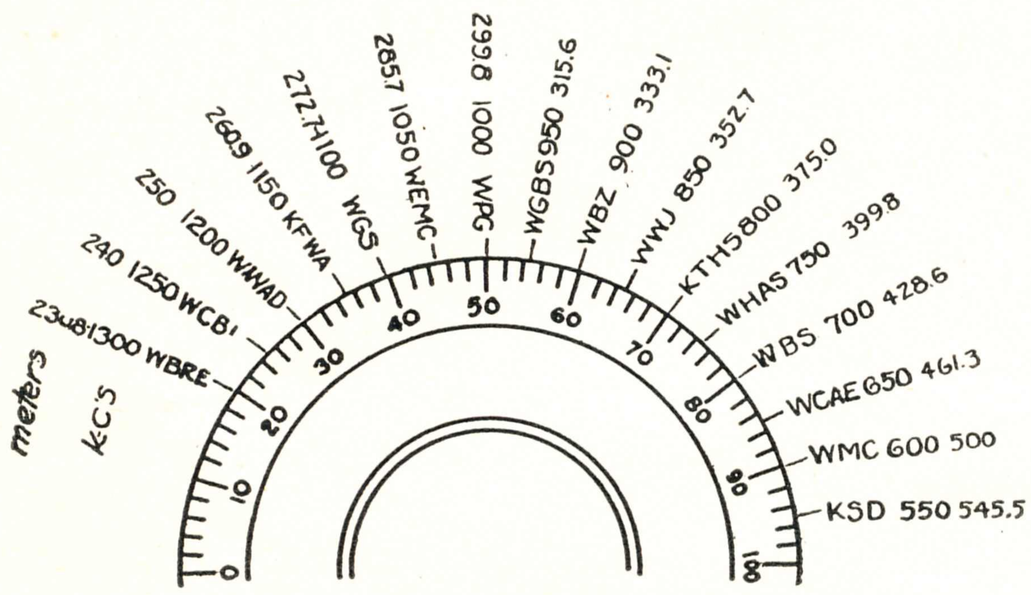

Fig. 1. If the Stations Are Arranged Like This Around Your Dial, Don't Read Any Farther in This Article

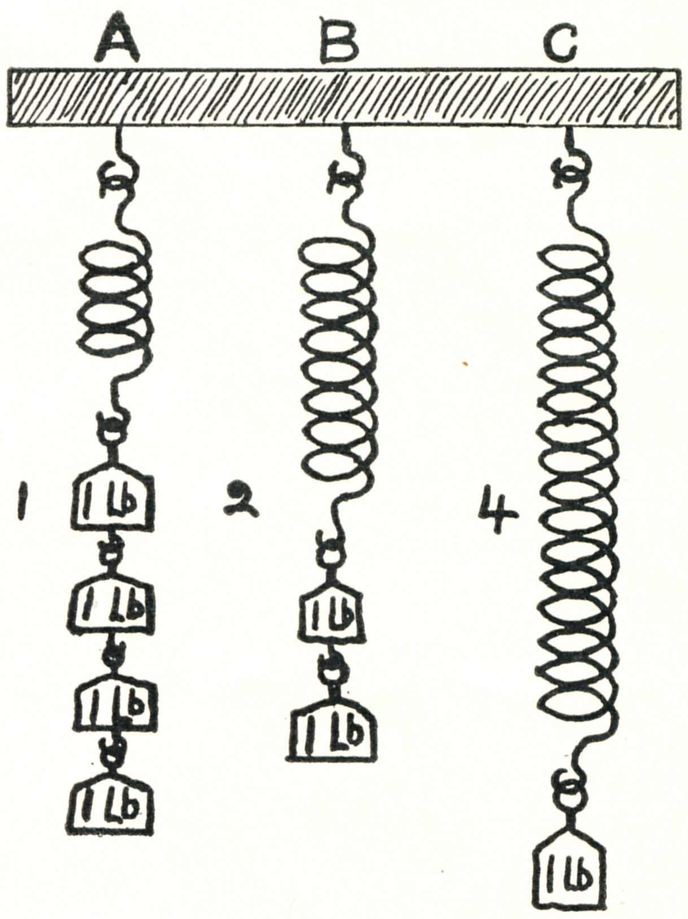

Fig. 2. Coils and Condensers Work Just Like Weights and Springs.

In the same way some fans say that they can tune out the local station "by turning the dials only fifteen degrees." This may or may not show good selectivity. If that 15 degrees represents 100 kilocycles difference, the selectivity is only fair, but if it means only 20 kilocycles, then the set is a very selective one. It is another case of the Chinese boy and the map—a question of scale.

No Change at Ends

When the condenser and coil are properly designed to go together, then

the highest frequency or shortest wave length broadcast station will appear near the zero of the scale and the lowest frequency station at just about 100. Such an arrangement appears in Fig. 1. This happens to be a straight line frequency condenser, so the stations are equally spaced. With one of the old style they would be crowded a little closer together at the left hand end and

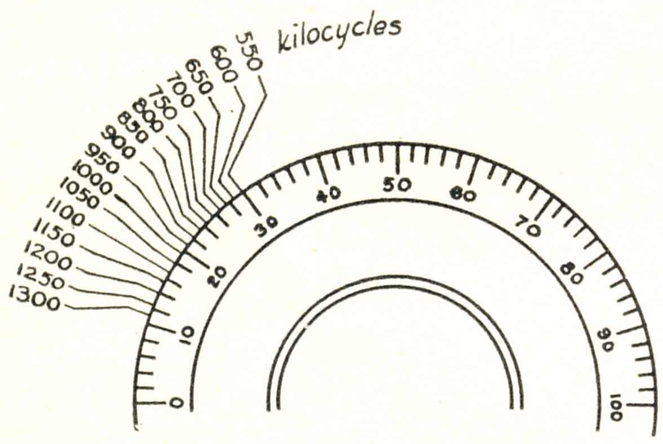

Fig. 3. The Coil in This Set is Correct, but the Condenser is Too Big.

a little more open at the right, but even then 1300 kc. would be at 20 and the 550 kc. at 95 just as shown.

The highest frequency vibrations at the present time assigned by the government are only slightly above 1300. However, it is possible that still higher speeds will be used by the Department of Commerce, and so the space from zero to twenty is left blank for this possibility. On the other hand, 550 kc. is the lowest vibration speed which has been given out, and it looks doubtful whether the scale will be extended any farther in this direction. That is why it is best located so close to the end of the dial.

Bobbing Up and Down

As you no doubt recall, the vibration speed of a station depends on the capacity of its condenser multiplied by the inductance of its coil. As long as the products of these two quantities is the same, it makes no difference what pair of values are used. The capacity is just like a spring and the inductance like a weight. When a spring and weight are fastened together and set in motion, they will bob up and down at a definite speed just as the electricity oscillates back and forth in a condenser and coil.

This is seen better in Fig. 2. Here are three springs which are alike except for length in their free position. The first is 1, the second 2, and the last 4 inches long when unstretched. The first carries a weight of 4 pounds, the second 2, and the latter 1. The product of the springs by the weight in each case is the same, that is four. In other words 1x4 equals 4, 2x2 equals 4, and 4x1 equals 4. Since this product is the same in all cases, the springs and weights will bob up and down exactly in time. If you try this experiment you will find this to be true.

If They Fit Each Other

Condensers and coils work in a similar fashion. That is, if we use a big coil and small condenser it will give the same tuning for waves as will be had from a small coil and big condenser, provided that the product of capacity of the condenser and inductance of the coil is the same in the two cases.

From this it might appear that we could use a tiny condenser and an enormous coil, or the reverse to get the results. The objection to this is that there is considerable leakage capacity in the wiring of the set and all the leads,—even short lengths of connecting wires, have inductance. If you try to use a condenser which is unreasonably small, you will find that the leakage capacity of the wiring and the coil itself will be too big in comparison. This shows that reasonable figures for both these units must be worked with.

In what follows this idea will be brought out further. When we say that a condenser is too small, it means that the variation from zero to 100 as it is turned in and out of mesh, is small compared with the capacity which is already in the set even when the dial reads zero. If it were not for the effect of the residual capacity and inductance, we could not say that a coil was too small or that a condenser should be increased in size, but merely that the **combination** was either too little or too big.

Proving the Coil O. K.

Suppose we start with the effect of the variation in size of the capacity when a suitable size of coil is used. Fig. 3 indicates how the stations or the frequency will be spaced with the combination of the right coil but too big a condenser. Notice that the high speed waves at 1300 kc. come in not far from the zero end. This correct spacing shows that the coil is correct as has been already mentioned.

Now look at the slow waves—at 550 kc. The dial has been turned only an inch or so to cover the entire broadcasting range. All the rest of the scale from a reading of 30 up is wasted, since it would bring in very slow speed long wave lengths, which are not allowed for broadcasting. To be sure, such an arrangement would enable you to tune to any station which happened to be on the air, but it would make the dial very sharp. By "sharp" we do not mean selective, but merely that each station would come in over a tiny distance compared with the way it acted in Fig. 1.

Rip Out the Plates

The remedy for such a condition is to use a smaller condenser. If convenient, it is just as well to take out the old one and install a smaller capacity. However, if the old condenser is pretty well fastened in, the same result may be obtained by breaking some of the plates off the rotor. Most makers of condensers do not fasten moveable plates to the shaft so firmly, but what with a pair of pliers they can be bent back and forth and so broken out. The case shown in Fig. 2 is perhaps somewhat exaggerated in that the entire broadcast range is covered inside of 20 degrees. Here at least two-thirds or more of the plates might be scrapped with much improved results. However, by removing them one at a time you can easily see how the waves are spread out on the dial.

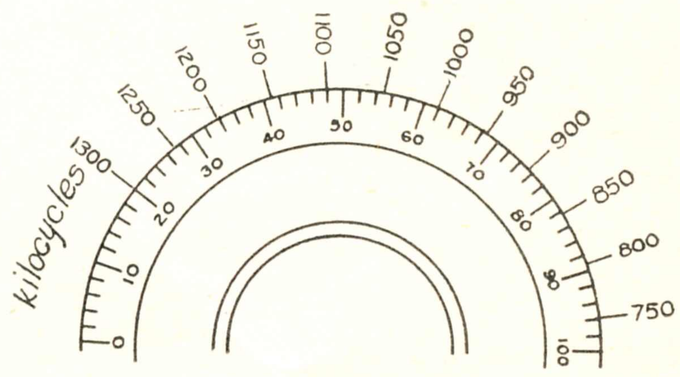

Fig. 4. Coil is O. K., but the Condenser Ought to be Twice as Big.

Fig. 4, on the other hand, shows what happens when the condenser is too small. Again notice that the 1300 kc. starts fairly close to the left of the dial, which indicates that the correct size of coil is hooked up. The small number of plates requires such a big amount of rotation to cause a given change in capacity, that when the dial is turned way around to the end, 100,

we have not yet reduced the frequency below 725. From there down to 550 is lost. We are therefore unable to get any of the slow speed (long wave length) stations. The remedy here is to increase the size of the condenser. Of course this means a new unit, since you cannot doctor the old condenser to make it fit.

All the Fast Ones Lost

Now let us take up the case of a proper size condenser but the wrong coil. Fig. 5 shows what happens in such a case. The various frequencies are pretty well separated you will notice, which shows that the condenser used is about right for size. However, when the dial is turned so that it is at zero, we have a frequency which has reached only 1150. From there to 1300 is completely lost so there is no use listening for any

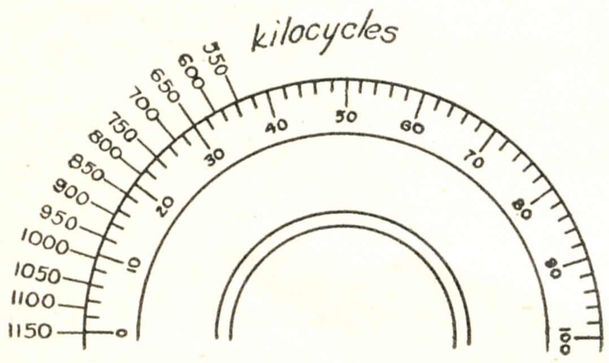

Fig. 5. In This Set, the Condenser is Proper, but There Are Too Many Turns on the Coil.

of the higher speed (shorter wave length) broadcasters. The slower speed vibrations are all there, way down to 550. Less than half of the dial is used and the upper half is of no value since it brings in waves which are outside the broadcast band.

It is interesting here to compare Fig. 3 with Fig. 5. In both of these the product of coil inductance and condenser capacity is too big. This is shown by the fact that the slowest waves come in on the thirties of the dial. From there up to 100, the tuner is never used. However, it is possible to tell whether it is the coil or the condenser which is too big in this combination. If the high speed vibrations at 1300 are properly spaced at somewhere around 10 or 15, then the coil is correct and it is the condenser which is too large, while if the high speed vibrations run off the lower end of the scale, it is the coil which is at fault.

Would Small Condenser Do?

You might ask in relation to Fig. 5, even though the coil is too big, why the conditions could not be corrected by using a smaller condenser. If a unit with fewer plates should be substituted, it is true that it would bring the 550 mark fairly well around to the right and this would be an advantage. However, the minimum capacity of a condenser, which is the value when the dial reads zero, is not lowered very much by removing plates, and the leakage capacity which is in the coil and the set wiring is not reduced at all by cutting down the plates. For this reason even if in Fig. 5 a smaller condenser were employed, it would not restore to our use the band from 1150 up to 1300. The only way to accomplish this is to use a smaller coil.

If we have a proper size condenser and the coil is too small, the results will be as in Fig. 6. Notice that the 1300 kc. comes in at 32, and so that the lower third of the scale is wasted. The separation of the various waves indicates that the condenser itself is about the right value. Here again the only good remedy is to use a larger coil, which will bring the stations back as shown in Fig. 1. As just discussed, by using a larger capacity with this too small coil, the high point will be improved so that all the waves could be got on the dial.

This Way is Much Better

This would, however, not be such a good solution because the 1300 point would still be pretty well up the scale and so space at the lower end would not be used. The stations would, of course, be crowded together considerably closer than is shown. By using a few more turns on the coil, the spacing of the stations would be just as good as shown here, and the whole set would be swung around toward the left hand end of the dial so that it would all be in use.

Many sets, even of those manufactured, are poorly designed in the size of their tuning units. Many of the neutrodynes, for instance, never use the condensers much above 60 on the dial. Of course, that means that all the stations are crowded into a much narrower band and so are proportionately harder to separate conveniently. It is especially foolish to waste the **upper** part of the dial. The general tendency of sending stations is towards the faster (shorter length) wave. There is no indication at all that any more stations will ever be operated beyond the present frequency of 550 kc. (545 meters.)

Improving Your Own Set

If you have a set which thus neglects the upper part of the dial, you will find that your tuning is added to very greatly by cutting down the size of your condensers. If it is a three-dial set like a neutrodyne or other tuned radio frequency hook-up, then all three condensers must be treated alike. Just break off one of the rotor plates. Any one will do, but those at the inside end are usually easiest to get at. You will find that the lowest frequency station has been shifted from 60 up to say 68 on the

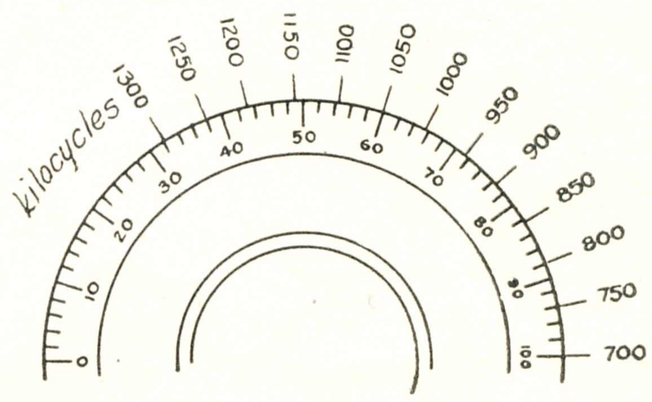

Fig. 6. And Here the Coil Has Been Reduced in Size Until it is Too Small.

dial. This is an improvement, but not enough. Cut off a second plate from each rotor and test again. The reading will now be around 76. This process may be kept up until you see that the removal of another plate will throw the slowest station off the scale.

After you have made these changes, you will find that the lower end has not shifted very much in its readings. There will be a slight change allowing a little more room for new, high speed-low wave length stations, which if anything is an advantage.

THEY PAY IN CANADA

Canada has 56,063 licensed radio receiving sets. Ontario leads all the provinces with a total of 28,507. There are 87 on Prince Edward Island; 22 in Yukon, and five in the Northwest territories.

American Radio Relay League

TURKEY COOKING—SWISS SWEEPING

Housewives who have curiosity about how women in Turkey do their cooking, and those in Switzerland do their laundering, and how the English and French women keep their houses, may have their curiosity satisfied by tuning in on a new feature coming to radio by way of Westinghouse Station KYW.

This new feature is being given by Jane Burr, poet, lecturer, world traveler and novelist. Her series of talks from the KYW studio of the Chicago Evening American, embraces "Housekeeping in Many Lands."

In her recent extensive travelling throughout the European Continent she made a close study of housekeeping as it is done in England, Sweden, Norway, Denmark, Finland, France, Germany, Switzerland, Austria-Hungary, Roumania, Bulgaria, Turkey and Morocco, and in each of her talks she will discuss conditions typical of one of these countries.

Miss Burr will talk each Friday afternoon, from the Hearst Square Studio, immediately after the 3 o'clock "World Crier" schedule during the coming radio season.

A. R. R. L.—ADMIRAL LAUDS SCHNELL

Praise for his efforts in developing a new field of radio communication for the use of the Navy is given to Lieutenant F. H. Schnell, traffic manager of the American Radio Relay League, in a letter from Admiral R. E. Coontz, Commander-in-Chief of the United States Fleet, just made public here.

Lieutenant Schnell, who was granted a leave of absence by the American Radio Relay League, has served as chief operator of experiment radio station NRRL, on board the Flagship "Seattle" throughout the Pacific cruise of the Fleet, making history with his valuable contributions to the knowledge of radio fast wave phenomena. This phase of radio work had been touched but slightly by the Navy, and the reliability which Lieutenant Schnell proved to be one of the outstanding features of this type of communication, gave rise to the letter of commendation from the Commander in Chief of the Fleet.

Station NRRL, working in daylight and at night, succeeded without a break, in communicating with American amateurs and the Navy fast wave station at Bellevue, D. C., during the entire time of the cruise. The importance of the work is well shown by the fact that the fleet visited Hawaii, the various South Sea islands, Australia and New Zealand.

A Genial Violinist

If you like good dance music, tune in to Station WLW at seven o'clock on Mondays, Wednesdays and Thursdays. You will hear Robert Visconti's Orchestra from the Hotel Gibson.

The leader of the orchestra appears above. One glance at this figure would seem to indicate that he goes in for the heavy type of music. However, you guessed wrong that time. Only a new style of sketch can do him justice and this was developed by the artist Shafer.

In his letter to Lieutenant Schnell, Admiral Coontz said:

"Upon departure from San Francisco, the fleet had no experience in super-high frequency radio. Upon completion of the cruise six months later the successful application of these frequencies for the Fleet long distance work had been thoroughly tested and proved.

"You have labored tirelessly for the success of the venture. The Commander-in-Chief takes pleasure in acknowledging the effectiveness of your work, and in thanking you for your efforts.

"The work you are doing in endeavoring to make the amateur organization ready in event of national need is an exceedingly important one. Through you, may I express my wishes for its happiness and success."

Lieutenant Schnell, when relieved from active duty, will once more take up his work as Traffic Manager at the headquarters of the American Radio Relay League in Hartford, Conn. It is expected that in this post he will have a large share in the amateur phase of the projected Army-radio amateur radio net plan.

This plan, which contemplates the development of a system of amateur radio stations for the use of National Guard and Organized Reserve units, is expected to make the army independent of ordinary communication systems in times of national stress that put other means out of commission.

The Traffic Department of the American Radio Relay League is expected to have a large share in the development of this plan.

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A Sharp Super Selector Circuit

A Five-Tube Set With Only Two Tuning Dials

By HARRY J. MARX

PROBABLY few of our readers have three hands. Indeed, most radio fans possess but two, and so the standard form of five-tube set with three tuning dials is a little hard to operate.

The circuit we are describing has only two tuning dials, and so is much easier to operate. It is quite selective, which is necessary these days with so many local stations strung through the United States. The quality of tone is good, and the music is loud when wanted, since one step of transformer coupling and two of resistance couplings are used on the audio frequency side.

A Lusty Two-Year Old

Here's a circuit that's not just an experiment either. Of course, it isn't really new for there *are* no new circuits, but it covers everything that its name indicates. It is not just a new kink or fancy, as it has weathered the storm of two years of additional experimenting, and it remains the same with one exception. A compensating device has been added that has enabled it to stand out in the field of selectivity and range of long distance reception.

One stage of good transformer-coupled and two of resistance-coupled amplification, as just mentioned, furnish all that is to be desired in volume and tone quality. Instead of two or three jacks to regulate volume, a control is placed right on the panel that will give just the volume desired to suit the most fastidious.

You Take Your Choice

On the left side of the panel (Fig. 1) is placed a real selectivity control. It is an adjustment that permits you to adapt your set to reception conditions wherever you happen to be located. You see a receiver cannot, at the same time, be most selective and yet give the loudest tone. You must choose between getting the most volume with moderate selectivity for use when your local stations are silent, or great selectivity which tunes out your neighboring broadcaster but at a sacrifice of reduced loudness on all stations.

Many sets have no adjustment for this condition and so in them a compromise has to be worked out which sacrifices something of both selectivity and volume. During the early hours of the evening while locals are on, the left-hand knob of the clarifier of Fig. 1 is turned to "Selectivity" which lets you get through your local. When they have shut off at ten or eleven o'clock, throw the pointer over to "volume" and go DX hunting.

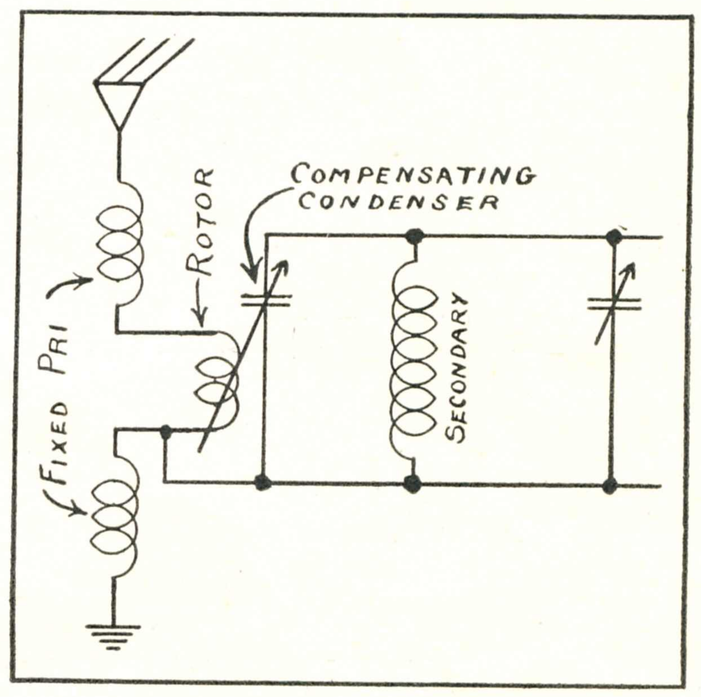

Fig. 2. Here is the Hook-up for Clarifier. The Condenser Rotor Turns with Coil.

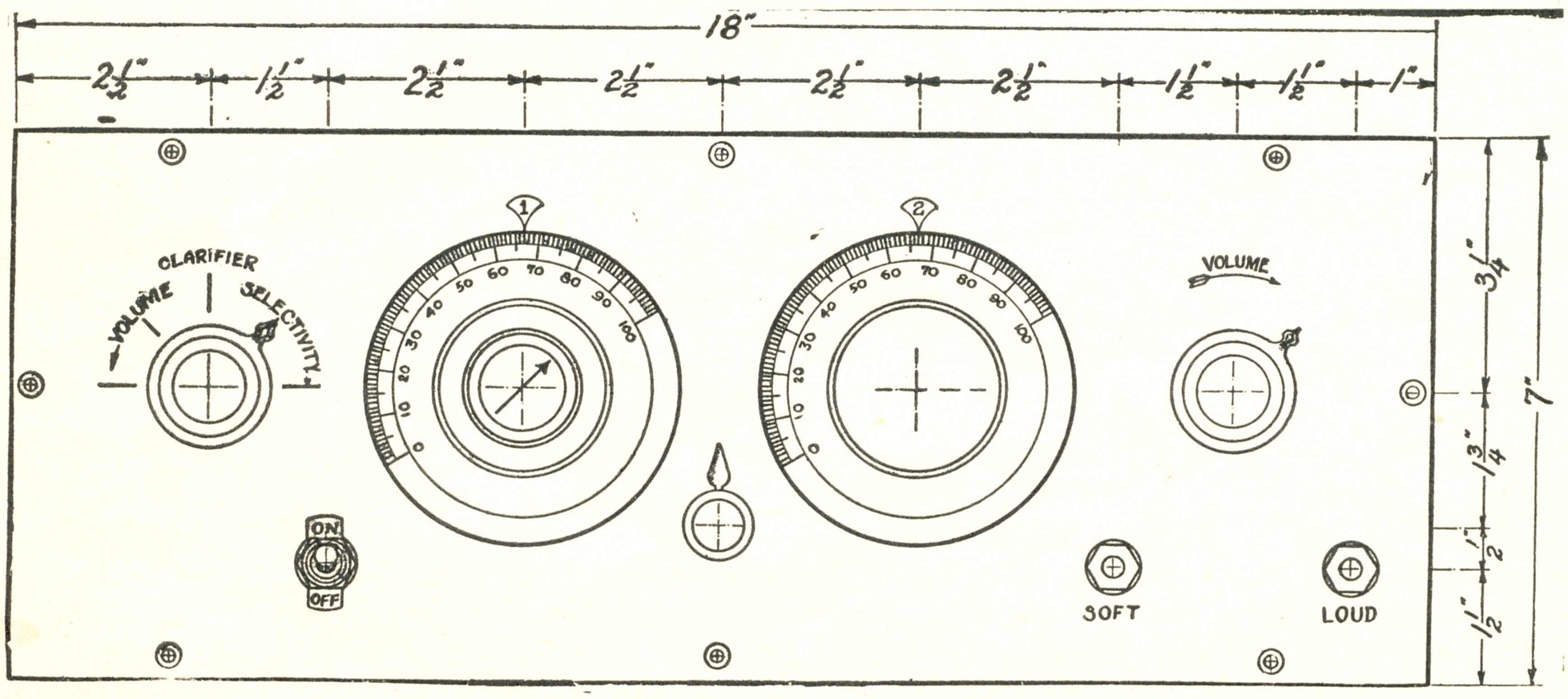

Fig. 1. This Neat-looking Panel Contains Everything Needed for Fine Control. The Clarifier, at the Left, Compensates for Changes in Selectivity.

A Condenser Used for Coupling

The question is naturally asked: "Just what is this control?" It consists of a coupling device. Then the statement is made: "Oh, that's old!" Yes, if you are just considering inductive coupling, but why overlook the fact that you can make use of a condenser coupling, and then make that help increase selectivity? That's the secret of the Elkay Selector. First, it consists of a fixed secondary winding (Fig 2) that is tuned with a separate .0005 mfd. variable condenser.

Second, it has a two-section primary or antenna winding, part of which is fixed-coupled to the secondary, and then the other part on a rotor can be adjusted to permit any degree of inductive coupling. In fact if rotation is carried far enough, a variometer effect is obtained, and the coupling of the fixed part of the winding can be counteracted. A small compensating condenser mounted on the end of the selector is automatically operated by the rotor shaft. This compensator eliminates any alteration of the condenser dial with change of coupling, and in addition this compensator automatically controls a capacitive coupling from the antenna circuit to the secondary or grid circuit. This instrument can be used to advantage wherever an antenna tuner is required.

A Six to One Transformer

Between the first or radio frequency amplifier tube and the detector tube, an Elkay Vario-Transformer is used. This instrument is a tuned radio frequency transformer, so designed that it will amplify equally throughout the entire broadcast range. This low-loss unit consists of a non-adjustable primary closely coupled to a secondary which uses no capacity. It is tuned, not with a variable condenser, but the secondary is similar to a variometer and can be adjusted to any wave in the broadcast band. Due to the close coupling between the two circuits the primary and secondary are tuned together, permitting a step-up ratio of six to one.

Due to the low-loss apparatus, the tendency to oscillate is marked. This is taken care of by an oscillation control called the stabilizer, consisting of a resistance in the plate circuit of the first tube. The direct current from the "B" battery is thus forced through the resistance. If the radio waves also had to thread this unit they would suffer loss and so a large capacity is connected in parallel with the resistance, thus allowing the high frequency waves an easy path to the "B" battery.

This permits maximum selectivity and volume over the entire wave-length range without oscillation troubles.

List of Parts Required

1 Panel, 7 x 18.
1 Binding post panel strip, 1¾ x 17⅞.
1 Baseboard, ¾ x 9¾ x 17⅞.
1 Variable clarifying selector (Elkay type C recommended).
1 Variable condenser, .0005 mfd., with vernier control.
1 Vario-transformer (Elkay type VT-25 recommended).
5 Standard tube sockets.
1 Double circuit jack.
1 Open circuit filament control jack.
1 Stabilizer, 5,000 to 250,000 ohms.
1 Rheostat, 10 ohms (volume control).
1 Battery switch.
1 Audio frequency transformer.
1 By-pass condenser, 0.5 mfd.
1 Set two stage resistance coupling units.
1 Set four filament control cartridges with mounting.
1 Fixed condenser, .002 mfd.
1 Grid condenser with clips, .00025 mfd.
1 Grid leak, 5 megohms (or adjustable).
7 Binding posts.
Necessary wire, spaghetti, screws, etc.
Dials and knobs.
Cabinet to suit.

A Good Panel Arrangement

The panel layout is shown in Fig. 1. On the left is the pointer-knob of the variable clarifying selector. Dial No. 1 is the variable condenser with a vernier knob. Dial No. 2 is the vario-transformer. The pointer-knob on the right is the rheostat for the filament of the first tube and provides an efficient volume control. The knob and pointer in the lower center of the panel is the stabilizer for controlling oscillation. In the lower left is the battery switch, and similarly on the right are the two jacks for phone or loud speaker. The jack marked SOFT can be used for loud speaker when local reception is being tuned in.

The circuit diagram is shown in Fig. 3. The markings correspond to those shown in the panel layout. The com-

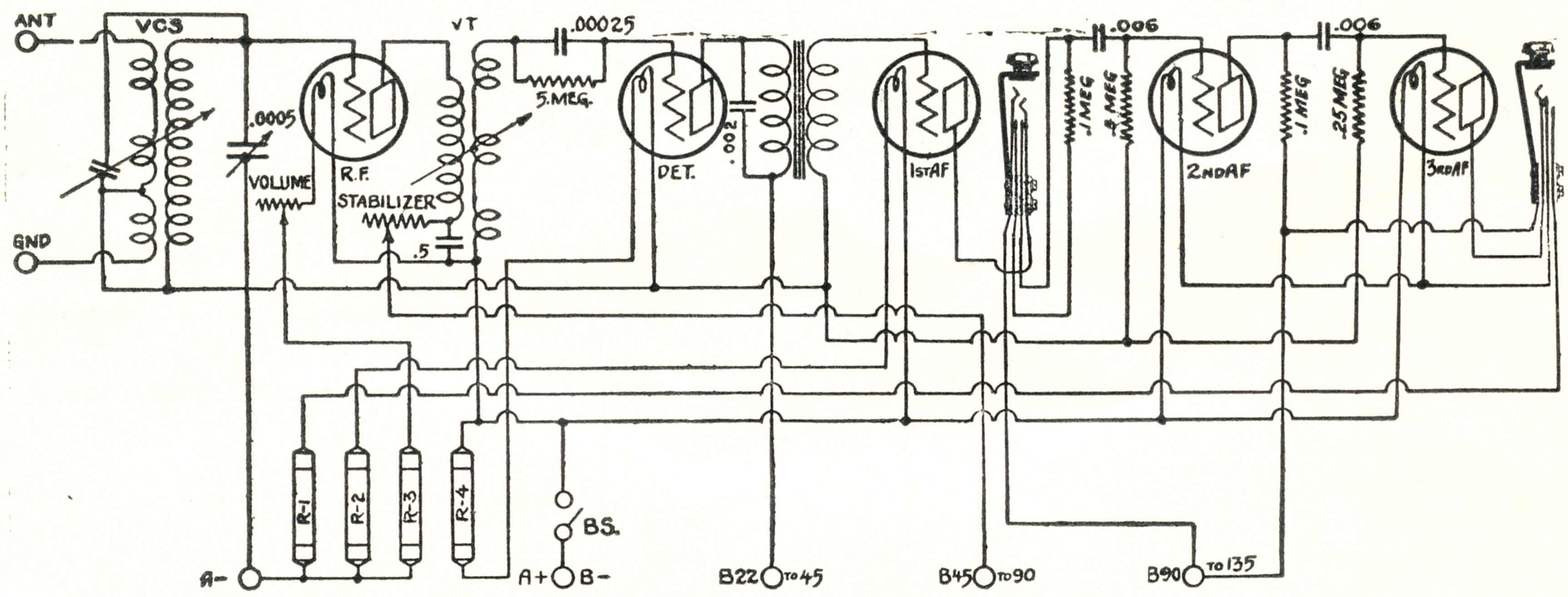

Fig. 3. Hook-up of Set. Clarifier is at Left. Stabilizer Prevents Squeals, and is By-passed for High Frequency by .5 Condenser. Two-Resistance Stages Used.

pensator on the variable clarifying selector is shown, drawn at a slight angle, on the extreme left of the diagram. The Vario-Transformer is indicated with the letters "VT." R-1, 2, 3, and 4 are the filament control cartridges. Further details are obvious and require no explanation.

Making the Panel Layout

The first step after all the parts for a set have been obtained is to make a full size layout of the panel. This can be made from the dimensions given in Fig. 1. It is only necessary to add the mounting holes for the various pieces of apparatus, as the center lines of the shaft are given in each case. The layout should then be secured to the face of the front panel and the centers of each hole punched through on to the face of the panel with a center punch. The holes can then be drilled with a hand drill.

If the panel is to be engraved, it should be done now, before any apparatus is assembled on the panel. Engraving cannot be done after the set is completed. In assembling the apparatus on the front panel, the smaller units, such as the jacks, battery switch, rheostat and stabilizer, should be mounted first. The vario-transformer, variable condenser and variable clarifying selector should then be mounted in the order named.

You Can't See the Wiring

The layout of the apparatus on the baseboard is illustrated in Fig. 4. There is ample room for all the parts, permitting access for wiring and soldering. The binding post panel strip is fastened to the end of the baseboard and carries the seven binding posts, spaced two inches from center to center. The illustration shows holes drilled where the wiring is carried through the board to the underside. Little of the wiring should be visible from the top.

The sockets, transformers, and other units should be mounted in the exact way as shown, so that the terminals face for the shortest possible leads. This is not only important but will save the constructor a lot of difficulty in wiring.

After the apparatus has been assembled on the baseboard and before the front panel is secured, it is advisable to solder two long leads to the battery switch, which is difficult to get at with a soldering iron. These leads can then be passed through the holes in the baseboard and the front panel fastened. These two leads can then be run to the proper connections as indicated in the layout. Before doing any wiring, be sure to study both Fig. 3 and 4 to avoid errors.

How to Locate the Wires

For those who find difficulty with the regular hook-up diagram, the picture wiring diagram of Fig. 4 will be of decided assistance. It helps solve the problem of identifying the various terminals on the different units. If the terminal is shown in dotted line, it indicates that it is on the lower side of the unit. This holds true of both the selector and the transformer. All wiring in solid line runs above the baseboard, while that shown in dotted line is below.

Keep the leads as short and as straight as possible. See that all joints

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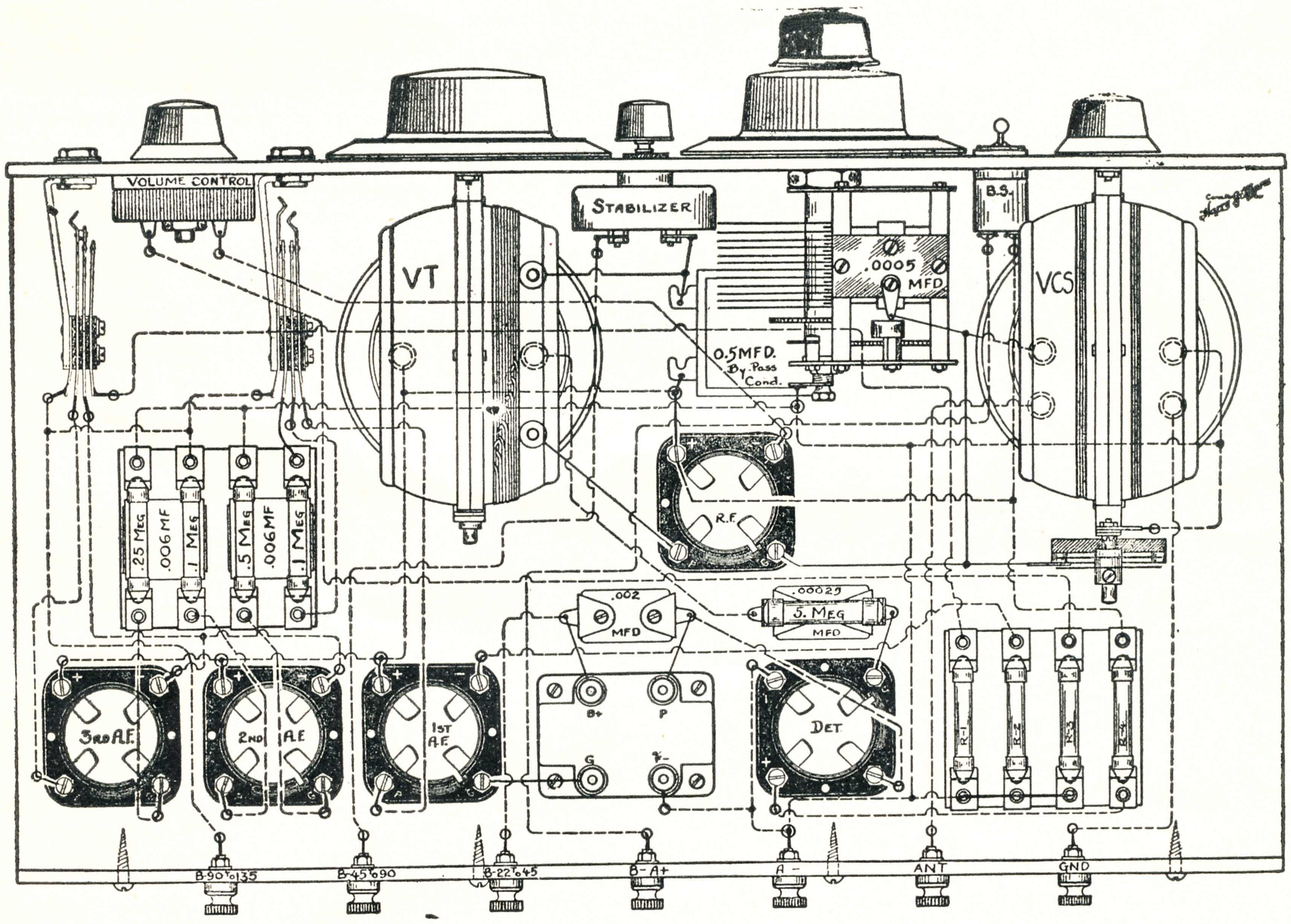

Fig. 4. Plan View of Sub-Panel. A Variocoupler of Special Design Acts as R. F. Transformer and Also as Detector Tuner.

New Styles in Switchboards

This May Affect Your Broadcasters and Your Power Company, Too

By OLIVER D. ARNOLD

LAST night, just at the breathless point of the radio drama coming in from your favorite broadcasting station, the set went dead and left your thrills suspended in mid-air. What was the trouble?

It was not the fault of your receiver. This was proved from the fact that other stations could be picked up quite easily. No, the trouble lay in the sending equipment, and may have been caused by defective tubes or a bad battery. The most likely cause, however, was probably to be found in some of the apparatus mounted on the switch board.

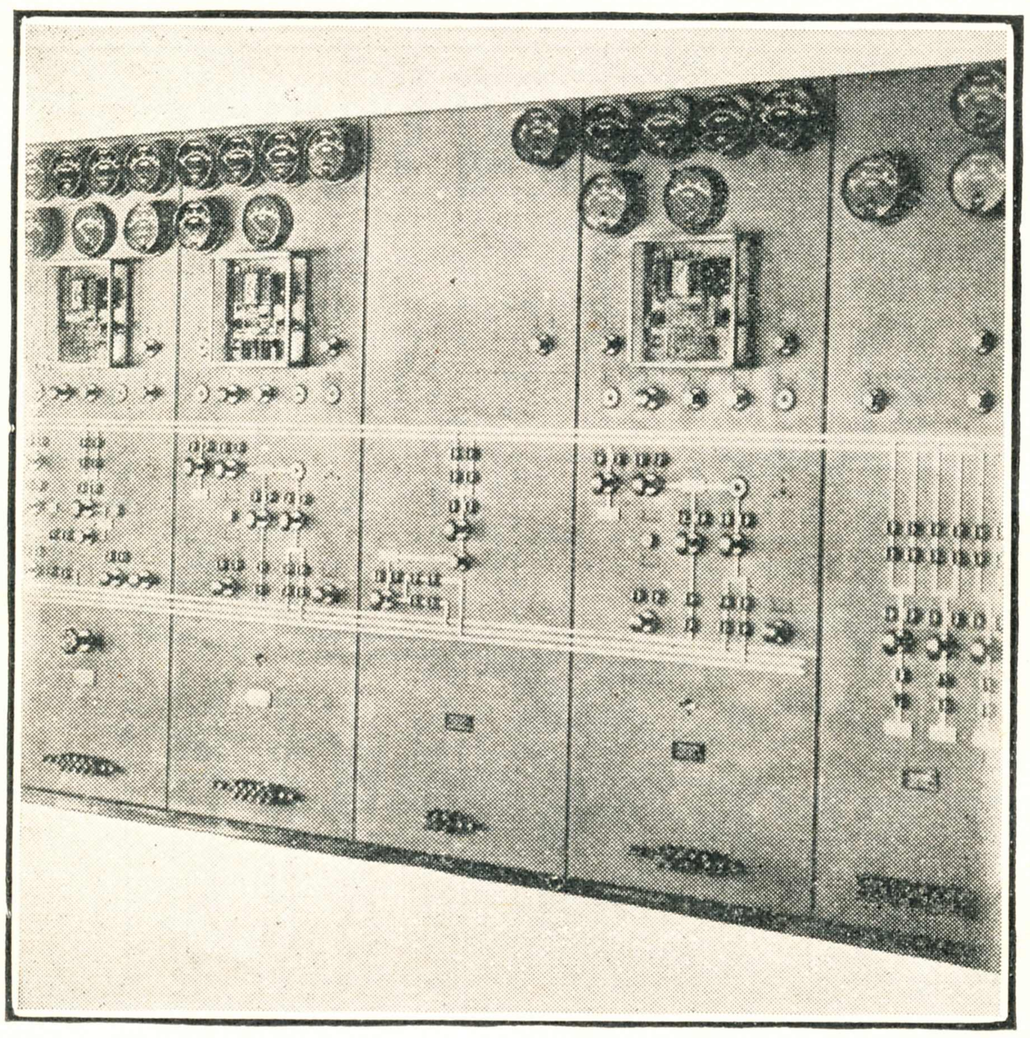

Fig. 1. This Steel Switchboard Gives Service Which Means Fewer Interruptions.

Marble for the Wealthy

This matter of switchboards has been a problem which keeps coming up more or less all the time, not only in radio broadcasting stations, but also in electric light plants. The older stations have often used marble for the panels which support the various switches, meters and other instruments. Such panels are very nice looking and give an air of wealth and solidity to the switch room.

However, there are two objections to marble. The most evident one is that it is very expensive. The cost of a modern switchboard in marble is so much out of proportion that the price is practically prohibitive. But even aside from that there is another reason why marble has fallen into disuse. The trouble is that it is a natural rock and so is apt to have various kinds of impurities in it. A hidden vein of metallic ore (particularly iron) often occurs and is not discovered until at some time it short circuits and shuts down that part of the station.

Continued on Next Page

SUPER SELECTOR CIRCUIT

Continued from Previous Page

are soldered, not stuck with resin. Holes should be drilled in the baseboard to match up with the terminal holes of the resistance coupling units and the mounting of the filament control cartridges. All wiring to these units is then passed up from underneath and soldered, filling the hole with solder. The wire can then be cut off.

Setting the Stabilizer

Set the stabilizer in mid-position for wavelengths of about 1,000 kc. (300 meters). For higher kilocycles (lower wavelengths) turn to the right. When the stabilizer is set properly it is impossible to make the set squeal.

Set the clarifying selector knob at mid-position. Turn the volume knob about in the position shown in Fig. 1; this should be adjusted for the volume as desired. Adjust dials 1 and 2 to about the same numbers, running up and down the scale until a station is heard. Then adjust the clarifier for clearness, and set the volume knob as desired. Stations can be logged and brought in again on the same dial settings.

Cutting Out the Locals

When there is much interference and much extraneous noise, set the clarifier knob in the region marked SELECTIVITY, but for daytime reception, when signals are weak set the pointer on the side marked VOLUME.

The hook-up shows resistance units in series with the tubes to control the filament current. Of course, if you prefer, an additional rheostat of about six ohms or less can be substituted. This modification and others which may suggest themselves to you may be tried out without affecting the essentials of a very good set.

NEW STYLE SWITCHBOARDS

Continued from Previous Page

Weight Counts at the Top

Slate was the next choice for panel material. It is not nearly so expensive and usually runs fairly free from metallic impurities. There are thousands of electric stations all over the country which have slate boards and as a whole they have proved satisfactory. Even slate costs quite a bit and is very heavy. Many broadcasting stations are located in the tops of tall buildings and the tremendous weight needed for slate switchboards is something of a disadvantage.

There is another drawback to slate which is not very serious as a rule, and that is that it is comparatively easily broken. When shipped from the factories of the switchboard makers it must be handled carefully on the railroads, and in setting up the various panels the greatest care must be taken that a sudden strain does not crack the material through the holes which are drilled to carry the various instruments.

Would Not Work in a Fight

In 1915 the electrification of battleships proved that slate was too brittle to stand the shocks from the firing of heavy guns. As a substitute, ebony asbestos lumber was used, but it proved to be as expensive as slate, even though it would withstand the heavy shocks. Because there was no saving, the ebony asbestos boards were not generally employed on land. The use of some heavy insulating material has been universal for switchboards up until the present time, but now the development of switchboards made from sheet metal has marked the end of the reign of heavy, breakable panels.

Of course, slate and marble will be used for some time, but only to match up switchboards in some of the older stations, and many switchboard engineers predict that all of the newer stations and power houses will use steel switchboards. This is due to the fact that the steel boards are cheaper, lighter and stronger. The light weight makes them easier to handle and to place in position. With steel boards there will be no cracked panels or broken corners, to avoid which required very careful handling when other material was used.

Insulating the Steel Panel

These advantages are bound to make the steel the predominating material for use in switchboards. The change from the use of the insulating material to that of one which has no insulating qualities seem odd, but where insulation is required it is secured by means of insulating bushings on the live parts that pass through the switchboard. This effectively prevents the leakage of current and makes the steel switchboard the equal of the slate as far as electrical characteristics are concerned.

This new type of switchboard, constructed of "stretcher level sheet steel," as it is called, has been designed by the Westinghouse Electric and Manufacturing Company. It may be used advantageously in power, railway industrial and marine installations, as well as in broadcasting stations. This new type of switchboard is light, substantial, sturdy and easily erected.

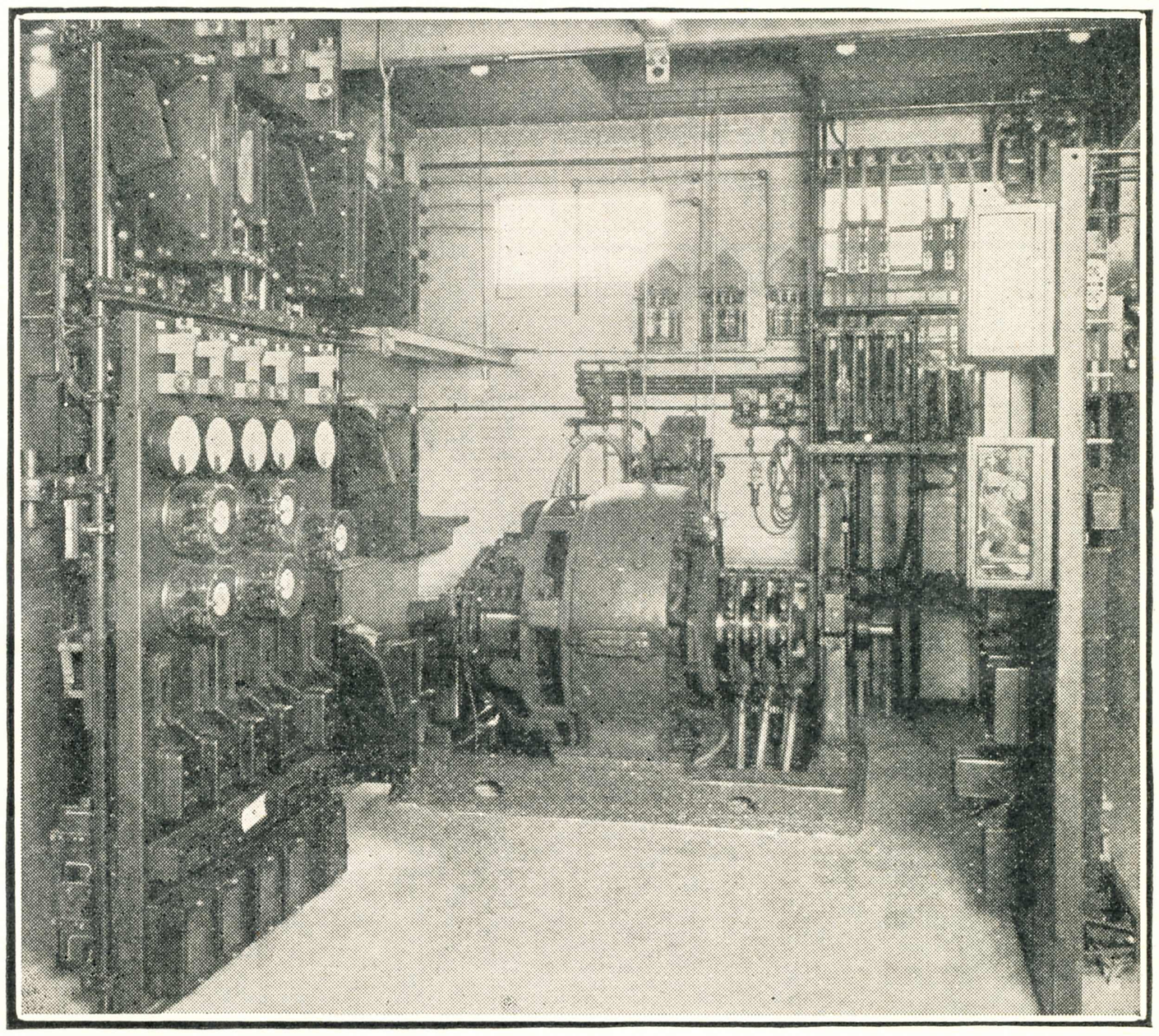

Fig. 2. How the New Switchboard Looks in a Power House. All the Meters Are Held Rigid.

Like Oil Can Bottom

This kind of a panel is called "stretcher level" as already described, because of the unusual means for keeping the material absolutely straight. Of course, you have often times pushed in the bottom of an oil can and noticed how the metal will bulge one way and the other. The same thing is true on a much larger scale of a sheet of steel even though it may be as much as one-eighth of an inch thick, as is used in this case.

Besides the effect of bulging, there is also the warping of the panel to be considered. If you make a wooden frame of any large size and stretch a piece of canvas on it, you will see that two of the opposite corners are almost sure to spring in while the other two go out. Of course, such an action would never do in a switchboard panel, as it would throw that section out of alignment with the rest of the board. How to get rid of these two bad effects has been a problem, which up to recently had not been solved.

Holds Its Shape Forever

The answer, as found by the Westinghouse engineers, is to take the section of 1/8 inch thick sheet steel and stretch it in powerful jaws, one along each edge. A steel framework which is short of the sheet by about one inch all around, is then pressed against it and the edge of the sheet metal bent sharply back over the framework while still subject to the severe stretching. After its being fast-

ened in place, the result is a panel which is absolutely flat and level. There is no chance of any part bulging out like the oil can bottom, for instead of being compressed at any point, the metal is everywhere under tension and is pulled back into line if a blow tries to knock it out of place. Steel of this character will hold its tension practically forever unless it is heated to a temperature so high that it gets red hot.

Fig. 1 shows a switchboard made up of units of stretcher steel. It is easy to fasten one section to the next by means of bolts through the end frames. Such fastening is much more rigid and considerably stronger than the old way of holding slate panels by means of bolts and spacers. New units can be added from time to time without any trouble or any need for dismantling the parts already put up.

Why They Are Light

The steel itself is a trifle heavier than the same size (area and thickness) of stone. However, when you know that the steel is 1/8 of an inch thick, whereas the old style panels ran two or three inches thick, you will see what a tremendous saving there is in weight for this modern construction.

Another advantage is this. Suppose a broadcasting station decides to increase its power from perhaps 500 watts to 750, by adding another tube. This will require some extra instruments on the board. If there is room on the existing panel, it is the work of a few moments to drill a hole through the sheet steel with an ordinary metal drill. No precautions need be observed, as the panel is quite foolproof. If the material had been slate or marble, a special kind of drilling would have to be done and experts would need to use the greatest care or else the stone might crack and ruin the entire panel.

A Picture of Connections

A rather neat idea is also illustrated in Fig. 1. Notice the various white lines which run across the board. These are nothing but paint. However, they show what the connections are behind the panel and this gives the operator the clue as to where to look for trouble if anything unusual happens. It is much quicker and easier to grasp this method of identifying the circuits than the old way of *labelling* each particular switch and contact. By using these painted markers only the main items need be named on the labels.

Such a development cannot come suddenly, as it must be tried out in smaller stations to see whether it works out in practice as well as it promises. For some time stretcher level steel switchboards have been used on small installations in a more or less experimental way and have proved successful, so that they are now being used on larger projects. The erection and maintenance costs are lower than those of the slate and marble boards.

No Worry at Seashore

The steel panels are given a baked enamel finish similar to that used in the auto industry. They thus present a most pleasing appearance and in addition are impervious to moisture and easily resist the corroding action of salt sea air.

Another point which might escape you is this. If you go into any of the older generating stations and look at their switchboards, you will usually find dark stains in irregular blotches all over some parts of the marble. Slate boards are also effected, although they do not show up quite so badly. These stains come from oil, which has accidentally been spattered on the boards. Of course, every station tries to be careful in this respect, but it is surprising how many switch boards suffer in appearance from this cause. The enamel finish of the sheet steel can be bathed in oil and never know that it is there.

Used by Power Houses, Too

As has been already mentioned, this type of board is just as good for the electric light and power stations as it is for the radio broadcasters. Fig. 2, shows one of the most important installations from the power and railway standpoint. It is a picture of the Staten Island project which is part of the complete electrification of the B & O system from Baltimore to New York.

Left to Right—Louise Homer, A. Atwater Kent and Anna Case. Mme. Homer is signing up to broadcast in the series of Sunday night concerts over WEAF, New York, and twelve connecting stations. Miss Case and about forty other artists will be on the programs, which are sponsored by A. Atwater Kent, of Philadelphia.

Rolls-Royce Tubes Can't Be Bought

The Patent Office Looks Out For Inventor's Rights

By LEO T. PARKER, Cincinnati, Ohio

HAVE you ever applied for a patent? Perhaps you know that it takes a very long time to get an answer through as to whether the government will give you a seventeen-year monopoly or not.

The long delay, often a matter of years, is caused by the fact that Americans are too smart for the small number of men in the office. So many citizens have bright ideas about new inventions that the Patent Office is swamped.

America is More Careful

But although the service is not anything to boast of as regards speed, still the examiners are right on the job when it comes to protecting the rights of the patentees. In some countries abroad, the government does not pretend to look the matter up to see whether anyone else has had the same idea first. Such protection is almost worthless, as it depends on the applicant to make his own investigation. In America, this condition is much better, since the Patent Office does its best to see that the letters which it issues really represent protection to the inventor.

Trade-marks also come under the jurisdiction of the office. In many cases this distinguishing emblem or name is worth thousands or even millions of dollars. Take the case of "Ivory Soap" for instance. Just imagine the big loss that would occur to the manufacturers if this name should be changed. The courts are anxious to protect the rights of the owners of any trade mark.

The Name on the Tube

A quite recent higher U. S. Court trade name case is particularly interesting. It explains the situation from the view point of the restricted use of a trade mark adopted for employment on a somewhat different class of merchandise. This case is that of "Rolls-Royce" as applied to radio tubes.

The Rolls-Royce of America, manufacturers of high priced automobiles and aeroplanes, instituted legal proceedings against Howard Wall, doing business under the name of Rolls-Royce Tube Company, to prevent the use of the word "Rolls-Royce" in carrying on his regular business.

Henry L. Dixon

Henry L. Dixon, once of Hodgenville, Ky. (where Abraham Lincoln was born), later of WHAS, Louisville, and now attached to KYW, the Westinghouse station at Chicago, has elevated the "uke," the instrument he plays, to what is known to the art as "complete harmony." He plays the heavy classics. In a single melody he uses every stroke known to the instrument. His theatrical activities have earned for him the title of "the world s greatest ukelele player."

Besides being an adept "uke" strummer, his skill can be attested to on the Hawaiian steel guitar, and he will be heard as an exclusive radio player from KYW—playing in the Hearst Square studio of the Chicago Evening American, during afternoon and night broadcasts.

The Eat-a Motor

Ordinarily it is considered legitimate for any person or firm to adopt and use a well known and popular trade mark, provided its use is confined to goods or merchandise of an entirely different class from those sold by the original user. In that case the public is not likely to purchase the goods of the later user of the mark, believing them to be the product of the former user. For example, if "Eat-a" is recognized as a trade mark for bread, there is nothing to prevent its use by another firm as a trade mark for automobiles or other products not of the same or kindred class of goods. This is true because no one is likely to be deceived into purchasing an automobile thinking it is made in a bread maker's factory, and therefore, no harm usually can come to the original user of the mark "Eat-a."

But in the presently described case, the court restrained the use of the name "Rolls-Royce" as a trade mark for radio tubes, and also as a part of the name of the company that was selling them. It appears that the Rolls-Royce Tube Company has met with considerable success selling Rolls-Royce radio tubes by mail. The tubes were simply marked "Rolls-Royce" without other indications to show where or by whom they were manufactured. Also, in advertising the tubes the words "Rolls-Royce" were used alone in quotation marks with the statement following "like their name, significant of quality." The advertisement directed correspondence to be sent to "Dept. A of the Rolls-Royce Tube Company," thus

Continued on Next Page

A Small Station with a Big Voice

Four Candles on the Cakes of 10,000 Mile Station

By VANCE

IF you have a four-year-old neighbor, maybe his cries at night will carry apparently for miles. However, here is a youngster of that age, who has been heard 10,000 miles away.

Not many radio broadcasters can celebrate their fourth birthday for sometime to come. Station WHAZ did it recently and used the same group of entertainers that had presented its first program way back in 1922. But putting out pleasing programs is not all that this up-to-date station is attempting.

Looking Most at Quality

Through a variety of new installations made this summer it will further develop the experimental side of broadcasting, which as a part of the communications department of the college is made an important feature. Although its engineers have through the summer experimented with varied power and sources of energy, they will concentrate largely during the coming season upon a power range between 250 and 1000 watts, with especial emphasis upon the quality of modulation.

A new pickup system, believed to be a long step in advance, will be tried with the purpose of reducing as far as possible the microphone and generator noises while reproducing the whole range of sound with fidelity. The study of the sources of annoying radio noises and their elimination will be one of the main aims. Another new installation is an additional fast wave experimental department, occupying 5000 square feet of floor space in the loft of the big electrical laboratory just underneath the antenna system.

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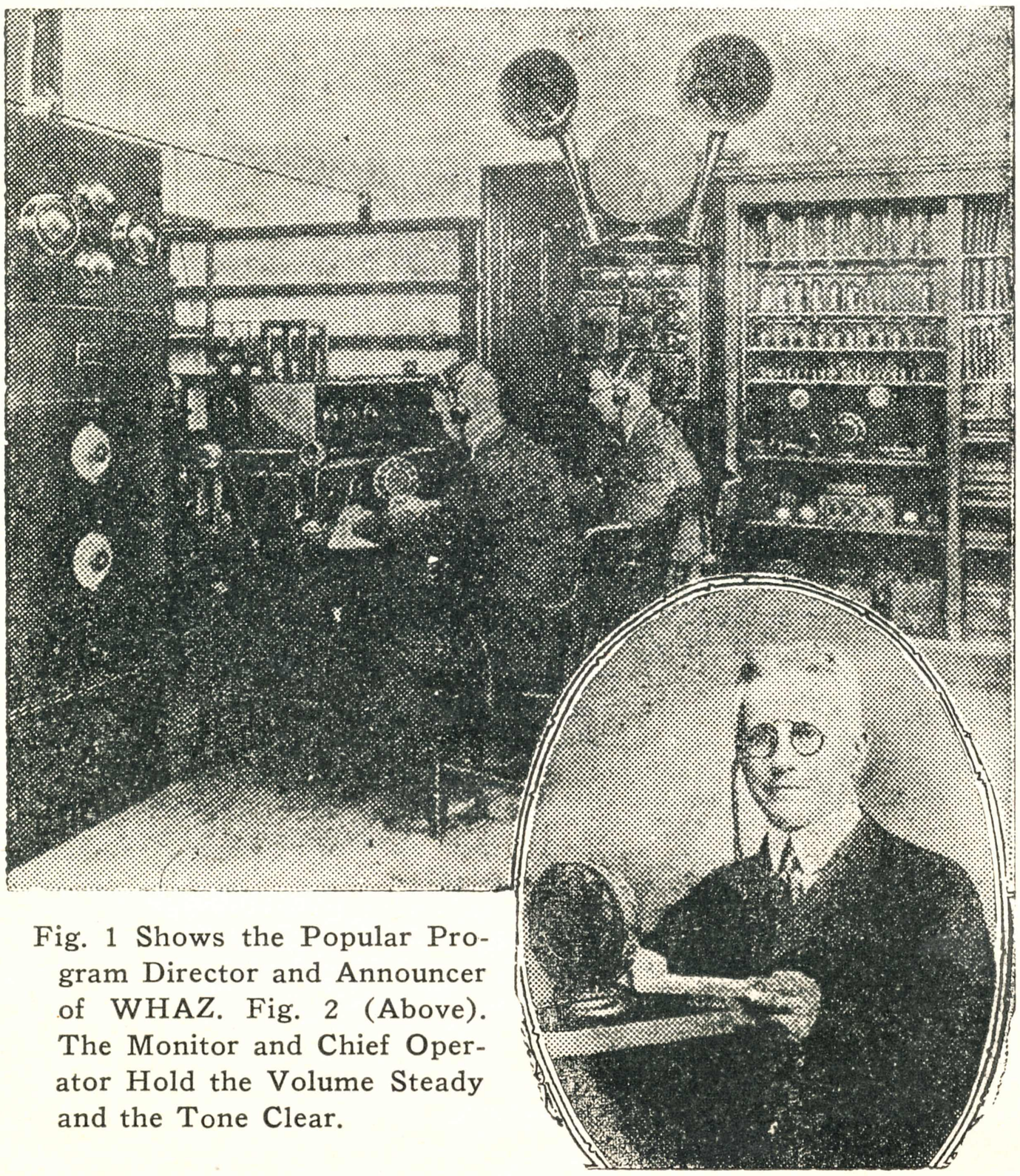


Fig. 1 Shows the Popular Program Director and Announcer of WHAZ. Fig. 2 (Above). The Monitor and Chief Operator Hold the Volume Steady and the Tone Clear.

ROLLS ROYCE TUBES

Continued from Previous Page

giving the suggestion that the business comprised this and other departments.

How Rolls-Royce Name Started

It was shown that the name "Rolls-Royce" is a hyphenated combination of the family names of the two founders of the British corporation Rolls-Royce, Limited.

The court decided that inasmuch as the tubes bore only the name Rolls-Royce, with nothing to indicate their origin, and as electricity is a vital element of automobiles, purchasers of the tubes might suppose the original Rolls-Royce Company had extended its high grade products to include radio tubes. And if the Rolls-Royce radio tubes proved unsatisfactory, it would tend to destroy, in the minds of the purchasers, the excellence of product for which the words "Rolls-Royce" heretofore stood.

They Had to Quit

The court further said in effect that it is quite possible the use of the name "Rolls-Royce" might lead uninformed persons to believe the original Rolls-Royce Company stands financially behind the Rolls-Royce Tube Company, which impression, in the event the radio tube business was not carried on successfully, might cause the name "Rolls-Royce" to suffer accordingly.

The use of the words "Rolls-Royce" in connection with radio tubes was, therefore, enjoined.

STATION WITH BIG VOICE

Continued from Previous Page

Cannot be Called Selfish

These are the days when all the Class B stations are clamoring for their "Place in the Moon" to paraphrase an old saying. Many of the biggest senders must share their time during the week with someone else on the same wave frequency. Yet here is one of the influential broadcasters who is content to take only one evening a week—to tell its story to the world.

WHAZ is unique in that it broadcasts for the entertainment of the public but once a week, from two to four hours on Monday evenings. It has no fixed broadcasting features—except the popular monthly programs by the students' symphony and dance orchestras and musical clubs, but its programs run the whole gamut of broadcasting. The station furnishes no regular news, sports or market services.

It Certainly Has a Big Voice

In the early days of general broadcasting, in February, 1923, this station hung up the long distance transmission record of four-fifths of the way around to the opposite point of the earth, nearly 10,000 miles to New Zealand, and that too under very ordinary conditions of Class B broadcasting. At the time it was using its regular wave of 790 kc. (379.5 meters) and with only 500 watts power. This station has earned the title of the "Transcontinental and International Broadcaster" from the fact that its programs have spanned the continent for approximately forty weeks a year for the last three years. Its broadcasts have been heard with great fidelity and regularity, as more than 30,000 letters and messages prove from coast to coast, from Alaska to Panama, and frequently in the Pacific islands, West Indies, South America, England and Continental Europe.

The Program Director, Rutherford Hayner (Fig. 1), who is also the sole announcer, has always sought unusual programs and unique features in radio, as becomes a college experimental station, and many novelties, some of which are now regular features of radio programs. The first minstrel show broadcast was in the WHAZ studio. The first Boy Scouts' evening, the first program of old-time songs, and one of the earliest radio plays were heard from here.

Have You Met "Hearies?"

The station introduced the "Hearies" in which plays were re-written and adapted for radio as they are for the "movies"; first all-Spanish program by Latin-American students heard as far south as Peru, first Far East program by Chinese, Japanese and Siamese students, first concert by all blind performers, the ringing before the microphone of the same bell with which Professor Joseph Henry in 1831 first transmitted signals at a distance by means of the electro-magnet, and the first radio pageant of the Revolution were among many others. "Personality" is put into the station by the program and participants rather than the announcer who merely tries to make what is going on in the studio intelligible.

Long distance transmissions from WHAZ are not mere chance "pick-ups" in which the call letters were made out laboriously and the rest an unintelligible jumble. Four successive broadcasts were heard in New Zealand. Chief Lone Eagle of Eagle Bar Ranch at Winett, Montana, requested a special program by the Campus Serenaders, students' dance orchestra, and sixty Indians danced to the music at the ranch. A college fraternity at Hotel Atwater, Catalina Islands, danced to music from the Troy studio, and at another time a group of cowboys in western Nebraska held a hop to its strains.

One graduate of the Institute makes it a point to entertain with much regularity, the public of his native city, San Salvador, Central America, with student programs from his alma mater by means of a loud speaker. A Harry Lauder imitator notified relatives in Scotland that he would sing on a certain night and they heard him. Receivers in the British Isles reported hearing WHAZ programs on seven successive Monday nights last winter.

Of course, the personnel of the station has a lot to do with getting the programs out to its host of listening friends. Two operators are constantly listening in to check up on the words and music. They are seen in Fig. 2, which shows the apparatus by which they keep the volume of tone on the air quite constant. If a speaker or singer happens to walk away from the microphone, then by turning a small knob, the reduced sound picked up is amplified more than usual so as to restore its tone. On the other hand, if the artist gets vigorous and lets out a few blood curdling yells the soft pedal is instantly applied in the form of this self same control knob.

A Gift from Roeblings

Of the broadcasting apparatus it is sufficient to state that it is the standard Western Electric 500-watt outfit, complete in every detail as revealed in Fig. 3. It was installed through a gift of the Roeblings, graduates of the Troy Tech, and famous as the builders of

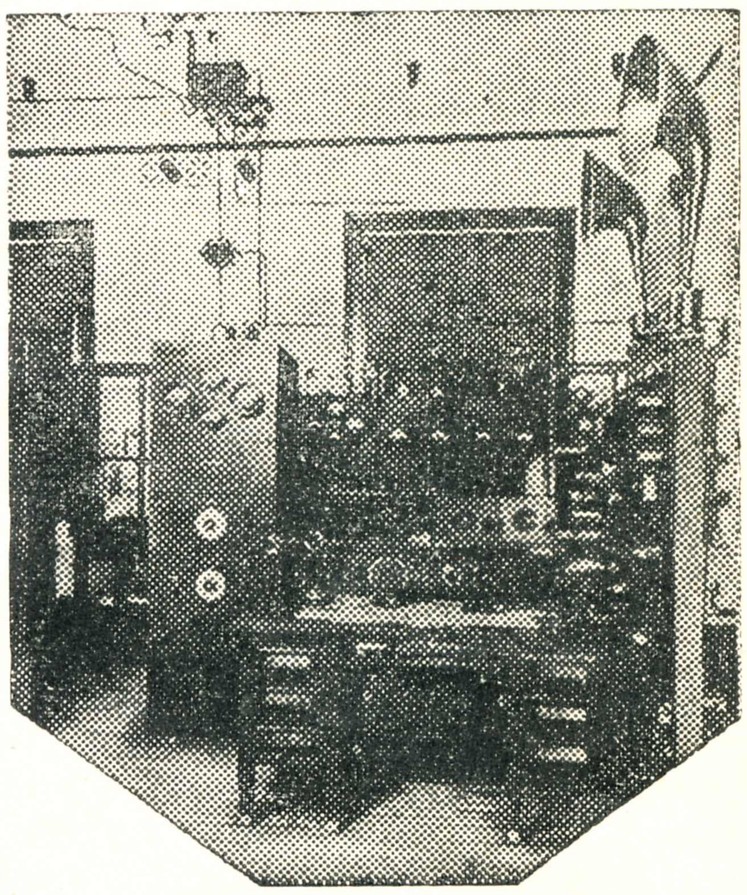


Fig. 3. One Corner of the Control Operating Room. Same Desk as in Fig. 2.

the Brooklyn Bridge. WHAZ is under the direction of Professor Wynant J. Williams, associate professor of electrical engineering in charge of the course in communication engineering, with a corps of instructor-operators, Harry R. Mimno, Hiram D. Harris and Bertram H. Carmer, Jr., each of whom has been engaged in radio experimentation from boyhood.

In physical equipment station WHAZ is similar to many other leading broadcasting stations of the country. Its ideal location is on the top of the big Sage building, one of the largest college electrical and mechanical laboratories in the country, at the crest of the beautiful hilltop campus, overlooking the Hudson River at the head of tidewater navigation, 150 miles from New York. The remarkable success of the station is credited chiefly to the superior skill of

the engineering experts in charge of its operation. The studio is attractive and in excellent taste, its walls being covered with soft gray draperies, floor heavily carpeted and ceiling with a double perforated covering preventing reverberation or undue echo.

Regular Midnight Programs

Naturally the programs by the students of the Rensselaer Polytechnic Institute on the last Monday evening of each month with a midnight program on the second Mondays have become a popular feature of WHAZ broadcasts. The Symphony Orchestra, Campus Serenaders dance orchestra, Fig. 4, Glee Club and individual students participate. While the purpose of this sending station is not merely to entertain, it has done that so well as to receive the commendation of every type of radio listener through its always varied and unusual programs.

Of course, educational features find an important place in the broadcasts in a way that makes them interesting as well as instructive. Members of the faculty contribute practical and non-technical talks on subjects of current interest in the scientific and engineering field and prominent speakers are frequently heard on topics of the day.

A Radio Antique

As an engineering college in which electrical and communication engineering is one of the major courses, Rensselaer Polytechnic Institute radio department has a remarkable equipment embracing practically every variety of apparatus. There are numerous slow and fast (long and short) wave transmitters and receivers. Transmission and experimentation is almost continuous. The equipment includes the first wireless telephone equipment ever sold—an old DeForest set—by means of which Professor Williams delivered a lecture to students as far back as 1910, long before the general public knew anything of radio broadcasting. There is a Marconi wireless telegraph set of 1902, including a coherer of the original type, a German Telefunken system wireless outfit, and all the infinite variety of apparatus that has been developed in the intervening years down to the very latest improved devices.

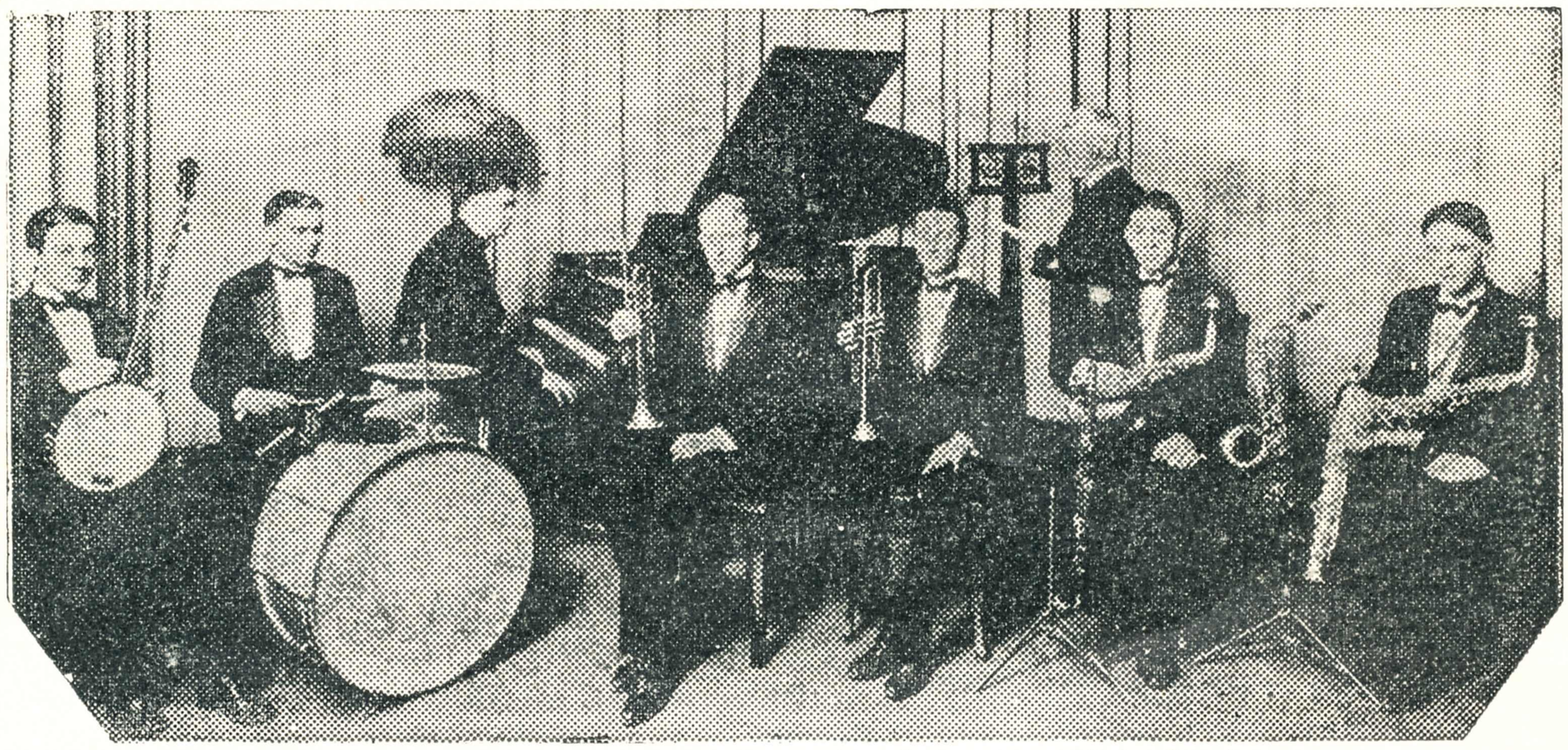


Fig. 4. Here is One of the Favorite Groups at This Station. It is the Campus Serenaders, All of Them Students Here.

BELGIUM JOINS GLOBE CLUB

For the first time in the history of amateur radio transmission a Belgium station has succeeded in overcoming the distance half-way around the world to New Zealand and the New Zealand station has answered. While New Zealand and English stations had been in communication several times before, this was the first time that the Belgian-New Zealand link has been closed.

Station 4YZ, owned and operated by Engineer A. Courtois of Verviers, Belgium, holds the distinction at one end, while Ivan O'Meara of Gisbourne, New Zealand, successfully handled the other end of the record-breaking test.

Engineer Courtois, who is vice-president of the Radio Club Belge, started work on 6,670 kc. (45 meters) using 64 watts power. At 5:30 A. M. he received his first reply from O'Meara.

HAVE YOU HEARD SKINNY-DE-DE?

A. M. Creighton, a Lynn, Mass., manufacturer, returned recently from a hunting trip into British East Africa, and reported finding a radio receiving set near a tiny native village. The owner, when asked if he had ever heard an American station, replied:

"We had some place in the United States called Skinny-de-de."

After considerable questioning, Mr. Creighton found that the man had heard WGY at Schenectady, N. Y.

Keeping in with India

England is planning a new high-power radio station at Winthorpe, near Skegness, on the east coast. This station, when completed, is expected to be used for communication with Australia and India.

BURNING AWNING BEATS SOPRANO

Recently the operators of WJZ had a chance to show their ability as fire fighters. An awning near the studio caught fire from a cigarette butt. The flames were noticed and the control room operator was called with a fire extinguisher. The fire was extinguished with no loss other than that of the awning itself, and the city fire department was not even notified.

The station operator considers that flames are easier to control than a hot soprano.

LOOK OUT FOR FIRE

The vacuum-type ligthning arrestor is generally considered the best. Before installing the arrestor the underwriters' rules for your locality should be consulted.

Putting Up a First-Class Aerial

It Must be Kept in Good Shape, Too, for Best Results

By W. S. STANDIFORD, Youngstown, Ohio.

Once there was a fisherman who cast his net in the ocean and then left it. He went around a year later to gather in the fish.

You may think this fisherman was not so wise, but many a person puts up his aerial and then proceeds to forget it. To be sure a year later it is still bringing in the concerts. However, if he would take a little time once every six months or so, the chances are that his music would be clearer and louder.

A Good Aerial Needed

As increasing numbers of persons new to the "radio game" are building and operating radio receivers, the following practical pointers on how to erect your antenna will, no doubt, be of interest, especially to the newcomers. In the brief time since broadcasting began, many amateurs have been able to construct good working instruments, thanks to the wiring diagrams and other information published in the magazines.

There is one drawback to this rapid advance. There seems to be a dearth of information on aerials, their care, and how to keep them in good condition, writers concentrating on the construction of radio outfits and various new hook-ups. At the present stage of the art, your antenna, whether of the loop, or ordinary outside type, plays an important part in the reception of the broadcast concerts, so it will readily be seen that it is of the utmost importance to keep your aerial wire in good shape in order to obtain all the enjoyment possible from your outfit. Every year it is advisable to wipe off all accumulations of smoke, corrosion, and dust from your aerial insulators, otherwise part of the electricity sent out from the broadcasting stations will leak off to the ground by way of the house or supporting wires.

Guarding Wayward Waves

Fig. 1 shows the idea of this leakage. The aerial and lead-in are insulated from the supporting pole by an insulator of porcelain, glass, or moulding material. The radio waves coming from the aerial are supposed to travel down the lead-in to your set. For the most part this is what happens, but if there is a conducting path over the surface of the insulator, then a proportion of the power coming in from the antenna will flow over the surface of the insulator and down the pole or other support to ground.

The amount you lose in this way will naturally be more or less, depending how conducting the dirt on the insulator becomes. If, instead of a metal pole, a wooden part of a house or barn is used as a support, then in dry weather the wood itself will act as insulator and largely reduce the leakage current. But wood that has been water soaked by rain becomes a fairly good conductor for the aerial waves, and after a storm you must rely entirely on the insulator to keep your radio waves from straying off their regular path.

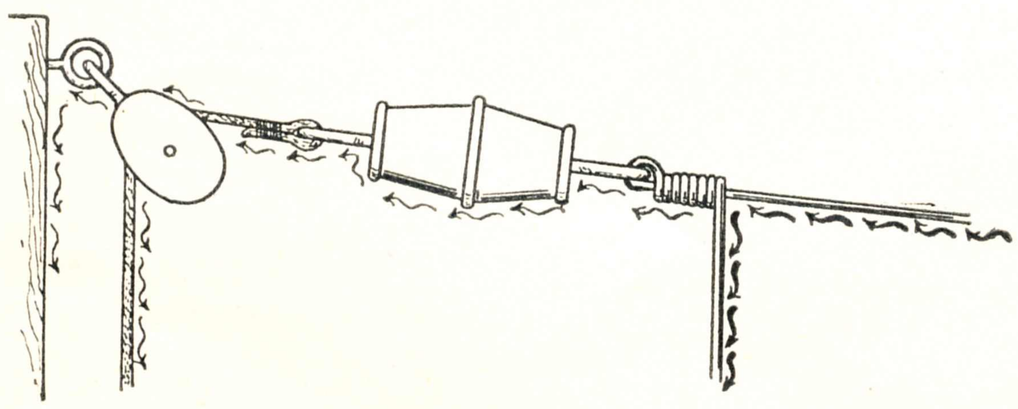


Fig. 1. With Leaky Insulators the Incoming Waves Divide, Some Through Lead-in—the Rest Wasted.

Damp Days Fool Fans

Damp weather causes more leakage than a dry atmosphere. It is characteristic of electricity that it will always take a short cut if possible. These facts are ignored by many amateur radio fans, as they consider when once an antenna is strung up in position with good insulators, that it requires no further looking after. Many times they blame the loss of signal strength on some other part of their receiver when, as a matter of fact, the cause is due to dirty or broken aerial insulators.

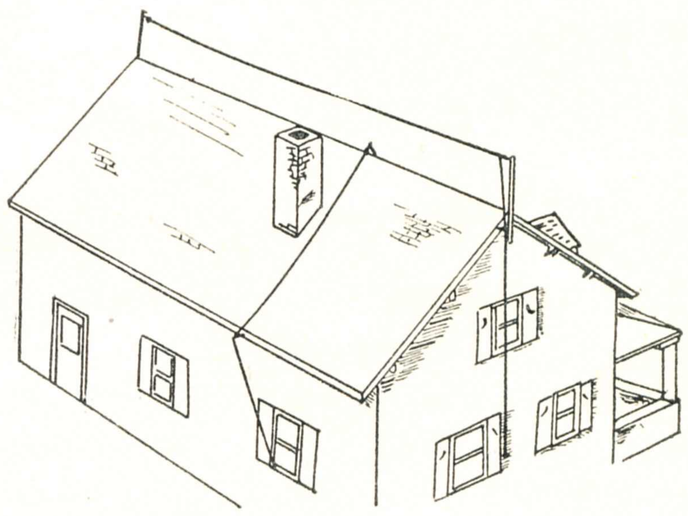


Fig. 2. The Best Way of Supporting Two Aerials on the Same Roof.

Newcomers in radio construction who live in the same building often connect their receiving instruments to the same antenna so as to save extra work and expense, and then wonder why their sets do not run satisfactorily. If both receivers are crystal sets and both listeners want to hear the same station, this double hook-up will sometimes work very nicely.

An Electrical Shake Up

If one or more tube sets are connected to the same wire, then the trouble begins. The aerial, you will remember, vibrates at the same frequency as the incoming radio waves. To be sure this is not a mechanical oscillation, in which the particles of metal shake first up and then down. Instead it is an electrical pulsation and the wire conducts currents of electricity forward and back at

the rate of about a million times every second.

When two radio sets are attached in parallel the combination does not vibrate readily at the wave frequencies, which are sought for by the listener. Each set has a very pronounced effect on the tuning of its neighbor, and so if each one is adjusted to a point which would naturally give a certain wave then the two together will no longer pick up that wave, but some other entirely different.

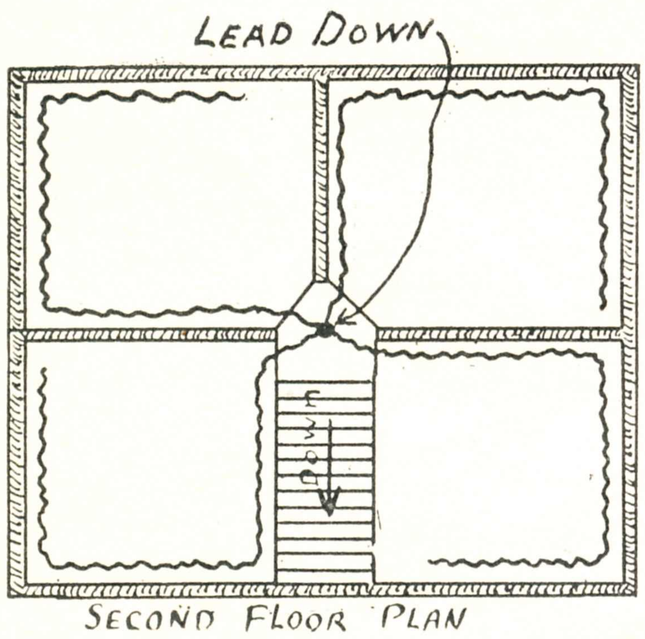


Fig. 3. For a Two-Story House, This Indoor Aerial is Practically as Good as an Outside One.

If one outfit is adjusted to one wave and the other to a different one, then there will be even more of a mix-up and the interference between the two sets will be so great that neither program can be brought in.

When Both Want the Air

If the two sets are in use in the same building and both radio novices would like to listen-in to the broadcast concerts, then how shall aerial equipment be provided? There are two possible methods by which this can be accomplished. The first is to erect two outside antennas on the same roof. This will work well with the crystal sets and no trouble will be experienced, even if they are placed quite close together.

Tube outfits can also be used if their antennas are spaced far apart and run in different directions from each other. In connection with this type of apparatus it ought to be remembered, however, that regenerative sets with their ticklers turned up too high are actually transmitting continuous waves at the same time that they are receiving, and so if it should happen that two sets tuned at different wave lengths are using separate aerials in close proximity to one another, there will be interference.

Takes Joy Out of Life

The house, which is shown in Fig. 2, has two aerials which are at right angles and separated as far as possible. It might even be better for the one which runs along the ridge pole to be brought a few feet down on the farther side of the slope, and thus put three or four feet between the two systems. Such an arrangement will not prevent a squealing receiver from disturbing the other. Indeed such an oscillating outfit will take all the pleasure out of listening for neighbors within one or two blocks. But at least it will reduce the interference between the two aerials to as low a value as is possible.

The other method is in the use of a small antenna inside of the building, preferably in the room where the set is located. The loop type is most selective for interior work, and it is being used more extensively every year. It should be on a pivot so as to swing around in the direction of the broadcasting stations so that an edge of the loop is facing in the direction of the incoming waves, and not broadside to them, as then reception will not take place. Another factor in regard to a loop aerial located in a room in an apartment house, which is equipped with an electric elevator, is that whenever the latter is in operation, a snapping sound will probably be heard in the phones, which is due to the make and break of the contacts in the elevator controller.

Steel Robs the Waves

Novices must remember, however, that an indoor aerial never gives as good results in regard to loudness of signals as an outdoor one. This is partly due to the absorption effects of the electrical wiring in the house or the steel framework, if the aerial is located in a large building. But the broadcasting stations are beginning to use more powerful sending apparatus with the result that the signals are coming in stronger and with a louder volume than was formerly the case, when weak transmitters were used, so loop aerials are being employed more extensively.

Do not try to use a loop aerial for your set if it was not designed to fit it. Most sets do not show good results at all unless an antenna at least fifty feet or longer is attached to the aerial post. Two or three radio frequency amplifier steps are needed ahead of the detector to make a signal loud enough to work the detector properly if a loop is employed. Even sets built on the neutrodyne principle, with two steps of RF amplification, will not give satisfactory results without 50 or more feet of wire.

Don't Make It a Loop

Of course the inside aerial is also quite popular. It may be run on the ceiling of the same floor on which the set is located, but is much more efficient if it can be installed in the story above. It is best to have it go around three sides of the room, rather than come back on itself, making a complete loop. It is also well to have it pick up the waves from two or more different rooms.

In the case of an ordinary style of house, with the set on the ground floor, and four rooms in the second story, the lead-in may run up the stair-case, or through a hole drilled in the ceiling, to the center of the upstairs rooms where a branch can be taken off into each bedroom. Fig. 3 shows such a scheme, which is very efficient.

When to Omit Arrester

There is one good thing about indoor aerials, and that is that they do not need lightning protection, being as safe as a storage battery in this respect. Pivoted loop antennas also make fine direction finders, so that any broadcasting station can be tuned out or heard by merely turning the loop around until the signals are received the loudest.

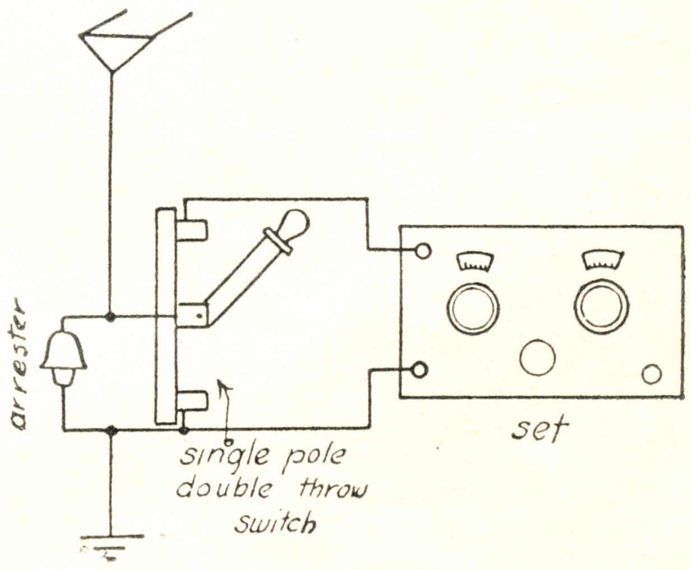


Fig. 4. Combining the Lightning Arrester with the Grounding Switch.

For receiving with loop aerials, stranded copper wire is better than

stranded bronze wire of the same size, as the resistance of the bronze wire is several times greater than that of copper. Bronze is sometimes used on outside work where the aerial is very long or subjected to a great deal of strain, as on shipboard.

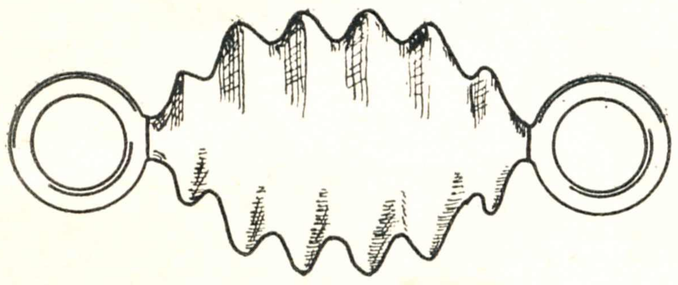


Fig. 5. A Ball Insulater is Sometimes Made of Shellac Compound.

Outside aerials should have a lightning arrester connected between the lead-in wire and the ground; it is good practice to include a large single-pole, double-throw switch rated at 100 amperes and 600 volts capacity to protect the set as well. Then, in case you forget to ground the aerial after the concert is over, the lightning arrester will protect your set from damage. The ground wire should be copper and not smaller than No. 14 guage, and to afford the proper protection, it must run as straight as possible to a good permanent ground.

Detouring a Bolt

Fig. 4 shows the combination of switch and lightning arrester. Notice that the arrester is directly in the line from aerial to ground, and no matter what the condition of the switch or set, a bolt of lightning can pass directly from the aerial to ground without depending on either switch or other wiring. When the handle is thrown up, the aerial is connected to the set for receiving. When it is *down*, the set is disconnected and the arrester is short circuited. The advantage is that a severe stroke of lightning might perhaps injure the arrester if it passed through, but with the switch short circuiting it, no danger will result.

Connection to a water-pipe makes an ideal ground, but a gas pipe is forbidden by the Fire Underwriters for this purpose. Inspect your lightning switch arrester terminals and the lead-in and ground wires at points of contact so as to see that they have not corroded. Should they be merely blackened, brighten them up with fine sandpaper. If they are found to be badly corroded, replace them with new terminals, as it is much better not to run any risk. This also applies to the lightning arrester and switch, if they are in bad shape, as corrosion makes high resistance to the electrical current.

Omit the Soldered Joint

In erecting single-wire aerials, many radio novices, as well as some of the more experienced ones, end their aerial wire at the house insulator and then solder on a separate wire to be used as a lead-in. This is not the best practice, it being better from an efficiency standpoint to eliminate outside joints as much as possible. Have your antenna wire of sufficient length to pass through the ring in one end of the house insulator; then wrap it a few turns around itself, close to the ring, to prevent its loosening; then use the rest of it for a lead-in.

In soldering any aerial or other wires in receiving sets, avoid using an acid flux solder. Use a rosin core solder and prevent noises in your set, which later on are sure to occur if an acid flux is employed. Opinions seem to differ as to which is the best material for aerial insulators; some prefer glazed porcelain and others Electrose. A poor insulator shows a porous surface caused by a shellac-like compound, and it should be avoided, no matter how attractive the price may be. A high grade insulator is one that has a smooth glazed surface, sturdy construction and a long leakage path. The Navy type of ball insulator, made of Electrose and having corrugations (Fig. 5), is an excellent design, as it offers a high resistance to electrical leakage.

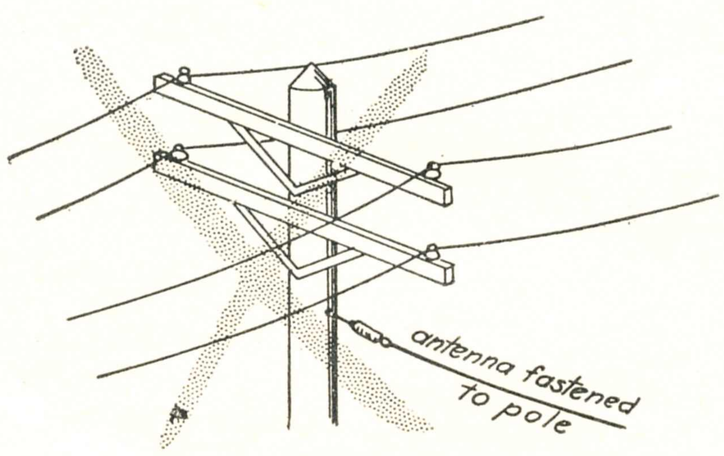


Fig. 6. If You Do This You May be Killed.

Swings Cause the Fading

Aerial wires should be held taut by means of a spring, so that they will not sway sideways in the wind. If it swings in the wind very much, it causes a change in the frequency; this means that a set would be no longer exactly in tune, thus reducing the loudness of the signals and producing an apparent fading.

Fig. 6 illustrates a practice common among some newcomers in the radio game, of stringing the aerial to an electric light wire pole. This is a very bad practice, as it is necessary to keep the antenna away from all power circuits. Only in this way can you prevent death, or the burning out of the wires in a receiver in case the power wire should touch the antenna.

EGGS ON THE ETHER

The type of assistance given by transmitting radio amateurs to other members of the community is well illustrated by the system in use between Station 9DKS of Madison, Wis., owned and operated by Herbert O. Brickson, and Station 9DTK of Milwaukee, Wis., belonging to and run by Fred W. Catel. Both men are prominent members of the Traffic Department of the American Radio Relay League, and they operate their stations on the plan of accomplishing the greatest good for the community.

Each day Catel secures reports on the butter and egg market in Milwaukee and lists of livestock prices, which he transmits to Brickson. The latter turns over this information to radio broadcasting station WLBL, operated by the Wisconsin State Department of Markets at Stevens Point. Here the broadcasting station puts the news on the air by voice, in order that all of the farmers of the state may have the latest and most accurate market information without delay. The entire transaction from the time Catel secures the news, until it is sent over the ether from WLBL, consumes only a few minutes.

The farmers within the hearing of the broadcasting station's voice have been strong in their praise of the work, and the assistance that it gives them helps a great deal in the proper marketing of their farm products.

Portraits of Popular Performers

New Lights at K D K A

"International Art" is the subject of a series of six radio talks which Homer Saint-Gaudens is giving from the University of Pittsburgh radio station of Station KDKA each Monday evening, the last to be given November 23.

Homer Saint-Gaudens

Mr. Saint-Gaudens, who is director of Fine Arts at Carnegie Institute, is the son of the late Augustus Saint-Gaudens, one of the greatest of American sculptors.

For ten years previous to his coming to Pittsburgh, Mr. Saint-Gaudens gave much of his time to the production of standard plays such as "A Kiss for Cinderella" in which Maude Adams took part; Brieux, "The Red Robe," in which Lionel Barrymore took part, and "Beyond the Horizon" by Eugene O'Neil, in which Richard Bennett played. Since 1922 Mr. Saint-Gaudens has been Fine Arts Director at Carnegie Institute.

Particular interest is attached to the talks which Mr. Saint-Gaudens gives from the University studio because they are broadcast shortly after the opening of the Twenty-fourth Carnegie Institute International, and they are given by the man who is responsible for the exhibition. Mr. Saint-Gaudens spent four months in Europe during the past summer collecting paintings for this exhibition. The International, which opened on October 15 and will continue through December 6, is the largest but one in the history of the Institute. Over five hundred paintings representing thirteen nations are being shown.

Not only is the exhibition larger than usual, but this year a special effort has been made to secure the latest and most important work of the foremost artists of the world. Many of the European paintings come to Carnegie direct from famous galleries and important exhibitions, as for instance, the Paris Salon, Royal Academy, London; Prado Museum, Madrid, and the National Gallery, Canada.

FREDERICK G. RODGERS

Frederick G. Rodgers, nationally known announcer and baritone soloist of Station KDKA, who appears before the microphone each Monday evening, introducing and taking part in the Spear Happy Home Hour.

Mr. Rodgers began his musical career when a boy, attending the Durham University at England and studying voice with Edwin Kellett, senior tenor lay clerk at Durham Cathedral. Since coming to America, he has had considerable stage experience, appearing in light opera, having taken part in the "Chocolate Soldier" as Colonel Popoff, in "Mikado" as Ko Ko, "H. M. S. Pinafore" as Dick Deadeye, and in Victor Herbert's "Eileen" as Colonel Lester.

Radio On The Job As Nurse

The Red Cross Is Sending Out Good Radio Programs

By DOUGLASS GRIESEMER, Washington

AFTER you have helped your friend out of some trouble, it is only reasonable to expect that he will give you a hand some day when you need it.

Many a time the American Red Cross has had a lift from the services of radio waves. Whenever a serious calamity like a fire or tornado or earthquake strikes some town, the first arrivals on the scene are the agents of the Red Cross. How did they know about the disaster?

The Red Cross Turns About

In times gone by when the wires were all down, the only way of getting news to the outside world was by messenger. This might delay the arrival of help for some little time. Such waits are no longer experienced as inside the stricken district one or two amateurs will get together and send out code messages describing the horror and asking for help. If radio has been aiding the Red Cross in getting them the news, it is only fair that by turning about the latter has contributed its bit to radio programs.

One of the first services which the Red Cross did was that of supplying "daily dozen" exercises to be broadcast every morning. Perhaps you have hopped out of bed around 7 o'clock or 7:30 and have had the invigorating feeling which comes from swinging through the exercises to the snappy music of the daily dozen. But that is not all.

Keeping Ahead of Doctor

It has now gone a step farther not only by teaching the well how to keep fit, but by offering instruction to the healthy and strong as to how to treat the sick and weak. It is giving instructions also on how the home should be cared for in order to keep the whole family up to a high health standard.

By a co-ordination of the efforts of the broadcasting stations and the American Red Cross, the Red Cross lessons in Home Hygiene and Care of the Sick have been sent out to many sections of the country. The farmer listens in, as does the city dweller; more often than not he heeds the advice given with the result that American health standards are being raised almost daily.

Fig. 1. The Newsboys Compete with Radio in Spreading the Good Work of the Red Cross.

WJAR One of the First

A notable example of success is that attained by the Providence, Rhode Island Chapter of the Red Cross, broadcasting through WJAR, the Outlet Company.

Fifteen minutes are allowed every Tuesday evening for six weeks for talks on Home Hygiene. The lectures tell just why the course is useful to every household. They outline the phases of the subject covered and give a general resume without going into the technical details.

The following letter, one of hundreds sent in to the station, shows the general trend of sentiment in regard to the instruction given:

"When I first heard of the classes in Home Hygiene and Care of the Sick, I thought I should like to have some practical knowledge of nursing, but I was almost afraid to join, as my duties as housekeeper and the mother of three children, did not allow me much spare time for lessons or for study. Having joined the classes I was surprised to find how interesting the work was. The text book we received contains much valuable information, but in the class the nurse explains all the terms so plainly and gives so many valuable instructions that it is made more interesting and of greater value to the pupils.

Her Own Boy Fell Sick

"During my course of instruction my little boy was taken sick with measles, and I found the knowledge that I had gained was of the greatest help to me in caring for him, in making him more comfortable, in feeding him, in taking his temperature, and in detecting the presence of fever. Of course I had had some experience in caring for children in sickness, but it had always been a case of guesswork, filled with uncertainty. Now I felt that I was caring for my boy almost as well as if I had a trained nurse for him.

"I would advise every mother to spare two hours once a week for this class, for I know she will feel well repaid. Any young girl, too, will find the instruction useful, for there is always a time when we are called upon to assume the duties of nursing."

Lots of Peace Time Work

Instructions in Home Hygiene and Care of the Sick is an important part of the Red Cross health program. During the year it gave such instruction to 67,281 persons. In its peace-time mission the Red Cross finds much other work to do in its disaster relief program, its services to disabled veterans of the World War, and to the men of the regular Army and Navy and their families, in the nutrition education offered, in the campaign for safety and accident prevention, carried on by the Red Cross Life Savings Corps, in its class in first aid to the injured and in the altruistic work of the American Junior Red Cross.

In broadcasting the news that the Ninth Annual Roll Call will be held from Armistice Day to Thanksgiving, November 11 to 26, the Red Cross does so in the hope that the radio audiences of the country will not only listen in, but respond by joining.

Our illustration, Fig. 1, shows one of the posters which is being put out in the interests of this fine organization. Most every radio fan will feel that he wants to give from $1.00 up to become a member of the American Red Cross.

"LOPEZ SPEAKING" ONCE MORE

Vincent Lopez has returned to the good old U. S. A. and is back on the air again playing through WEAF every Tuesday, Thursday and Saturday from the Hotel Pennsylvania. One of the pioneers of radio broadcasting, whose "Lopez speaking" is famous throughout the country, Lopez returned to New York on the S. S. Paris following an unusually successful engagement at the immense London "Hippodrome" and at the famous Kit Kat Club.

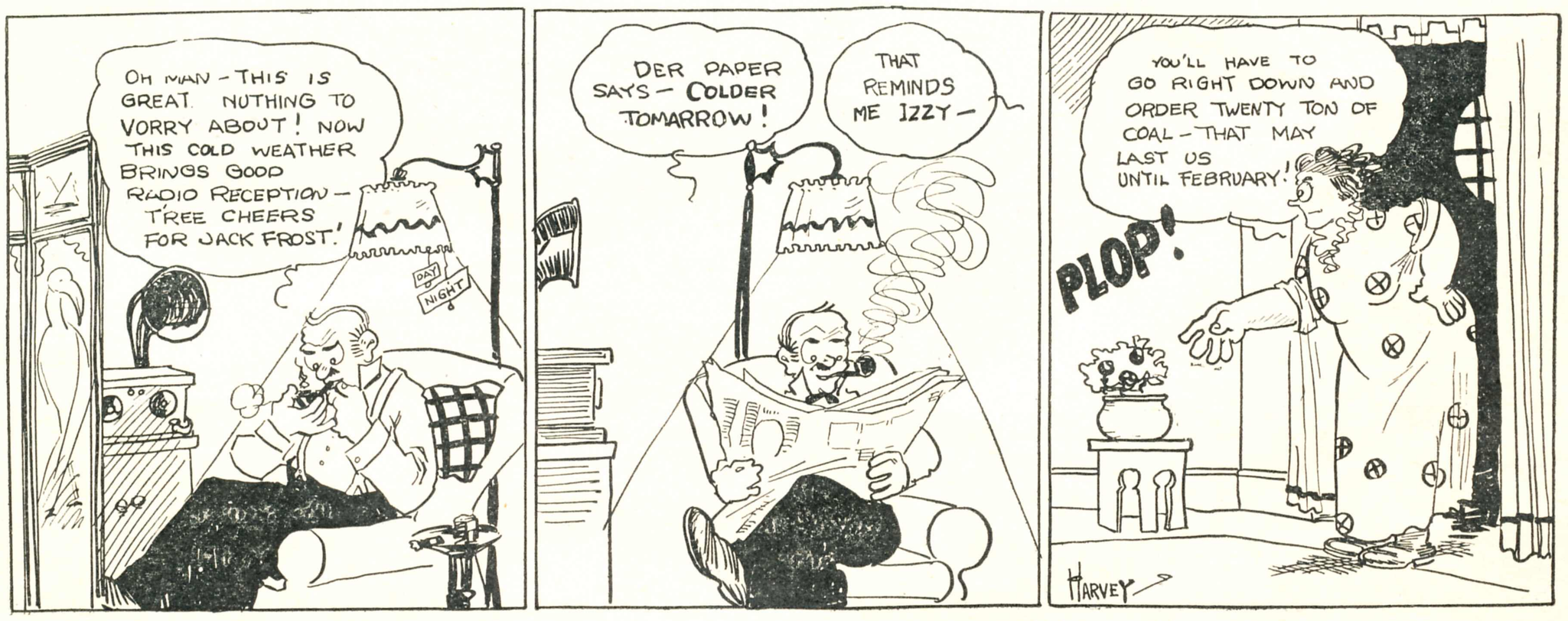
Although the sole attraction in a theatre ordinarily the home of spectacular operattas, and in spite of what is generally considered the unfavorable season of the year by the box office men, the Lopez Orchestra proved a sufficient drawing card to fill most of the 3,000 seats daily. His friends in America, a large number of whom are included in his radio audience, have deluged him with mail and telegrams wishing him a sincere "Welcome Home."

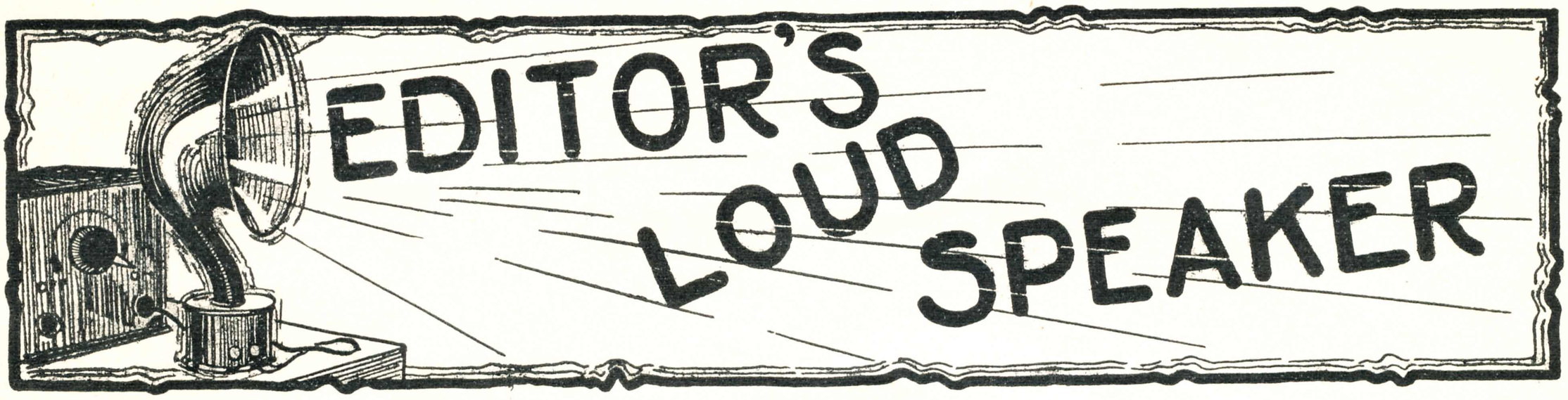
THE TOWN DOES THIS

A community radio set is being operated at the town of Roann, Ind., to furnish entertainment for the 500 people in the village and country nearby.

The village also has community motion picture shows, and sometimes the radio set is operated while the pictures are being shown.

IZZY A. NUTT. Now He Wishes He Had Kept Still. By Harvey





A JAIL SENTENCE

Radio is usually regarded as such a good influence in the world —who would imagine that it would be sent to prison.

Yet this is what is happening pretty regularly at many of the penal institutions of the country. Take the case of the famous prison, Sing-Sing, for instance. Recently two of the popular radio stars from WJZ, Godfrey Ludlow, the Australian violinist, and Keith McLeod, pianist and manager of the broadcasting station, appeared in person in a special concert for the prisoners.

Pleasant Jails?

It is a question with some people whether a prison ought to be made at all attractive, as they think that the idea of punishment should be to make conditions so disagreeable that the prisoners at release would go straight rather than risk the danger of a return to the jail.

However, a more modern view of this punishment seems to be to make the stay of the prisoner undesirable from the point of view of taking away his freedom. In the meantime such refining and humanizing influences are exerted on him as will tend to make him more like normal when he is finally released.

Along these lines it is found that the occasional use of concerts and such entertainments has a very good effect on the morale of the inmates. The concert which was given by the two artists we have just mentioned was quite a success. The performers agreed that they never had had a more appreciative audience.

Mail is Censored

Since that time a large amount of mail has arrived at the broadcasting station thanking the musicians for the enjoyment which they gave. This gratitude is especially touching as coming from a prisoner since the number of letters which they are allowed to send is strictly limited by law.

The next time you are asked to send an applause card for a particularly good entertainment and feel inclined to let the other fellow do it, just think of these convicts. *They* were willing to write in spite of the fact that such a letter meant that they were forbidden to communicate with some friend or relative whom they otherwise might have addressed, because their allotment was used up.

FOILING THE EARTHQUAKE

Earthquakes sometimes do a lot of good. At least that is what insurance men on the West Coast are perhaps beginning to feel since it is reported that no big undertaking out there can get any money from the banks unless earthquake insurance is taken out.

But we are not the only ones who must consider this proposition. The Japanese, particularly, have suffered very severely because of the tremendous damage done by the tremblers. One of the serious troubles, aside from the actual destruction of buildings is the fact that communication is immediately cut off from the strickened districts. Of course all the cables and air lines are immediately destroyed and so it is

WOMEN BEAT THE MEN

We often think of radio as being more interesting to the men. It is certain that the boys of America have done more set building than any other class.

However, when it comes to the intricate careful work of assembling radio sets, its seems that the women shine more than the men. Here is a school conducted by the Crosley Company for training prospective assemblers of radio sets.

impossible for outside help to be directed intelligently.

To the Rescue

The Japanese Government, through their department of communication, have been studying this matter recently and have arrived at a plan which they think will at least keep the outside areas in touch with any troubled districts.

In general this consists of radio stations installed at strategic points all through the Empire. These stations are hooked up with telephone and telegraph lines running in various directions. Also through the centers of populated districts posts are established where expert operators can get in touch with the radio centers just mentioned. In the event of a catastrophe, several such operators will be available to connect with the land lines through the link of radio. Let us hope it will be a long time before the efficiency of this system is ever tested.

MAKING IT ALL MOLASSES

There is a story of the time back when sugar was hardly known as an ingredient for sweetening the breakfast coffee and molasses was used instead.

The minister came for breakfast to a poor man's house. When serving his coffee the hostess kept pouring in molasses. "That will do, that's quite enough, thank you," said the minister, and the woman replied, "It wouldn't be enough for the *minister* if it were all molasses," as she continued to pour it in.

Wire and Mantle

Whether or not the same idea will obtain with a new invention, remains to be seen. You no doubt recall that the peculiar thing about the filament of the 201A and the 199 tube is the particular kind of filament used. The wire is made up of an alloy with a small percentage of thorium in it. This latter element is a metal and is well known as one of the ingredients of the ordinary gas mantle.

When this constituent is eventually burned out of a mantle the latter stops its radiation of light to a very great extent. Although it continues to glow and send out heat, its useful radiation (light) has practically stopped. And in the same way when the thorium is burned out of the vacuum tube filament it also loses its useful radiation although it continues to glow when the "A" battery is turned on.

As Good as New

Since the useful part of the filament is the thorium, and even after the latter is all used up, the alloy which held it is still doing business at the old stand, it would seem reasonable to think that it would be an improvement if the whole filament could be made of thorium. In such a case it would appear that after the surface was used up, a new thorium layer would be revealed underneath to keep up the good work. Or to put it in another way, "Use the surface and you use all."

At least one reason why this has not been done in the past is that there has been no known way of making thorium into a wire. It could be used as an ingredient in making up an alloy, but would not stand by itself.

It is particularly interesting at this time to hear from the Westinghouse Lamp Company that they have discovered a method of making ductile thorium wire which can be drawn down to the size used in making filaments. It is still too early to tell whether vacuum tubes using this for one of the elements will have the tremendously long life which would seem to be indicated. However, it looks as if a promising clue to a big new development had been discovered.

HE WINS THE BROWN DERBY

An interested broadcast listener recently happened upon an unusual coincidence in programs. His letter explains the incident as follows:

"I was enjoying from WJZ, New York, an offering entitled 'June Brought the Roses.' I tuned in on WEAF, New York, for a moment and again heard 'June Brought the Roses.' By turning back to WJZ and humming the air in WEAF's tempo during the operation, I landed precisely on the same note at WJZ. I repeated, going this time back to WEAF with the same result.

"A difference of only a few seconds' delay in WEAF's announcer following that of WJZ, permitted me to hear that each number had been an encore. If you will be kind enough to check me up and in the event that this occurence was not manipulated, possibly for experimental purposes, will you be good enough, to award me the 'Brown Derby' for picking up the unusual in programs?"

Let it be said that the check-up has been made and that the incident was not intentional and the "Brown Derby" has found its proper owner.

GETS 70 MILES PER WATT

The tedious watches of the ice-berg patrol of the Coast Guard Cutters Tampa and Modoc were relieved to a great extent by recent contact established between amateur radio station 1BQQ of Mansfield, Mass., and the radio stations on the two ships.

The work of these ice patrols is lonely and the problem of getting personal messages back and forth between the men and their families ashore is not readily met through the busy staffs of regular naval or commercial stations. This problem was solved by George Howard, owner and operator of Station 1BQQ, who arranged a nightly schedule with the patrol boats. Messages from the men to their families and the replies from home were both handled through the local station.

A remarkable phase of the work was the low power used by Howard on his 1,940 kilocycle (154 meters) wave length. With a 20-watt transmitter, Howard managed to carry out a reliable schedule over distances varying from 1,000 to 1,400 miles.

What Do You Mean by Modulation?

It Measures How Much of the Sending Power is Used!

An Interview with HARRY SANDEWATER

DID you ever send a telegram to a broadcasting station about half way across the Continent as applause for a good program? Perhaps you said "Modulation is perfect."

Many people use that word when what they mean is that the tone or the quality of speech is perfect. The modulation, as we shall see, is really not a measure of how good and clear the tones of the music come through. It is more of an

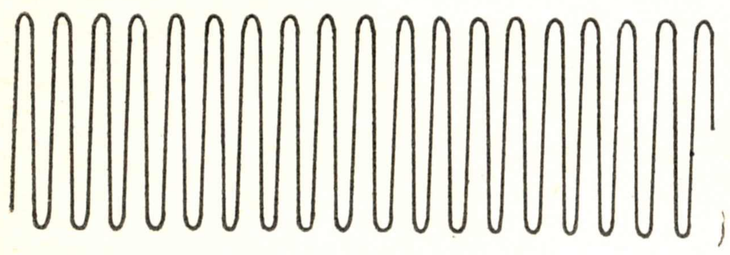


Fig. 1. This is the Carrier Wave Before Connecting the Microphone.

indication of whether the sending station is making good use of all the energy which the oscillator is putting into the aerial.

Loudness of the Carrier

To understand the word "modulation" you will want to recall the facts about the carrier wave. This is a vibration sent out by the oscillator and is a continuous note of the same loudness until it is modified. By "note" is meant the sort of tone which our ears *would* hear if they could work at the tremendously high speed of these pulsations.

This vibration speed is the one which is assigned to the stations by the Department of Commerce. WGY, Schenectady, has been given the figures of 790,000 oscillations per second (790 kc.) An average figure of all the broadcasters might be somewhere around 1,000,000 per second, which happens to be the vibration speed of WPG, Atlantic City. Our ear drums are large enough so that they cannot take up such tremendously fast waves and so we never hear the carrier wave. Indeed, there are mighty few men who can hear as high up as 10,000 oscillations per second (10 kilocycles).

Crowded at High Speeds

This carrier wave is illustrated in Fig. 1. The height up and down of the hills and valleys is a measure of the loudness or amount of power in the waves. A small height would show a weak station, while a powerful broadcaster would naturally have a curve with considerable up and down height. The number of waves in a given length (say the number per inch) is proportional to the frequency or kilocycles. With a high speed wave they are crowded together, while a very slow vibration like KSD, St. Louis, running only 550 kc., will have a wide spacing. These waves are sent out continuously from the instant the broadcasting station goes on the air. With an average of 1,000,000 per second, you see there will be the tremendous number of over three billion hills and valleys every hour of sending.

Now suppose that the microphone in the studio picks up some music. The vibration speed of the air waves for the ordinary singer varies from 100 up to 1,000 oscillations a second. The notes of the piano run up to several thousand. Such a curve of a constant note sung in front of the microphone appears in Fig. 2. This wave also has the loudness indicated by the height and the frequency, or pitch, by the spacing. To be exact the spacing is out of scale with Fig. 1, since there ought to be several thousand of the radio frequency waves to one of the audio. This would take up altogether too much room on the page, however, and so the diagrams are drawn to to get them into a reasonable length.

Fig. 2. The Artist Before the Mike Produces This Sound Wave.

Changing Height of Peaks

When the audio wave, Fig. 2, is run through the transmitting tube it changes the height of the waves of the latter so they look like Fig. 3. Notice that the voice or audio wave length is just the same as before, and that the radio wave length is also unchanged. It is only the heights of the peaks and valleys which is modified. This is called "Modulation."

Have you ever seen a gang of men tamping down broken stone when they were mending a hole in the road? Each man has a heavy, flat iron weight with a long handle and he raises this and drops it on the stones. The weight of the iron is important, of course, but the distance he lifts it up and lets it fall again is just as important. A lazy man, who will raise his iron only an inch or two will not accomplish a great deal, even though the weight itself is quite heavy or powerful.

When the Wave is Lazy

In the same way the carrier waves of Fig. 1 may be quite powerful, but if the modulation is only a slight amount, less than in Fig. 2, it will cause only a

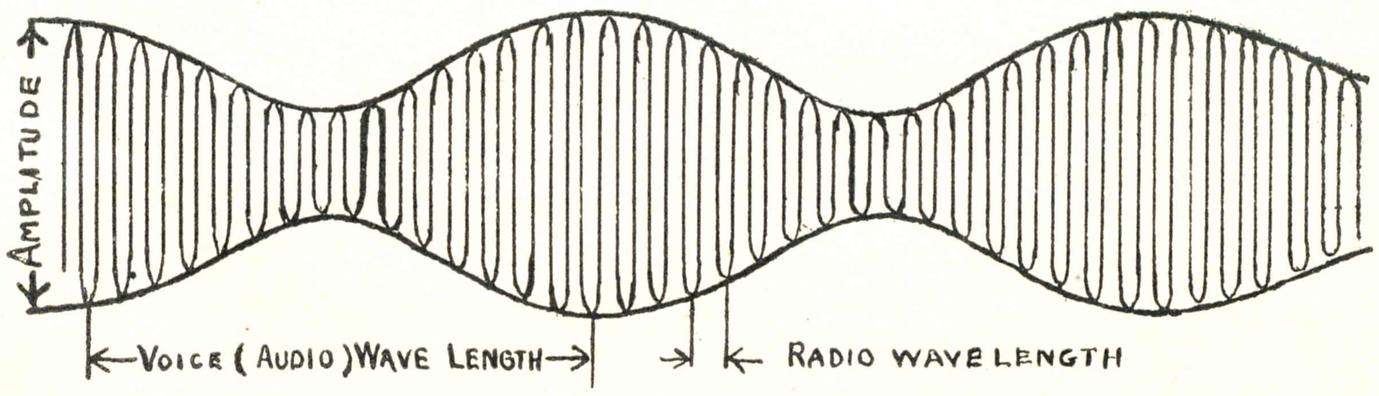


Fig. 3. The Modulator Tube Combines Figs. 1 and 2 to Give This Vibration

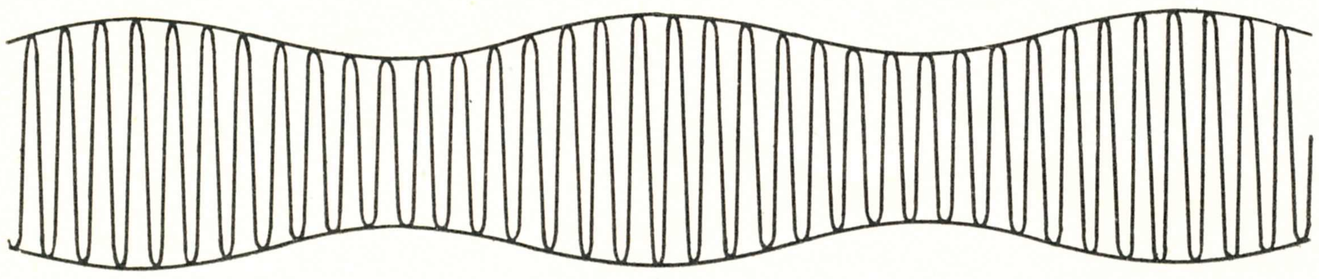


Fig. 4. This is Like Fig. 3, Except That the Modulation is Only One-third Instead of Two-thirds.

small change in the broadcast oscillation, Fig. 4. This is like the lazy man with a rise and fall of only a few inches as just mentioned.

The actual amount of modulation is measured in this way. Put a ruler on the wide part of the curve, Fig. 3. In our drawing it measures about 15/16 of an inch. Then measure the narrow part or waist of the curve. This is 5/16, or one-third of the broad part. In other words, the effect of the modulation is to cut down the waist by two-thirds. This value of modulation is 66 2/3 per cent (2/3).

Measure Its Waist Line

In the same way Fig. 4, when measured up, will show that the waist is two-thirds as wide as the broad part. That is to say, it has been narrowed down one-third, so the modulation here is 33 1/3 per cent. In every case by following this rule when you have a wave shape for the output you can get the value by simple measurement.

What will happen if you keep increasing the amount of modulation? This appears in Fig. 5. This figure does not require any measurement with a ruler to show you that the waist is reduced 100 per cent, and so the answer for modulation is 100 per cent. Such a curve shows that for every wave of the audio frequency the carrier wave is for an instant entirely snuffed out.

Less Than Nothing Left

What would happen if the modulation were made even stronger? In this case the upper and lower curves would cross each other and great irregularity at such a point would occur. The receiving set with the regular detector would not be able to respond to any such freak and the result would be that the music or talking heard in the loud speaker would be terribly distorted. There have been attempts made to try to work out some sort of broadcasting system and receivers to fit, which would enable the use of more than 100 per cent modulation, but so far they have not been a commercial success.

When you get the idea of the measurements which have been described so far, you will understand fully what is meant by "modulation." But what good would it do a broadcasting director to know this if he had no such curves to measure? Of course, the sending outfit does not have any such tags tied to it to put a ruler on. How can the man by the microphone tell whether he is getting much or little modulation in actual practice?

Mirror Worked by Direct Current

At the broadcasting station, the percentage of modulation is measured by means of an oscillograph which consists of a tiny mirror mounted on a moving coil system in a magnetic field, in such a way that it can turn. The moving coil system is excited by the high frequency antenna current, but after it has been passed through a detector to rectify it, or make it direct rather than alternating current.

A beam of light is directed at the mirror and as the current through the moving coil is varied the mirror deflects the beam of light and this movement gives a measure of the percentage of modulation. See Fig. 6.

The tuning coil is brought up near enough to the aerial so that enough current will be induced in it to work the oscillograph and give a good deflection. The variable condenser is of course adjusted so that the apparatus will be tuned to the same wave as the sending station. The current from the detector after running through the movable coil (with the mirror on it) returns to the detector tube by way of the "B" battery.

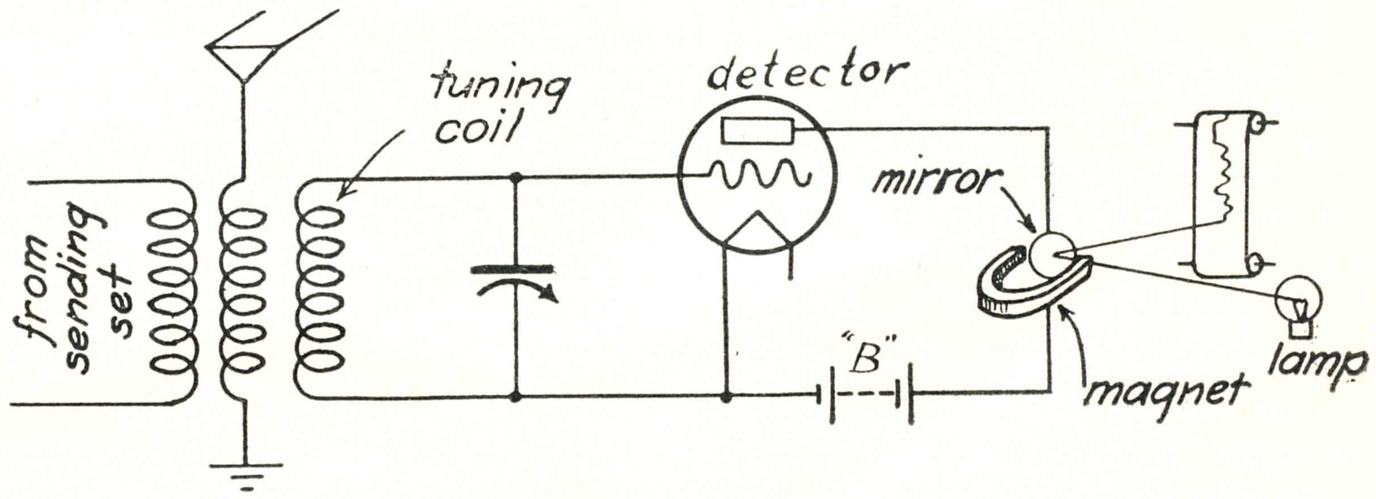


Fig. 6. Here is an Oscillograph Circuit for Showing Curves of Modulation. A Record is Made on the Film.

When the Light Wiggles

The rays of light from the lamp strike the mirror and are reflected on a moving roll as shown. If a permanent record is wanted this is made on a roll of film which is revolved at a steady speed by an electric motor. The vibrating mirror is so small (the size of a pin head) that the light reflected on the film is only a small spot and as it wiggles back and forth under the influence of the sending station current, it leaves a wavy line on the film. Naturally, the film must be kept in a dark box and no light is admitted to it at all, except that from the mirror. After the film is developed a permanent record is obtained.

Just like a camera it is often desired to see what is going on before taking an actual picture. In that case a ground glass is used. If you have ever focused

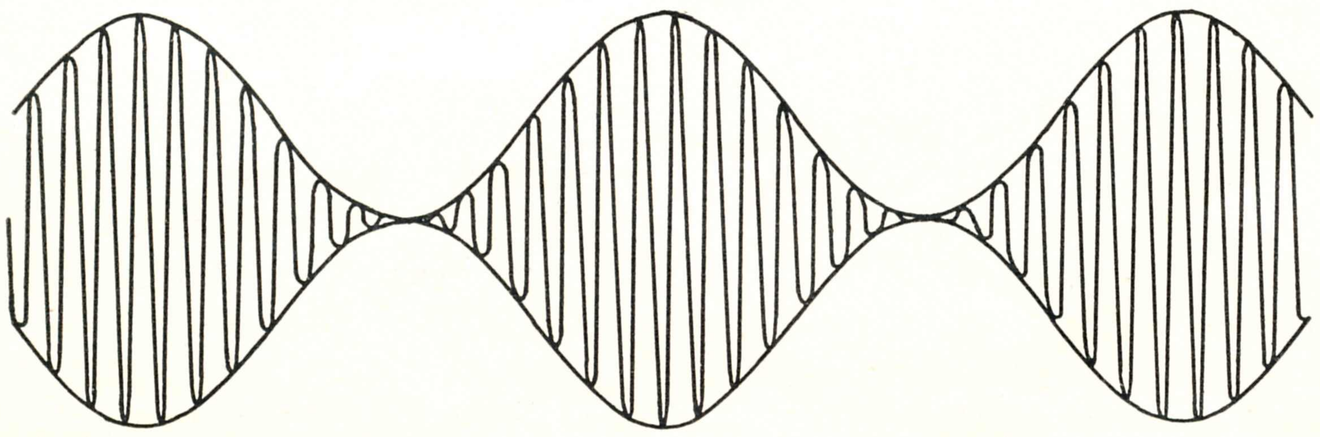


Fig. 5. When the Modulation Reaches 100% We Get This Sort of Shape.

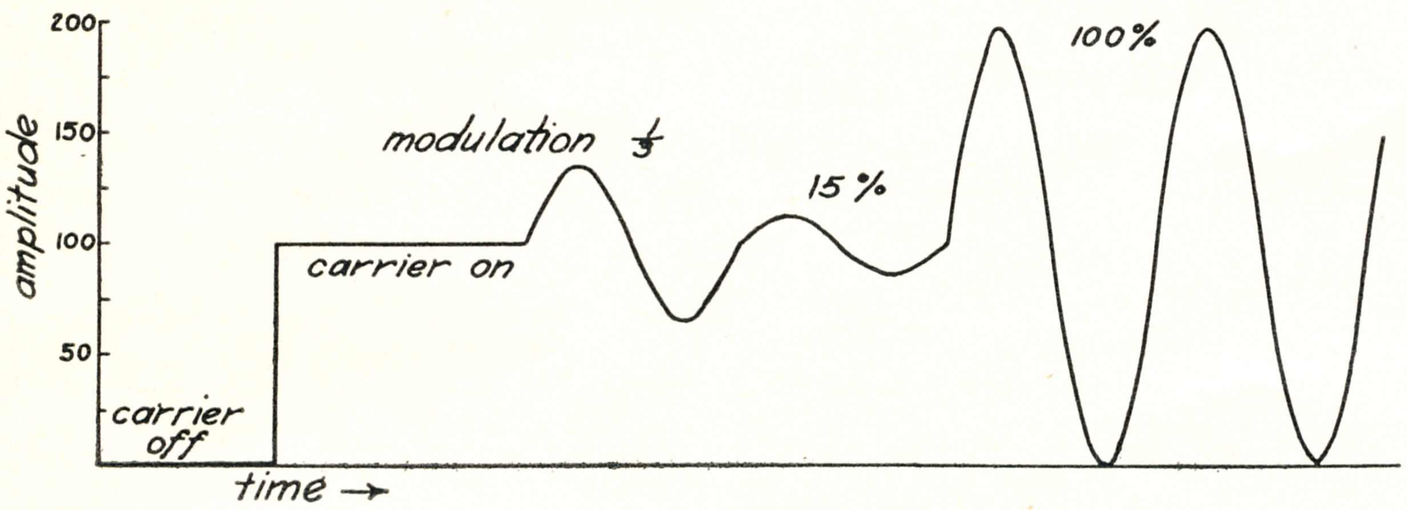


Fig. 7. A Record Like This is Taken by the Film of Fig. 6 for Different Amounts of Modulation.

a camera, you will know that you can see exactly what the picture will look like on the ground glass. In the same way where routine tests are going on and no record is needed it is a foolish waste of money to use a photographic film and so the ground glass is substituted. Now what shall we expect to see when we look at the record of broadcasting? Fig. 7 shows the curve of what occurs.

Getting the Base Line

Without any rectified antenna current the beam assumes a so-called base or zero deflection position. With only the carrier wave on the antenna, the reflected beam assumes a new position, say one inch above the zero line. Call this 100. When the carrier is modulated, the antenna current is increased and decreased at audio frequencies.

With symmetrical modulation this increase and decrease from the unmodulated position of the beam is observed on the ground glass placed in front of the beam scale, and if the increases reach a value twice the unmodulated value and the decreases dip to the zero line, the percentage of molulation is 100 per cent. With decreasing deflections the percentage is proportional to the swing. as compared with the deflection from zero to carrier position.

Adjusting the Grid Voltage

The percentage of modulation is proportional to the voltage impressed on the grids of the modulator tubes and is varied by means of a "gain control." This gain control consists of a potentiometer arrangement at the input or grid side of one of the previous stages of amplification, Fig. 8. The output voltage of the previous stage of amplification is impressed across the entire resistor and the grid voltage of the succeeding tube is tapped off by a switch contactor for the required percentage of modulation.

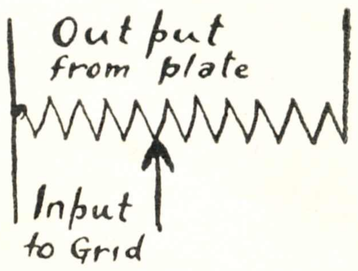


Fig. 8. Control of the Loudness is Made in This Way.

It is easy to understand that in general it is a good idea to make efficient use of the power of the sending station and for this reason to make the modulation reasonably high. This result is brought out in some of the tests run on super-power run by the General Electric Company. On successive days Station WGY used 25, 50, and 75 per cent modulation. The first night 14 out of 100 reports received from radio fans stated that the signals were exceptionally strong. When the modulation was increased to 50 per cent, 29 fans out of 100 were enthusiastic. The last night on 75 per cent modulation, 42 per cent of the applause cards noted the unusual strength.

Why Not Go to 100%?

From this you might wonder why the modulation was not held constant at 100 per cent. If that were attempted then, when an unusually loud note was played or sung the modulation would run over 100 per cent with the conflicting of the curves, as already mentioned. There must be a liberal factor of safety and for that reason 75 per cent is about as high as it is safe to go.

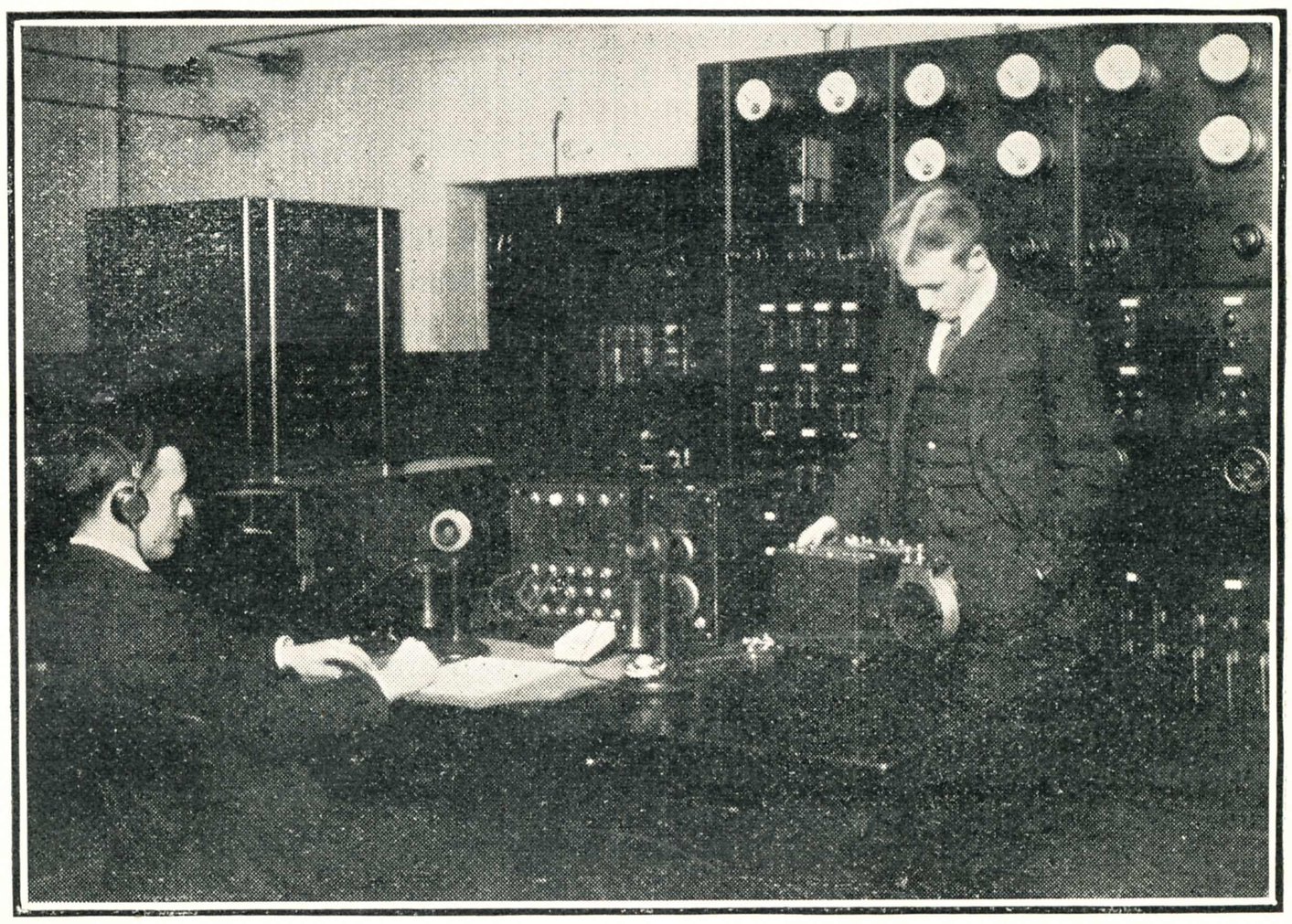


Fig. 9. Two Radio Engineers Are Checking the Modulation of Station WGY. Oscillograph at Right Center.

Fig. 9 shows a picture of the modulation apparatus as used at WGY. The control board is in the center. One of the engineers is shown inspecting the oscillograph to see that the curves are correct.

Radio Has Wooden Anniversary.

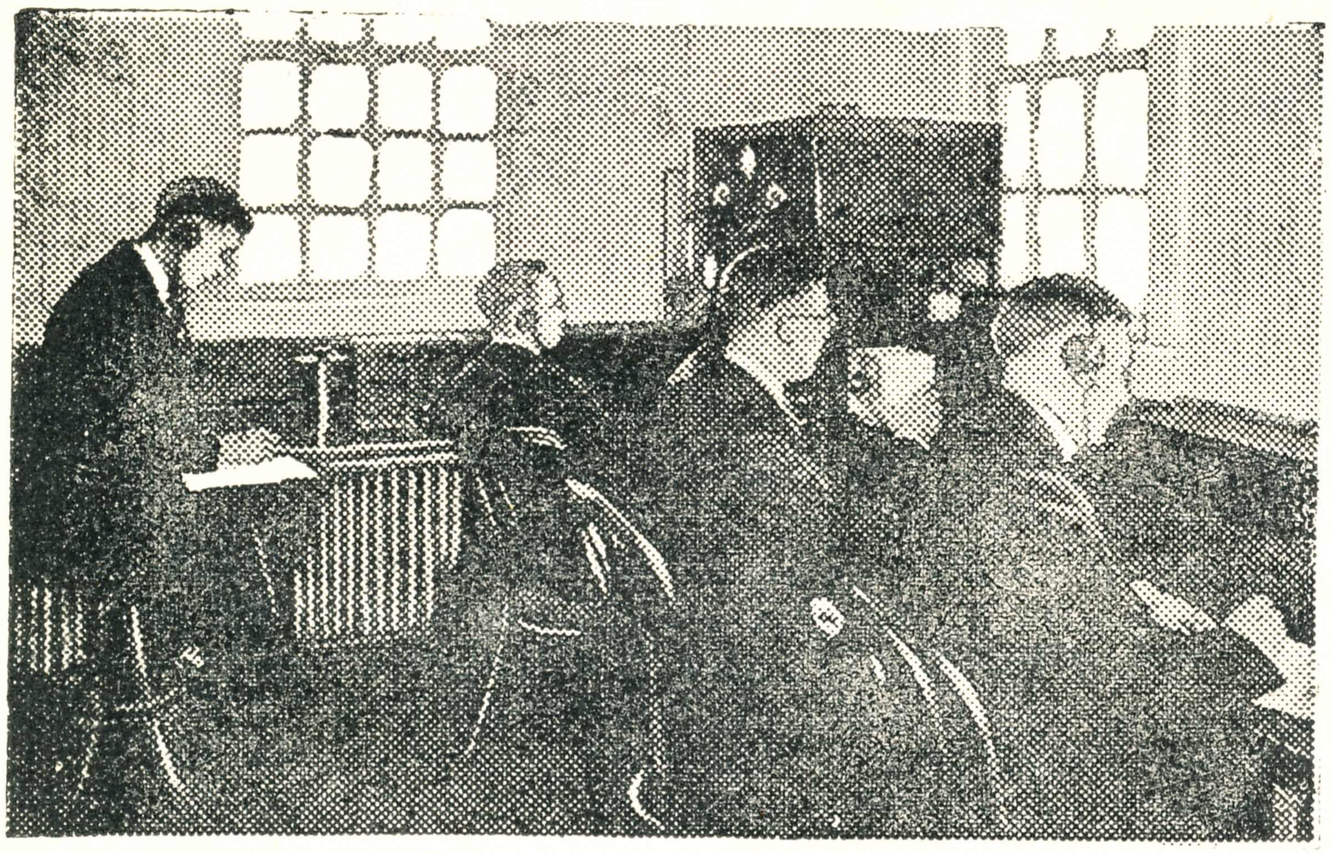


Fig. 1. Here is the Studio of Five Years Ago—the Pioneer Broadcaster of the World. It is Also the Transmitting Room. Harding-Cox Election Night.

THE amazingly rapid growth of radio broadcasting is brought to mind with the announcement that the "Pioneer Broadcasting Station of the World" will observe its fifth anniversary, Tuesday, November 3.

It was on the presidential election day in 1920 that Westinghouse Station KDKA inaugurated regular daily broadcasting. The anniversary really falls on November 2, but in order that the fifth or "wooden" anniversary may be held under as nearly the same circumstances as the initial program five years ago, the date for the celebration was moved back one day, which happens to be election day.

The First Broadcast Engineer

Station KDKA originated in an experimental transmitting and receiving laboratory which the Westinghouse Electric & Manufacturing Company installed at the home of Frank Conrad, now assistant chief engineer of the company, in 1915 for experimental work in developing radio apparatus for the Allies.

The editor of "Radio Progress," Horace V. S. Taylor, was Mr. Conrad's personal assistant in this work. After the United States entered the war, the experiments were confined to apparatus for the American forces.

After the end of the war, Mr. Conrad continued his experiments, and in 1919 started the transmitting of an intermittant radio telephone service. This service consisted of programs of talking machine records or impromptu addresses to those interested in radio. The interest grew, and with it the audience, until the audience numbered several hundred.

Helped Elect President Harding

The new station, on top of a nine-story building at the East Pittsburgh plant, was ready to begin operation in the fall, and it was decided to begin broadcasting on election day. The first regular program, therefore, consisted of broadcasting the returns of the Harding-Cox election, which were collected by the Pittsburgh Post and telephoned to the station, where they were put on the air, Fig. 1.

The programs immediately succeeding were made up of the reading of news events, together with music provided by talking machine records. In order to vary the program, short talks later were given or read, and musicians were asked to broadcast direct. The microphone was located in the same room with the transmitters, but soon a separate studio was erected, at first on the roof of the building near the transmitter, and later in another building which was more convenient for the people who came to broadcast. Later other studios were established at the Pittsburgh Post, in the heart of downtown Pittsburgh; the National Stockman and Farmer, from where market reports and special features of interest to the farmer were broadcast, and the University of Pittsburgh, from where educational talks were broadcast. See Fig. 2.

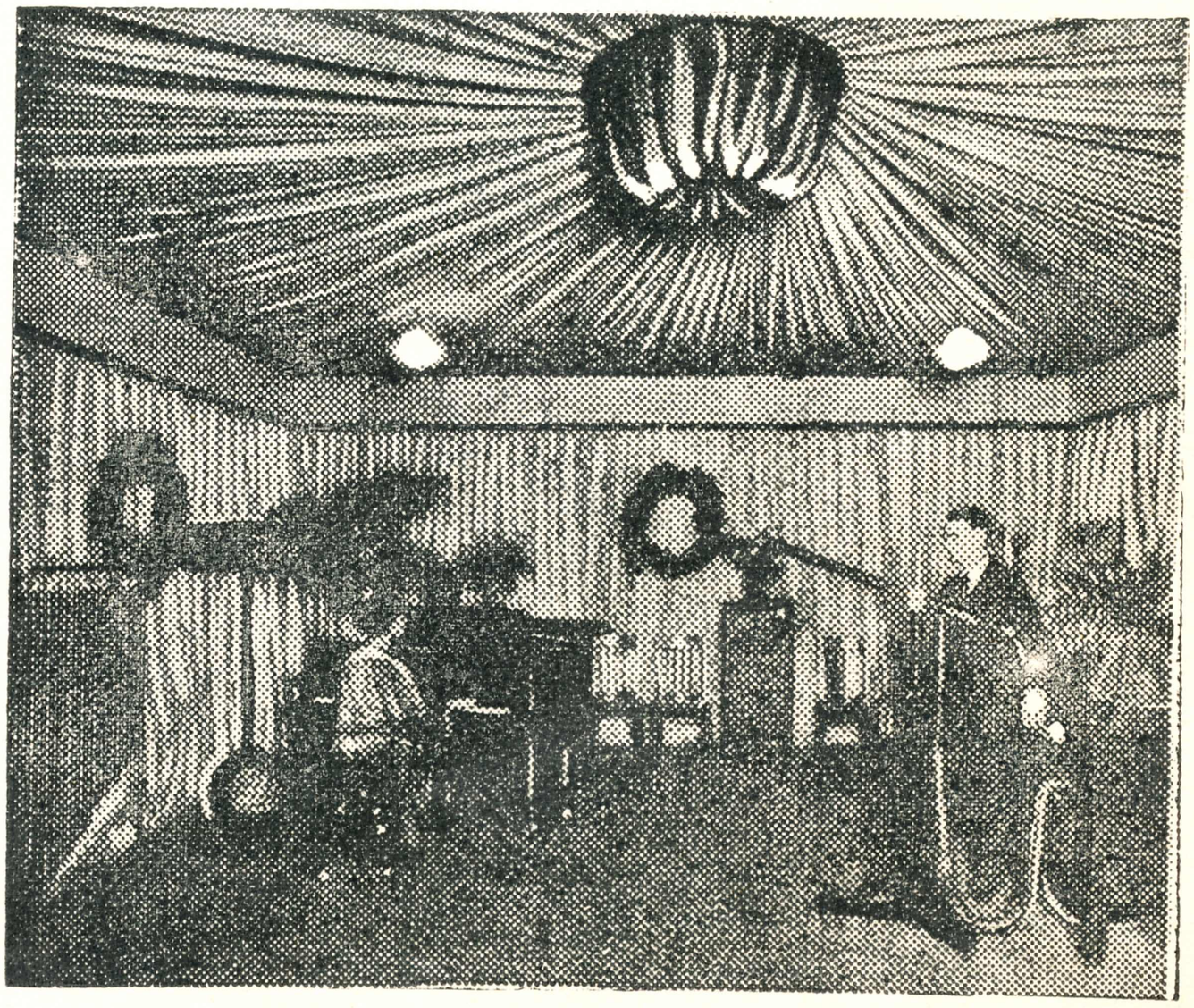


Fig. 2. Five Years Later. One of Several Studios of KDKA.

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. In the wave meter shown in the August 15th issue, how is the instrument connected to the set for measuring the waves and also as a wave trap?

Answer. When used as a wave meter, this instrument is so sensitive that it does not need to be connected to the receiving set at all. Close the switch and lay the instrument down near your set and it will work from the leakage capacity effect which exists in any set. It may be well to turn the wave meter around this way and that so to get it in a favorable position. When used as a wave trap (and it makes a good one) disconnect one of the binding posts (either one) from the coil. Then hook the binding post up to the aerial lead-in and run the loose end of the coil to your radio set. This puts the condenser and coil both in series with the aerial. By tuning with the condenser to the wave you want, you will exclude all other signals to a large extent.

Question. How does a three-control set compare with a two-control in operating?

Answer. By the three-control you doubtless mean the hook-up using two stages of tuned radio frequency and a tuned detector. The two-control system is the tuner and tickler.

The first style of hook-up has the advantage that when properly built it will not squeal or radiate even though it is poorly operated. It is also possible to log each of the three dials so that once a station has been found it is always picked up at the same place. It has the disadvantage that there is no indication of when the dials are turned nearly to the right position to pick up an outside station, and furthermore all three must set exactly before the distant programs come in.

The regenerative circuit has the advantage (particularly to the neighbors) that it requires fairly expert handling or else it will wreck the enjoyment of radio within several blocks. Although the tuner may be logged the tickler handle will vary in position from time to time as the batteries and tubes get older. However, there is a very decided advantage in that when a station is nearly brought in, it may be made to whistle to the operator as a signal to make a slight shift in the setting. Also there are required only two hands needed for smooth tuning.

Question. Why is the unit of capacity made so large that it is never used in practice?

Answer. All the electrical units are made to depend on each other in the easiest way. Thus one volt of pressure across one ohm of resistance gives one ampere of current. In the same way the size of the unit capacity was chosen so that one volt would put one unit quantity of electricity into a capacity of one farad.

It is found in practice that one farad (named after Faraday, the eminent electrician) is larger than is ever needed in radio and so the millionth part of that or one microfarad is used instead. One volt of such a condenser will put one-millionth of a unit of electricity into such a capacity.

Question. Are the aerial connections, which are screwed into electric light sockets found to be reliable?

Answer. In many cases they are very satisfactory. However, in new construction where the electric light wires are run through a metal conduit which is grounded, they are usually found to give very weak signals. To be sure, static in such a case is largely absent, but it requires quite a powerful set to pick up any distance with them. About the only way you can tell whether your own house has suitable wiring for the use of such an aerial connected is to try it out.

Question. Can a storage "B" battery be charged from a tungar "A" battery charger?

Answer. The new style of charger has a terminal for charging "B" batteries by merely inserting an ordinary electric light bulb for a resistance. The older styles can be used by putting a resistance like an ordinary lamp in series with the "B" battery to cut down the charging rate.

Question. What causes the blue glow in a detector tube?

Answer. This is a sign that you are using too much "B" battery pressure on the detector or else the tube itself is a bad one. It is rare that this blue glow appears except in soft tubes, which have not a very high vacuum. When too much plate battery voltage is impressed on such a tube, the electrons shot off from the filament travel so very rapidly through the remaining gases that they ionize the gases molecules. By this is meant that the high speed electrons collide with the particles of gas with so much force that they break up the latter and it is this disintegration which causes the blue glow.

In the hard tubes there is not enough gas left to have much chance of collisions. For that reason quite high "B" battery voltages may be employed without the glow appearing. Of course, the remedy for the glow is to reduce the pressure of the "B" batteries usually to about 18 or 20 volts.

Question. Does a straight line frequency condenser have more capacity than an ordinary kind?

Answer. The capacity of the condenser has nothing to do with its straight line effect. Two condensers each with .00025 mfd. will have exactly the same amount of action when fully in mesh (at 100 on the dial) no matter whether they are straight line frequency or not. The leakage capacity at zero will be nearly alike also, provided both are made by skillful manufacturers. However, at points between 0 ond 100, the straight line condenser has less capacity for any given setting than the old style.

Question. In using a loop aerial, is there any advantage in having one loop inside another, or on top of it?

Answer. No, there have been various trick styles of loops built, but they are all inefficient compared with the ordinary style. The most efficient of all is one that approximates the shape you get when you wind the wire around a cylinder—upon one side, across the end, and down the other side, and across the bottom and repeat.

Question. Have the curtain aerials proved practical?

Answer. This style consists of a number of wires wound into various shapes and sewed to a curtain, which may be rolled up. Of course, the curtain itself has no electrical effect at all, and serves merely to hold the wires together.

Such an aerial will be in the same class as a loop and will not work except with sensitive sets. Such a flat form of loop is, however, not as good as the more ordinary style. Sometimes instead of a loop the wire in the curtain is not a loop but one continuous length. It then may be used as an ordinary inside aerial, but is not nearly as good as one installed on your ceiling, since it does not take in nearly as much space.

NAME THE NINE

In response to Major Bowes' request for suggestions as to a suitable name for the new nine-piece studio orchestra recently organized for broadcasting from the Capitol Theatre, many interesting and amusing nicknames were sent in by fans. The name selected was "Capitol Baby Grand Orchestra," to differentiate it from the Grand Orchestra which plays in the auditorium and from the larger studio orchestra.

A far fetched but amusing suggestion was "Catstette," since both the orchestra and a cat have nine "lives" in them. A classically inclined fan suggesed the "Nonas," a word taken from the Greek numerals, and another clever name was "Les Bowes Arts," a French play on words. Other proffered titles were: "The Capitol Nine," sent in by a baseball fan; "Miniature Orchestra," and "Capitol Orchestrette."

HIT IT WITH TWO HAMMERS

A novelty in musical instruments was recently introduced to the WEAF listeners by Bill Groen, player of the dulcimer. The peculiarities of the instrument make it particularly suited for light fast numbers, so that Mr. Groen's program was made up of Irish reels and jigs, lively Spanish numbers and a medley of popular hits.

The dulcimer is a trapeze shape instrument about three feet in greatest width, across whose broad surface are stretched numerous wires of varying length, each wire tuned to a different note. Music is produced by striking these strings with two small hammers, the heads of which are clothed on either side with hard and soft leather to produce the forte and piano effects. This string instrument is known as the forerunner of the pianoforte, just as the psaltery was of the harpsichord.

Your Friend Will Thank You

When you finish reading this magazine, don't throw it away. Just hand it to your friend. Any intelligent person can understand it, and your friend will thank you.

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

I Guarantee to Increase Your Memory 100% In 10 Days

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

GEO. J. SPINNER
Author and Educator

My Secret for 30 Years

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

Command Success

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

Learn My Secret

I prefer to place my secret within the easy reach of everyone. Therefore, the price I am going to ask for VI-FLECT—my wonderful method of memory-building, which I have developed and perfected during my 30 years of constant study and application is ONLY $5.00.

Let nothing stand between you and a successful, happy, prosperous future. If it is not convenient to enclose the money, or if you prefer, I will mail your copy of VI-FLECT and you can hand the small amount to your postman when he delivers the package. The important thing is—SEND NOW.

COUPON

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

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

Name .....

Address .....

City .....State.....

ALIVE ALL OVER!

Why Use a Fixt Crystal That May Deteriorate Quickly?

There is no pleasure in fishing for a sensitive spot on the ordinary crystal. Just when the music is best the cat whisker may slip and before you get the proper adjustment the station has gone.

We are selling the

AUDION CRYSTAL

Which is alive all over. Drop the cat whisker anywhere and you can hear the music. Unlike a fixed crystal, if it is damaged by a shock or by static it need not be thrown away, as only that one portion is injured.

Price of Audion Crystal 25c. Postpaid

We also supply GOLD-PLATED CAT WHISKERS wound up to shape, at 15c. postpaid.

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1206 Broad Street **Providence, R. I.**

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

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

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

KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. 970-309- var.
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O...1200-250- 500
KDZB—Frank E. Siefert, Bakersfield, Cal.....1430-210- 100
*KFAB—Nebraska Buick Auto Co., Lincoln, Neb..... 880-341-1000
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz....1100-273- 100
KFAJ—University of Colorado, Boulder, Colo.....1150-261- 100
KFAU—Boise High School, Boise, Idaho.....1080-278- 500
KFBK—Kimball Upson Co., Sacramento, Cal.....1210-248- 100
KFBL—Leese Brothers, Everett, Wash.....1340-224- 100
KFBU—Bishop N. S. Thomas, Laramie, Wyo.....1110-270- 500
KFDJ—Oregon Agricultural College, Corvallis, Ore.....1180-254- 500
KFDM—Magnolia Petroleum Co., Beaumont, Tex..... 950-316- 500
KFDX—First Baptist Church, Shreveport, La.....1200-250- 100
KFDY—S. Dak. Ste. Col. Ag. & Mech. Arts, Br'kngs., S. D.1100-273- 100
KFEQ—Scroggin, & Co. Bank, Oak, Nebr.....1120-268- 500
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..... 640-469-3000
KFJF—National Radio Mfg. Co., Oklahoma, Okla.....1150-261- 225
KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb...1040-288-2000
*KFLR—University of New Mexico, Albuquerque, N. Mex.1180-254- 100
KFLV—Swedish Evangalical Mission Church, Rockford, Ill.1310-229- 100
KFLZ—Atlantic Automobile Co., Atlantic, Iowa.....1100-273- 100
KFMQ—University of Arkansas, Fayetteville, Ark.....1000-300- 750
KFMR—Morningside College, Sioux City, Iowa.....1150-261- 100
KFMX—Carleton College, Northfield, Minn..... 890-337- 500
KFNF—Henry Field Seed Co., Shenandoah, Iowa.....1130-266- 500
KFNV—L. A. Drake Battery Sup. Co., Santa Rosa, Cal..1310-229- 100
KFOA—Rhodes Dept. Store, Seattle, Wash..... 660-454-1000
KFON—Echophone Radio Shop, Long Beach, Cal..... 1290-233- 100
KFOO—Latter Day Saints Univ., Salt Lake City, Utah...1270-236- 250
KFOR—David City Tire & Electric Co., David City, Neb.1330-226- 100
KFOX—Technical High School, Omaha, Nebr.....1210-248- 100
KFPG—K. M. Turner Radio Corp., Los Angeles, Cal....1260-238- 250
KFPR—Los Angeles County Forestry, Los Angeles, Cal...1300-231- 500
KFPY—Symons Investment Co., Spokane, Wash.....1130-266- 100
KFQA—The Principa, St. Louis, Mo.....1150-261- 100
KFQB—Searchlight Publishing Co., Fort Worth, Texas...1140-263- 150
KFQC—Kidd Brothers Radio Shop, Taft, Cal.....1300-231- 100
KFQU—W. E. Riker, Holy City, Calif.....1350-222- 100
KFQZ—Taft Products Co., Hollywood, Calif.....1330-226- 250
KFRB—Hall Bros., Beeville, Texas.....1210-248- 250
KFRU—Etherical Radio Co., Bristow, Okla..... 760-395- 500
KFSG—Echo Park Evangelistic Asso., Los Angeles, Cal...1090-275- 500
KFUM—W. D. Pyle, Colorado Springs, Colo.....1240-242- 100
KFUO—Concordia Seminary, St. Louis, Mo..... 550-545- 500
KFUT—University of Utah, Salt Lake City, Utah.....1150-261- 100
KFVE—Film Corporation of America, St. Louis, Mo.....1250-240- 500
KFVW—Airfan Radio Corporation, San Diego, Cal.....1220-246- 500
KFWA—Browning Bros. Co., Ogden, Utah.....1150-261- 100
KFWB—Warner Bros. Pictures, Inc., Hollywood, Cal.....1190-252- 500
KFWD—Arkansas Light & Power Co., Arkadelphia, Ark...1130-266- 500
KFWH—F. Wellington Morse, Jr., Chico, Cal.....1180-254- 100
KFWI—Radio Entertainments, Inc., So. San Fran., Cal..1360-220- 500
KFWM—Oakland Educational Society, Oakland, Cal....1430-207- 500
KFWO—Lawrence Mott, Avalon, California.....1420-211- 250
KFWU—Louisiana College, Pineville, La.....1260-238- 100
KFXC—Santa Maria Val. R. R. Co., Santa Maria, Cal...1430-210- 100
KFXF—Pikes Peak Broad. Co., Colorado Springs, Col....1200-250- 500
KGB—Tacoma Daily Ledger, Tacoma, Wash.....1200-250- 100
KGO—General Electric Co., Oakland, Cal..... 830-361-3000
KGU—Marion A. Mulrony, Honolulu, Hawaii.....1110-270- 500
KGW—Portland Morning Oregonian, Portland, Ore..... 610-491- 500
KHJ—Times-Mirror Co., Los Angeles, Cal..... 740-405- 500
KHQ—Louis Wasmer, Seattle, Wash.....1100-273- 100
KJR—Northwest Radio Service Co., Seattle, Wash..... 780-384-1000
KLDS—R. Ch. Jesus Christ, L. D. Sts., Independence, Mo. 680-441-1000
KLS—Warner Bros. Radio Supplies Co., Oakland, Cal.....1240-242- 250
KLX—Tribune Publishing Co., Oakland, Cal..... 590-508- 500
KLZ—Reynolds Radio Co., Denver, Colo.....1130-266- 250
KMA—May Seed & Nursery Co., Shenandoah, Iowa.....1190-252- 500
KMO—Love Electric Co., Tacoma, Wash.....1200-250- 100
KNRC—Clarence B. Juneau, Hollywood, Cal.....1440-208- 250
KNX—Los Angeles Express, Los Angeles, Cal..... 890-337- 500
KOA—General Electric Co., Denver, Colo..... 930-322-5000
*KOB—New Mexico Col. of Agriculture, State Col., N. Mex 860-349-1000
KOCH—Omaha Central H. School, Omaha, Neb.....1160-258- 100
KOIL—Monarch Manufacturing Co., Council Bluffs, Ia..1080-278- 500
KOP—Detroit Police Dept., Detroit, Mich.....1080-278- 500
KPO—Hale Bros., San Francisco, Cal..... 700-428- 500
KPRC—Houston Printing Co., Houston, Texas.....1010-297- 500
KPSN—Pasadena Star-News, Pasadena, Cal..... 950-316-1000
KQP—Apple City Radio Club, Hood River, Ore.....1110-270- 100
KQV—Double-Hill Electric Co., Pittsburg, Pa.....1090-275- 500
*KRE—Berkeley Daily Gazette, Berkeley, Cal.....1160-258- 100
KSAC—Kansas State Agric. College..... 880-341- 500

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

KSD—Post-Dispatch, St. Louis, Mo..... 550-545- 750
KSL—The Radio Service Corp., Salt Lake City, Utah....1000-300-1000
KTAB—Tenth Ave. Baptist Church, Oakland, Cal.....1250-240- 500
KTBI—Bible Institute of Los Angeles, Los Angeles, Cal..1020-294- 750
KTCL—American Radio Tel. Co., Inc., Seattle, Wash.... 980-310-1000
KTHS—New Arlington Hotel Co., Hot Springs, Ark..... 800-375- 500
KTW—First Presbyterian Church, Seattle, Wash..... 660-454-1000
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
*KWKH—W. G. Paterson, Kennonwood, La.....1150-261- 500
KWSC—State College of Washington, Pullman, Wash..... 860-349- 500
KWWG—City of Brownsville, Brownsville, Texas.....1080-278- 500
KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill..... 560-535-2000
KZKZ—Electrical Supply Co., Manila, P. I.....1110-270- 100
KZM—Preston D. Allen, Oakland, Cal.....1240-242- 100
KZRQ—Far Eastern Radio, Manila, P. I.....1350-222- 500
KZUY—F. Johnson, Elser, Baguio, P. I..... 833-360- 500
*NAA—United States Navy, Arlington, Va..... 690-435-1000
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., Neark, N. J..... 1140-263- 500
WAAW—Omaha Grain Exchange, Omaha, Neb.....1080-278- 500
WABA—Lake Forest University, Lake Forest, Ill.....1320-227- 200
WABO—Lake Avenue Baptist Church, Rochester, N. Y...1080-278- 100
WABX—Henry B. Joy, Mount Clemens, Mich.....1220-246- 150
*WADC—Allen Theatre, Akron, O.....1160-258- 500
WAFD—Albert B. Parfet Co., Port Huron, Mich.....1090- 275- 500
WAHG—A. H. Grebe Co., Richmond Hill, N. Y..... 950-316- 500
WAMD—Hubbard & Co., Minneapolis, Minn.....1230-244- 500
WAPI—Alabama Polytechnic Institute, Auburn, Ala.....1210-248- 500
WARC—Am. Rad. & Research Corp., Medf'd H'lsde, Mass.1150-261- 100
WBAA—Purdue University, West Lafayette, Ind.....1100-273- 250
WBAK—Pennsylvania State Police, Harrisburg, Pa.....1090-275- 500
WBAO—James Millikin University, Decatur, Ill.....1110-270- 100
*WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex. 630-476-1500
WBAV—Erner & Hopkins, Columbus, Ohio.....1020-294- 500
WBAX—John H. Stenger, Jr., Wilkes-Barre, Pa.....1170-256- 100
WBBG—Irving Vermilya, Mattapoisett, Mass.....1210-248- 100
WBBL—Grace Covenant Church, Richmond, Va.....1310-229- 150
WBBR—People's Pulpit Assoc., Rossville, N. Y.....1100-273- 500
WBCN—Foster & McDonnell, Chicago, Ill.....1130-266- 500
WBES—Bliss Electrical School, Takoma Park, Md.....1350-222- 100
*WBNY—Shirley Katz, New York, N. Y.....1430-210- 500
WBOQ—A. H. Grebe Co., Richmond Hill, N. Y.....1270-236- 100
*WBRE—Baltimore Radio Exchange, Baltimore, Md.....1300-231- 100
WBT—Southern Radio Corp., Charlotte, N. C.....1090-275- 250
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass. 900-331-2000
WBZA—Westinghouse Elec. & Mfg. Co., Boston, Mass...1240-242- 250
WCAC—Connecticut Agric. College, Mansfield, Conn.....1090-275- 500
WCAD—St. Lawrence University, Canton, N. Y.....1140-263- 250
WCAE—Kaufmann & Baer Co., Pittsburg, Pa..... 650-461- 500
WCAH—Entrekin Electric Co., Columbus, O.....1130-266- 500
WCAJ—Nebraska Wesleyan Univ., Univ. Place, Nebr....1180-254- 500
WCAL—St. Olaf College, Northfield, Minn..... 890-337- 500
WCAO—A. A. & A. S. Brager, Baltimore, Md.....1090-275- 100
WCAP—Cheaspeake & Potomac Tel. Co., Wash., D. C... 640-469- 500
WCAR—Southern Radio Corp. of Texas, San Antonio, Tex.1140-263- 100
WCAU—Durham & Co., Philadelphia, Pa.....1080-278- 500
WCAX—University of Vermont, Burlington, Vt.....1200-250- 100
WCBC—University of Michigan, Ann Arbor, Mich.....1310-229- 200
WCBD—Wilbur G. Voliva, Zion, Ill..... 870-345-5000
WCBQ—First Baptist Church, Nashville, Tenn.....1270-236- 100
WCCO—Washburn Crosby Co., Minneapolis, Minn..... 720-416-5000
WCEE—Charles E. Erbstein, Elgin, Ill.....1090-275-1000
WCLS—H. M. Couch, Joliet, Ill.....1400-214- 150
WCM—Texas Markets & Warehouse Dept., Austin, Tex...1120-268- 250
WCSH—Congress Square Hotel Co., Portland, Me.....1170-256- 500
WCTS—C. T. Sherer Co., Worcester, Mass.....1120-268- 500
WCUW—Clark University, Worcester, Mass.....1260-238- 250
*WCX and WJR—The Detroit Free Press and Jewett Radio and Phonograph Co., Pontiac, Mich., (operating jointly)..... 580-517-2500
WDAD—Dad's Auto Accessories, Inc., Nashville, Tenn...1330-226- 150
WDAE—Tampa Daily News, Tampa, Fla.....1100-273- 250
WDAF—Kansas City Star, Kansas City, Mo..... 820-366- 500
WDAG—J. Laurence Martin, Amarillo, Tex.....1140-263- 100
WDBE—Gilham-Schoen Electric Co., Atlanta, Ga.....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
WDCH—Dartmouth College, Hanover, N. H.....1170-256- 100
WDWF—Dutee W. Flint, Cranston, R. I..... 680-441- 500
WDZ—James L. Bush, Tuscola, Ill.....1080-278- 100
*WEAF—American Tel. & Tel. Co., New York, N. Y..... 610-492-5000
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, N. Plainfield, N. J..1150-261- 250
*WEAN—Shepard Co., Providence, R. I.....1110-270- 500
WEAO—Ohio State University, Columbia, Ohio.....1020-294- 500
WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio... 770-389- 750
WEAU—Davidson Bros. Co., Sioux City, Iowa.....1090-275- 100
WEAY—Iris Theater, Houston, Tex.....1110-270- 500

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Even the set makers admit that.

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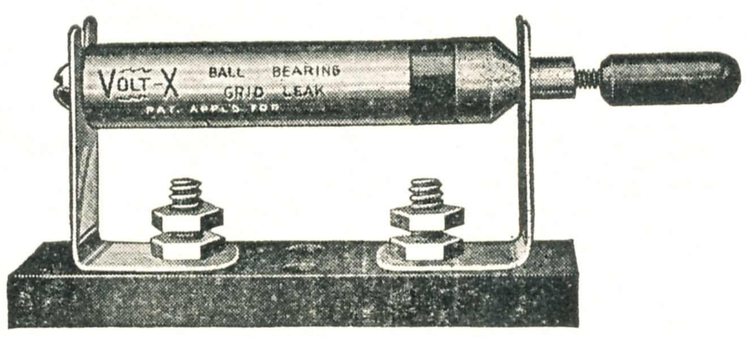
Buy It  **Try It**

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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.

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NAME. . . . . .

ADDRESS. . . . . .

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

WEBC—Walter C. Bridges, Superior, Wis.....1240-242- 100
WEBH—Edgewater Beach Hotel Co., Chicago, Ill..... 810-370-1000
WEBJ—Third Avenue Railway Co., New York, N. Y.....1100-273- 500
WEBK—Grand Rapids Radio Co., Grand Rapids, Mich...1240-242- 100
WEBL—Radio Corp. of America, United States (portable).1330-226- 100
WEBM—Radio Corp. of America, United States (portable).1330-226- 100
WEBW—Beloit College, Beloit, Wis.....1120-268- 500
WEEI—Edison Electric Illuminating Co., Boston, Mass... 630-476- 500
WEMC—Emmanuel Missionary Col., Berrien Springs, Mich.1050-286- 500
*WENR—All-American Radio Corp., Chicago, Ill.....1130-266-1000
WEW—St. Louis University, St. Louis, Mo.....1210-248- 100
WFAA—Dallas News & Dallas Journal, Dallas, Tex..... 630-476- 500
WFAV—University of Nebraska, Lincoln, Neb.....1090-275- 500
WFBG—William F. Gable Co., Altoona, Pa.....1080-278- 100
WFBH—Concourse Radio Corp., New York, N. Y.....1100-273- 500
WFBI—Galvin Radio Supply Co., Camden, N. J.....1270-236- 250
WFBL—Onondoga Hotel, Syracuse, N. Y.....1190-252- 100
WFBM—Merchant Heat & Light Co., Indianapolis, Ind...1120-268- 250
WFBR—Fifth Infantry, Maryland N. G., Baltimore, Md.1180-254- 100
WFDF—Frank D. Fallain, Flint, Mich.....1280-234- 100
WFI—Strawbridge & Clothier, Philadelphia, Pa..... 760-395- 500
*WFKB—Francis K. Bridgman, Chicago, Ill.....1380-217- 500
WFRL—Robert Morrison Lacey, Brooklyn, N. Y.....1460-205- 100
WGBB—Harry H. Carman, Freeport, N. Y.....1230-244- 100
WGBF—Finke Furniture Co., Evansville, Ill.....1270-236- 100
WGBQ—Stout Institute, Menomonie, Wis.....1280-234- 100
WGBS—Gimbel Bros., New York..... 950-316- 500
*WGBU—Florida Cities Fin. Co., Fulford By-The-Sea, Fla. 1080-278- 500
WGBX—University of Maine, Orono, Me.....1190-252- 100
WGCP—D. W. May, Newark, N. J.....1190-252- 500
WGES—Coyne Electrical School, Oak Park, Ill.....1200-250- 500
WGHP—Geo. H. Phelps, Inc., Detroit, Mich.....1110-270- 500
WGMU—A.H.Grebe&Co.,Inc.(portable),Richmond Hill,N.Y.1270-236- 100
WGN—The Tribune, Chicago, Ill..... 810-370-1000
WGR—Federal Telephone Mfg. Corp., Buffalo, N. Y..... 940-319- 750
WGST—Georgia School of Techonology, Atlanta, Ga.....1110-270- 500
*WGY—General Electric Co., Schenectady, N. Y..... 790-380-4000
WHA—University of Wisconsin, Madison, Wis..... 560-535- 750
WHAD—Marquette Univ. and Mil. Jour., Mil., Wis.....1090-275- 500
WHAG—University of Cincinnati, Cincinnati, O.....1290-233- 100
WHAM—University of Rochester, Rochester, N. Y.....1080-278- 100
WHAP—William H. Taylor Finance Corp., Brooklyn, N. Y.1250-250- 100
WHAR—Seaside Hotel, Atlantic City, N. J.....1090-275- 500
WHAS—Courier Journal & Louisville Times..... 750-400- 500
WHAT—George W. Young, Minneapolis, Minn.....1140-263- 500
WHAV—Wilmington Elec. Specity Co., Wilmington, Del..1130-266- 100
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y..... 790-380- 500
WHB—Sweeney School Co., Kansas City, Mo..... 820-366- 500
WHBF—Beardsley Specialty Co., Rock Island, Ill.....1350-222- 100
WHBH—Culver Military Academy, Culver, Ind.....1350-222- 100
WHBP—Johnstown Automobile Co., Johnstown, Pa.....1170-256- 100
WHBW—D. R. Kienzle, Philadelphia, Pa.....1390-216- 100
WHDI—Wm. Hood Dunwoody I. Inst., Minneapolis, Minn.1080-278- 500
WHEC—Hickson Electric Co., Inc., Rochester, N. Y.....1160-258- 100
WHK—Radiovox Co., Cleveland, O.....1100-273- 250
WHN—George Schubel, New York, N. Y..... 830-361- 500
WHO—Bankers Life Co., Des Moines, Iowa..... 570-526-5000
WHT—Radiophone Broadcasting Corporation, Deerfield, Ill.1260-238-1500
WIAD—Howard R. Miller, Philadelphia, Pa.....1200-250- 100
WIAS—Home Electric Co., Burlington, Iowa.....1180-254- 100
WIBA—The Capital Times Studio, Madison, Wisc.....1270-236- 100
WIBC—L. M. Tate Post No. 39, V.F.W. St.Petersburg, Fla.1350-222- 100
WIBK—University of the City of Toledo, Toledo, O.....1460-205- 100
WIBO—Nelson Brothers, Chicago, Ill.....1330-226-1000
WIBT—O. E. Miller, New York, N. Y.....1420-211- 100
WIBW—L. L. Dill, Logansport, Ind.....1360-220- 100
WIL—St. Louis Star, Benson Radio Co., St. Louis, Mo...1100-273- 250
WIP—Gimbel Bros., Philadelphia, Pa..... 590-508- 500
WJAD—Jackson's Radio Eng. Laboratories, Waco, Texas.. 850-353- 500
*WJAG—Norfolk Daily News, Norfolk, Nebr.....1110-270- 200
WJAK—Clifford L. White, Greentown, Ind.....1180-254- 100
WJAM—D. M. Perham, Cedar Rapids, Ia.....1120-268- 100
WJAR—The Outlet Co., Providence, R. I..... 980-306- 500
WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa...1090-275- 500
WJAZ—Zenith Radio Corp., Mt. Prospect, Ill. (Limited). 930-322-1500
WJBC—Hummer Furniture Co., La Salle, Ill.....1280-234- 100
WJBI—Robert S. Johnson, Red Bank, N. J.....1370-219- 250
WJBL—Wm. Gushard Dry Goods Co., Decatur, Ill.....1110-270- 500
WJJD—Supreme Lodge L. O. Moose, Mooseheart, Ill..... 990-303- 500
WJR—Same as WCX.
WJY—Radio Corporation of America, New York, N. Y... 740-405-1000
WJZ—Radio Corporation of America, New York, N. J..... 660-454-1000
WKAA—H. F. Paar, Cedar Rapids, Iowa.....1080-278- 500
WKAF—WKAF Broadcasting Co., Milwaukee, Wis.....1150-261- 250
WKAQ—Radio Corporation of Porto Rico, San Juan, P. R. 880-341- 500
WKAR—Michigan Agric. Col., E. Lansing, Mich.....1050-286-1000
*WKBB—Sanders Bros., Joliet, Ill.....1400-214- 100
WKBE—K. and B. Electric Co., Webster, Mass.....1300-231- 100
WKBG—C. L. Carrell (portable), Chicago, Ill.....1390-216- 100
WKBK—Shirley Katz, New York, N. Y.....1430-210- 500
WKRC—Kodel Radio Corp., Cincinnati, O..... 710-422-1000
WKRC—Kodel Radio Corp., Cincinnati, O..... 920-353-1000
WLAL—First Christian Church, Tulsa, Okla.....1200-250- 150
WKY—E. C. Hull and H. S. Richards, Oklahoma, Okla..1090-275- 100

*Additions and corrections.

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

WLB—University of Minnesota, Minneapolis, Minn.....1080-278- 500
WLBL—Wisconsin Dept. of Markets, Stevens Point, Wis.1080-278- 500
WLIT—Lit Bros., Philadelphia, Pa..... 760-395- 500
WLS—Sears, Roebuck Co., Chicago, Ill..... 870-345- 500
WLTS—Lane Technical High School, Chicago, Ill.....1160-258- 100
WLW—Crosley Radio Corp., Harrison, O.....710-422 {5000 / 500}
WLWL—Mis. Soc. of St. Paul the Apostle, New York....1040-288-1000
WMAC—Clive B. Meredith, Cazenovia, N. Y.....1090-275- 100
WMAF—Round Hills Radio Corp., Dartmouth, Mass.... 680-441-1000
WMAK—Norton Laboratories, Lockport, N. Y.....1130-466- 500
WMAQ—Chicago Daily News, Chicago, Ill..... 670-448- 500
WMAZ—Mercer University, Macon, Ga.....1150-261- 500
WMBB—American Bond & Mortgage Co., Chicago, Ill....1200-250- 500
WMBF—Fleetwood Hotel, Miami Beach, Fla..... 780-384- 500
WMC—Commercial Appeal, Memphis, Tenn..... 600-500- 500
WMCA—Greeley Square Hotel Co., Hoboken, N. J..... 880-341- 500
WNAB—Shepard Stores, Boston, Mass.....1200-250- 100
WNAC—Shepard Stores, Boston, Mass.....1070-280- 500
WNAD—University of Oklahoma, Norman, Okla.....1180-254- 250
WNAP—Wittenberg College, Springfield, Ohio.....1090-275- 100
WNAT—Lennig Bros. Co., Philadephia, Pa.....1200-250- 100
WNAX—Dakota Radio Apparatus Co., Yankton, S. Dak...1230-244- 100
WNJ—Radio Shop of Newark, Newark, N. J.....1290-233- 100
WNOX—People's Tel. & Tel. Co., Knoxville, Tenn.....1120-268- 500
WNYC—City of New York, New York, N. Y.....1190-233- 100
WOAI—Southern Equipment Co., San Antonio, Texas....760-395-1500
WOAN—James D. Vaughn, Lawrenceburg, Tenn.....1060-283- 500
WOAW—Woodmen of the World, Omaha, Nebr..... 570-526-1000
WOAX—Franklyn J. Wolff, Trenton, N. J.....1250-240- 500
WOC—Palmer School of Chiropractic, Davenport, Iowa... 620-484-5000
WODA—O'Dea Temple of Music, Paterson, N. J.....1340-224- 100
WOI—Iowa State College, Ames, Iowa.....1110-270- 750
WOK—Neutrowound Radio Mfg. Co., Homewood, Ill....1380-217-5000
WOO—John Wanamaker, Philadelphia, Pa..... 590-508- 500
WOQ—Unity School of Christianity, Kansas City, Mo.....1080-278- 500
WOR—L. Bamberger & Co., Newark, N. J..... 740-405- 500
WORD—People's Pulpit Association, Batavia, Ill.....1090-275-5000
WOS—Missouri State Marketing Bureau, Jefferson City, Mo. 680-441- 500
WOWL—Owl Battery Co., New Orleans, La.....1110-270- 100
WOWO—Main Auto Supply Co., Fort Wayne, Ind.....1320-227- 500
WPG—Municipality of Atlantic City, Atlantic City, N. J.1000-300- 500
WPRC—Wilson Printing & Radio Co., Harrisburg, Pa....1390-216- 100
WPSC—Pennsylvania State College, State College, Pa.....1150-261- 500
WQAA—Horace A. Beale, Jr., Parkesburg, Pa.....1360-220- 500
WQAC—Gish Radio Service, Amarillo, Tex.....1280-234- 100
WQAM—Electrical Equipment Co., Miami, Fla.....1140-263- 100
WQAN—Scranton Times, Scranton, Pa.....1200-250- 100
WQAO—Calvary Baptist Church, New York, N. Y..... 833-360- 100
WRAK—Economy Light Co., Escanaba, Mich.....1170-256- 100
WRAM—Lombard College, Galesburg, Ill.....1230-244- 100
WRAV—Antioch College, Yellow Springs, Ohio.....1140-263- 100
WRAX—Flexon's Garage, Gloucester City, N. J.....1120-268- 500
WRC—Radio Corporation of America, Washington, D. C... 640-469-1000
WRCO—Wynne, Radio Co., Raleigh, N. C.....1190-252- 100
WREO—Reo Motor Car Co., Lansing, Mich.....1050-286- 500
WRK—Doron Bros. Electrical Co., Hamilton, O.....1110-270- 100
WRM—University of Illinois, Urbana, Ill.....1100-273- 500
WRMU—A. H. Grebe & Co., Richmond Hill, N. Y.....1270-236- 100
WRNY—Experimenter Publishing Co., New York, N. Y...1160-258- 500
WRR—Dallas Police & Fire Dept., Dallas, Tex.....1150-261- 350
WRST—Radiotel Mfg. Co., Bay Shore, N. Y.....1390-216- 250
WRW—Tarrytown Radio Research Labs., Tarrytown, N. Y.1100-273- 500
WSAC—Clemson Agric. Col., Clemson College, S. C..... 890-337- 500
WSAI—United States Playing Card Co., Cincinnati, O... 920-326-5000
WSAJ—Grove City College, Grove City, Pa.....1310-229- 250
WSAN—Allentown Call Publishing Co., Allentown, Pa....1310-229- 100
WSAR—Doughty & Welch Electric Co., Fall River, Mass..1180-254- 100
WSAX—Zenith Radio Corp., Chicago, Ill.....1120-268- 100
WSB—Atlanta Journal, Atlanta, Ga..... 700-428-1000
WSBC—World Battery Co., Chicago, Ill.....1430-210- 200
WSBF—Stix, Baer & Fuller, St. Louis, Mo.....1100-273- 250
*WSBT—South Bend Tribune, South Bend, Ind.....1090-275- 250
WSDA—The City Temple, New York, N. Y.....1140-263- 250
WSKC—World's Star Knitting Co., Bay City Mich.....1150-261- 100
WSMB—Saenger A'm'h Co., & Maison Blanche N. O. La. 940-319- 500
WSMK—S. M. K. Radio Corp., Dayton, Ohio.....1090-275- 500
WSOE—School of Eng'rng of Milwaukee, Milwaukee, Wis.1220-246- 500
WSRO—Radio Co., Hamilton, Ohio.....1190-252- 100
WSUI—State University of Iowa, Iowa City, Iowa..... 620-484- 500
WSY—Alabama Polytechnic Institute, Auburn, Ala.....1200-250- 500
WTAB—Fall River Daily Herald Pub. Co., Fall R'vr, Mass.1130-266- 100
WTAC—Penn. Traffic Co., Johnstown, Pa.....1120-268- 100
*WTAG—Worcester Telegram Pub., Co., Worcester, Mass..1120-268- 500
*WTAM—Willard Storage Battery Co., Cleveland O..... 770-389-3500
WTAR—Reliance Electric Co., Norfolk, Va.....1150-261- 100
WTAT—Edison Illum'ting Co., Boston, Mass., (portable)..1230-244- 100
WTAW—Agri. & Mech. Col. of Texas, Col. Station, Tex..1110-270- 500
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- 250
WWGL—Radio Engineering Corp., Richmond Hill, N. Y..1410-213- 500
WWI—Ford Motor Co., Dearborn, Mich.....1130-266- 500
WWJ—Detroit News, Detroit, Mich..... 850-353-1000
WWL—Loyala University, New Orleans, La.....1090-275- 100

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