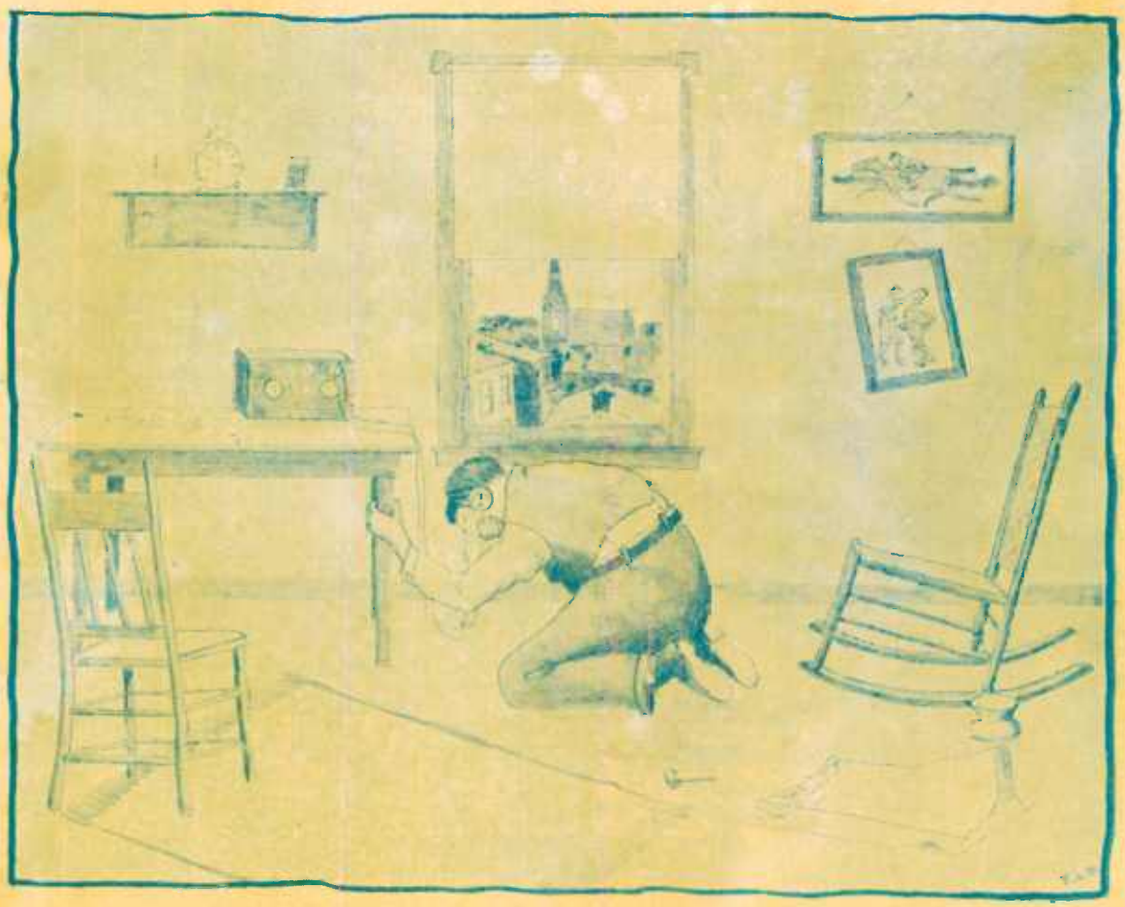
A REAL DX CRYSTAL SET

The BROADCAST RECEIVER



Every normal man has an active or latent interest in the soul, immortality and higher life here, and the minister who has the gift of getting at a man's mind and heart can do mighty missionary work with radio.—(From editorial in Washington Sunday Star, Dec. 30, 1923.)

SHALL WCAP STOP BROADCASTING?

February 15, 1924

10 CENTS A COPY
$2.00 A YEAR

The BROADCAST RECEIVER

VOL. 1 FEBRUARY 15, 1924 NO. 7

Shall WCAP Stop Broadcasting?

Future of This Station's Entertainment Service May Be Decided Next Week

By WALTER BARRETT

ON a decision of the Public Utilities Commission of the District of Columbia next week, hangs the fate of WCAP, the popular and powerful broadcasting station of the Chesapeake & Potomac Telephone Company.

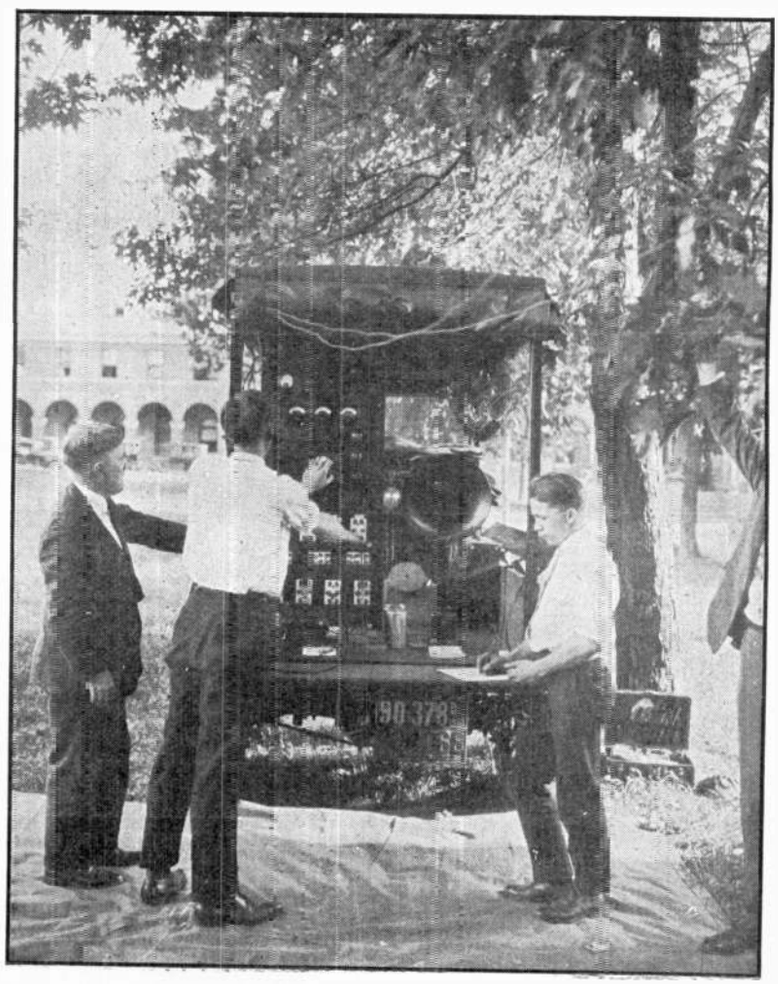
There are persistent rumors in Washington—and they are taken seriously in some quarters—that should the Utilities Commission order a reduction in telephone rates the telephone company's high class broadcasting service would automatically cease.

What the telephone company expects to ultimately gain through its radio broadcasting has never been satisfactorily explained. Where the revenues for the costly service are derived, is another question that has not been definitely cleared up. However, the Federation of Citizens' Associations, in its petition to the Utilities Commission demanding a reduction in telephone rates, charges that the thousands of telephone subscribers in the District of Columbia are paying for this radio service.

If the Utilities Commission, in its investigation, finds that the telephone company is using surplus profits derived from its telephone service to pay for its radio service, it undoubtedly will order a reduction in the present 'phone rates. Then, where will the funds come from for the broadcasting service?

The answer is simple. The public will either have to pay the cost of operating the telephone company's broadcasting station, or depend entirely on the Radio Corporation of America's station, WRC, for its local radio entertainment. The telephone company has nothing to lose, except an enormous amount of free advertising, should it shut down its broadcasting station. The thousands of radio

(Continued on page 3.)



WCAP's radio truck which will go out of operation if the station shuts down.

Radio Fans Neglect to Protect Their Apparatus

By D. O. GABLE

TAKE a trip into your cellar; no, not for what you think I mean, but take a trip there and inspect the protection on the electrical lighting system in your home. You will find that your electric meter is fused on the incoming and outgoing sides. This not only protects the meter but also protects the valuable apparatus at the generating station and in your home. In fact, if you should go on to examine the entire system supplying electrical power to your home you would soon discover that there is a most elaborate amount of protection at every point you turn. On casual inspection, however, you might say that the entire scheme had been overdone, and, still, most any electrical engineer will tell you that they are constantly searching for more means of protection. In fact, the entire application of electrical energy is a study of safety and protection when it comes to our radio outfits. We often neglect to place fuses on the lead wires from our storage battery, although, an ordinary storage battery is easily capable of giving 200 amperes or more on a dead short circuit. Such a high current can often melt a copper wire and is certainly sufficient to cause a fire if not checked in time. Yet, this is only one hazard that radio fans run daily and think nothing of it.

Still another neglected feature is the protection of the vacuum tubes in the radio set. Millions of dollars are spent by radio fans every year to renew or replace tubes that are burnt out through just plain accident. Still many radio people continue with the old routine and are content to gamble with luck that it won't happen again. Accidents will happen, no matter how many precautions are taken, and although you may take the utmost care yourself you must always take precautionary steps against others who are perfectly capable of causing much trouble. Vacuum tubes are burnt out in many accidental ways: some are placed across the high voltage "B" battery, others are blown out by excessive "A" battery voltage, and, then some are blown by strange and mysterious ways, such as placing a WD-12 tube in a set that was just operating with a 201-A; forgetting that the filament voltage of the WD-12 is 1.5 and the filament voltage of the 201-A is 5.0 volts. Flash, goes the tube in a mere fraction of a second. A $5.00 tube is gone in an instant, and yet, for a small cost this tube and all others could be insured against all mistakes.

It was an easy matter to design a fuse to protect your home and radio set from fire that might be caused by a shorted storage battery, but there was an altogether different problem when radio engineers endeavored to protect the vacuum tube. A tube fuse must not only be capable of blowing on an exceedingly low current as compared to the battery fuse, but also must be always ready to function in a much shorter period of time. The tube fuse must act and act effectively before any harm is done to the tube filament. In the case of the battery fuse nothing serious would happen if the fuse did not act promptly within 1/1,000th of a second, but a tube fuse must regularly act exactly within the allotted time. One of the oldest New England radio houses has spent much time and money to perfect a tube fuse that slips over the filament leg of the tube.

Shall WCAP Stop Broadcasting?

(Continued from page 1)

fans in Washington and the Eastern section of the country, who enjoy WCAP's programs, would suffer the greatest loss.

Thousands of dollars have been spent by the telephone company in equipping its broadcasting station, and furnishing for more than a year, air entertainment that can find no equal in any section of the country. WCAP also can take a large share of the credit for the prosperity of Washington's radio dealers. The high class programs broadcast by this station undoubtedly increased the sale of radio receiving sets while at the same time stimulated interest in radio.

Any person who heard WCAP the other night broadcast that epochal international and transcontinental radio and long distonce telephone demonstration, and did not immediately become a radio enthusiast, fails to appreciate the seeming miracles of the present era. Scores of cases could be cited where the telephone company indirectly has stimulated an interest in radio among persons who, from the inception of the radio craze, have steadfastly contended that it was a fad that would soon disappear into oblivion.

Should it be true that the excess profits of the telephone company are paying for the broadcasting service, the rate reduction which the Utilities Commission will order will amount to about 50 cents a month. The broadcasting service, therefore, on this basis, would be costing telephone subscribers a little more than 10 cents a week. A vast majority of the telephone subscribers are radio fans. Are they not willing to contribute 50 cents a month toward paying for the entertainment they receive through WCAP, sixteen nights a month?

A continuation of the present telephone rates will see a continuation in the telephone company's broadcasting service. A reduction probably will sound the death of WCAP.

Announcement

IN the issue of January 14 the hook-up and description of the Superdyne Receiver was featured. Almost immediately letters from radio fans in Washington and from as far away as Florida began pouring into the office of publication, seeking additional information. All of these requests have been tabulated and forwarded to the manufacturer of the set. As soon as the information desired can be compiled at the factory, those readers of the BROADCAST RECEIVER who have requested additional data, will be furnished with copies.—EDITOR.

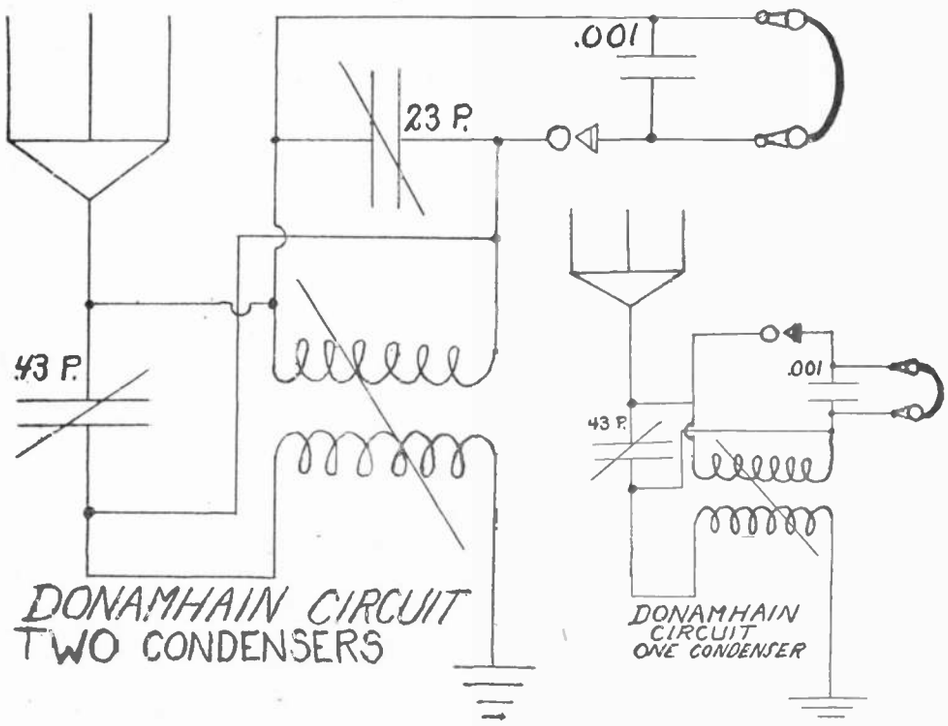
Long Distance Crystal Receving Station

By J. K. Donovan

MANY experts have come to the conclusion that all effective radio receiving will eventually revolve about the crystal set. After the inefficient coherer method the crystal was the first development, then the three-element tube. Conditions everywhere, at present, indicate that receiving will finally abandon the tube with its complicated apparatus and again adopt the old system. The greater part of radio progress has thus far been directed to the perfection of the tube. Experimenters with crystal stations, however, have not remained entirely inactive nor have their efforts been fruitless. DX crystal receiving has now actually been accomplished. After exhaustive experimentation for several years the Donamhain circuit has been evolved.

The Donamhain DX crystal receiving circuit is about as efficient and selective as any so far devised. The first salient feature of this set is its antenna installation. An aerial of less than 140 feet long has been found to be ineffective. This, however, may comprise as many wires as necessary. If the aerial is located in a congested district, where a greater length than 50 feet is not permitted, the difficulty may be somewhat lessened by employing two or more ground connections. Even if your aerial is sufficiently long it would be a good practice to follow this plan. Automobile tire rims, metal plates, coils, etc., will give fine results if added to the ground system. These should be buried preferably in the cellar, as the earth is usually damper at this depth. An underground loop has been operated successfully in connection with this hook up, thus entirely eliminating the elevated antenna.

If you construct a ground system as described it would be well to connect your ground wire to the aerial binding post and your aerial lead-in to the ground binding post, as this gives much sharper tuning. Ground wires should be connected to all-metal objects which would appear to detract from the energy of the aerial.



This increases the effective height of your wires. A 50-foot counterpoise also would increase the efficiency of the aerial if you have trouble with your ground connections.

Keep resistance in antenna connections as low as possible by scraping corrosion from your wires at least twice each month. A good cat whisker and crystal are of prime importance for satisfactory results. An efficient cat whisker may be easily constructed of a short piece of bare copper wire, this should be filed to a fine point once each week. A galena crystal is not advisable. Galena gives superior results for about two weeks but it must be continually broken to preserve its sensitiveness. Due to its extremely soft surface it must be replaced very often if the maximum volume is desired.

Two variable condensers and a variocoupler are the tuning instruments embodied in the Donamhain circuit. The condensers should be 43 plate (.005 MFD.) and 23 plate (.001 MFD.). Excellent long-distance reception, however, may still be accomplished by elimination of one of the condensers (23 plate). A good detector stand and .001 MFD. by-pass should also be used. When tuning this circuit place the first switch on the first tap and the second switch on the last tap. Set the variocoupler secondary at 50 degrees by the dial, or straight up and down, then tune with the condensers. This method utilizes all of the coil and besides minimizing the possibility of loss by "dead ends" renders the set capable of a greater selectivity. The Donamhain circuit may be tuned on other taps but the above mentioned are the most satisfactory.

For summer thunderstorms a good lightning arrester or ground switch should be used. A ground switch may be constructed of two binding posts and a two-inch piece of bus bar. Screw the two binding posts about an inch apart with their connection holes directly facing each other. Connect the ground binding post to the screw of one of them and the aerial bind-

(Continued on page 12)

A Page With The Editor

THE BROADCAST RECEIVER, beginning with this issue, becomes a semimonthly instead of a weekly publication. Hereafter it will appear on the 1st and 15th of each month.

The change was made for several important reasons. First, it was found impossible, due to the vast amount of work in publishing a magazine of the type of THE BROADCAST RECEIVER, to enlarge it to the size desired by the publishers and continue as a weekly and at the same time give to the readers and advertisers the high-class service that has been maintained in the past. Second, it was planned to publish as a weekly feature the advance programs of the local and distant broadcasting stations. These programs, arranged so far in advance in the date of publication, have been juggled and changed so frequently that they were virtually valueless to the radio listener who used them. The advance programs, therefore, will not be published in this and subsequent issues.

As a semimonthly, THE BROADCAST RECEIVER will take rank among national radio magazines as an instructor and entertainer in the realm of radio. Future issues will be bigger and better, with no change in price—10 cents a copy. Don't miss an issue.

THE outstanding need of radio to-day, both for the enjoyment of the art and to promote its further development as a sound industry, is more efficient amplification.

Not only research engineers but manufacturers agree that the wider use of better amplification is the next stage of development of the utility. This will not only vastly increase the number of radio users, but immeasurably improve the standard and quality of results obtained in homes throughout the land.

To be sure, amplification is already used with a vengeance. Vengeance is often the precise word! Too much of it sounds like an alley cat singing to its mate: "Last night on the back fence I loved you best of all."

Radio's supreme need is amplification with distortion. To amplify is easy, but to amplify so that no distortion or change in the sound is made requires apparatus designed and constructed by specialists in amplification. In all amplifiers there are transformers and vacuum tubes. The transformer is the heart of the amplifier. Unless the proper transformer is used, the singer's voice in Washington is distorted into squalls and squawks in Chicago. The voice will be amplified, but the tone and the rich natural quality will not be preserved without a proper transformer.

The general public is realizing more every day that amplification is the most important single factor in radio. It is so fundamental that without amplification, radio to-day would be impossible. Changing electric waves to sound waves wouldn't mean much if they couldn't be heard plainly. Amplification builds them up so that they are clear and easy to hear. Amplification is used at the transmitting station as well as at the receiving instrument. Faint whispers thousands of miles away become clear, living voices in the homes of millions.

Amplification is multiplication. The small amount of sound energy generated by the voice or violin string at the broadcasting station is changed to electrical energy and then multiplied or amplified millions of times. This large amount of energy is then put into an antenna and radiated out into space as an electromagnetic wave. When this wave strikes a similar antenna thousands of miles away it gives up to it a small amount of this energy to be amplified again so that a whole room full of people at the remote point can listen and understand.

In a very real and vital sense the key to radio is amplification, and the public is increasingly realizing this. Even more important, they are demanding amplification which gives not only volume but quality of sound—amplification without distortion.

What's Coming Next

BRUCE Lum, whose informative articles have been a regular feature of The Broadcast Receiver, has written another interesting story for the issue of March 1. Don't miss it.

MECHANICALLY inclined amateurs, especially those who have just been bitten by the "radio bug" will be interestel in the article Carlton E. Butler, Radio Engineer, has written for the issue of March 1, on "A Good Beginner's Hook-Up." This hook-up describes in detail the famous ultra audion circuit which is unusually easy to construct. It is a real "DX" circuit.

A SPECIAL "Show Number" of the Broadcast Receiver will be issued on March 15, four days prior to the opening of Washington's first annual radio show at Convention Hall. Besides the regular technical and news features, the show edition will contain a complete program of the radio show.

Published by the Capital Radio Publishing Company, 333-34 Evening Star Building, Washington, D. C.

TERMS.—To the United States and Canada, $2.00 a year. Postage to other countries $1.00 a year additional. Foreign subscriptions are payable in United States funds or their equivalent.

Checks should be made payable to the Capital Radio Publishing Company.

Application to enter as second-class matter made in the Post Office at Washington, D. C., under the Act of Congress of March 3, 1879. Printed in U. S. A.

Interference from Regenerative Sets

By C. B. Joliffe,
Radio Laboratory, Bureau of Standards

Editor's Note.—*This interesting and valuable talk on interference from regenerative receiving sets was broadcast recently from WRC by C. B. Jolliffe, of the radio laboratory of the Bureau of Standards. It is published at the request of hundreds of our readers.*

AS YOU tuned in to-night, did you come in with a whistle? If so, you probably caused many people in your neighborhood discomfort. You would not walk into a hall whistling loudly during a concert or lecture. If you did you would probably be told to leave. For the same reason, if users of receiving sets which may be made to produce whistles insist on going into and out of radio concerts and lectures whistling and causing disturbances the large number of users of radio receiving sets who are operating their sets so as not to cause this type of interference will demand that some means be taken to stop the use of sets which can go into self-generation, that is oscillate. It may be necessary to put regulations prohibiting the use of such sets into the laws of the Nation. We hope not.

The so-called "regenerative receiving set" is blamed for the most of this type of interference, but it should be pointed out that it may be caused by other types of receiving sets as well. Sets which include radio frequency amplification may cause the same kind of interference unless they are kept stable at all times. In general, whenever an electron tube circuit, which is connected or coupled to an antenna circuit, is allowed to go into self-generation; that is, produce whistles with incoming signals, interference is produced.

Many article in the technical and popular magazines have condemned the receiving sets which produce whistles without suggesting any more constructive method of eliminating the interference than to throw the set away and buy one which the salesman says will not re-radiate. It would seem to me more desirable to explain how this interference is produced, how it can be avoided and the set used satisfactorily and without causing interference.

In order to be specific let us take for an example the so-called regenerative receiving set which is used by a large number of people. Suppose a distant station is tuned in without the set producing any whistles—let us say the regeneration control set at zero. Now if the regeneration control, called tickler, plate variometer, or loudness control is increased the signal becomes louder. The set is now in the regenerative condition and is operating without causing any interference. As the regenerative control is further increased, the signal is still further increased but there comes a point at which a dull click is heard, the music becomes distorted, and a whistle or gurgling sound appears. As the tuning control is varied slightly the pitch of the whistle changes. The set has passed out of the region of regeneration and has become a transmitting set. It is now in the self-generating or oscillating condition. Other receiving sets in the neighborhood can hear the whistle and interference is being produced. This whistle is usually used to locate a station and hunting for stations by this beat-note method in order to get distance records is responsible for a large amount of this type of interference.

An article on "Hints on the Adjustment of Radio Receivers," by L. W. Chubb, of the Westinghouse Electric & Manufacturing Company, in "Radio" (Toronto, Canada), May, 1923, explains how a regenerative receiving set may be adjusted to receive stations without any disturbance being produced. A portion of the article is quoted:

"I would like to suggest," says Mr. Chubb, "the following method of receiving broadcasting programs with your regenerative receivers: After adjusting the filament currents of the vacuum tubes to a point which you have found to be satisfactory, increase your regeneration to a point just below oscillation. Now tune the set slowly up or down the scale, keeping the regeneration adjusted just below oscillation until the desired signal is heard or a breathing sound is noticed, indicating the presence of a carrier wave from a station which may not be operating at the instant. If your receiver is well designed, the adjustment will be practically the same throughout the range of broadcasting wave lengths, and any worthwhile signal can easily be tuned in, after which the volume may be increased by a final adjustment of the regeneration."

This method suggested by Mr. Chubb is well worth trying. Maybe you won't get a station 2,000 miles away, but your neighbor will be able to enjoy without interruption the program from this or other stations. A distance record obtained with a regenerative set which is never allowed to whistle is much more to your credit than one obtained by requiring your neighborhood to give up radio reception for the evening.

Some people have stated that a regenerative receiving set sends out radiation which causes interference when it is in the regenerative condition but not in the self-generating condition; that is, adjusted so that the signals are being received with maximum loudness without sending out whistles. It has been stated by some that a regenerative set acts as a screen to prevent other persons receiving the same station, but still others have explained long-distance reception by crystal receiving sets to re-radiation from regenerative receivers. These statements would seem contradictory.

When two antennas or receiving sets are close together then they may be in the magnetic or electric field of each other and any change in the current of one will cause by induction a change in the current of the other. To cause this, the two antennas or sets must be quite close together and would be an exceptional case. Two antennas at the Bureau of Standards which have parallel lead-in conductors approximately 100 feet apart and open ends approximately 50 feet apart and fastened between the same buildings cause no effect on one another when the sets attached

to them are in a regenerative condition but not generating. There is, however, much interference when one or both sets are in the self-generating condition, the whistles being quite loud. When, however, a small low antenna was erected parallel to and about 25 feet under one of the antennas, an insensitive receiving set attached to the small antenna would receive clear signals from a transmitting station when a highly regenerative receiving set on the larger antenna was receiving the same station. However, when the regeneration in the set attached to the large antenna was reduced to zero, the signals in the insensitive receiving set were reduced nearly to zero. Under such a condition a regenerative receiving set assists an insensitive receiving set in receiving signals, but it is the exceptional case. Such results as these have been reported from other laboratories and are to be expected if the phenomenon is considered from alternating current theory.

A simple numerical calculation can show that if an antenna A is receiving a program from a given transmitting station and a regenerative receiving set is operated properly, that is, giving maximum signals without whistles, on an antenna B 100 feet away, the change in the signal at A caused by the regenerative receiving set at B can not be greater than 1/10 of the strength of the signal received directly from the transmitting station. Such a small change can not be detected by the ear.

Summarizing, any receiving set that is producing whistles is causing interference and the whistles should be stopped. However, a regenerative receiving set properly controlled does not cause interference.

The By-Pass Condenser

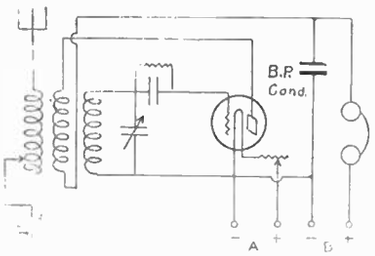
ONE of the pieces of apparatus most neglected by the constructors of radio receivers is the radio frequency by-pass or phone condenser.

The radio frequency current that is present in the telephone or plate circuit and which is fed back into the secondary or grid circuit, causes the action called regeneration to take place, and thus increases to a very considerable extent the receiving signal intensity.

It is, however, very necessary for the maximum of results that there shall be no resistance in the way of this radio frequency energy which is present in the plate circuit.

It is the function of the by-pass condenser, therefore, to make the way clear for the feed back of these currents, so that one's radio receiver may work with the utmost efficiency.

The diagram shows the proper position for this by-pass con-



denser, and we urge that all our readers who have the condenser connected in another manner make a change, or rather place the condenser in the recommended position and then compare the results obtained with the new location with those obtained with the condenser in the former position. We firmly believe that the results will be noticeable enough to make a change in most receivers.

IN A telegraphic dispatch from Minneapolis, Walter K. Foley, chief of the medical service of the U. S. Veterans' Bureau Hospital No. 68, is quoted as declaring that radio is a valuable adjunct to the treatment for tuberculosis and is of great therapeutic value in the treatment of other hospital cases.

He revealed that more than 250 radio sets are being used in the hospital and that whenever a patient enters he is given the option of receiving a radio set as part of the hospital equipment.

Here is additional proof of the assertion that radio has tremendous value in addition to that of providing amusement and entertainment. It is relieving the suffering, not only by causing time to pass more rapidly for them, but by actually assisting them in their fight for recovery. Dr. Foley does not explain just how radio accomplishes what he says it does, but he comes out with the flat assertion that we who are engaged in the radio business are doing our share in returning strength and health to the men who sacrificed theirs for us.

"Push-Pull" System of Amplification Makes Loud Speaker Practical

Third Stage Possible with Tapped Transformers and Two Amplifier Tubes

By CARLTON E. BUTLER, Radio Engineer.

"HOW can I add to my present set so that I can use a loudspeaker?" is a question often asked. The use of a loudspeaker on distant stations as well as local stations is sought for by most every one who owns a radio set.

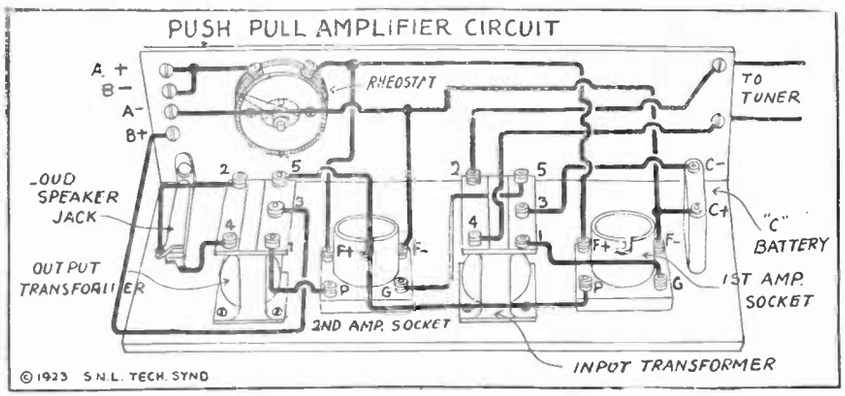
Many one tube sets will operate a loudspeaker on powerful broadcasting stations that are in the near vicinity. Many two tube sets will operate a loudspeaker on stations within a radius of fifty miles, and a dectector and two-stage audio frequency amplifier will often have sufficient volume to operate a loudspeaker on stations a great deal further away.

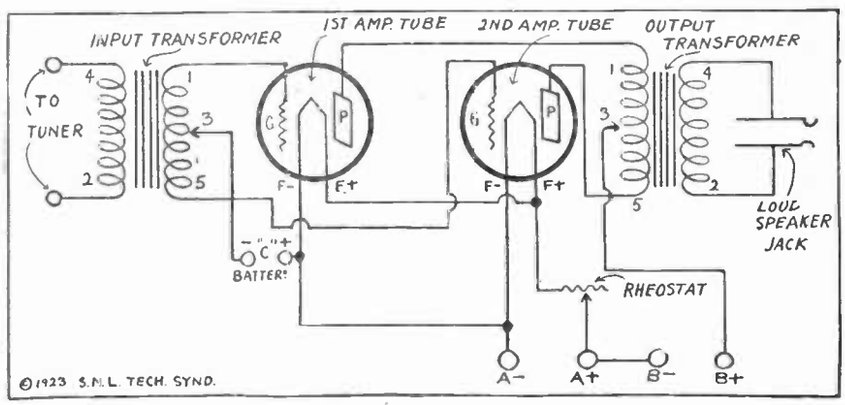
To accomplish these results the tubes must be pushed to their utmost and the set must be efficiently built and installed properly, and last, but not least, operated with skill.

When the set and the tubes are forced, the filaments are burned at a greater than normal brilliance, especially the detector tube. This produces distortion in various forms, and introduces a great number of disagreeable noises. The loudspeaker can but faithfully reproduce the quality of the material that it put into it, and if distorted music is furnished the loudspeaker, then the sound coming forth from the horn will be distorted.

A high amount of "B" battery current can be used on the amplifier tubes to bring out more volume, but this method produces distortion unless a biasing or "C" battery is used. In addition an added drawback is that the current from the "B" battery is constantly being impressed on the windings of the phone or loudspeaker. This exerts a pull on the diaphram of the unit that also adds distortion to the output.

One of the best means of avoiding the above difficulties is in the construction of a Push-Pull or "Differential" amplifier. Due to the fact that it has been almost an impossibility to secure the transformers, I have not shown the construction of this type of amplifier before. Several well known manufacturers have now placed transformers of this type on the market, one transformer having a tapped secondary and called an "input" transformer, and the other having a tapped primary and called an "output" transformer.





Follow the picture diagram and the wiring diagram given in assembling the apparatus. Two binding posts are shown at the left side of the wiring diagram and one at the hight side of the picture diagram. These binding posts are connected to the primary of the first or "input" transformer.

Number one terminal of the secondary winding of the input transformer is wired to the grid of the first amplifier tube. Number five terminal of the transformer, or the other end of the secondary winding is wired to the grid of the second tube. The mid-tap or number three terminal of the transformer is wired to the negative terminal of the "C" batteries.

The positive terminal of the "C" battery is connected to the negative filament line, which in turn is wired to the negative filament binding post of each socket and to the negative "A" battery binding post on the front of the panel. The plate of the first tube is wired to number 1 terminal of the output transformer. The number five terminal of this transformer is connected to the plate of the second tube. The mid-tap is wired to the positive "B" binding post.

Negative "B" and positive "A"

battery binding posts are connected together and to the rheostat. The other side of the rheostat is connected to the "F+" post on each socket. Number 2 and 4 terminals of the secondary of the output transformer are wired to a single stage jack for the loudspeaker and the connections are complete. In the diagram only one rheostat is shown to control the two amplifier tubes given in the push-pull amplifier. For this reason you should use two tubes of like characteristics. That is, a UV199 and a UV 201-A should not be used together in the circuit. Use either two UV 201-A or two UV 199 tubes together.

Another reason for this is that a balancing action takes place between the two tubes used and if they are not of the same general characteristics one tube will do more than its share. The circuit will operate nearly as well with one tube entirely removed from the socket.

The conventional amplification unit of an audio frequency transformer and an amplifying tube, in the case of the push-pull circuit, is supplanted by two transformers and two tubes. The first transformer serves as an amplifying tranformer and delivers the energy to the grid of each of the tubes. The grid of one tube is taken from one end of the secondary, the grid of the other tube from the other end.

This arrangement takes care of both sides of the cycle of current instead of only one half of the cycle as in the case of the usual straight audio frequency amplifier. When one tube is removed from the amplifier then only one tube is working and only one half of the current cycle is amplified.

In general the benefits to be derived from this type of amplification is that pure distortionless output is assured, if, of course, it is not distorted when put into the amplifier. The volume is greater than that of a single stage of audio frequency amplification and for these reasons it is especially desirable when a loudspeaker is to be run from a set which cannot be made to operate a loudspeaker without forcing the tubes.

A substitution can be made for the special transformers required for the "Push-Pull" circuit if you are unable to obtain them in local radio stores. Purchase four low radio transformers of a good make, two for the input, and two for the output side of the circuit.

Connect the B+ terminal of the primary of the first transformer to the "P" terminal of the second transformer. Wire the "F" terminal of the secondary of the first transformer to the "G" terminal of the second transformer. This connects up the primaries of the two transformers in series, and the secondaries of the transformers in series.

Now use the "P" terminal of the first transformer and the "B" connection on the primary of the second transformer as the primary connections of your push-pull input transformer. The "G" terminal of the first transformer secondary and the "F" terminal of the secondary of the second transformer now serve as the connections for the secondary of the input transformer. The mid-tap of the transformer is taken off of the wire connecting the secondary of the two transformers together.

Similarly connect the other two transformers together so that their primaries are in series, using the connection between the two primaries for the mid-tap of the output transformer. The two secondaries connected together form the secondary of the output transformer.

Tests have proven that this method is quite practical, however, it proves to be a rather expensive method as four audio frequency transformers are required to add a single stage of amplification. Get the regular tapped transformers for the push-pull circuit if available, if not the method just described will suffice. Use four transformers of the same characteristics and, if possible, of the same manufacturer.

Dry Cells Run Down Rapidly in Radio Work

Current Required to Heat Filament of Tubes Exhaust Batteries in Few Days.

A GOOD many complaints have come in from my radio fans who own and operate dry cell tubes in their sets. All of these complaints center around one thing; that the dry cells they are using for the filament supply for their set do not last over a short period of time, and that they have to buy new batteries frequently.

The dry cell usually lasts for a period of several months when used for intermittant duty such as furnishing current for the purpose of ringing a doorbell or a buzzer.

The demands of a radio set upon dry batteries is of an entirely different character. When the cell is used for lighting the filament of a vacuum tube the current demand is steady and heavy, and is required for hours at a time, often overnight if you forget to turn off the rheostats.

It is not an uncommon thing to be forced to change dry cell batteries every ten days or two weeks. If you use a storage battery to light the filaments of your tubes a few cents will pay for the cost of recharging. This is much cheaper than the cost of several new batteries. A single charge of your storage battery will light your tubes for over a month; so, in the long run, it is cheaper to use the storage battery.

Dry cells can be connected in parallel to lengthen the life of the "A" battery but you will find that if you have an old dry cell in the bank of batteries it will allow the current from the good cells to flow through it and thereby run the whole bank down in short time.

BROADCASTING STATION DIRECTORY—Part 1

(REVISED TO FEBRUARY 15, 1924.)

KAO—Young Men's Christian Association, Denver, Colo. 360
KFI—E. C. Anthony.....Los Angeles, Calif. 469
KFZ—Doerr Mitchell Electric Co.....Spokane, Wash. 283
KGB—Tacoma Daily Ledger.....Tacom, Wash. 252
KGG—Hallock & Watson Radio Service, Portland, Oreg. 360
KGN—Northwestern Radio Mfg. Co.....Portland, Oreg. 360
KGU—M. A. Mulrony.....Honolulu, Wawaii 360
KGW—Oregonian Publishing Co.....Portland, Oreg. 492
KGY—St. Martins College.....Lacey, Wash. 258
KHJ—Times Mirror Co.....Los Angeles, Calif. 395
KHQ—Louis Wasmer.....Seattle, Wash. 360
KJQ—C. O. Gould.....Stockton, Calif. 360
KJR—Northwest Radio Service Co .....Seattle, Wash. 270
KJS—Bible Institute of Los Angeles, Inc.,
Los Angeles, Calif. 360
KLN—Monterey Electric Shop.....Monterey, Calif. 261
KLS—Warner Brothers.....Oakland, Calif. 360
KLX—Tribune Publishing Co.....Oakland, Calif. 360
KLZ—Reynolds Radio Co.....Denver, Colo. 360
KMC—Lindsay-Weatherill & Co.....Readley, Calif. 360
KMJ—San Joaquin Light & Power Corp., Fresno, Calif. 273
KMO—Love Electric Co.....Tacoma, Wash. 360
KNT—Grays Harbor Radio Co.....Aberdeen, Wash. 263
KNV—Radio Supply Co.....Los Angeles, Calif. 256
KNX—Electric Lighting Supply Co., Los Angeles, Calif. 360
KOB—New Mexico College of Agriculture and
Mechanical Arts, State College, N. Mex. 360
KOP—Detroit Police Dept.....Detroit, Mich. 286
KOQ—Modesto Evening News.....Modesto, Calif. 360
KPO—Hale Bros.....San Francisco, Calif. 423
KQI—University of California.....Berkeley, Calif. 360
KQP—Apple City Radio Club.....Hood River, Calif. 360
KQV—Doubleday-Hill Electric Co.....Pittsburgh, Pa. 360
KQW—Charles D. Herrold.....San Jose, Calif. 360
KRE—Berkeley Daily Gazette.....Berkeley, Calif. 278
KSD—Post-Dispatch.....St. Louis, Mo. 546
KSS—Prest & Dean Radio Rsch. Lab.,
Long Beach, Calif. 360
KTW—First Presbyterian Church.....Seattle, Wash. 360
KUO—The Examiner Printing Co., San Francisco, Calif. 360
KUS—City Dye Works & Lndry Co., Los Angeles, Calif. 360
KUY—Coast Radio Co.....El Monte, Calif. 256
KWG—Portable Wireless Telephone Co., Stockton, Calif. 360
KWH—Los Angeles Examiner.....Los Angeles, Calif. 360
KXD—Herald Publishing Co.....Modesto, Calif. 252
KYQ—Electric Shop.....Honolulu, T. H. 360
KYW—Westinghouse Elec. & Mfg. Co.....Chicago, Ill. 536
KZM—Preston, D. Allen.....Oakland, Calif. 360
KZN—The Desert News.....Salt Lake City, Utah 360
KZV—Wenatchee Hat. & Motor Co., Wenatchee, Wash. 360
KDKA—Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa. 326
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, Ohio. 270
KDPT—Southern Electric Co.....San Diego, Calif. 244
KDLY—Telegram Publishing Co....Salt Lake City, Utah 360
KDYM—Savoy Theatre.....San Diego, Calif. 252
KDYQ—Oregon Institute of Technology, Portland, Oreg. 360
KDYS—The Tribune, Inc.....Great Falls, Mont. 360
KDYW—Smith, Hughes & Co.....Phoenix, Ariz. 360
KDYX—Star Bulletin Publishing Co.....Honolulu, T. H. 360
KDZB—Frank E. Siefert.....Bakersfield, Calif. 240
KDZE—Rhodes Co.....Seattle, Wash. 455
KDZF—Automobile Club of Southern California,
Los Angeles, Calif. 278
KDZI—Electric Supply Co.....Wenatchee, Wash. 360
KDZK—Nevada Machinery & Electric Co.....Reno, Nev. 360
KDZQ—Pyle & Nichols.....Denver, Colo. 360
KDZR—Bellingham Publishing Co....Bellingham, Wash. 261
KDZT—Seattle Radio Association.....Seattle, Wash. 360
KDZY—Cope & Corawell Co.....Salt Lake City, Utah 360
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz. 360
KFAE—State College of Washington.....Pullman, Wash. 360
KFAF—Western Radio Corporation.....Denver, Colo. 360
KFAJ—University of Colorado.....Boulder, Colo. 360
KFAN—Electric Shop.....Moscow, Idaho 360
KFAP—Standard Publishing Co.....Butte, Mont. 360
KFAR—Studio Lighting Service Co.....Hollywood, Calif. 280
KFAT—Dr. J. T. Donohue.....Eugene, Oreg. 275
KFAU—Independent School District of Boise City,
Boise, Idaho 270
KFAV—Abbot Kinney Company.....Venice, Calif. 258
KFAY—W. J. Virgin.....Medford, Oreg. 283
KFAW—The Radio Den, Ashford & White,
Santa Anna, Calif. 280
KFBB—F. A. Buttrey & Co.....Havre, Mont. 360
KFBC—W. K. Azbill.....San Diego, Calif. 360
KFBE—Reuben H. Horn.....San Luis Obispo, Calif. 360
KFBK—Kimball-Upson Co.....Sacramento, Calif. 283
KFBL—Leese Bros.....Everett, Wash. 224
KFBS—Chronicle News and Gas & Elec. Supply Co.
Trinidad, Colo. 360
KFBU—Bishop N. S. Thomas.....Laramie, Wyo. 283
KFCD—Salem Elec. Co.....Salem, Oreg. 360
KFCF—Frank A. Moore.....Walla Walla, Wash. 360
KFCH—Electric Service Station.....Billings, Mont. 360
KFCK—Colorado Springs Radio Co.,
Colorado Springs. Colo. 242
KFCM—Richmond Radio Shop.....Richmond, Calif. 360
KFCP—Ralph W. Flygare.....Ogden, Utah 360
KFCQ—Motor Service Station.....Casper, Wyo. 360
KFCV—Fred Mahaffey, Jr.....Houston, Tex. 360
KFCY—Western Union College.....LeMars, Iowa 252
KFCZ—Omaha Central High School.....Omaha, Nebr. 258
KFDA—Adler's Music Store.....Baker, Oreg. 360
KFDB—Mercantile Trust Co.....San Francisco, Calif. 500
KFDD—St. Michaels Cathedral.....Boise, Idaho 360
KFDF—Wyoming Radio Corp.....Casper, Wyo. 360
KFDH—University of Arizona.....Tuscon, Ariz. 360
KFDJ—Oregon Agri. College.....Corvallis, Oreg. 360
KFDL—Knight-Campbell Music Co.....Denver, Colo. 360
KFDO—H. E. Cutting.....Bozeman, Mont. 248
KFDR—Bullock's Hardware & Sporting Goods,
York, Nebr. 360
KFDU—Nebraska Radio & Electric Co., Lincoln, Nebr. 240
KFDV—Gilbrech & Stinson.....Fayetteville, Ark. 360
KFDX—First Baptist Church.....Shreveport, La. 360
KFDY—South Dakota College of Agriculture and
Mechanical Arts, Brooklings, S. Dak. 360
KFDZ—Harry O. Iverson.....Minneapolis, Minn. 231
KFEC—Meier & Frank Co.....Portland, Oreg. 360
KFEJ—Guy Greason.....Tacoma, Wash. 360
KFEL—Winner Radio Corporation.....Denver, Colo. 360
KFEP—Radio Equipment Co.....Denver, Colo. 240
KFEQ—J. L. Scroggin.....Oak, Nebr. 360
KFER—Auto Electric Service Co.....Ft. Dodge, Iowa 231
KFEV—Radio Electric Shop.....Douglas, Wyo. 263
KFEX—Augsburg Seminary.....Minneapolis, Minn. 261
KFEY—Bunker Hill & Sullivan Mining & Const. Co.,
Kellogg, Idaho 360
KFEZ—American So. of Mech. Engrs.....St. Louis, Mo. 360
KFFE—Eastern Oregon Radio Co.....Pendleton, Ireg. 360
KFFJ—Jenkins Furniture Co.....Boise, Idaho 360
KFFO—Dr. E. H. Smith.....Hillsboro, Oreg. 229
KFFQ—Markschoffel Motor Co...Colorado Springs, Colo. 360
KFFR—Jim Kirk.....Sparks, Nev. 226
KFFY—Garceland College.....Lamont, Iowa 360
KFFX—McGraw Co.....Omaha, Nebr. 278
KFFY—Pincus & Murphy, Inc.....Alexandria, La. 275
KFFZ—Al. G. Barnes Amusement Co.....Dallas, Tex. 226
KFGC—Louisiana State University....Baton Rouge, La. 254
KFGD—Chickasha Radio & Elec. Co., Chickasha, Okla. 248
KFGF—Buchanan Stevens & Co.....Mt. Vernon, Wash. 360
KFGH—Leland Stanford, Jr.. Uni., Stanford Uni., Colo. 360
KFGJ—National Guards Co., 138th Inf., St. Louis, Mo. 266
KFGL—Arlington Garage.....Arlington, Oreg. 234
KFGQ—Crary Hardware Co.....Boone, Iowa 226
KFGV—Heidbreder Radio Supply Co.....Utica, Nebr. 224
KFGX—First Presbyterian Church.....Orange, Tex. 250
KFGZ—Emmanuel Missionary Co., Berrien Spgs., Mich. 268
KFHA—Western State Col. of Colo.....Gunnison, Colo. 252
KFHB—The Rialto Theatre.....Hood River, Oreg. 280
KFHD—Utz Electric Co.....St. Joseph, Mo. 220
KFHF—Central Christian Church.....Shreveport, La. 246
KFHH—Ambrose A. McCue.....Neah Bay, Wash. 283
KFHJ—Fallon Co.....Santa Barbara, Calif. 360
KFHQ—Curtis Bros. Hardware Store, Los Gatos, Calif. 242
KFHR—Star Elec. & Radio Co.....Seattle, Wash. 270
KFHS—Robert Washington Nelson....Hutchinson, Kans. 229
KFIB—Franklin W. Jenkins.....St. Louis, Mo. 244
KFIC—Philip Laskowitz.....Denver, Colo. 224
KFID—Ross Arbuckles Garage.....Iola, Kans. 246
KFIF—Benson Tech. Student Body.....Portland, Oreg. 360
KFIK—Gladbrook Electric Co.....Gladbrook, Iowa 234
KFIL—Windisch Elec. Farm Equipment Co.,
Louisburg, Kans. 234
KFIO—North Central High School.....Spokane, Wash. 252
KFIQ—Yakima Valley Broadcasting Association,
Yakima, Wash. 224
KFIU—Alaska Elec. Lt. & Power Co., Juneau, Alaska 226
KFIV—V. H. Broyles.....Pittsburg, Kans. 240
KFIX—Reorganized Church of Jesus Christ,
Latter Day Saints, Independence, Kans. 240
KFIY—Brott Laboratories.....Seattle, Wash. 236
KFIZ—Daily Commonwealth.....Fond du Lac, Wis. 273
KFJA—Central Power Co.....Brand Island, Nebr. 244
KFJB—Marshall Electric Co., Inc., Marshalltown, Iowa 248
KFJC—Post Intelligencer.....Seattle, Wash. 233
KFJD—Weld County Printing & Pub. Co., Greeley, Colo. 236
KFJF—National Radio Mfg. Co., Oklahoma City, Okla. 252
KFJH—The Sugar Bowl.....Selma, Calif. 273
KFJI—Liberty Theatre.....Astoria, Areg. 252
KFJJ—Carrollton Radio Shop.....Carrollton, Mo. 236
KFJM—University of North Dakota, Grand Forks, N. D. 229
KFJR—Ashley C. Dixon & Co.....Stevensville, Mont. 258
KFJU—Central Power Co.....Kearney, Nebr. 234
KFJV—T. H. Warren.....Dexter, Iowa 224
KFJW—Le Grand Radio Co.....Towanda, Kans. 226
KFJX—Iowa State Teachers College....Cedar Falls, Iowa 229
KFJY—Tunwall Radio Co.....Fort Dodge, Iowa 246
KFJZ—Texas Nat'l Guard, 112th Cav., Ft. Worth, Tex. 254
KFKA—Colorado State Teachers College, Greeley, Colo. 248
KFKB—Brinkley-Jones Hospital Asso.....Milford, Kans. 286
KFKH—Denver Park Amusement Co.....Lakeside, Colo. 226
KFKQ—Conway Radio Laboratories.....Conway, Ark. 224
KFKV—F. F. Gray.....Butte, Mont. 283
KFKX—Westinghouse Electric Co.....Hastings, Nebr. 286
KFKZ—Nasour Bros. Radio Co., Colorado Springs, Colo. 234
KFLA—Abner R. Wilson.....Butte, Mont. 283
KFLB—Signal Electric Mfg. Co.....Menominee, Mich. 248
KFLE—National Educational Service.....Denver, Colo. 268
KFLH—Erickson Radio Co., Inc.....Salt Lake City, Utah 261
KFLP—Everett M. Foster.....Cedar Rapids, Iowa 240
KFLQ—Bizzell Radio Shop.....Little Rock, Ark. 261
KFLR—University of New Mexico, Albuquerque, N. M. 254
KFLU—Rio Grande Radio Supply House, San Benito, Tex. 236
KFLV—Rev. A. T. Frykman.....Rockford, Ill. 229
KFLW—Missoula Electric Supply Co.....Missoula, Mont. 234
KFLX—George R. Clough.....Galveston, Tex. 240
KFLY—Fargo Radio Supply Co.....Fargo, N. D. 231

BROADCASTING STATION DIRECTORY—Part 2

(REVISED TO FEBRUARY 15, 1924.)

KFLZ	Atlantic Automobile Co.	Atlantic, Iowa 273
KFMQ	University of Arkansas	Fayetteville, Ark. 263
WBL	T. & H. Radio Co.	Anthony, Kans. 261
WBS	May & Co.	Newark, N. J. 360
WBT	Southern Radio Corporation	Charlotte, N. C. 360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass. 337
WCE	Findley Electric Co.	Minneapolis, Minn. 360
WCK	Stix-Baer-Fuller	St. Louis, Mo. 360
WCM	University of Texas	Austin, Tex. 360
WCX	Detroit Free Press	Detroit, Mich. 517
WDM	Church of the Covenant	Washington, D. C. 360
WDT	Ship Owners Radio Service, Inc., Premier Grand Piano Corporation,	New York, N. Y. 405
WDZ	James L. Bush	Tuscola, Ill. 278
WEB	Benwood Co.	St. Louis, Mo. 360
WEV	Hurlburt-Still Electrical Co.	Houston, Tex. 360
WEW	St. Louis University	St. Louis, Mo. 261
WFI	Strawbridge & Clothier	Philadelphia, Pa. 395
WFY	Cosradio Co.	Wichita, Kans. 360
WGI	American Radio & Research Corporation,	Medford, Hillside, Mass. 360
WGL	Thomas F. J. Howlett	Philadelphia, Pa. 360
WGR	Federal Tel. & Tel. Co.	Buffalo, N. Y. 319
WGV	Interstate Electric Co.	New Orleans, La. 360
WGY	General Electric Co.	Schenectady, N. Y. 380
WHA	University of Wisconsin	Madison, Wis. 360
WHB	Sweeney School Co.	Kansas City, Mo. 411
WHK	The Radiovox Company	Cleveland, Ohio 360
WHN	Loew's State Theatre	New York City, N. Y. 360
WHX	Iowa Radio Corporation	Des Moines, Iowa 360
WIK	K. & L. Electric Co.	McKeesport, Pa. 234
WIL	Continental Elec. Supply Co.,	Washington, D. C. 360
WIP	Gimbel Bros.	Philadelphia, Pa. 509
WIZ	Cino Radio Mfg. Co.	Cincinnati, Ohio 360
WJD	Richard Harris Howe	Granville, Ohio 229
WJH	White & Boyer Co.	Washington, D. C. 273
WJK	Service Radio Equipment Co.	Toledo, Ohio 360
WJX	DeForest Radio Tel. & Tel. Co.,	New York, N. Y. 360
WJY	Radio Corp. of America	Aeolian Hall, N. Y. C. 405
WJZ	Radio Corp. of America	Aeolian Hall, N. Y. C. 455
WKA	Landaus Music & Jewelry Co.,	Wilkes-Barre, Pa. 360
WKY	Oklahoma Radio Shop	Oklahoma City, Okla. 360
WLB	University of Minnesota	Minneapolis, Minn. 360
WLH	Hamilton Mfg. Co.	Indianapolis, Ind. 360
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio 309
WMA	Arrow Radio Laboratories	Anderson, Ind. 360
WMC	Commercial	Memphis, Tenn. 500
WMH	Precision Equipment Co.	Cincinnati, Ohio 248
WMU	Doubleday-Hill Co.	Pittsburgh, Pa. 261
WNJ	Shotten Radio Mfg. Co.	Albany, N. Y. 400
WNO	Wireless Telephone Co. of Hudson County,	Jersey City, N. J. 360
WOC	Palmer School of Chiopractic	Davenport, Iowa 484
WOI	Iowa State College	Ames, Iowa 360
WOK	Arkansas Light & Power Co.	Pine Bluff, Iowa 360
WOO	John Wanamaker	Philadelphia, Pa. 509
WOQ	Western Radio Co.	Kansas City, Mo. 360
WOR	L. Bamberger Co.	Newark, N. J. 405
WOS	Missouri State Marketing Bureau,	Jefferson City, Mo. 441
WPA	Fort Worth Record	Fort Worth, Tex. 360
WPG	Nushawg Poultry Farm	New Lebanon, Ohio 234
WPI	Electric Supply Co.	Clearfield, Pa. 360
WQX	Walter A. Kushl	Chicago, Ill. 360
WRC	Radio Corp. of America	Washington, D. C. 469
WRK	Doron Brothers Electric Co.	Hamilton, Ohio 360
WRL	Union College	Schenectady, N. Y. 360
WRM	University of Illinois	Urbana, Ill. 360
WRR	City of Dallas (Police and Fire Signal Department),	Dallas, Tex. 360
WRW	Tarrytown Radio Resch. Lab.,	Tarrytown, N. Y. 273
WSB	Atlanta Journal	Atlanta, Ga. 429
WSL	J. & M. Electric Co.	Utica, N. Y. 273
WSY	Alabama Power Co.	Birmingham, Ala. 360
WSZ	Marshall-Gerken Co.	Toledo, Ohio 360
WTG	Kansas State Agr. College	Manhattan, Kans. 360
WTP	George M. McBride	Bay City, Mich. 360
WWI	Ford Motor Co.	Dearborn, Mich. 273
WWJ	The Detroit News	Detroit, Mich. 517
WWL	Loyola University	New Orleans, La. 280
WAAB	Valdemar Jensen	New Orleans, La. 268
WAAC	Tulane University	New Orleans, La. 360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio 360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill. 286
WAAK	Gimbel Bros.	Milwaukee, Wis. 280
WAAM	L. R. Nelson Co.	Newark, N. J. 263
WAAN	University of Missouri	Columbia, Mo. 264
WAAQ	New England Motor Sales Co.,	Greenwich, Conn. 360
WAAS	Georgia Radio Co.	Decatur, Ga. 360
WAAW	Omaha Grain Exchange	Omaha, Nebr. 360
WAAZ	Hollister-Miller Motor Co.	Emporia, Kans. 360
WABA	Lake Forest College	Lake Forest, Ill. 266
WABB	Dr. John B. Lawrence	Harrisburg, Pa. 266
WABC	Fulwider-Grimes Battery Co.	Anderson, Ind. 229
WABD	Parker High School	Dayton, Ohio 286
WABE	Y. M. C. A.	Washington, D. C. 283
WABF	Mt. Vernon Register-News Co.,	Mt. Vernon, Ill. 234
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla. 248
WABH	Lake Shore Tire Co.	Sandusky, Ohio 240
WABI	Bangor Railway and Electric Co.,	Bangor, Me. 240
WABJ	Radio Laboratories	South Bend, Ind. 240
WABK	First Baptist Church	Worcester, Mass. 252
WABL	Connecticut Agri. College	Storrs, Conn. 283
WABM	F. E. Doherty	Saginaw, Mich. 254
WABN	Waldo C. Grover	La Crosse, Wis. 234
WABO	Lake Avenue Baptist Church	Rochester, N. Y. 252
WABP	Robert F. Weinhig	Dover, Ohio 266
WABQ	Haverford College Radio Club	Haverford, Pa. 261
WABR	Scott High School	Toledo, Ohio 270
WABS	Essex Mfg. Co.	Newark, N. J. 244
WABT	Holliday-Hall	Washington, Pa. 252
WABU	Victor Talking Machine Co.	Camden, N. J. 226
WABV	John H. De Witt, jr.	Nashville, Tenn. 263
WAJV	Indian Pipe Line Corp.	Princeton, Ind. 360
WBAA	Purdue University	West Lafayette, Ind. 360
WBAD	Sterling Electric Co. and Journal Printing Co.,	Minneapolis, Minn. 360
WBAH	The Dayton Co.	Minneapolis, Minn. 417
WBAN	Wireless Phone Corporation	Paterson, N. J. 244
WBAO	James Millikin University	Decatur, Ill. 360
WBAP	Wortham-Carter Pub. Co., The Star Telegram,	Fort Worth, Tex. 476
WBAV	Erner & Hopkins Co.	Columbus, Ohio 390
WBAW	Marietta College	Marietta, Ohio 246
WBAX	John H. Stenger, jr.	Wilkes-Barre, Pa. 360
WBAY	Western Electric Co.	New York, N. Y. 492
WBBA	Newark Radio Laboratory	Newark, Ohio 240
WBBD	Barbey Battery Service	Reading, Pa. 224
WCAD	St. Lawrence University	Canton, N. Y. 280
WCAE	Kaufman & Baer Co.	Pittsburgh, Pa. 462
WCAF	Michigan Limestone & Chemical Co.,	Rodgers, Mich. 360
WCAG	Clyde R. Randall	New Orleans, La. 268
WCAH	Entrekin Electric Co.	Columbus, Ohio 286
WCAJ	Nebraska Wesleyan University,	University Pl., Nebr. 360
WCAK	Alfred P. Daniel	Houston, Tex. 360
WCAL	St. Olaf College	Northfield, Minn. 360
WCAM	Villanova College	Villanova, Pa. 360
WCAO	Sanders & Stayman Co.	Baltimore, Md. 360
WCAP	Chesapeake & Potomac Tel. Co.,	Washington, D. C. 469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex. 360
WCAS	Dunworthy Indus. Institute,	Minneapolis, Minn. 246
WCAT	S. Dak. School of Mines	Rapid City, S. Dak. 240
WCAU	Durham & Co.	Philadelphia, Pa. 286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark. 360
WCAX	University of Vermont	Burlington, Vt. 360
WCAY	Kesselman O'Driscoll Music House,	Milwaukee, Wis. 261
WCAZ	Carthage College	Carthage, Ill. 246
WCBA	Charles W. Halmbach	Allentown, Pa. 280
WCBD	Zion Radio Broadcasting Station	Zion, Ill. 345
WDAE	Tampa Daily Times	Tampa, Fla. 360
WDAF	Kansas City Star	Kansas City, Mo. 411
WDAG	Martin J. Laurence	Amarillo, Tex. 263
WDAH	Trinity Methodist Church	El Paso, Tex. 268
WDAK	Hartford Courant	Hartford, Conn. 261
WDAL	Florida Times Union	Jacksonville, Fla. 360
WDAM	Weston Electric Co.	New York, N. Y. 360
WDAO	Automotive Electric Co.	Dallas, Tex. 360
WDAP	The Board of Trade	Chicago, Ill. 360
WDAR	Lit Brothers	Philadelphia, Pa. 395
WDAS	Samuel W. Waite	Worcester, Mass. 360
WDAU	Slocum & Kilburn	New Bedford, Mass. 360
WDAX	First National Bank	Centerville, Iowa 268
WDAY	Fargo Radio Service Co.	Fargo, N. Dak. 244
WDBC	Kirk Johnson & Co., Inc.	Lancaster, Pa. 258
WEAA	Fallain & Lathrop	Flint, Mich. 280
WEAE	Virginia Polytechnic Institute.	Blacksburg, Va. 360
WEAF	American Tel & Tel.	New York, N. Y. 492
WEAH	Wichita Board of Trade	Wichita, Kans. 244
WEAI	Cornell University	Ithaca, N. Y. 286
WEAJ	University of South Dakota,	Vermillion, S. Dak. 283
WEAM	North Plainfield, Borough of Plainfield,	North Plainfield, N. J. 252
WEAN	Shepard Co.	Providence, R. I. 273
WEAO	Ohio State University	Columbus, Ohio 360
WEAP	Mobile Radio Co., Inc.	Mobile, Ala. 360
WEAR	Baltimore Am. & News Pub. Co.,	Baltimore, Md. 360
WEAS	Hecht Company	Washington, D. C. 360
WEAU	Davidson Brothers Co.	Sioux City, Iowa 369
WEAY	Will Horwitz, jr.	Houston, Tex. 360
WEAZ	Donald Redmond	Waterloo, Iowa 360
WFAA	A. H. Belo & Co.	Dallas, Tex. 476
KFAB	Carl C. Woese	Syracuse, N. Y. 234
WFAF	Henry C. Spratley	Poughkeepsie, N. Y. 273
WFAG	Radio Engineering Lab.	Waterford, N. Y. 360
WFAH	Electric Supply Co.	Port Arthur, Tex. 236
WFAJ	Hi-Grade Wireless Instrument Co.,	Asheville, N. C. 360
WFAM	Times Publishing Co.	St. Cloud, Minn. 360
WFAN	Hutchinson Elec. Service Co.,	Hutchinson, Minn. 360
WFAQ	Missouri Wesleyan College and Cameron Radio Co.,	Cameron, Mo. 360
WFAT	Daily Argus Leader	Sioux Falls, S. Dak. 360
WFAV	University of Nebraska	Lincoln, Nebr. 275
WGAC	Orpheum Radio Stores Co.	Brooklyn, N. Y. 360
WGAD	Spanish Am. Sch. of Telegraphy,	Enconada, P. R. 360
WGAJ	W. H. Glass	Shenandoah, Iowa 360
WGAL	Lancaster Elec. Supply & Const. Co.,	Lancaster, Pa. 248
WGAN	Cecil E. Lloyd	Pensacola, Fla. 360
WGAQ	W. G. Patterson	Shreveport, La. 360
WGAW	Ernest C. Albright	Altoona, Pa. 261
WGAX	Radio Elec. Co.,	Washington Courthouse, Ohio 360
WGAY	North Western Radio Co.	Madison, Wis. 360
WGAZ	South Bend Tribune	South Bend, Ind. 360

BROADCASTING STATION DIRECTORY—Part 3

(REVISED TO FEBRUARY 15, 1924.)

WHAA—State University of Iowa	Iowa City, Iowa	283
WHAB—Clark W. Thompson	Galveston, Tex.	360
WHAC—Cole Brothers Elec. Co	Waterloo, Iowa	360
WHAD—Marquette University	Milwaukee, Wis.	360
WHAG—University of Cincinnati	Cincinnati, Ohio	222
WHAH—J. T. Griffin	Joplin, Mo.	360
WHAK—Roberts Hardware Co	Clarksburg, W. Va.	258
WHAM—Eastman School of Music of University of Rochester	Rochester, N. Y.	283
WHAP—Dewey L. Otta	Decatur, Ill.	360
WHAR—Paramount Radio and Elec. Co.,	Atlantic City, N. J.	231
WHAS—Courier Journal and Times	Louisville, Ky.	400
WHAV—Wilmington Elec. & Supply Co.,	Wilmington, Del.	360
WHAX—Huntington Press	Huntington, Ind.	360
WHAZ—Rensselaer Polytechnic Institute	Troy, N. Y.	380
WIAB—Joslyn Automobile Co	Rochford, Ill.	360
WIAD—Howard R. Miller	Philadelphia, Pa.	254
WIAF—Gustav A. De Cortin	New Orleans, La.	234
WIAH—Continental Radio and Mfg. Co., Inc.,	Newton, Iowa	258
WIAI—Heers Stores Co	Springfield, Mo.	252
WIAK—Journal Stockman Co	Omaha, Nebr.	278
WIAP—J. A. Rudy & Sons	Paducah, Ky.	360
WIAQ—Chronicle Publishing Co	Marion, Ind.	226
WIAS—Burlington Hawkeye-Home Elec. Co.,	Burlington, Iowa	360
WIAT—Leon T. Noel	Tarkio, Mo.	360
WIAU—American Sec. & Sav. Bank	Le Mars, Iowa	360
WIAV—New York Radio Labs	Binghamton, N. Y.	360
WIAW—Saginaw Radio & Elec. Co	Saginaw, Mich.	360
WJAD—Jackson's Radio Eng. Lab	Waco, Tex.	360
WJAF—Press Pub. Co	Munice. Ind.	360
WJAG—Huse Publishing Co	Norfolk, Nebr.	360
WJAJ—Y. M. C. A	Dayton, Ohio	360
WJAK—Rev. C. L. White	Greentown, Ind.	254
WJAM—D. C. Perham	Cedar Rapids, Iowa	268
WJAN—Peoria Star Co	Peoria, Ill.	280
WJAR—The Outlet Co	Providence, R. I.	360
WJAS—Capper Publications	Topeka, Kans.	360
WJAT—Kelly-Vawter Jewelry Co	Marshall, Mo.	360
WJAX—Union Trust Co	Cleveland, Ohio	390
WJAZ—Chicago Radio Laboratory	Chicago, Ill.	448
WKAA—H. F. Paar	Cedar Rapids, Iowa	268
WKAD—Charles Looff	East Providence, R. I.	240
WKAF—W. S. Radio Supply Co. and Wm. Schack,	Wichita Falls, Tex.	360
WKAN—Alabama Radio Mfg. Co	Montgomery, Ala.	360
WKAP—Dutee Wilcox Flint	Cranston, R. I.	360
WKAQ—Radio Corp. of Porto Rico, San Juan, P. R.		360
WKAR—Michigan Agri. College	East Lansing, Mich.	280
WKAS—L. E. Lines Music Co	Springfield, Mo.	360
WKAV—Laconia Radio Club	Laconia, N. H.	254
WKAW—United Battery Service Co.,	Montgomery, Ala.	226
WKAY—Brenau College	Gainesville, Ga.	280
WLAG—Cutting & Washington Radio Corp.,	Minneapolis, Minn.	417
WLAH—Samuel Woodworth	Syracuse, N. Y.	234
WLAJ—Waco Electrical Supply Co	Waco, Tex.	360
WLAK—Vermont Farm Mach. Co	Bellows Falls, Vt.	360
WLAL—Tulsa Radio Co	Tulsa, Okla.	360
WLAN—Putnam Hardware Co	Houlton, Me.	283
WLAP—W. V. Jordan	Louisville, Ky.	360
WLAQ—Arthur S. Schilling	Kalamazoo, Mich.	283
WOAR—Henry F. Lundskow	Kenosha, Wis.	229
WLAS—Central Radio Supply Co	Hutchinson, Kans.	244
WLAT—Radio and Specialty Co	Burlington, Iowa	360
WLAV—Electric Shop, Inc	Pensacola, Fla.	254
WLAW—New York Police Dept	New York, N. Y.	360
WLAX—Greencastle Community Broadcasting Station,	Greencastle, Ind.	231
WMAB—Radio Supply Co	Oklahoma City, Okla.	360
WMAC—J. Edward Page	Cazenovia, N. Y.	261
WMAF—Round Hills Radio Corp	Dartmouth, Mass.	360
WMAH—General Supply Co	Lincoln, Nebr.	254
WMAJ—Drovers Telegram Co	Kansas City, Mo.	275
WMAK—Norton Laboratories	Lockport, N. Y.	360
WMAL—Trenton Hardware Co	Trenton, N. J.	250
WMAN—First Baptist Church	Columbus, Ohio	286
WMAP—Utility Battery Service, Inc	Easton, Ohio	246
WMAQ—Chicago Daily News	Chicago, Ill.	448
WMAV—Alabama Polytechnic Institute	Auburn, Ala.	250
WMAW—Wahpeton Elec. Co	Wahpeton, N. Dak.	360
WMAY—Kingshighway Presby. Church	St. Louis, Mo.	280
WMAZ—Mercer University	Macon, Ga.	268
WNAB—Park City Daily News	Bowling Green, Ky.	360
WNAC—Shepard Stores	Boston, Mass.	278
WNAD—Oklahoma Radio Eng. Co	Norman, Okla.	360
WNAL—R. J. Rockwell	Omaha, Nebr.	242
WNAM—Ideal Apparatus Co	Evansville, Ind.	360
WNAN—Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP—Wittenberg College	Springfield, Ohio	360
WNAQ—Charleston Radio Elec. Co	Charleston, S. C.	360
WNAR—Rhodes, C. C	Butler, Mo.	231
WNAS—Texas Radio Corporation and Austin Statesmen,	Austin, Tex.	360
WNAT—Lenning Bros. Co	Philadelphia, Pa.	360
WNAV—Peoples Tel. & Tel. Co	Knoxville, Tenn.	236
WNAW—Henry Kunzmann	Fortress Monroe, Va.	360
WNAX—Dakota Radio Apparatus Co.,	Yankton, S. Dak.	244
WNAY—Ship Owners' Radio Service	Baltimore, Md.	260
WOAA—Dr. Walter Hardy	Ardmore, Okla.	360
WOAC—Maus Radio Co	Lima, Ohio	266
WOAD—Friday Battery & Elec. Co	Sigourney, Iowa	360
WOAE—Midland College	Fremont, Nebr.	360
WOAF—Tyler Commercial College	Tyler, Tex.	360
WOAG—Apollo Theatre	Belvedere, Ill.	224
WOAH—Palmetto Radio Corp	Charleston, S. C.	360
WOAI—Southern Equipment Co	San Antonio, Tex.	385
WOAJ—Ervin's Electrical Co	Parsons, Kans.	360
WOAL—Wm. Evans Woods	Webster Groves, Mo.	286
WOAN—James D. Vaughan	Lawrenceburg, Tenn.	360
WOAP—Kalamazoo College	Kalamazoo, Mich.	360
WOAT—Boyd Martell Hamp	Wilmington, Del.	360
WOAV—Pennsylvania National Guard	Erie, Pa.	242
WOAW—Woodmen of the World	Omaha, Nebr.	526
WOAX—Franklin J. Wolff	Trenton, N. J.	240
WPAB—Pennsylvania State College, State College, Pa.		283
WPAC—Donaldson Radio Co	Okmulgee, Okla.	360
WPAD—Wieboldt & Co	Chicago, Ill.	360
WPAG—Central Radio Co., Inc	Independence, Mo.	360
WPAH—Wisconsin Dept. of Markets	Waupaca, Wis.	360
WPAJ—Doolittle Radio Corp	New Haven, Conn.	268
WPAK—North Dakota Agri. College, Fargo, N. Dak.		360
WPAL—Superior Radio & Tel. Co., Columbus, Ohio		286
WPAM—Awerbach & Guettel	Topeka, Kans.	360
WPAP—Theodore D. Phillips	Winchester, Ky.	360
WPAQ—General Sales & Eng. Co	Frostburg, Md.	360
WPAR—R. A. Ward	Beloit, Kans.	360
WPAS—J. & M. Electric Co	Amsterdam, N. Y.	360
WPAT—St. Patrick's Cathedral	El Paso, Tex.	360
WPAU—Concordia College	Moorhead, Minn.	360
WPAV—Bangor Radio Laboratory	Bangor, Me.	360
WPAZ—John R. Koch	Charleston, W. Va.	273
WQAA—Horace A. Beale, jr	Parkersburg, W. Va.	360
WQAC—E. B. Gish	Amarillo, Tex.	360
WQAD—Whitehall Electric Co	Waterbury, Conn.	242
WQAE—Moore Radio News Station	Springfield, Vt.	275
WQAF—Sandusky Register	Sandusky, Ohio	240
WQAH—Brock Anderson Elec. Eng. Co.,	Lexington, Ky.	254
WQAK—Appel-Higley Electric Co	Dubuque, Iowa	360
WQAL—Cole County Tel. & Tel. Co	Mattoon, Ill.	258
WQAM—Electrical Equipment Co	Miami, Fla.	360
WQAN—Scranton Times	Scranton, Pa.	360
WQAO—Calvary Baptist Church	New York, N. Y.	360
WQAQ—West Texas Radio Co	Abilene, Tex.	360
WQAS—Prince Walter Co	Lowell, Mass.	266
WQAT—Radio Equipment Corporation	Richmond, Va.	360
WQAV—Huntington and Guerry, Inc	Greenville, S. C.	258
WQAW—Catholic University of America,	Washington, D. C.	236
WQAX—Radio Equipment Co	Peoria, Ill.	360
WRAA—Rice Institute	Houston, Tex.	360
WRAD—Taylor Radio Shop	Marion, Kans.	249
WRAF—Radio Club, Inc	Laport, Ind.	224
WRAH—Stanley N. Reed	Providence, R. I.	231
WRAL—Northern States Power Co., St. Croix Falls, Wis.		248
WRAM—Lombard College	Galesburg, Ill.	244
WRAN—Black-Hawk Electric Co	Waterloo, Iowa	236
WRAO—Radio Service Co	St. Louis, Mo.	360
WRAV—Antioch College	Yellow Springs, Ohio	360
WRAW—Horace D. Good	Reading, Pa.	238
WRAX—Flexon's Garage	Gloucester City, N. J.	268
WRAY—Radio Sales Corporation	Scranton, Pa.	280
WSAA—B. S. Sprague Elec. Co	Marietta, Ohio	360
WSAB—Southeast Mo. State College,	Cape Girardeau, Mo.	360
WSAC—Clemson Agri. College	Clemson College, S. C.	360
WSAD—J. A. Foster Co	Providence, R. I.	261
WSAH—A. G. Leonard, jr	Chicago, Ill.	248
WSAI—U. S. Playng Card Co	Cincinnati, Ohio	309
WSAJ—Grove City College	Grove City, Pa.	360
WSAL—Franklin Electrical Co	Brookville, Ind.	248
WSAN—Allentown Radio Club	Allentown, Pa.	229
WSAP—Seventh Day Adventist Church.,	N. Y., N. Y.	263
WSAR—Doughty & Welch Elec. Co	Fall River, Mass.	254
WSAT—Plainview Elec. Co	Plainview, Tex.	263
WSAW—Curtice & McElwee	Canandiagua, N. Y.	275
WSAX—Chicago Radio Laboratory	Chicago, Ill.	268
WSAY—Irving Austin Chamber of Commerce,	Port Chester, N. Y.	233
WSAZ—Chase Electric Shop	Pomeroy, Ohio	258
WTAB—Fall River Daily Herald	Fall River, Mass.	248
WTAC—Penn Traffic Co	Johnstown, Pa.	360
WTAD—Robert E. Compton	Carthage, Ill.	229
WTAG—Kern Music Co	Providence, R. I.	258
WTAH—Carmen Ferro	Belvidere, Ill.	236
WTAJ—The Radio Shop	Portland, Me.	236
WTAL—Toledo Radio and Electrical Co.,	Toledo, Ohio	252
WTAM—Williard Storage Battery Co	Cleveland, Ohio	390
WTAN—Orndorff Radio Shop	Mattoon, Ill.	240
WTAP—Cambridge Radio & Elec. Co	Cambridge, Ill.	390
WTAQ—S. H. Van Gorden & Son	Osselo, Wis.	226
WTAR—Reliance Electric Co	Norfolk, Va.	256
WTAS—Charles E. Erbstein	Elgin, Ill.	275
WTAT—Edison Elect. Ill. Co	Boston, Mass.	244
WTAU—Ruegy Battery & Elec. Co	Tecumseh, Nebr.	360
WTAW—Agri. and Mech. College.,	College Station, Tex.	254
WTAX—Williams Hardware Co	Streator, Ill.	231
WTAY—Iodar-Oak Leaves Broadcasting Station,	Oak Park, Ill.	226
WTAZ—Thomas J. McGuire	Lambertville, N. J.	283
WWAB—Swern Hoenig & Co	Trenton, N. J.	226
WWAC—Sanger Brothers	Waco, Tex.	360
WWAD—Wright & Wright, Inc	Philadelphia, Pa.	360
WWAE—Alamo Dance Hall	Joliet, Ill.	227
WWAF—Galvin Radio Supply Co	Camden, N. J.	256
WWAO—Michigan College of Mines	Houghton, Mich.	244

BROADCASTNG STATION DIRECTORY—Part 4, Canada

(REVISED TO FEBRUARY 15, 1924.)

CKY—Manitoba Telephone System.....Winnipeg, Manitoba
CFAC—Radio Corp. of Calgary (Ltd.).....Calgary, Alberta
CFCA—Star Publishing and Printing Co.....Toronto, Ontario
CFCB—Marconi Wireless Telegraph of Canada (Ltd.), Vancouver, B. C.
CFCD—Canadian Westinghouse Co. (Ltd.), Winnipeg, Manitoba
CFCE—Marconi Wireless Telegraph Co. of Canada, Halifax, Nova Scotia
CFCF—Marconi Wireless Telegraph Co. of Canada (Ltd.), Montreal, Quebec
CFCH—Abitibi Power and Paper Co. (Ltd.), Iroquois Falls, Ontario
CFCI—Motor Products Corporation.....Walkerville, Ontario
CFCN—W. W. Grant Radio (Ltd.).....Calgary, Alberta
CFCX—The London Advertiser.....London, Ontario
CFPC—International Radio Development Co., Fort Frances, Ontario
CFTC—The Bell Telephone Co. of Canada....Toronto, Ontario
CFUC—University of Montreal.....Montreal, Quebec
CFVC—Roy Russell Brown.....Courtenay, British Columbia
CFYC—Victor Wentworth Odium.....Vancouver, B. C.
CFZC—Canadian Westinghouse Co. (Ltd), Montreal, Canada
CHAC—Radio Engineers (Ltd.).....Halifax, Nova Scotia
CHBC—The Alberta Publishing Co.....Calgary, Alberta
CHCA—Radio Corp. of Vancouver (Ltd.), Vancouver, B. C.
CHCB—Marconi Wireless Telegraph Co. of Canada (Ltd.), Toronto, Ontario
CHCC—Canadian Westinghouse Co. (Ltd), Edmonton, Alberta
CHCF—Radio Corporation of Winnipeg (Ltd.), Winnipeg, Manitoba
CHCQ—The Western Radio Co. (Ltd.).....Calgary, Alberta
CHCS—London Radio Shoppe.....London, Ontario
CHCX—B. L. Silver.....Montreal, Quebec
CHCZ—The Globe Printing Co.....Toronto, Ontario
CHFC—John Millen & Sons (Ltd.).....Toronto, Ontario
CHIC—Canadian Westinghouse Co. (Ltd.), Hamilton, Ontario
CHOC—Canadian Westinghouse Co. (Ltd.), Vancouver, B. C.
CHVC—Metropolitan Motors (Ltd.).....Toronto, Ontario
CHXC—J. R. Booth, Jr.....Ottawa, Quebec
CHYC—Northern Electric Co.....Montreal, Quebec
CJBC—Dupuis Freres.....Montreal, Canada
CJCA—The Edmonton Journal (Ltd.).....Edmonton, Alberta
CJCB—James Gordon Bennett.....Nelson, British Columbia
CJCD—T. Eaton Co. (Ltd.).....Toronto, Ontario
CJCE—Vancouver Sun Radiotelephones (Ltd.), Vancouver, B. C.
CJCF—News Record (Ltd.).....Kitchener, Ontario
CJCG—Manitoba Free Press Co. (Ltd.), Winnipeg, Manitoba
CJCH—The United Farmers of Ontario.....Toronto, Ontario
CJCI—McLean, Holt & Co (Ltd.), St. Johns, New Brunswick
CJCN—Simons Agnew & Co.....Toronto, Ontario
CJCS—Eastern Telephone and Telegraph Co. (Ltd.), Halifax, Nova Scotia
CJCY—Edmund Taylor.....Calgary, Alberta
CJGC—London Free Press Printing Co. (Ltd.), London, Ontario
CJNC—Tribune Newspaper Co. (Ltd.)....Winnipeg, Manitoba
CJSC—The Evening Telegram.....Toronto, Ontario
CKAC—La Presse Publishing Co.....Montreal, Quebec
CKCB—T. Eaton Co. (Ltd.).....Winnipeg, Manitoba
CKCD—Vancouver Daily Province.....Vancouver, B. C.
CKCE—Canadian Independent Telephone Co. (Ltd.), Toronto, Ontario
CKCK—Leader Publishing Co. (Ltd.), of Regina, Regina, Saskatchewan
CKCR—Jones Elcctric Radio Co.....St. John, New Brunswick
CKCS—The Bell Telephone Co. of Canada, Montreal, Quebec
CKCZ—Canadian Westinghouse Co. (Ltd.), Toronto, Ontario
CKKC—Radio Equipment and Supply Co., Toronto, Ontario
CKOC—The Wentworth Radio Supply Co....Hamilton, Ontario
CKQC—Radio Supply Co. of London.....London, Ontario
CKZC—Salton Radio Engineering Co.....Winnipeg, Manitoba

Crystal Set Makes Good Wavetrap

Undesirable Signals Can Be Tuned Out on Main Set.

IF you place an oscillatory circuit in series with the antenna lead of your set and tune it to the frequency of a station whose signals you do not wish to receive, these signals will be weakened considerably or eliminated entirely.

A very good wavetrap can be made by using a crystal receiver which has an inductance and capacity in the form of a variable condenser and a coil of wire. Attach a pair of headphones to the crystal receiver. Connect the aerial to the aerial binding post of the crystal receiver. Connect the ground binding post of the crystal set to the antenna binding post of the main receiving set.

Now tune in the station you wish to eliminate on the crystal receiver until its volume in the headphones is as loud as possible. Now the greater part of the energy from this station will be absorbed by the oscillatory circuit of the crystal receiver and you can tune in other stations on the main set without hearing the local station on all of the tuner dial.

Once of crystal set is adjusted for a certain station no further adjustments are necessary for that particular station. This arrangement will only eliminale one station at a time and if two strong stations are going at the same time in your vicinity you will have to employ two wavetraps, one to tune out each undesirable signal.

There are some losses introduced by the use of a crystal set in the aerial circuit in this manner and it is advisable to provide a means of shorting the wavetrap out when its use is not required. This is easily done by placing a shorting switch between the aerial and ground binding posts of the crystal set. Close this switch when there are no interfering stations on.

Long Distance Crystal Receiving Station.

(Continued from page 3.)

ing post to the screw of the other. Insert the straight piece of bus bar in the holes of the posts so that it may be easily slid back and forth. When the set is in use the bus bar should pass through only one of the posts but during a thunderstorm it should pass through and be tightened in both of them with the set screw. This protects your set from probable damage due to unusually severe charges of static.

The following stations have been received QSA almost nightly on the Donamhain circuit: 2XI, 8XT, KDKA, WBZ, WFI, WGR, WGY, WJZ, WLW, WOR, WOO, WWJ, WIP, WDAR, WEAF, WHAZ, WJAX, WSAI, WTAM, and WNAC.

On several occasions KDKA has been received with sufficient volume as to be audible over an entire room. Our two powerful local stations are invariably received with as great a volume as this. A small aluminum pan may satisfactorily be used as a loud speaker. Set the pan upright on a table and set the phones upright in it with their backs turned toward you. This speaker will deflect the sound waves in such a manner as will serve to render them pleasantly audible at a considerable distance. Always be careful not to drop or jar the phones as this weakens the permanent magnets.

The crystal should be washed daily in denatured alcohol in order to remove dust and the oily film left by the hands and to enable it to give the greatest and longest service. The following stations have been received frequently, using only one condenser, in the Donamhain circuit: 2XI, 8XT, KDKA, WFI, WYG, WJZ, WLW, WOR, WWJ, WDAR, WEAF, WHAZ, and WTAM.

If the specifications are followed closely you will have a long-distance crystal receiving station the equal of any in existence at the present time.

Government to Cooperate in Washington's Radio Show

Unusual Exhibits on Public View for First Time

WASHINGTON'S radio dealers, with the cooperation of officials of the Federal Government, will stage in Convention Hall here the week of March 19 to 26, one of the most pretentious radio expositions ever held in the United States.

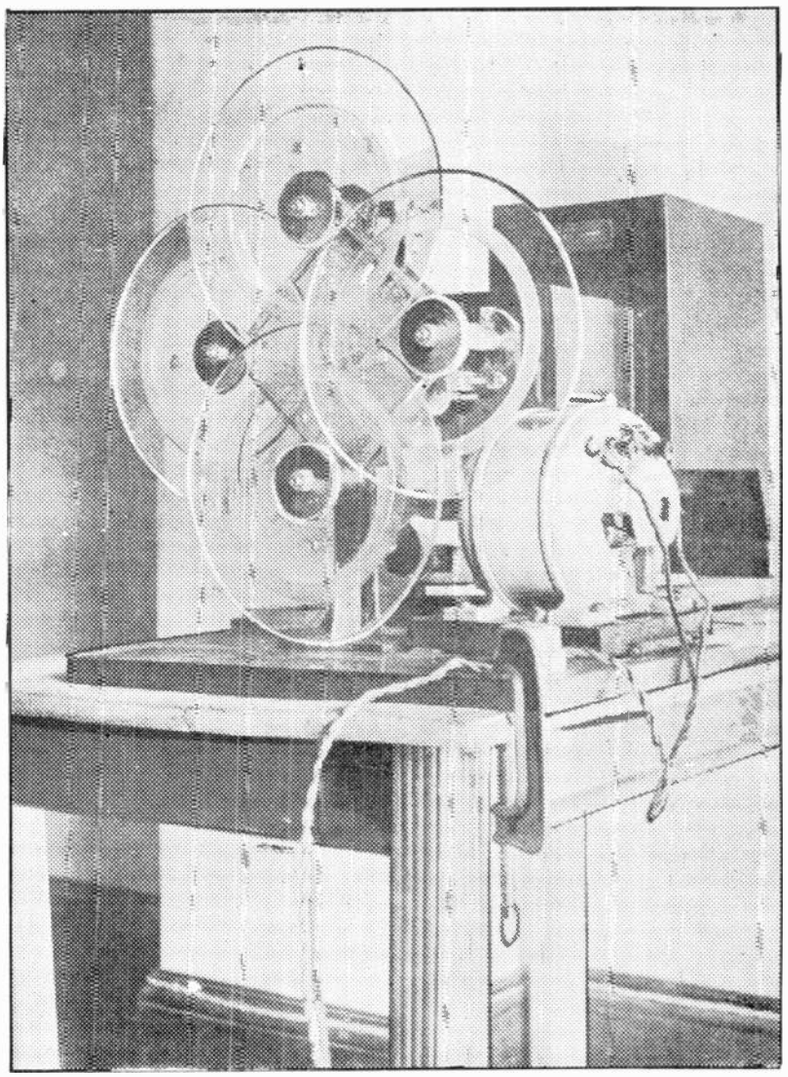
With the array of exhibits that have featured radio shows in other cities, augmented by special Government displays, some of which have never been on public view, Washington's first radio show is destined to attract nation-wide attention.

The Department of Commerce, which has supervision and control over all of America's activities in the field of radio; the Bureau of Standards, the Government's famous experimental laboratory, and other Federal agencies interested directly or indirectly with radio and its development, will take an active and leading part in making the radio exposition in the Nation's Capital an epoch in radio history.

The fighting arm of the Government—the Army, Navy and Marine Corps—also will be represented at the show with exhibits of historical value. The Navy has planned a replica of the 300 watt radio transmitting station on the giant dirigible Shenandoah, which kept the Navy Department in constant communication with the big ship during her sensational gale driven flight up the Atlantic Coast in January. The Army, which proudly boasts that its radio engineers are at least two years in advance of the radio wizards employed by the leading manufacturers of radio products in the development of improved apparatus, has promised an exhibit to prove its claim.

Officials of the Government Departments, including President Coolidge, the chief executive, and members of his cabinet, are expected to take an important part in the elaborate and unique entertainment features of the show, tentative arrangements for which already have been made.

Efforts are being made by the committee in charge of the show to have the President speak on the subject of radio on the opening night of the exposition, which will be broadcast to the nation through a chain of high powered broadcasting stations scattered across the continent and linked together by telephone lines. Secretary of Commerce Hoover, the "Czar" of radio; Secretary of War Weeks, Secretary of Navy Denby, and Chief Radio Supervisor Terrell, as well as the master radio minds of the Bureau of Standards, are to be urged to participate in the show program.



Radio photography apparatus, the invention of C. Francis Jenkins, for the transmission of pictures by radio.

Besides the Government exhibits, the secrets of the modest appearing laboratory of C. Francis Jenkins, noted Washington inventor, whose creative genius has given to the world the motion picture machine and the even more remarkable apparatus which transmits pictures by radio, will be revealed publicly for the first time at Washington's show.

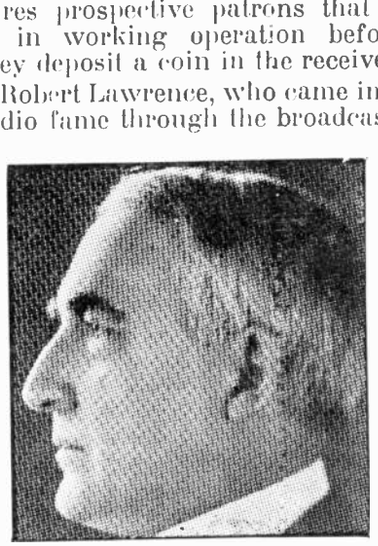
Mr. Jenkins has declined flatter-

ing offers to exhibit at radio shows in other sections of the country the remarkable machine which makes it possible for pictures, movable or stationary, and even great panoramas of transpiring scenes to travel on the radio waves. A conspicuous place in the show auditorium will be assigned Mr. Jenkins for the display of his radio photography apparatus.

The whole apparatus is comparable to a camera with lens in Washington and its photographic plate in Boston; with this difference, that the one lens in Washington may put its picture on ten, one hundred or a thousand photographic plates is as many different cities simultaneously, and at distances limited only by the power of the broadcasting station.

Other Washington inventive geniuses are coming to the show with radio inventions that never before have been seen at similar exhibits in New York, Chicago, Philadelphia, Boston and other large cities. For instance, the first coin controlled radio receiving set ever created, will be on display. This device, the invention of D. J. Richardson, will reveal for 5 cents, what the ether waves are saying. It presents a number of unique features and differs from all other vending machines in that it assures prospective patrons that it is in working operation before they deposit a coin in the receiver.

Robert Lawrence, who came into radio fame through the broadcast-



Pictures of late President Harding, transmitted by radio from Washington to Philadelphia, a distance of 139 miles, in three minutes.

ing of community singing fests through WCAP, the Chesapeake & Potomac Telephone Company station, is director of the entertainment program. Unusual "stunts" never before attempted at other radio shows are planned by Mr. Lawrence.

Convention Hall, the scene of the big event, will be wired through-

C. Francis Jenkins, the Washington inventor, whose radio photography apparatus will be exhibited at the radio show.

out for the public speech amplification system. Amplifying horns will carry the program features to the most remote corner of the big auditorium, and thereby preclude crowding any one point.

Unlike previous radio shows, the Washington exposition will prohibit all private demonstrations of radio sets in the booths. This plan was adopted in order to avoid a bedlam of noise which would result from hundreds of receiving sets in operation at the same time. Each exhibitor, however, will be assigned a certain period in which to demonstrate his products without interference from other exhibitors. His demonstration will be designed to form a part of the entertainment program and therefore will be more elaborate and interesting than a simple exhibition of the merits of the set.

Washington's radio dealers have taken more than 50 per cent of the available space for exhibits. A number of nationally known manufacturers of radio products also have reserved space. Alfred L. Stern, director of the show, predicts that every inch of the 60,000 square feet of floor space, will be contracted for long before the date for the opening of the show.

The first radio show in Washington which is destined to be an annual affair in the future, will be held under the auspices of the Radio Merchants' Association of Washington, of which William P. Boyer, a leading dealer in radio apparatus, is president. Fred S. Lincoln, a prominent Washington business man is chairman of the general show committee.

Future Developments in Radio

By H. Gernsback

STRANGE as it may seem, there are still many people who have an idea that radio is only a fad, and that it will not last—all this, in spite of the fact that the industry during the last two years has leaped from an annual turnover of approximately $8,000,000 to about $200,000,000 per year. These same doubters do not seem to appreciate the fact that radio is well on the road to becoming one of the 10 leading industries in our country. There are many well-wishers, however, who believe that it will soon be on the same level as the automobile industry is today.

We hear, on all sides, the cry that radio cannot last because it is not built upon a solid economic foundation. The argument is that the entire radio industry is founded upon broadcasting—which, of course, is true. The line of reasoning then is, that sooner or later the broadcast stations will find that it does not pay them to broadcast entertainments free, and that they will eventually shut down. And naturally, if that does happen (so critics say), the entire industry will go up in smoke. They even go so far as to make analogies with the automobile industry, claiming that it would be just as logical for an automobile manufacturer to sell a car to his customer and then provide him with free gasoline.

The trouble with these pessimists is that they preach only half (or near) truths. In the first place, there is no parallel between the radio industry and any other industry (this the writer has pointed out in his editorials for the past 15 years), just as there is no parallel for the motion picture industry. The two are distinctly new thoughts on this planet. They never existed before.

The "Doubting Thomases" may rest assured that if there should at any time arise a threat, or even a near threat, to do away with free broadcasting, the industry will then rise to the occasion and meet that emergency. Of course, there are some people who claim that broadcasting should be paid for by a Federal tax. Personally the writer does not believe in any such measure. He is of the opinion that this would be the worst blow that could be dealt the industry at this time.

Broadcasting, as it is carried on in America today, is distinctly an American institution. It is founded upon a broad and human basis. That the policy is right has been proven by the extraordinary, as well as the tremendous growth of radio in this country. If any argument were necessary, we would only need to point to England, France, Germany, Australia and other countries, which have recently taken up radio in conjunction with a Governmental tax. What is the result? The industry has been stifled.

Take the second greatest country, from the standpoint of the radio industry—England. What is the situation there? The percentage of stations, as compared to the United States, is very small, that is, licensed stations which pay a tax to the Government. On the other hand, so-called "bootleg" stations, i. e., those which operate without paying a tax, are said to be so great in number as to constitute a scandal.

No, we do not believe that broadcasting should be regulated by a Federal tax. We believe that in due time the radio industry will solve the problem, if it threatens to become serious. Probably in time most stations will derive revenue from indirect advertising, as does station WEAF of New York City. This station, which is classed as a commercial station, furnishes excellent entertainment, nearly all of which is paid for by indirect advertising; and the publicity given the various firms renting this station by the hour or by the evening has, so far, not proven objectionable.

No listener-in, for instance objects to the announcer when he says: "You will now hear the Jones & Jones Department Store Band," or "The Male Quartette of the John Doe Garter Company will now broadcast a selection." In deriving a monetary benefit from the indirect advertising the broadcast station will be enabled to enlist better talent than those stations without this means of support. All in all, we feel certain that the radio industry is built upon a stable foundation, and that it will continue to grow rapidly.

We must now speak of the next set of doubters, those who discourage their acquaintances from buying radio sets. The argument in this case is that the prospective radio fan should wait for a while as the sets at present are not the best that can be had and will soon be superseded by better ones. Of course, this is a perfectly good argument, though foolish. Moreover, it is true that if the first motion picture attendants had given this advice, we would not today have good pictures; and if we had not bought the first squeaky, unmanageable phonographs, we would not have a good phonograph today; and if we had not patronized the makers of the first horseless carriages that puffed along the road and stopped more often than they ran, we would not be riding in limousines today.

With all our progress, we still have practically every year, new model phonographs, new and better automobiles, as well as airplanes, and we will have them for many years to come. The same thing holds true of our present radio outfits. We will have new models every year for many years to come. The outfits we have today are tolerably good ones, and all those made by reputable manufacturers will be found to do the work as advertised. To be sure, we still have a good deal of poor merchandise with us, but no reputable dealer will carry it. Aside from all this, there are really excellent radio outfits on the market today which no one need be ashamed to own. All these sets perform well and give the entertainment for which they were designed. So why wait?

While speaking of next year's set or perhaps of the radio outfit of five years hence, the writer would like to put a thought into the minds of our designers.

There was a time when there were no complete radio outfits. We

bought the different parts, such as a loose coupler, detector and condenser, and assembled them on a board. There was no such thing in those days as a graduated dial. Then someone conceived the idea of putting all the apparatus into a box. The apparatus was then controlled by means of knobs and graduated dials. We have stuck to this idea for a number of years, but the writer feels that this is not the ultimate radio outfit. *He believes that the dial and knob idea is entirely wrong.*

Recent experiments, which were made by the writer, have convinced him that future radio sets will have no dials whatsoever. Instead, we will have nothing but a panel on which will be a series of jacks, each labeled with the name of a station. If, for instance, we wish to listen to KYW, we will insert a plug into a jack labeled KYW. If we wish to listen to WDAP, we will insert a plug into that jack. The plugs will be constructed in such a way that a slight turning of one will bring the station into full intensity. The plug, in other words, will act as a sort of vernier. When the outfit is first set up it will be tuned by the owner or by the firm installing it, in such a manner that all tuning elements are fixed, or rather locked. Each outfit will be equipped with a dozen or more jacks, so that a dozen or more stations may be listened to. The owner will first pick out the stations, local or long distance, which he desires to listen to, and he will then provide his jack-openings with inscribed tags, identifying each one. It will then be a simple matter for any member of the family to instantly operate the outfit.

Of course the writer is well aware of the criticism which will now arise. What about other DX stations we may wish to get? The answer to this is: If you wish to play radio golf, there are a quantity of outfits with which that purpose can be accomplished. There is no reason why a man could not have two outfits, one for the family and one for his experimental work. But the argument for the dial-less, tuning-less radio outfit is a sound one. After all, the lady of the house has a right to have radio entertainment without requiring an expert to operate the set.

At the present time, the writer ventures to say that there are not 1,000 women in the United States who can operate the family radio outfit satisfactorily. Radio cannot become really great until this objection has been overcome. As a matter of fact, if the truth must be known, the average householder who wants a radio outfit does not wish to go hunting all over the Universe for broadcasting stations.

The Interference Problem in Radio

By E. F. McDonald Jr.
President of the National Association of Broadcasters.

IN analyzing the interference situation at the present time, it should always be remembered that while broadcasting is of paramount importance to millions of people throughout the country, there are other phases of the radio industry which must be considered and upon which depend much of the commerce of the world. Trans-Atlantic and ship-to-shore radio traffic are of vital importance. The work of the serious radio experimenter is also of the highest value in furthering the advancement of the radio art. In order that the broadcast listener may get the most out of his radio receiver, a thorough knowledge of the causes of the interference which he occasionally experiences together with the various means available for their reduction or elimination is essential.

There are, of course, various types of interference occasioned by different causes. The most annoying at the present time are telegraph code interferences from ship and shore stations working on low wave lengths of around 450 meters, and the re-radiation of radio receivers of improper design or improperly operated by unskilled users. It is to the interest of all participating in the radio industry to assist in correcting these conditions as well as the other causes of interference. The National Association of Broadcasters have been in conference with Herbert Hoover, Secretary of Commerce, on the subject of ship interference, and through his efforts and cooperation are arranging for international regulations providing for the carrying on of ship-to-shore traffic on wave lengths outside the broadcasting band. This article, therefore, treats only with the interference created by re-radiation from radio receivers.

It is a popular fallacy that all that is necessary to put a stop to any undesirable condition is the passing of legislation. Unfortunately this idea has occasionally taken root and grown into something that constitutes a real menace at the heart of our American civilization. There is nothing more detrimental to the morale of a nation than the adoption of legislation which is obviously impossible of enforcement and which, through the ease with which it may be ignored, teaches wholesale disrespect for not only the law but the authorities that make it.

We have, at the present time, a startling example of an "iron-clad" law which so far at least has been impossible to enforce, and which has possibly worked at greater evil than that which it was designed to eliminate—the Prohibition Amendment. During the war the Navy Department undertook through its Intelligence Service to prohibit the use of transmitting and receiving apparatus throughout the country. The prohibition on transmitting was comparatively easy to enforce, but although every effort was made to eliminate reception, in the final analysis it came down simply and squarely to reliance on the loyalty and patriotism of the individuals which go to make up our great nation. Obviously the individuals who really desired to use radio for ulterior purposes had no such sense of loyalty and as a consequence, to a great extent all that was accomplished was the pronibition of the use of radio receivers in the hands of those who would not use them in any case to the disadvantage of the country, whereas it was practically impossible to stop the use of such apparatus in the hands of those intent on serving their own ends.

For these reasons, the adoption of legislation prohibiting the use of receivers which feed back energy into the antenna is obviously absurd. The *adoption* of an act of this kind would be comparatively easy but the *enforcement* would require a greater force of officers and special agents than we have at the present time attempting to enforce prohibition. Certainly our Government can not afford such an expenditure even if it were possible to completely eliminate radio feedbacks by such means. It should be remembered that in the first place the locating of the offending receivers which feed back into antennae would be comparatively difficult, and even when they were located, it would be a simple matter for the user of a set of this kind to disconnect the tickler coil or whatever means was used to feed back the energy, while the inspector was present, and attach it the moment he left. The enforcement of any such act would also be rendered extremely difficult because of the statutes prohibiting the entrance of private dwellings without proper search warrants.

Granting that the feed back from radio receiving sets is harmful and that preventative legislation if not impossible, at least is impractical, what is to be done? Only end the present annoyance but, through uniform retail price and its advantages from the selectivity standpoint, will be desirable for general public use. Let's have no more unenforceable legislation!

Obviously the solution to the problem is constructive action on the part of the radio manufacturer. At the present time the laboratories of eight of the largest manufacturers of receiving apparatus are at work night and day on the production of a simple device to be connected ahead of receivers feeding back which will not allow the passing of this energy out to the antenna. Such a device when developed and perfected will be put on the market by the manufacturers, according to an agreement among them, at practically actual cost, so that the users of all types of sets will have the benefit of this device without undue expense. It is not fair or reasonable to expect the users of feed-back receivers to junk and throw away apparatus representing the investment of many hundreds of thousands of dollars, when by the addition of some simple device the harmful re-radiation can be entirely removed and reception improved.

The public will not be hard to persuade to use a device which will cost little and which will not only through reciprocity eventually eliminate all feed-back howls but will also improve reception and increase the selectivity of a receiver with which it is used.

It is often said that one of the most interesting phases of radio to

the novice is its possibility of original experiment. Many of the more important developments in the radio field have been made by novices. From this standpoint then, the development of a one-way valve to prevent radiation from receivers certainly offers wonderful possibilities. With the general public interested in the development of a universal attachment of this kind, as well as with the well-equipped laboratories of the larger manufacturers of radio apparatus earnestly working on the problem, it is safe to predict that not much time will elapse before there is available a universal radiation preventer which will be adaptable to all types of receivers and will not only end the present annoyance but, through uniform retail price and its advantages from the selectivity standpoint, will be desirable for generaly public use. Let's have no more unenforceable legislation!

Questions and Answers

FOREWORD BY THE TECHNICAL EDITOR—Most question and answer columns are operated solely as a clearing house for all types of inquiries in this prolific field of radio. From constant study and perusal of these columns in radio publications, the Technical Editor has come to the conclusion that the average inquiry is made without any basic knowledge of fundamentals in radio. The novice in radio has his opinion tossed about on a stormy sea of prejudiced notions and unfounded hunches. Advice and misinformation, alleged "straight dope" and recommendations are running wild.

The purpose of this column will be to set the owners of receiving sets on the right road to understanding the basic HOWS and WHYS of this new hobby. The questions answered in it will be chosen with the greatest care and answered in non-technical discussions of these ever important basics. By this method we are certain that each issue of THE BROADCAST RECEIVER will have something of very certain value to most owners of radio receiving sets.

Address all communications to Technical Editor, The Broadcast Receiver, 333-34 Evening Star Building, Washington, D. C.

Question—Please tell me something about the sodion tube. Does it produce better results than other types of tubes on the market?
—R. M. K.

Answer—The sodion tube resembles other vacuum tubes in appearance, but in internal structure and in operation entirely different principles are employed. The tube is highly evacuated, and has a filament and plate similar to the usual type of tube. It has, however, no "grid," but employs instead a trough-shaped electrode, which is placed around the filament, the open side of the trough being toward the plate. In another respect the tube is radically different from the usual tube, and that is in the fact that within the container is a quantity of alkali metal, sodium. When in an operative condition this sodium is in a vaporous condition, and the particles of the metal play an important part in the operation of the tube. It is from the name of these particles, "sodium" ions, that the tube derives its name Sodium.

It is claimed that results which are equal to those obtainable with the usual type of vacuum tubes, employing regeneration, are obtained with this tube. Owing to the construction and method of operation of the tube, the sodium tube can not be made to oscillate, so that no squeals or whistles can be made to appear with the signal, no matter how the tube is adjusted. The tone quality is remarkably good, so clear and clean cut that the tube has been termed the "crystal clear" detector tube.

Question—In my receiver I have been using a dry-cell tube for detector. As I understand that the UV-200 type was a much better detector than the one I was using, I changed over to that type. After much trouble I finally heard two local stations, but not at all as clearly or as loudly as with the old tube. Do you think that the trouble is in the tube, or is there some reason that such a tube will not operate in my circuit?
—E. R. N.

Answer—In general, the UV-200 is a much more sensitive detector than any of the "hard" tubes. In order to realize the best results from this tube, however, it is necessary that the voltage of the "B" battery be very closely adjustable. The taps which are made on the battery itself do not provide a sufficiently fine regulation, so that a "potentiometer" is generally used to obtain the fine adjustment. This instrument is simply a resistance (of reasonably high value, so that

it will not draw an excessive current from the filament battery) with a variable contact. The two ends of the winding are connected to the terminals of the filament lighting battery. The negative terminal of the "B" battery, instead of being taken to the positive "A" terminal, is connected to the arm of the potentiometer. The "B" battery voltage is then adjusted approximately by means of the taps on the unit, and then a fine adjustment is obtained by moving the arm of the potentiometer. A smooth change in the "B" battery voltage of about six volts may be obtained in this way. The resistance of the potentiometer may be anywhere from 200 to 400 ohms. You do not say what type of heating battery you use—the UV-200 should be operated from a storage battery, as the current drawn by the filament is so high that it will exhaust dry cells in a very short time.

Question—have you any information regarding the ST-100 circuit? If so, will you kindly advise as to the following: (1) Number of tubes; (2) type of circuit; (3) range; (4) volume. Is this circuit used in any receivers which are on the market at the present time?

—H. H. R.

Answer—This circuit is not in common use in this country. According to reports, experimenters in Great Britain have obtained very favorable results with it. The general classification of the circuit is "one-tube reflex, with crystal detector and one stage (or more) of separate audio frequency amplification." Two tubes are required; more may be used if desired. We have no information as to the range or volume obtainable with the circuit. Claims for great distance and volume have been made for it in various reports.

Question—Is it possible to have an aerial which is too long to receive broadcasts? I have a two-wire aerial which is nearly 200 feet long. The results which I have obtained with my set have been rather disappointing, and my friends have suggested that the aerial is the cause. I do not quite see this, because I have also been told that "the longer and higher" the aerial is, the better.

—F. C. V.

Answer—For broadcast reception it is not advisable to use an antenna which is over 100 feet long. Excellent results are obtainable with aerials considerably shorter than this. Without any doubt the antenna which you have been using is too large for satisfactory broadcast reception. A rather crude mechanical analogy may be taken from the strings on a piano: With a given size of wire the pitch of the note may be adjusted by altering the length and tension of the wire. To reach the higher notes it is necessary to use fine wire and shorter lengths. With an antenna which is very large, the higher frequencies can not be received, for it is something the same as trying to get a high-pitched note from a heavy long wire. If you can not change the suspension of the antenna as used at present, cut the wire and insert an insulator about 100 feet away from the receiver. If the remaining length is greater than 40 or 50 feet, cut the wire again at a point beyond the first insulator and insert a second insulator. The purpose of this second insulator is to prevent the unused portion of the wire from acting as an aerial for the broadcast wave lengths and absorbing energy from the waves which might otherwise be led to the receiver.

Question—Is there any reason why signals should be improved when I touch the cases of my receivers with my hands? No matter how carefully I tune-in a station, I can always increase the strength of the signals slightly by touching the receivers. Is this a usual occurrence? I am not troubled with body-capacity effects with the receiver, as the panel is shielded and the shield is grounded. Is there any way in which this added signal strength could be obtained without the necessity of touching the receivers?

—S. E. D.

Answer—Effects of the nature which you describe are peculiar to particular sets, and do not hold in all cases, or even in most. Without definite information as to the exact connections of your set, it is only possible to guess at the procedure for maintaining the signals at their greater strength. You might try the following: (1) Grounding the filament of the tubes; (2) connecting the cores of the audio frequency transformers to plus "B" or minus "A"; (3) placing the phones between the filament and "B" battery, instead of between the "B" battery and plate.

"Mrs. Auditron told me her filaments were twins."

"That's nothing; Mrs. Coupler told me her honeycombs were triplets."

Daughter Ill, Amateur In Porto Rico Communicates With States In Two Minutes

ANXIOUS to obtain daily reports regarding the condition of his daughter who was ill in New York City, where she had been sent to attend school, Louis Rexach, a contractor and builder of San Juan, Porto Rico, succeeded in establishing desired contact with the United States by means of his amateur radio station. A letter would require fifteen days and the condition of the cable service at the time was such that it required three days to get a reply.

"Last spring I found it necessary to send my five-year-old daughter to a school in the United States, so that she should properly learn the English language," said Mr. Rexach. "Recently we were advised that the child had suddenly became sick and her condition was serious; the fact that she was born in the Tropics and unaccustomed to a cold climate making it worse for her recovery. We decided to try amateur radio.

"At various times I had communicated fairly regularly with amateurs in the southern part of the States, but seldom with New York, as the interference at that end was terrific. However, H. H. Carman, an amateur at Freeport, L. I., said he could copy my signals at any time. He willingly offered his services and we at once made a nightly schedule.

"Exactly 10.30 p. m. every night I would call 2EL and he would always come back with the courteous 'QTC? QSA QRV GA'. He would then telephone direct to the child's residence and inquire how she was getting along. He transmitted the information to me immediately. Frequently it required less than two minutes to obtain a reply as I used to stand by until he called again. If amateur radio should do nothing else for me in my whole life-time, I will always feel that my debt to my fellow amateurs and to the American Radio Relay League, can never be fully paid."

Broadcasters Increase

TWENTY-SEVEN new broadcasting stations started operation during January and twenty "signed off" for the last time, according to the Department of Commerce. Broadcasting gained seven stations. On February 1 there were 435 stations in the United States.

The new stations licensed last week by the department follow: WBBN, Wilmington, N. C. (10 watts); WBBQ, Pawtucket, R. I. (50 watts): WBBM, Lincoln, Ill. (200 watts): WBBK, Pittsburgh, Pa. (10 watts); WBBO, Rogers, Mich. (500 watts); WBBR, Rossville, N. Y. (500 watts); WBBF, Petoskey, Mich. (10 watts); KDZE, Seattle, Wash. (100 watts); and KFJQ, Grand Forks, N. Dak. (5 watts).

Station WJAS, at Pittsburgh, Pa., increased its power to 500 watts and was transferred last week from class A to class B.

The stations which ended their broadcast service in January follow: KFAV, Venice, Calif.; WJAB, Lincoln, Nebr.; KFIY, Seattle, Wash.; KFCK, Colorado Springs, Colo.; KFKH, Lakeside, Colo.; WOAJ, Parsons, Kans.; WDAX, Centerville, Iowa; WABC, Anderson, Ind.: KFIK, Gladbrook, Iowa; WAAZ, Emporia, Kans.; KFIB, St. Louis, Mo.; WBAW, Marietta, Ohio; KFDU, Lincoln, Nebr.; WGAY, Madison, Wis.; WLAN, Houlton, Me.; WLAT, Burlington, Iowa; WABJ, South Bend, Ind.; KFCD, Salem, Oreg.; WKAW, Beloit, Wis.; and KFJD, Greeley, Colo.

WCAP's New Studio Opened

THE new broadcasting studio of the Chesapeake and Potomac Telephone Company was formally dedicated Thursday night with an elaborate program. The studio is located on the third floor of the Homer Building, at Thirteenth and F Streets N. W.

There are two studios—A and B. The former is larger than studio B and will be used for bands, orchestras, etc. Studio B is a small room and will be used by speakers and lecturers.

In both studios the draperies on the walls are so hung that they may be adjusted to give the correct degree of deadening for the particular kind of entertainment being transmitted. Bands require more deadening than a quartet or a singer, and a speaker requires less deadening. In every case the studio director may make the proper adjustments.

These hangings are of light gray monk's cloth, which has been found to be more efficient and less costly than many of the other materials now in use.

A small soundproof chamber with a double glass window separates studios A and B, and from this room the announcer operates the controls and signal lights in the studios. The progress of the different operations is shown by colored lights, which signal the artist when all arrangement are complete for that particular number. As soon as one studio goes into operation a red light appears over that door to warn against intrusion.

ATWATER KENT, NO. 10

If you want long distance without interference from local stations, see us about an

Atwater Kent, No. 10

Or a

Freed-Eisemann Neutrodyne

Denton and Cragg Co.

3908 Fourteenth Street N. W. Columbia 2442

"TESTED—THEN SOLD"

BOYS

EARN $5 OR MORE EACH WEEK AFTER SCHOOL HOURS

CALL ROOM 334 EVENING STAR BUILDING

CUNNINGHAM TUBES

EVEREADY BATTERIES

Westinghouse Rectigons

Westinghouse Radio Batteries

DISTRIBUTED BY

Maryland Battery Service, Inc.

Main 97 1019 SEVENTEENTH STREET N. W. Main 98

SOLE DISTRIBUTERS FOR

DE FOREST

D-10 4 Tube

REFLEX

No Outside Aerial Needed

ALSO DISTRIBUTERS FOR

Gem Crystal Receiving Sets
Savoy Tube Receiving Sets
Crosley Sets
Music Master Loud Speakers
and
Various other standard sets and parts

Satisfaction Guaranteed

CONVENIENT TERMS CAN BE ARRANGED

Haverford Cycle Sales Co.

RADIO DIVISION

522 10th ST. N. W. MAIN 6588

RADIO PRODUCTS

SETS

A-1 Crystal Receiver complete with phones	$ 12.00
Garod-Neutrodyne...	135.00
Crosley XJ	65.00
Radiola 2, complete	97.50
Aerola, Sr., with tubes and Brandes phone	39.50

LOUD SPEAKERS

Music Master.....	$ 30.00
Magnavox	35.00
Brandes	10.00

PARTS, BATTERIES AND TUBES

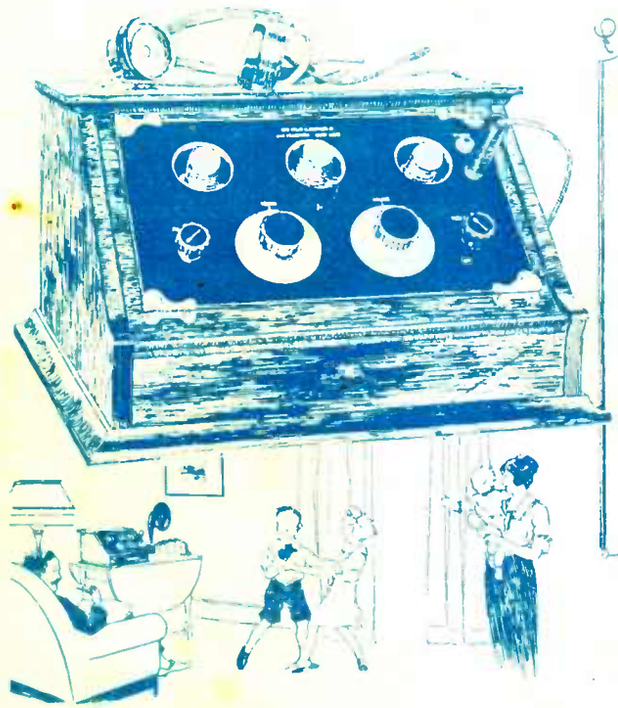
J. Harry Harding

1319 14th St. N. W.

PHONE MAIN 6605

Nationally Known

Colin B. Kennedy Radio Sets



$129

Pay as low as $10

—and we will deliver this famous set complete. Balance can be arranged in small sums to meet your convenience. A service charge of 6% is made for accounts extending over 90 days.

The Colin B. Kennedy Radio Set is one of the most famous and effective 3-tube sets made. It is complete in itself. All unsightly wires and batteries are enclosed in a special compartment directly back of the tubes. The cabinet is of solid mahogany, dull antique finish--correct in every detail.

You will enjoy many programs broadcast from various cities with a "Colin B. Kennedy." In every respect it is a wonderful set.

Complete with all this Equipment

Set Special Kennedy Head Phones
Phone Plug
Full Set A and B Batteries
3 UV 199 Tubes
100 Feet 7-Strand Aerial Wire
35 Feet Lead-In Wire
15 Feet Ground Wire
1 Lightning Arrestor
2 Insulators

Radio Studios Open Every Night Until 9 P. M.

The Hecht Co.

Radio Studios—624 F Street