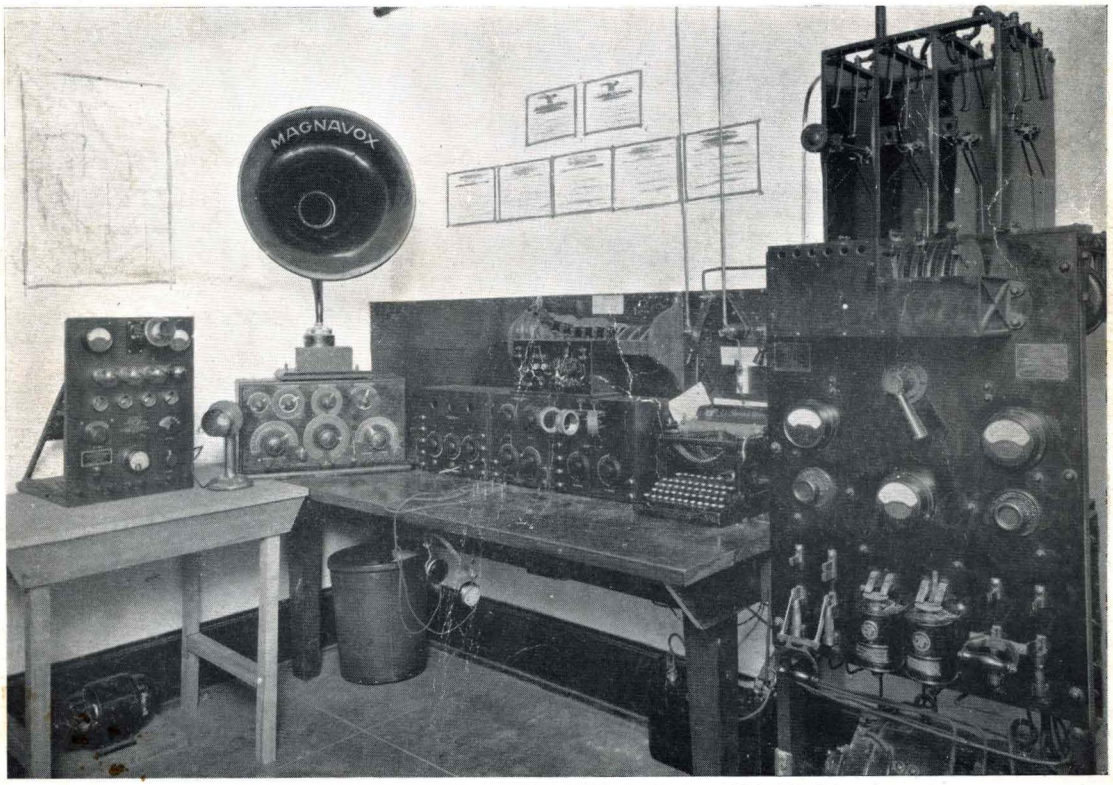
RADIO WAVES

Fifteen cents Sta List REGISTRATION PENDING *February, 1923*



RADIO STATION OF THE OREGON INSTITUTE OF TECHNOLOGY

"I Tappa Kee" Radio Fraternity
Third Annual Banquet of the Northwestern Radio Association
Notes on Radio-Frequency Amplification
An Ideal Single Circuit Receiver

RADIO WAVES

PORTLAND, OREGON

Contents for February, 1923

Coming for the March Issue

The description of a two-stage amplifier built to match the receiver described in this issue will be of special interest to those desiring more signal volume than one tube affords.

Mr. L. W. Ross, transmission engineer for the Pacific Telephone and Telegraph Company, at their Portland office, will describe some highly interesting experiments made on the "Peanut" tube. Mr. Ross is well acquainted with tubes, and tube characteristics, his work with the Telephone Company dealing largely with them as applied to the long-distance telephone.

Photographs and description of the "Telegraph Hill" broadcasting station, KFDB, have been promised us and will appear in the March issue.

Hale Brothers, KPO, at San Francisco, have installed a 500-watt Class B station, which is already famous. We will picture it if photos are forthcoming.

RADIO WAVES

PORTLAND, OREGON

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VOLUME I FEBRUARY, 1923 NUMBER 9

RADIO WAVES is published monthly by the Radio Waves Publishing Company, 306 Davis Street, Portland, Oregon. Articles dealing with radio in any form desired. All articles must be accompanied by return carrier. Will be pleased to receive good pictures of amateur stations and descriptions.
Advertising forms close on first of the month of issue. Subscription price, $1.50 per year. Single copies, 15 cents.

JOHN D. HERTZ . . . . . Editor

Introducing a New Policy

It is fitting, with the beginning of a new year, that we, too, create a new beginning. To this end the publishers have elected to place at the head of this magazine a new managing editor, and thus have established a new program. Let us consider this program.

There are in the radio game three principal classes of people—those who are in it for the living it affords, that is, in the commercial end of the game; the more numerous throng of men and boys, and a few women, who make up the ranks of the true wireless amateur; and the even greater, almost innumerable population which composes the Order of the Radio Fan. It is principally with the last two groups that our mission deals. With the present existing difference of feeling it is undoubtedly a very difficult proposition for a magazine to attempt to serve one of these factions without evoking condemnation from the other quarter.

Considering the question of "Who Owns the Ether," we cannot help but believe that it does not belong to any one more than to another, but he who can use it to the best advantage to the world at large, then to him does its use belong. We will endeavor to set forth in future issues of RADIO WAVES the relative merits of those two greater issues in radio: The Broadcasted Program, and its Audience; and, Amateur Radio Telegraphy, and its Operators. We are of the opinion that there can never be a satisfactory solution of the problem while unpleasant feelings exist, hence ours will be a neutral stand, with the earnest endeavor to bring about co-operation between the radio interests of our great Northwest.

Just What Do You Want?

This magazine is yours. It is published for you, and you must be satisfied with it. It is up to us to provide this satisfaction. Therefore! Stir yourself! Take your pen in hand and drop us a line. Tell us just what you would like to see in print, just what you think this magazine needs to make it a real live publication. Shall it be constructional articles? And if so, what shall we construct, receiving sets, amplifiers, C-W transmitters, rectifiers, telephone sets, portable sets, or what? Or shall we have pictures and descriptions of the famous broadcasting stations? Or would you rather meet the men whose voices you hear over the air?

Previously it has been a custom of this magazine to print a schedule of broadcasting stations of the Pacific Coast. Beginning with this issue a supplement will be issued containing this information as we have it to date, and only corrections and additions will be printed during the following three or four months, after which time a revised supplement will make its appearance. This will give us nearly two pages more room for live articles, and will present the schedules in a more convenient form.

A column of classified advertising is being added for the benefit of those who have apparatus they desire to sell or trade. Ads in this column need not be confined to radio, if you have something that you think will be of interest to our readers.

There are constantly coming before the radio world many perplexing problems, such as legislation, interference, underwriters' rules, and others. Let us open a page or two for the discussion of these things, a page presenting the views of our readers. Such questions affect you directly; then it is only fair that you be given an opportunity to express your opinion. Let us refrain from the use of fictitious signatures; if you do not wish your name printed, tell us. RADIO WAVES must be open and above-board in all of its departments.

You Have Been Warned, Too

Fred Zwahler, 18, of Portland, was instantly killed on the evening of January 2 while stringing an antenna. Death was due to contact with high tension wires on the pole he was climbing at East 50th Street and Columbia Boulevard.

Zwahler, while erecting the antenna, had carried one end of the wire to a platform, midway up the pole; the other end was lying on the ground. The end he was carrying came in close proximity to a high-tension line carrying power at a potential of 11,000 volts. The high potential suddenly broke down the short remaining gap, electrocuting Zwahler, and the accompanying muscular reactions threw him to the ground, fifteen feet below. The contact caused a brilliant flash and a pistol-like report that brought many neighbors out of their homes.

A fellow worker was standing near by when the accident occurred, and was the first to reach the victim's side. He immediately called an ambulance, which was of little use. Zwahler's face and scalp were badly burned by the heavy current.

Our Advertisers

On Sunday morning, when you shin down stairs and get the morning paper to take back to bed, do you ever stop to consider the cost of that great number of printed pages? Does it ever enter your head that the paper and ink alone cost more than the five pennies you pay for them? Then what makes the paper pay? Sure! Advertising, you will say. Just so! Then how about RADIO WAVES? Fifteen cents a copy does not pay for the cost of publishing it. It is only by means of advertisers that we can exist. No advertiser can afford to give us his business unless he feels that it is paying him some return on the investment, therefore we are putting it up to you to see that our advertisers realize that their business with us is bringing results. We know that you are trading with them, but they do not. Tell them about it, tell them you saw their ad in RADIO WAVES, and tell them even if you do not purchase.

On Legislation

In 1912 and 1913 the present radio law was adopted in Congress. Since that time there have only been minor changes, and as a whole the old law still exists. However, times have changed, and now there are approximately 21,000 licensed transmitting stations in this country, besides over 570 broadcasting stations, some cities having as many as twenty of this class, so Herbert Hoover has said. Just consider what confusion this must cause in some localities, especially when it is considered that most of these stations are in the Eastern part of the country, and also that these stations are all working on a narrow band of wave-lengths. In order that this jumble of jazz, jokes and junk, lectures on birth control and the boll weevil, market and spiritual quotations, sparks and arcs, all in a wireless, weird and wolly scramble, be brought under some sort of control, there has been introduced in Congress a bill known as the Kellog-White bill. The measure appears to have been drawn up along the lines of the Kellog cable act and the Sherman anti-trust act. It is modeled to permit private enterprise to operate in the radio field, and yet at the same time to prevent monopoly of radio communication by any direct or indirect method.

It provides several ranges of waves for broadcasting stations, and it allows the amateur even more freedom than before in the use of wave lengths. However, it seems to have one or two small defects; small in appearance, yet such that they might easily become of some consequence. It would give to all "government" stations the privileges intended only for military stations entitled to them for national safety. Then, too, such a provision that would permit the President to assign the wave lengths of government stations without regard for assignments made by the Department of Commerce would enhance the possibility of much confusion. These are matters of wording, rather than misguided effort, and we are assured that every effort will be made to correct them.

The Radio Service Company

A year ago last December, John D. Tait, at that time in charge of the battery service station of the Covey Motor Car Company, Lester White, old-time amateur of Portland, and George Cameron, Jr., likewise a seasoned wireless amateur and an expert battery man, formed what is known as the Radio Service Company, an organization which should not be confused with the Radio Service Bureau, also of Portland. The company first maintained its offices and shop at the home of Mr. Tait, specializing in general radio repair work, and the construction of receiving equipment to order, as well as C-W transmitter parts and complete sets.

Later Mr. White left the organization, and Mr. Tait bought out Mr. Cameron. Finding his time too occupied with the radio business, Mr. Tait left Covey's and established his shop on Fourteenth Street, just north of Morrison, the fifteenth of last May. There the business has flourished, as is testified to by a satisfied list of customers.

Realizing the inconvenience of this location, and the desirability of giving its customers better service, the Radio Service Company will be removed to 496 Burnside Street, or just east of Fourteenth, on the first of February. Here Mr. Tait will jointly occupy the quarters of the Exide Battery Shop. One desirable feature of the new location, so Mr. Tait says, will be the fact that there will always be someone there to answer the telephone. The company will continue to maintain the same line of business, general repairing, transformer core and coil construction, receiving equipment and C-W transmitter construction. Battery service will be continued by the battery shop at the same place of business.

Antenna Requirements

While speaking about law, we have before us the fact that in Chicago an ordinance has been proposed specifying certain requirements in antenna construction. These deal principally with the mechanical features, such as strength of the antenna and its supports. Also antenna location in relation to other wires and structures is considered. Someone suggests that it is about time that similar measures be taken here in our own Northwest. It is true that as we journey about our cities we often cast our gaze upon some flimsy structure supporting an arrangement of wires, and the question looms before us, "How does it stay up?" Again we may wonder at the flexibility of a thin fir pole, which, unassisted by guys, is vainly endeavoring to maintain an upright position in this world. Radio is a real worth-while game; shall we not go into it in a worth-while way?

Just now a more wonderful thing is promised which proves the cumulative value of progressive development. It is considered that the near future will see the transmission by radio of something more complex than a likeness, in a word, finger-prints! Police Commissioner Enright, of New York, is authority for the statement that experts are now making progress in this direction. At Copenhagen a method is being worked out whereby an exact duplicate of one's finger-prints may be flashed across continents, or oceans, or even around the world. The object, of course, is to extend further the arm of the law as a preventive of crime. Once finger-prints can be sent any distance by radio, the world will be made smaller for criminals seeking to put distance between themselves and the justice desiring their apprehension.

The British postmaster general has recommended that American and other foreign radio apparatus be excluded from Great Britain. The radio industry is in its infancy in England and officials see the necessity for its protection from imports of the highly developed product in the United States.

Nobody can find fault with such a policy. It is precisely the sort of protection to American industries that the Republicans of Congress have written into the tariff bill that will soon become a law. The bill is not an embargo, but it will sufficiently control foreign importations so that our own industries will not suffer from cheap foreign competition.

Dr. Louis Cohen, consulting electrical engineer of the signal corps, U. S. A., claims to have devised a tube which greatly reduces static electricity in the reception of radio messages. The elimination of this objectionable feature will greatly improve its adaptability to both commercial use and as a mode of popular entertainment.

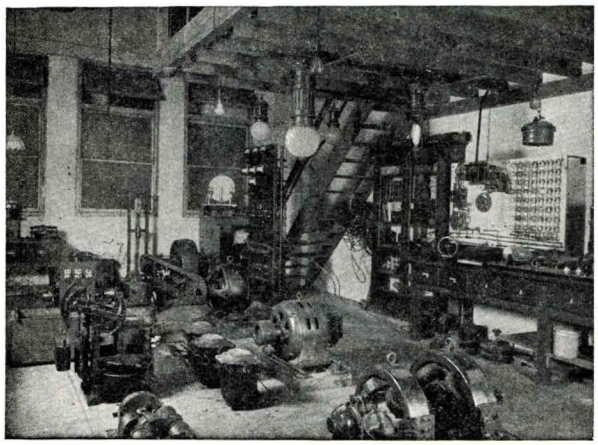
Station "7YG"

Oregon Institute of Technology Radio School

By LLOYD H. SIMSON, *Principal*

To the "old-timers" of the radio fraternity—the veteran "Lightning-jerkers" who still cherish fond memories of the glorious days of anchor gaps, single-slide tuners, and carborundum detectors, "7YG" needs no introduction. For the benefit of those who may not have followed this historic station through the many stages of its development, as it has kept pace with the gigantic strides of advancement in the radio art, perhaps a brief description of its present equipment may be of interest.

Those of you who have an opportunity to "listen in" during the daylight hours, and the "Knob-twisters" who, instead of switching off their filaments as the last of the local broadcasters shut down about 10 P. M.—cut in a couple stages of amplification and settle down to real work—often they are treated to a real thrill. If you have any regard for your ears and you hear a quick staccato dot or two, followed by — — · · — — (high-power warning), you will lose no time in grabbing for

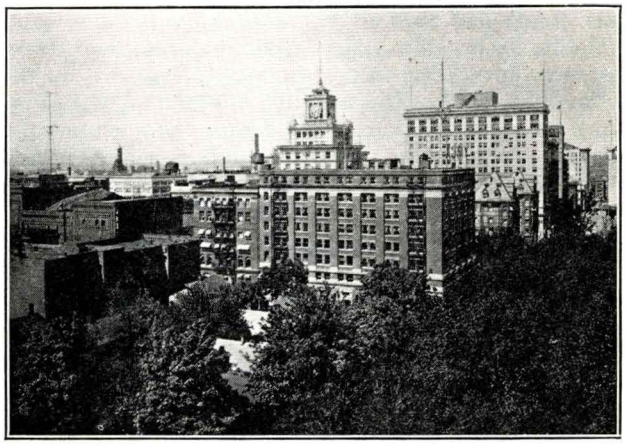


Experimental Electrical Laboratory at 7YG

a dial and detuning your receiver. A few degrees off 375 meters, unless you are so close that you are bound to get forced oscillations (7YG boasts an unusually low decrement for a spark station—0.045), and the signal strength will probably be reduced so that you can let go of the "cans" without further fear that they will jump off your ears.

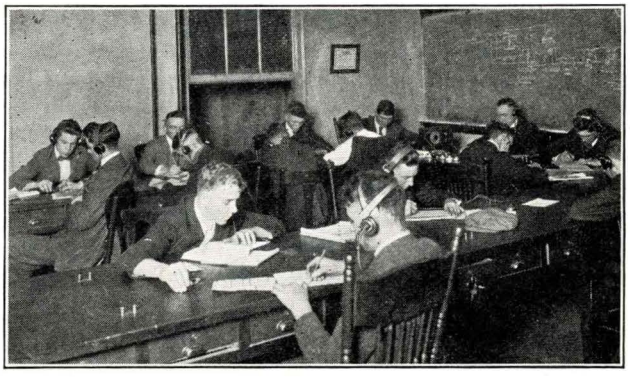
If you are one of the many thousands of radio enthusiasts who have yet to experience the genuine thrill that fluency in the fascinating language of the key brings, you will probably have a bored sigh and sit back with that "resigned-to-the-inevitable" air, and wait for the ether to calm down again. Yet, compelled as you are, to endure this meaningless jumble of dots and dashes, jamming an already over-crowded ether, as that penetrating business-like voice of the spark vibrates in your ears, do you not sense something there perhaps just as vital, just as important as the spoken accents of some broadcast announcer telling a world waiting with straining ears and bated breath that,—"This is stashun 'KECK-U-C-DOUBLEYUH'—K as in cucumber, Q as in fish, C as in cabbage, W as in 'Johnny Walker,' owned and operated by the Blah Blub Kump'ny—broadcasting. The next number"—etc., etc.

If you could but look over the shoulder of one of that vast army of earnest amateur operators and follow



Y. M. C. A. Building, Portland, Oregon, Where Station 7YG is Located

his speeding pencil across the page as those same mysterious dots and dashes flow from its point and magically transform themselves into the words of perhaps a message of greeting to someone in Canada, California, or—yes, even the South Seas (it is being done every day)—then would you not be willing to concede that possibly it isn't just merely the purposeless pastime of school boys? Might it not help you to realize the significance of the statements of authority that, were it not for the continually-experimenting amateur, the modern



Class at Code Practice—7YG

highly perfected radiophone would still be a dream of the remote future?

Experts agree that probably no other one factor contributed more towards victory for the Allies in the World War and a hastening of peace, than did the mar-

velously efficient military and naval communication systems of the Americans. In the training and building up of the personnel of those organiations "7YG"—that is, the Oregon Institute of Technology Radio School—took a most important part, both in the years previous to the war during which time she turned out hundreds of highly trained commercial operators who were to furnish the nucleus of the war-time organization, and also during the years of actual conflict when large numbers of operators were required to man our vessels in the war zone.

Unlike most of the radio schools, which were demobilized after peace was declared, 7YG is still "on the air", manned by students who have had the vision to foresee the unparalleled opportunities which radio as a profession offers to the man of special training. Many of them have had some previous training in the army signal corps or naval communication service, then were discharged and went back to their old jobs, and now since the popularization of radio, have realized its infinitely greater opportunities and have returned to complete their studies with a view of securing a federal operator's license.

In addition to the Institute's experimental laboratories, code, and lecture rooms, is this modern and complete radio station, "7YG" (or when broadcasting known as "KDYQ"). As soon as a student has acquired a sending and receiving speed of fifteen or more words per minute and can pass a satisfactory test in his knowledge of message forms, radio laws and operating procedure, he is assigned a watch here and gets actual practice in handling regular traffic.

Two self-supporting steel towers elevate a four-wire 80-foot "T" antenna 180 feet above the street level. Originally designed to accommodate a two-wire aerial 396 feet in length for the 1,875-meter wave, which at that time was the normal tune of this station, these masts were erected nearly two city blocks apart. The shorter wave-lengths now provided for (200—375—485 and 600), made necessary the re-designing of the antenna, which at present is supported on the east end by the tower on the roof of the 8-story Y. M. C. A. building, and then pieced out with a steel gantline to the west tower atop the Heilig theatre. This gantline is broken and insulated at frequent intervals to prevent absorption and re-radiation both from this station, and from the broadcasting transmitter of Hallock and Watson Radio Service (KGG), who are permitted the use of the west tower as a support for their antenna also.

The transmitting equipment consists of a 2 K. W. 500-cycle Kilbourne and Clark panel spark set and a DeForest type OT-20 C. W. and 'phone, the latter remodeled for special experimental modulating systems.

There are four separate receivers for the various bands of wave-lengths—a Northwestern SR-22 3-circuit regenerative receiver, detector and 2-stage A. F. amplifier for 200-600 meter reception, a K-C type "E", and Marconi 106 for 600-3,000 meter work, and a honey-comb set for trans-Atlantic and trans-Pacific reception from high power C. W. stations.

Using but one UV-202 5-Watt power tube in the C. W. set, signals from 7YG have been reported over almost unbelievable distances, while reliable communication has been carried on with amateurs as far South as San Diego, California. It would be interesting to know just how far the big spark set could reach out on full power, but using the maximum allowable in-put of one K. W. on 375 meters it has been reported in the Hawaiian Islands to the West and as far East as Dickson, Tennessee.

"I Tappa Kee" Radio Fraternity

By LLOYD H. SIMSON

Since these hectic days of radiophone broadcasting, the spoken word seems almost to have supplanted the original dot-and-dash system, and the men who handle the key aboard our ships are apt to be for the moment forgotten. Only when the press chronicles the heroic deeds of some one of these "Knights of the Key," and relates the thrilling details of some marine disaster in which another of them has distinguished himself, and lived up to the reputation they have earned in the past for their courage and coolness in the face of danger—then perhaps will you pause and contemplate. Possibly you have seen that modest little monument in Battery Park, New York, dedicated to the radio men who "Stuck to Their Posts," sending out the "SOS" call of distress, until either they had summoned assistance or were engulfed by the cruel rush of water as they went down with their ship. Many have been the means of saving their vessel and their shipmates from destruction, often at the price of their own lives, but *not one* has the history of marine disasters, in which radio figured, recorded a "Sparks" that has not kept his trust. "Greater Love Hath No Man . . ." What more noble example could be held up before the operators of the future?

That these noble traditions may be preserved and carried on in the years to come, there has been organized, and fostered particularly by the students and graduates of the Oregon Institute of Technology Radio School, a radio brotherhood to be known as the "I Tappa Kee" Radio Fraternity. Its members are sailing the seven seas, some aboard huge and luxurious passenger liners, others on rusty old tramps, palatial yachts, oil tankers, fishing schooners, etc.—all of them having interesting experiences, and thrilling ones, too, which they sometimes may be induced to relate at the meetings when they chance to be in port. At least they are assured of a friendly welcome; and to many a stranger in a strange city that means more than one can realize who has not been there himself.

This fraternity has four honorary degrees with eligibility based upon skill in operating, and experience. The title of "Lightning Jerker" is the highest and is only conferred upon a member who can qualify in sending and receiving Continental Morse code at a speed of 28 or more words per minute, and has actually stood a regular watch in some government, commercial or limited

Continued on Page 256

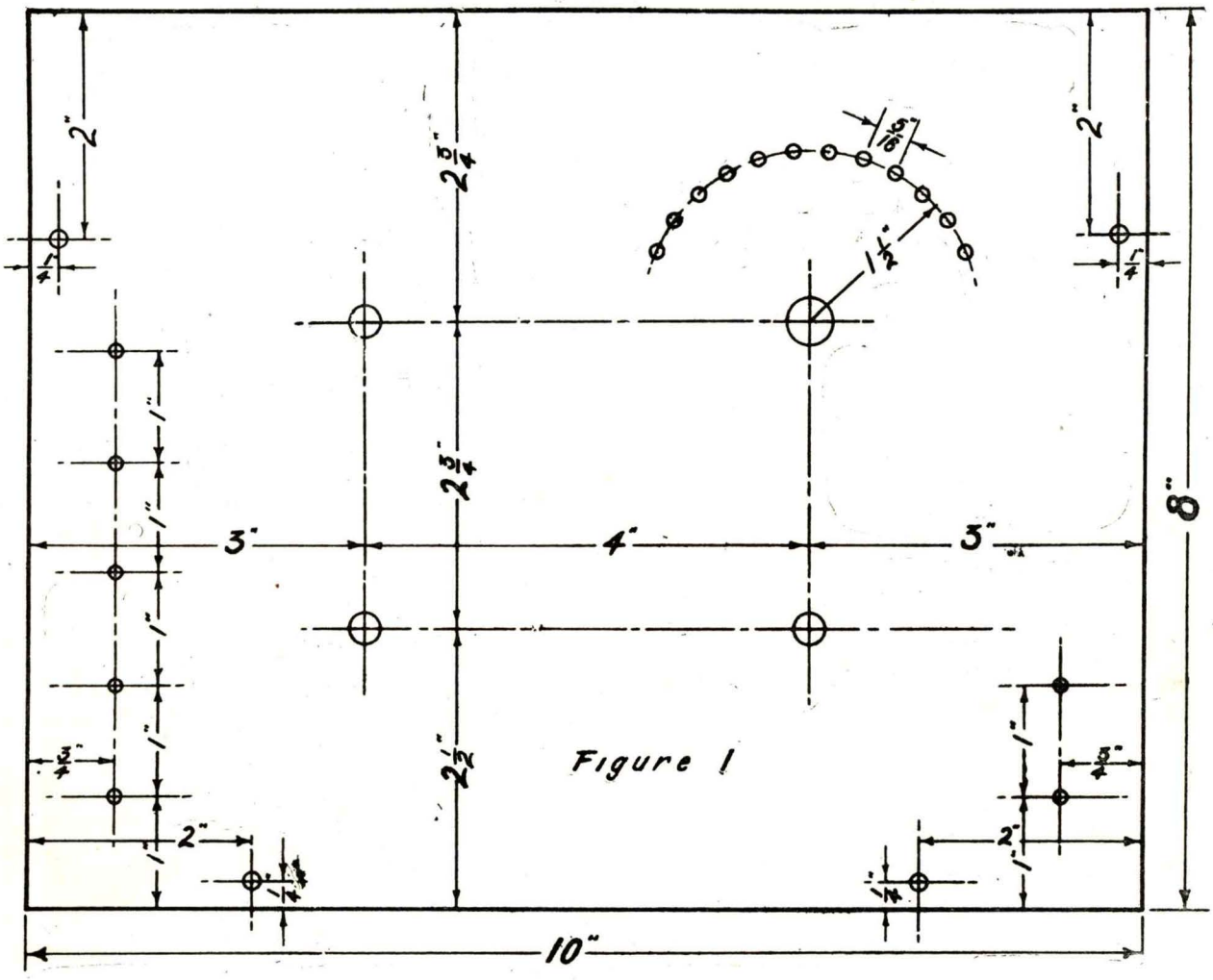


Figure 1

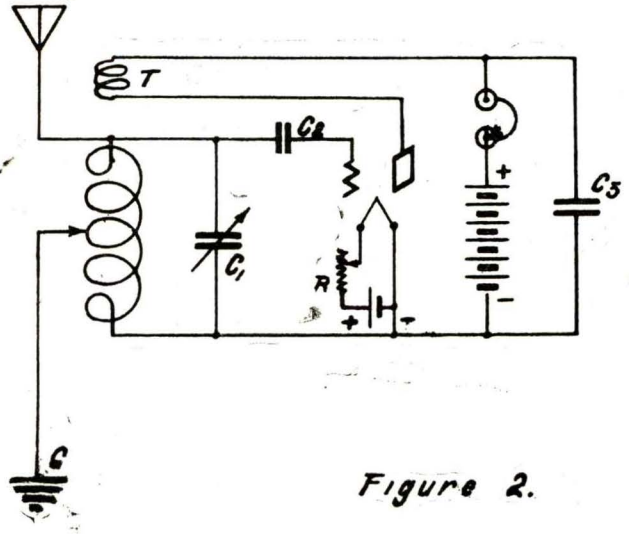


Figure 2.

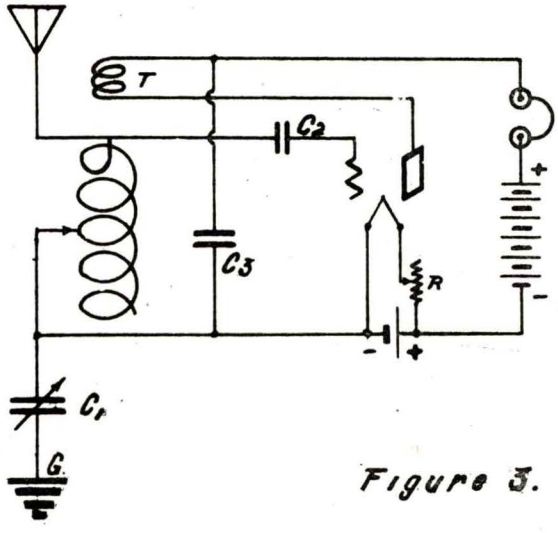


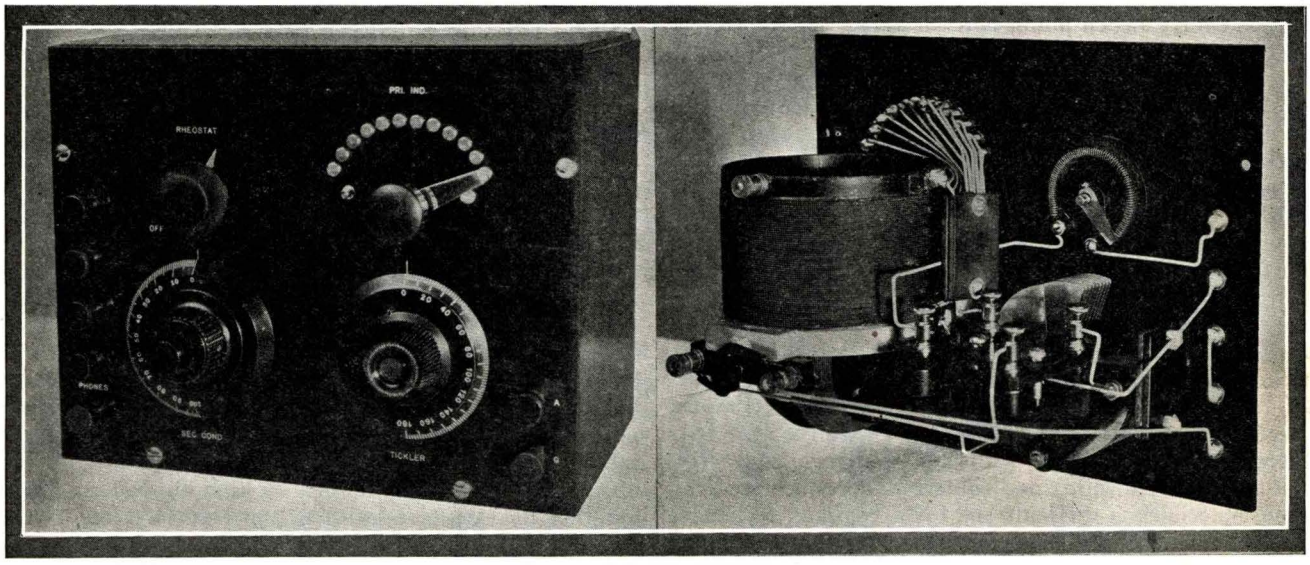
Figure 3.

PANEL LAYOUT AND CIRCUIT DIAGRAMS — SEE ARTICLE ON PAGE 247

An Ideal Single Circuit Receiver

By J. D. HERTZ

To those living in districts where storage battery charging facilities are unavailable, the pleasures and benefits of broadcast reception have long been denied. Even in the city many enthusiasts hesitate to install a vacuum tube receiving set because of the cost and inconvenience of a storage battery. It is for these people that the "peanut" tube has been brought out, and is properly known as the "Type W-D 11." It is a mighty useful and quite efficient vacuum tube, designed for operation entirely on dry cells. The filament, when in proper adjustment, does not show more than a very dull glow, and consumes two-tenths of an ampere, or one-fifth of the current used by the regular six-volt tube. The fact that a single dry cell is all that is needed for lighting the filament also proves to be an important consideration when portability is desired. The high-voltage or "B" battery is similar to that used on other types of tubes, varying from 22½ volts and up for the detector, and from 45 volts up for amplifier tubes.



The set described herein was designed for just such conditions as mentioned above, and has proven very satisfactory. On a duplicate of this set, installed in the White Salmon Valley, some 60 miles east of Portland, broadcasting stations have been listened to from St. Louis, Minneapolis, Ames (Iowa), Salt Lake City, San Francisco, Los Angeles, Calgary and many others at equal distances. The construction of the set will be described in detail, considering the actual parts used, and then variations in construction will be discussed, together with the effects they will cause in the operation. The diagram used is shown in Figure 2. Relative merits of that shown in Figure 3 will also be taken up.

The first consideration is a panel. In this set hard rubber of the variety known as "Mahoganite" was used. The material used is three-sixteenths inch thick, and is cut eight by ten inches, with the "grain" running the long way of the panel. Looking at the front of the panel (Figure 1), five holes are drilled on the left-hand side, one inch apart, beginning one inch from the bottom and three-quarters of an inch from the edge. A 5-32 inch drill is used, as the holes are to accommodate the 8-32 machine screw of the binding posts. Two similar holes are also drilled on the right-hand side, beginning at one inch from the bottom. Now on a line two and a half inches from the bottom of the panel two holes are drilled, each three inches from the sides. A 5-16 inch drill, or one of size "F," is used for these holes, as they are to accommodate the quarter-inch shafts of the variable condenser and variocoupler. Since condensers and variocouplers are built different, no holes for supporting screws were shown in the drawing. These can best be located by cutting a template from thin cardboard to fit the particular instrument and then drilling the holes in the panel according to the template.

On a line two and three-quarters of an inch from the top of the panel a hole is made three inches from the left-hand side, using a 5-16 inch drill, or one of "F" size. The same distance from the right-hand side and on the same line a three-eighths inch hole is drilled to accommodate the switch bushing. Before drilling this last hole it is well to use the point where it is to be located as a center from which to lay out the arc on which the holes are to be drilled for the switch points. This arc is of a one and one-half inch radius, and the holes for the switch points are drilled on 5-16 inch centers, using a one-eighth inch drill. Two similar holes are then drilled for the switch stops. These are not shown on the drawing, since their location will vary some with the type of switch used. While these can be omitted, they add very much to the appearance of the set, let alone the convenience. Lastly drill the holes along the edges of the panel as shown to accommodate the screws which hold the panel to the cabinet. These are one-quarter inch from the edge and two inches from the nearest corner.

Nothing remains to be constructed now with the exception of the cabinet and the shelf to support the socket. The first of these two items may be made, though the one used by the author was bought at a cost of $3.50, and was a fine piece of work. It should measure eight by ten inches on the outside and be six inches deep. The top should be hinged to admit opening for removal of the tube. The socket shelf or sub-base was cut from half-inch bakelite, and measured two and three-quarters of an inch on the side. This is held to the back of the variable condenser by two three-quarter inch 8-32 machine screws, as may be seen from the photograph of the interior of the set.

The next thing under consideration will be the apparatus used. We will need a variocoupler, a grid condenser, a bridging condenser, a rheostat, a switch arm with a one and one-half inch blade, a "peanut" tube socket, twelve switch points and two stops, and a variable 23-plate condenser combining a vernier plate. The first three of these items used were manufactured by the Northwestern Radio Manufacturing Company. The rheostat is a product of the Central Radio Laboratories. The socket bore no name, and was just one that happened to be on hand. The question of sockets will come in for further consideration later. Neither did the switch or the contacts bear a title. The variable condenser is a Duntley 23-plate vernier and comes furnished with a three-inch dial. Another three-inch dial must be provided for the variocoupler. This one is from the Kellog Switchboard and Supply Company. Ten feet of silver-plated wire will be more than enough, and as many feet of No. 22 bare copper wire and five feet of Empire sleeving, that yellow "spaghetti," will wire the set. This set was wired throughout with No. 14 silver-plated wire, but the task of forming and soldering the switch leads of such material is a difficult one for a beginner to tackle.

After drilling the holes, consider the matter of engraving. The set will work just as well without a letter on the panel, since you know what is behind it, yet if you ever have a desire to sell it, a well-engraved panel will help the sale a whole lot. This must be done before any apparatus is mounted. There are several concerns on the Pacific Coast prepared to do this work, the names of which will be furnished upon application to the editor of RADIO WAVES.

Supposing that we have now drilled all of the holes shown, and those necessary to secure the rheostat, variable condenser and variocoupler to the panel, let us proceed with the assembly. The above holes have not been located in the drawing, as before mentioned, since they will vary with the apparatus used. Place the binding posts, switch points and stops in their respective holes and make them secure. Mount the variocoupler and then place the switch-arm in position. If it is not necessary to shorten the switch-arm shaft to clear the variocoupler, it may be secured in place. Next mount the rheostat. It will be necessary to remove the rear end-plate from the variable condenser in order to mount the socket sub-base, as mentioned above. Before securing this sub-base to the condenser end-plate it will be well to mount the socket on it. After reassembling the condenser with the attached sub-base, mount the whole instrument on the panel and we are ready to wire up.

There are two satisfactory methods of wiring, together with two or three minor variations in either. We will discuss the relative merits of these. Figure 2 shows the set wired with the variable condenser across the tuning inductance. This arrangement is of most use in connection with a small aerial, such as an antenna indoors. In Figure 3 is shown a condenser in series with the ground instead of across the inductance. This method will be most satisfactory with a large antenna. It will permit sharper tuning, and will be less noisy. In the two circuits two different methods of wiring the filament circuit are shown, either of which may be used with equal success in either hook-up. The actual wiring will not be discussed, except to mention that the grid leads especially should be made as short as possible. The leads from the taps on the variocouplers to the switch points should be made with the No. 22, encased in Empire sleeving. This is that yellow tubing, sold for just such purposes. The rest of the set should be wired with No. 14 silver-plated copper wire. Bare copper wire is better than nickel-plated or tinned wire. The binding posts on the panel are as follows: The two on the right, looking at the front of the panel, are the aerial and ground posts. On the left-hand side, from the top down, are the "A" battery post, the post common to both "A" and "B" battery, and the "B" battery positive post. The two bottom ones are for the phones. In case diagram (Figure 2) is used the top post is "A" battery positive, and in the diagram of Figure 3 it is negative. The grid and bridging condensers, *C-2* and *C-3*, are not mounted on anything, but are merely supported by the wires to which they are attached, and are so located that their leads will be as short as possible. In the two diagrams the bridging condenser, *C-3*, apparently takes a slightly different position; however, in either case it is used to shunt the radio-frequency current in the plate circuit around the phones and batteries, which act as high impedance. Much question has arisen relative to the best location of the series condenser. From many trials, and from the experience of some of our foremost experimenters we have come to the conclusion that it doesn't make any difference whether the condenser be in the antenna or the ground lead. If the condenser be in the ground lead and the rotary plates grounded the capacity effect of the hand will be nil. If it be in the antenna circuit the balance of the controls will be at ground potential and hence will not be affected by the hand, yet the condenser will. So take your choice.

The choice of apparatus is a problem. There are hundreds of makes of apparatus on the market, many of them good. The variocoupler chosen was selected since it possessed the desired values of inductance, and seemed to be the best obtainable from several other points of view. Most any other variocoupler of the same size will serve, however. There are several makes of condensers suitable for use as described; the principal feature to observe is whether it will stand the strain imposed upon it when placing a tube in the socket or removing it. There are several types of sockets on the market for use with the "peanut" tube, some better than the one used herein. A standard six-volt tube socket may be substituted, making the set universal with the addition of an adapter for the "peanut" tube. The rheostat again gives a wide opportunity for personal selection. Preferably a vernier rheostat should be used, though some tubes do not seem

to be critical enough to require the use of such adjustment. The Cutler-Hammer rheostat is a smooth-running instrument and is easily mounted.

The set, when completed, should be secured to the cabinet with nickeled oval-headed screws, and the dials set on the shafts to agree with the position of the rotors, then the set is ready to go. We cannot call the set "completed," however, unless the wiring diagram has been checked over a second time, and if you are new at the game you will do well to have another person check it for you also, thus minimizing the chance of error.

As for how to operate the set, we can say little, since it will vary considerably with the choice of hook-up and the choice of parts. Also the size of the aerial will make a difference in tuning. In principle, there are two circuits, the primary and the secondary, one controlled by the tap switch and the other by the condenser. These two circuits must be tuned to the same wave length, and this can only be found by trial. There is a third circuit, the tickler, which is loosely coupled to the other two. The degree of coupling will control the amount of regeneration, or oscillation. It might be said here that the truest reproduction of music or speech can only be had when the tube is not actually oscillating, the louder signals, music or speech will be obtained just at the point where oscillations begin. Experiment will show the best adjustment, and it will also be found that varying the tickler coupling will indirectly vary the tuning of the other circuits, making a readjustment necessary. This has been called a single-circuit set, and such it is, though there are really three circuits in it, as well as in any vacuum tube set—the antenna, grid and plate circuit—though they may have parts in common, and hence are called single-circuit sets, to differentiate them from sets in which the various circuits are not directly connected.

A description of an amplifier to match this set will be described in a coming issue of RADIO WAVES, together with other items of interest on "peanut" tube operation.

Some Notes on Radio-Frequency Amplification

By CHAS. D. FARNHAM, *Northwestern Radio Association*

A great deal has been written lately concerning radio-frequency amplification; its merits and demerits; various methods of obtaining amplification at radio-frequencies and relative results. Very little has been said, though, regarding the *whys* and *wherefores* of the various circuits and methods, and reasons therefor.

The purpose of this article is to clear up, if possible, a few of the foggy notions prevalent on the subject and to familiarize the radio experimenter with the fundamental principles involved.

First, let it be said that *all* radio-frequency amplification must come from the tube itself and that no method of *coupling* will increase the amplifying powers of the tube. Therefore the ideal coupling would be as depicted in Figure 1.

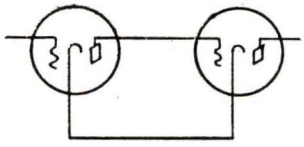


Fig. 1

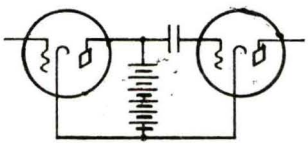


Fig. 2

But unfortunately for this method, some source of plate current must be supplied and then our troubles begin. We add a plate battery, as in Figure 2, and in so doing complete a close oscillating circuit, and because we are dealing with radio frequency some method must be used to tune this circuit to the frequency we wish to amplify; otherwise there will be no transfer of energy from tube to tube.

We have two methods of tuning an oscillating circuit —electro-static (condensers) and electro-magnetic (coils). The former we cannot use, because we must have a direct current supply for the plate of the first tube and a condenser will stop the flow of a direct current. Therefore we are reduced to the necessity of using electro-magnetic coupling only. We insert a coil as in Figure 3 and because we desire a number of different frequencies we make this coil variable, or in the shape of a variometer.

Now let us examine the working of this method. As pointed out above, energy transfer will take place only at the frequency to which this circuit is tuned and we find in actual operation that this tuning is rather critical, a feature not so objectionable where only one stage of amplification is used, but as more stages are added the difficulty of tuning becomes greater and greater with each stage until we reach a point where it is practically impossible to get it tuned in any reasonable length of time. Another feature which makes this method undesirable from a standpoint of efficiency is the insertion of a condenser in the grid lead of the second tube, necessary to insulate this grid from the direct current supply. This condenser because of its inherent characteristic will unbalance the two circuits; that is, the grid to filament circuit will be of a different natural frequency than the plate to filament circuit, therefore non-resonant and an imperfect coupling.

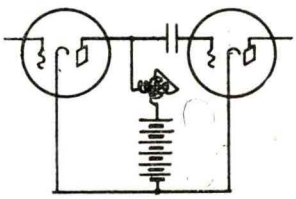


Fig. 3

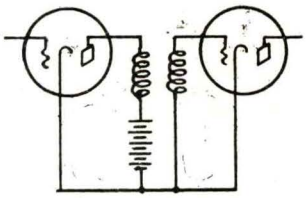


Fig. 4

Now to get rid of this condenser. This is done by using two separate circuits and coupling them together inductively; this is the common air-core transformer, Figure 4, and can be mad up in any convenient form. But again the bugbear of tuning enters in and unless his wants are provided for, the amplifying range of such a circuit is limited to the natural frequency of the trans-

Continued on Page 254

Elementary Principles of Radio Telegraphy and Telephony

Part Six

Comparison of Damped and Undamped Waves

A damped wave is originated by an oscillating body whose oscillations are gradually fading out. In radio this gradual fading out of an oscillation means that the current of the oscillation gradually decreases in value.

An undamped wave is originated by an oscillating body whose oscillations always retain their maximum value. In radio this means that the current of the oscillation always retains its maximum value. Thus in an undamped radio set the oscillations, and hence the wave generated by the oscillation is continuous as long as power is applied (as long as the key is held down). *This means that there are no wave trains in undamped waves as there are in damped waves.* An undamped wave is also a *continuous wave*, but a continuous wave is not necessarily an undamped wave. Any unbroken wave is a continuous wave. This continuous wave may vary in amplitude. Continuous waves are used in radio telephony.

To produce an undamped wave it is necessary to add energy to an oscillating body as fast as that body loses energy. For example, a child's swing once started will gradually come to rest. It loses energy due to friction of the air; the friction of the ropes where they are attached to the support, etc. If it is desired to keep it swinging through a constant arc, a push must be given it at each swing; this push adding just the same amount of energy as was lost during the swing. So in electric oscillation the current decreases because it loses energy by radiating some in the wave; by the resistanc of the wire causing heat losses, and by losing energy to other circuits and objects. To keep the current constant it is necessary to furnish just the same amount of energy during each oscillation as is lost in that oscillation. There are various methods of doing this and these will be described later.

Undamped waves have certain advantages over damped waves for use in radio communication. They carry much more energy in the same amount of time. For instance, suppose a dot used in radio telegraphy lasts one-twentieth of a second. Using a wave length of 1,500 meters, there would be in undamped wave transmission 10,000 waves in this dot. If this dot was sent by damped waves there would be, if a spark discharge occurred 1,000 times a second, 50 wave trains in the dot. If each train consists of 40 waves—a reasonable number—the total number of waves in a dot would be 2,000. Thus there are five times as many waves in the undamped wave dot as in the damped wave dot. But the damped wave has only one of its waves at maximum amplitude and the rest gradually die away, while the undamped waves have every wave at maximum value. For this reason the energy of each undamped wave is in this case about five times the average energy of the damped wave, providing the maximum amplitude of the damped wave has the same value as the undamped wave's amplitude. Thus the energy in a dot carried by the undamped wave is 25 times the energy in a dot carried by the damped waves. This is a great advantage, especially as it does not take much more power to generate the undamped waves than it does to generate the damped waves.

An undamped wave is a very pure wave and therefore has none of the disadvantages of a broad wave. These disadvantages have already been discussed. Because of the reasons stated in the preceding paragraph, the maximum steady energy of an undamped wave need not be nearly so large as the initial energy of a damped wave to establish communication over the same distance. A direct result of this is the fact that voltages used in undamped waves are not nearly so high as in damped waves, thus making easier the design of the instruments Still another advantage is in receiving. This will be explained later.

Production of Undamped Waves

One method of generating an undamped wave is by the use of the Alexanderson alternator described in the October issue. This alternator is capable of generating alternating currents of radio frequency. The energy lost in each oscillation is therefore supplied direct by the generator. There are other generators that are capable of generating radio-frequency oscillations. Prominent among these are the Goldschmidt machines. As the output of these generators are radio-frequency oscillations, the output current may be fed directly to the antenna. However, this is not usually done because of the necessity to control the radiation from the antenna in order to give the dots and dashes used in telegraphy. The arrangement for doing this varies in different sets and is usually more or less complex. There must be some special arrangement to control the speed of rotation of these machines, since speed of rotation controls the frequency, and if this varies it changes the wave length, hence the speed *must* be kept constant. As the speed is very great, the speed-control system is quite complex, and owing to the great expense these alternators are not used except at high-powered stations.

Another method of generating undamped waves is by means of the arc. The arc transmitters are less costly than the alternators mentioned above, and there is no difficulty in controlling the wave length, as this is determined by the inductance-capacity value of the circuit. This will be explained later. The sets are easily designed to give any power required. Those in use range from a power of 2 kilowatts to 1,000 kilowatts.

When a current passes continuously or nearly continuously through a small break in a circuit which is filled with air or other gas at atmospheric or greater pressure it is said to form an arc. This differs from a spark in that a spark is a disruptive discharge and the current passes only intermittently. A familiar example of an arc is the arc light used for lighting streets, etc. An arc has

an unusual feature in that it seemingly does not obey Ohm's law. It differs in the fact that it takes less voltage to cause a heavy current to pass across the arc than it does to cause a small current to pass.

If capacity and inductance of proper value are shunted around the arc under proper conditions (shown by dashed lines in Figure 27), there will be radio-frequency oscillations produced in the circuit. These oscillations are produced because of the characteristics of the arc stated in the preceding paragraph. This comes about as follows: Consider the circuit to the arc formed and fed from a *constant* current source and the condenser uncharged. The current feeding the arc will now also feed the condenser, thus charging it. But the current charging the

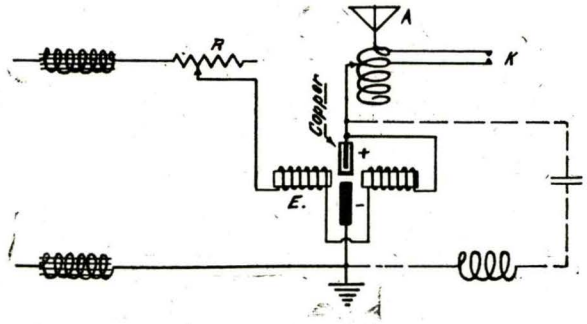


Fig. 27

condenser has been subtracted from the current passing through the arc, thus making the arc current less. The smaller arc current makes a higher voltage across the arc because of the arc characteristic mentioned. This higher voltage causes more current to pass into the condenser. This process goes on until the potential across the arc no longer rises rapidly with a decrease in current. Thus there is no higher potential available to charge the condenser and current stops flowing into the condenser and the total current now flows through the arc. This lowers the potential across the arc, and hence across the condenser. This lower potential allows the condenser to discharge and add its current to the current feeding the arc. The inertia in the circuit causes the condenser to be charged in the opposite direction. It immediately begins to discharge, and this time opposes the current flowing through the arc. These opposing currents neutralize each other, whereupon the first condition is brought about. In good operation the back discharge of the condenser is great enough to stop the arc current from flowing. This extinguishes the arc, which, however, immediately re-forms.

The frequency of the cycle described above can be varied by varying the inductance-capacity value of the shunt circuit around the arc. Thus the wave length may be changed. The oscillations are undamped because the source of current feeding the arc also supplies energy at each oscillation to the oscillating circuit, as has been described.

Figure 27 shows a diagram of such an arc set. The circuit shows the conditions under which the arc will work. The first condition is that the arc must be between copper and carbon electrodes, the copper being the positive electrode and being kept cool by a stream of water. The carbon must be slowly rotated around its own axis, though the mechanical arrangement for doing this is not shown. The second condition is that the arc must be subject to a strong magnetic field. This magnetic field is furnished by the electro-magnets *EE1*. The third condition is that the arc is formed in a gas containing hydrogen. Therefore the arc is inclosed and this gas is furnished to the inclosure. In practice this can be done by dropping a few drops of alcohol in the arc container at regular intervals. This is accomplished by an arrangement similar to an oil cup used on many machines. The fourth condition is that the value of the capacity and inductance of the shunt circuit must have a proper ratio. In the diagram of Figure 27 the antenna is the condenser and the antenna tuning inductance furnishes the inductance. The dashed circuit shows the equivalent of these.

Various arrangements of the key for controlling the output are possible. It has been found that the dots and dashes cannot be made by interrupting the source of constant current supply. This would extinguish the arc, which would have to be struck again by hand; that is, by touching the carbon to the copper and then withdrawing it to make the arc. In the arrangement shown in Figure 27 the key cuts out some of the inductance in the antenna circuit. This changes the wave length radiated and the receiving antenna is not affected by this changed wave length, as it is tuned to the proper wave length. The key is so arranged that when it is closed the proper inductance is in, and when it is open the inductance is changed from the proper value. Another method of controlling the output is by having a non-radiating circuit in addition to the antenna. Closing the key throws the output of the arc to the antenna from this non-radating circuit. Various other methods are also used.

Reception of Undamped Waves

The reception of damped waves has already been described. It was possible to receive them in that manner, because each signal (dot or dash) contained a number of wave trains and each wave train produced a vibration of the telephone diaphragm. The successive vibrations produced by successive wave trains made the tone

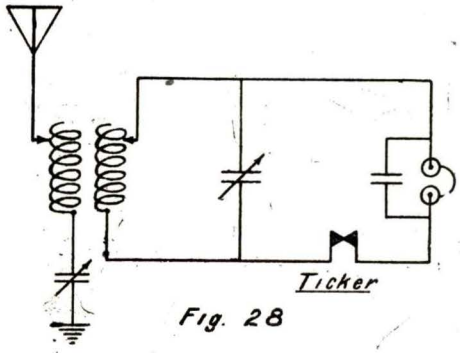


Fig. 28

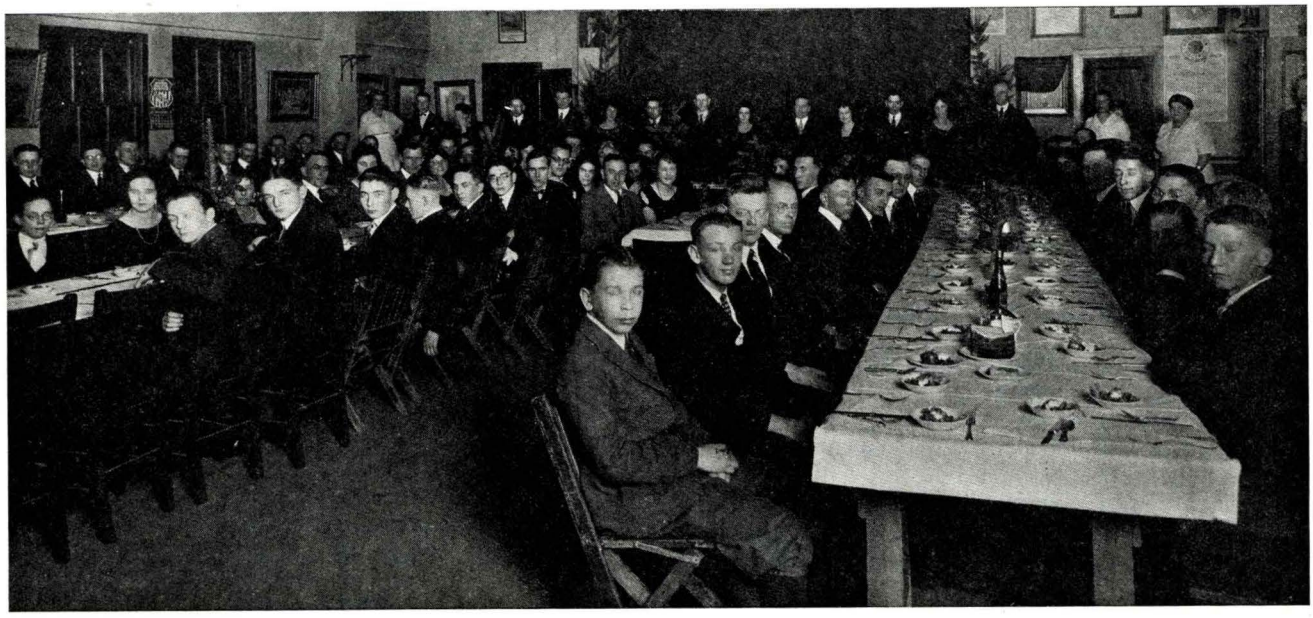
heard in the telephone receivers. As has been noted, an undamped wave signal is not broken up in wave trains, but consists of an unbroken series of waves of the same amplitude. The effect upon the diaphragm of the telephone receiver would then be to distort it at the beginning of a signal and release it at the end of the signal. This would result in a click being heard in the receiver,

Continued on Page 254

Third Annual Banquet of Northwestern Radio Association at Portland, Oregon

The Northwestern Radio Association, of Portland, successfully staged its third annual banquet in the East Side Business Men's hall on the night of December 28. Not only was practically the entire membership in attendance, but representatives from various sections of the Pacific Northwest also were present.

The dinner was served at 7 o'clock, after which some time was devoted to talks by well-known men affiliated with the radio game in the Northwest. Mr. W. V. Russ, president of the association, told of the purpose and



activities of the club. Mr. Howard F. Mason, well known as 7BK of Seattle and manager of the Northwestern division of the American Radio Relay League, presented some authentic data on just what amateurs all over the country are doing in long-distance radio-telegraph work. The principal speaker of the evening, Lieutenant-Commander Mathis, of the Bremerton Navy Yard, then told of the advantages of amateur organization in the seventh radio district and of the Seventh District Executive Council. Mr. Mathis has the amateur at heart, and is fighting strong for them.

Following this, a two-hour program dance was given, including a one-act sketch given by Mr. and Mrs. Harding on the hall stage.

To Mr. J. D. Tait and to Mr. and Mrs. John Julian is due credit for the success of the banquet, for under their able charge all work of arranging and managing a most enjoyable evening was placed.

Among other guests present were Karl Weingarten and Teddy Bentz, from Tacoma; W. A. C. Hemerich, of 7SC at Aberdeen, Wash.; Robert Waskey, from 7UU, Seattle, and his brother and partner, John Waskey; Mr. E. E. Ames, of 7NA at Eugene; Mr. L. C. Maybee, of 7GE at Pasco, Wash., and Mr. C. A. Lockwood, 7TJ, of Salem, Ore. An executive board meeting was held following the banquet. Mr. A. H. Babcock, Western member of the board of directors of the American Radio Relay League, and consulting electrical engineer for the Southern Pacific at San Francisco, was also present.

The Northwestern Radio Association is the direct descendant of the old Columbia River Wireless Association, organized way back in 1912 some time, by amateurs of Portland and its outlying territory. In the fall of 1915 the association was reorganized. The meeting at which this took place was held at the home of old "Bun" Montgomery, and there are still several men in the radio game in Portland who were there. At this time the new name of Northwestern Audion Association was adopted, and was retained, even though much confusion resulted, until another reorganization following the war. This happened in the fall of 1919, when a meeting was called to meet in the Central Library in Portland. Since that time the association has taken an active part in the enforcement of radio laws and regulations in its district, beside serving as an encouragement and help to many younger fellows just breaking into the game. Likewise its meeting at times have been the scene of stormy arguments over the rights and wrongs of fellow members and those not affiliated with the association. Time and time again the association has served as a means of settling differences of opinion, or in squaring up the misdeeds of some over-zealous amateur.

Meetings of the association are held regularly in the Journal Building at 8 P. M. on Friday evenings, in the auditorium directly above the main offices. While the meetings are of special interest to amateurs, anyone interested in radio events is welcome as a visitor. Walter V. Russ holds the office of president; C. N. Ashla is guardian of the cash box, and Geo. W. Cameron, Jr., drives the pen as secretary. While the organization is primarily of Portland amateurs, outlying districts are well represented, such as Vancouver, Hillsboro, Oregon City, and even members in Seattle and Tacoma are found listed on the rolls.

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Schedule Corrected Monthly

DAILY BROADCASTING SCHEDULE FOR THE PACIFIC COAST

CALL	CITY AND STATE	PROGRAM	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
AGI	San Francisco, Cal.....	Instruction	7:00						
CFAC	Calgary, Canada	Misc., 430 meters only (Mt.)...		3:30, 7:45	3:30, 7:45	3:30, 7:45	3:30, 7:45	3:30, 7:45	3:30, 7:45
CFCB	Vancouver, B. C.....	Miscellaneous, 440 meters.....		8:30	8:30	8:30	8:30	8:30	8:30
CFCN	Calgary, Canada	440 only (Mt.), miscellaneous...				10:30			10:30
CHBC	Calgary, Canada	Mis., 410 meters (Mountain time)	8:45	8:45	8:45	8:45	8:45	8:45	8:45
CHCQ	Calgary, Canada	Mis., 400 meters (Mountain time)	7:45	3:30, 7:45	3:30, 7:45	3:30, 7:45	3:30, 7:45	3:30, 7:45	3:30, 7:45
CJCB	Nelson, B. C.	400 only, miscellaneous	8:00	8:00	8:00	8:00	8:00	8:00	2:00
CJCE	Vancouver, B. C.	420 only, miscellaneous		12:30, 3:30, 8	12:30, 3:30, 8	12:30, 3:30, 8	12:30, 3:30, 8	12:30, 3:30, 8	12:30, 3:30, 8
CKCD	Vancouver, B. C.	410 only, miscellaneous		8:30	8:30	8:30	8:30	8:30	8:30
CKCK	Regina, Sask., Can.....	Mis., 420 meters only (Mountain)	1:15, 7:30		1:15, 7:30	1:15, 7:30	1:15, 7:30	1:15, 7:30	1:15
DD5	Denver, Colo.	Mis., 340 meters (Mountain time)		8:15	8:15	8:15	8:15	8:15	8:15
DN4	Denver, Colo.	340 only, miscellaneous (Mt.)..		8:15	8:15	8:15	8:15	8:15	8:15
KDN	San Francisco, Cal.....	Miscellaneous and 485 meters...	10:00, sacred	11, 1, 4:30, 8:30	11, 1, 4:30, 8:30	11, 1, 4:30, 8:30	11, 1, 4:30, 8:30	11, 1, 4:30, 8:30	11, 1:00, 4:30
KDPT	San Diego, Cal.....	Miscellaneous	7:30	7:30	7:30	7:30	7:30	7:30	7:30
KDYL	Salt Lake City, Utah...	Mis., 485 meters (Mountain time)	2:00	7:00	7:00	7:00	7:00	7:00	7:00
KDYS	Great Falls, Mont.....	Concert bedtime stories(Mt. time)	4:00			8:00			
KDYX	Honolulu, Hawaii	Miscellaneous (Honolulu time)...	11:00, 4:00	12:15, 6:30	12:15, 6:30	12:15, 6:30	12:15, 6:30	12:15, 6:30	12:15, 6:30
KDZE	Seattle, Wash.	Household talks		3:30, 7:15	3:30	3:30, 7:15	3:30	3:30, 7:15	3:30
KDZH	Fresno, Cal.	Miscellaneous	7:00, 8:00	8:15, 4, 7:00	8:15, 4, 7:00	8:15, 4, 7:00	8:15, 4, 7:00	8:15, 4, 7:00	8:15, 4, 7:00
KDZI	Wenatchee, Wash.	Concerts, church service.....	11:00, C. S.	4:30, 8:00	4:30	4:30, 8:00	4:30	4:30, 8:00	4:30
KDZM	Centralia, Wash.	Music		8:00	8:00	8:00	8:00	8:00	
KDZQ	Denver, Colo	Concerts (Mountain time).....		8:15		8:15			
KDZR	Bellingham, Wash.	Miscellaneous	7:00	7:00, 8:30	7:00, 8:30	7:00, 8:30	7:00, 8:30	7:00, 8:30	7:00, 8:30
KDZZ	Everett, Wash.	Miscellaneous		2:30, 8:00	2:30, 8:00	2:30, 8:00	2:30, 8:00	2:30, 8:00	2:30, 8:00
KFAC	Glendale, Cal.	Miscellaneous and 485 meters..	4:30	6:45	4:30	4:30	4:30	7:40	4:30
KFAE	Pullman, Wash.	Educational	No definite sched	ule					
KFAF	Denver, Colo.	Miscellaneous (Mountain time)..	Irregular	Irregular	Irregular	Irregular	Irregular	Irregular	Irregular
KFAS	Reno, Nevada	Music		8:00	8:00		8:00		
KFAT	Eugene, Ore.	Medical lectures, music	8:30 C. S.				7:00		7:00
KFAY	Medford, Ore.	Concerts		9:00		9:00		9:00	
KFAU	Boise, Idaho	Mis. and 485 meters (Mountain)	8:30	9:35, 8:15	9:35, 8:15	9:35, 8:15	9:35, 8:15	9:35, 8:15	9:35, 8:15
KFBJ	Boise, Ida.	Mis. (Mountain)		5:00, 7:45	5:00, 8:15	5:00, 7:45	5:00, 8:15	5:00, 7:45	5:00, 8:15
KFBK	Sacramento, Cal.	Miscellaneous	8:00, Church	3:00, 6:00	3:00, 6:00	3:00, 6:00	3:00, 6:00	3:00, 6:00	3:00, 6:00
KFCD	Salem, Ore.	Music		12:01, 8:00	12:01, 8:00	12:01, 8:00	12:01, 8:00	12:01, 8:00	12:01, 8:00
KFEC	Portland, Ore.	Music		4:00	4:00	4:00	4:00, 9:00	4:00	4:00
KFC	Seattle, Wash.	Miscellaneous		8 hours	8 hours	8 hours	8 hours	8 hours	8 hours
KFC 13	Phoenix, Ariz.	Miscellaneous (Mountain)		8:00	8:00	8:00		8:00	
KFI	Los Angeles, Cal.	Music, news	10:45, 4:00	1:45, 4:30	1:45, 4:30	1:45, 4:30	1:45, 4:30	1:45, 4:30	1:45, 4:30
KFU	Gridley, Cal.	Concert	3:00, 8:00	8:00			8:00		
KFV	Yakima, Wash.	Music		3:00, 8:00	3:00	3:00, 8:00	3:00	3:00, 8:00	3:00
KFZ	Spokane, Wash.	Concerts, lectures		7:30	7:30	7:30	7:30	7:30	7:30
KGB	Tacoma, Wash.	Miscellaneous	3:00	7:00	7:00	7:00	7:00	7:00	7:00
KGC	Hollywood, Cal.	Concert			7:30		7:30		7:30
KGF	Pomona. Cal.	Miscellaneous (Mountain time)..					7:30		
KGG	Portland, Ore.	Miscellaneous	9:00, Concert	5:00, 7:30	5:00, 7:30	5:00, 7:30	5:00, 7:30	5:00, 7:30	5:00, 7:30
KGN	Portland, Ore.	Miscellaneous		12:01, 2:30, 9	12:01, 2:30	12:01, 2:30, 9	12:01, 2:30	12:01, 2:30	12:01, 2:30
KGO	Altadena, Cal.	Miscellaneous	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00
KGW	Portland, Ore., Class B.	400 only, Concerts	3:30, 7:00	3:30, 8:00	3:30	3:30, 8:00	3:30	3:30, 8:00	3:30
KGY	Lacey, Wash.	Concert, news	8:30		8:30			8:30	
KHD	Colorado Springs, Colo..	Bulletins, 485 meters.....	8:15	8:15	8:15	8:15	8:15	8:15	8:15
KHJ	Los Angeles, Cal., Cls. B	400 only, Concerts		8:00	8:00	8:00	8:00	8:00	8:00
KJC	Los Angeles, Cal.....	Miscellaneous	1:00, 5:00	11:30, 10:00	11:30	11:30, 9:00	11:30	11:30	11:30
KJJ	Sunnyvale, Cal.	Concert			8:15			7:30	
KJR	Seattle, Wash.	Miscellaneous		8:00	8:00	8:00	8:00	8:00	8:00
KJS	Los Angeles, Cal.....	Sacred music, sermons.....	11:30			12:00			
KLB	Pasadena, Cal.	Concerts	3:00, 8:00	7:30				7:30	
KLN	Monterey, Cal.	Miscellaneous	12:00, 7:00	12:00, 7:00	12:00, 7:00	12:00, 7:00	12:00, 7:00	12:00, 7:00	12:00, 7:00
KLP	Los Altos, Cal.	Concerts, news	4:00	7:30				8:30	
KLS	Oakland, Cal.	Concert	12:00	12:00	12:00	12:00	12:00	12:00	12:00, 7:30
KLX	Oakland, Cal.	Miscellaneous	3:00	7:15	7:15, 7:30	7:15	7:15	7:15, 8:15	7:15
KLZ	Denver, Colo.	Mis., 485 meters (Mountain time)	8:00	7:30	7:30	7:30	7:30	7:30	7:30

KMJ	Fresno, Cal.	News and concert			7:00, 8:00			7:00, 8:00	
KMO	Tacoma, Wash.	Miscellaneous	11, 6:00, 9:15	11, 6:00, 9:15	11, 6:00, 9:15	11, 6:00, 9:15	11:00, 6, 9:15	11, 6:00, 9:15	11:00, 6, 9:15
KNJ	Roswell, N. M.....	Miscellaneous (Mountain time)..	7:00	7:00	7:00	7:00	7:00	7:00	7:00
KNN	Los Angeles, Cal.	Miscellaneous			10:00		10:00	10:00	
KNT	Aberdeen, Wash.	Concert, news	5:00, 7:30	5:00, 7:30	5:00, 7:30	5:00, 7:30	5:30, 7:30	5:00, 7:30	5:00, 7:30
KOB	State College, N. M....	Miscellaneous and 485 (Mt.)....		7:30		7:30		7:30	
KOG	Los Angeles, Cal.	Concert, news	12:15, 5:00	12:15, 5:00	12:15, 5, 8:15	12:15, 5, 8:15	12:15, 5:00	12:15, 5, 8:15	12:15, 5:00
KON	Los Angeles, Cal.	Concert, news	10, 4:00, 8:15	4:00, 8:15	4:00, 8:15	4:00, 8:15	4:00, 8:15	4:00, 8:15	4:00, 8:15
KPO	San Francisco, Cal.....	Miscellaneous and 300-600	11:00, Church	11:00, 3:30	11:00, 3:30, 8	11, 3:30, 7:30	11:00, 3:30, 8	11:00, 3:30	11:00, 3:30, 8
KQP	Hood River, Ore.....	Concert, news	9:00	7:00	7:00, 8:30	7:00	7:00	7:00, 8:30	7:00
KQW	San Jose, Cal.....	Concert	1:00	1:00	1:00	1:00, 8:15	1:00	1:00	1:00
KQY	Portland, Ore.	Concert		1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00
KRE	Berkeley, Cal.	Concert	5:30	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00	1:00, 6:00
KTW	Seattle, Wash.	Church service	11:00, 7:30						
KUO	San Francisco, Cal.....	News	5:00	3:00, 5:30	3:00, 5:30	3:00, 5:30	3:00, 5:30	3:00, 5:30	3:00, 5:30
KUY	El Monte, Cal.	Concert, lecture		4:00, 8:00	4:00	4:00	4:00, 8:00	4:00	4:00
KVQ	Sacramento, Cal.	Miscellaneous	5:00	5:30	5:30	5:30, 8:00	5:30	5:30	5:30, 8:00
KWG	Stockton, Cal.	Concert, news	2:00	4:00	4:00, 8:00	4:00	4:00	4:00, 8:00	4:00
KWH	Los Angeles, Cal.	Miscellaneous	2:00	12:30, 5:30	12:30, 5:30	12:30, 5:30	12:30, 5:30	12:30, 5:30	12:30, 5:30
KYG	Portland, Ore.	Music	2:00	11:00, 2:00	2:00, 9:00	2:00	11:00, 2:00	8:00	2:00, 9:00
KYJ	Los Angeles, Cal.	Miscellaneous		4:00, 8:00	4:00	4:00	4:00, 8:00	4:00	4:00, 8:00
KYW	Chicago, Ill., Class B..	4:00 and 485, misc., Central....	3:30, Church	9:35, 1:20, 8	9:35, 1:20, 8:00	9:35, 1:20, 8:00	9:35, 1:20, 8:00	9:35, 1:20, 8:00	9:35, 1:20, 8:00
KZC	Seattle, Wash.	Market advice		6:45	6:45	6:45	6:45	6:45	6:45
KZM	Oakland, Cal.	Concert, news		7:15	7:15	7:15	7:15	7:15, 8:15	7:15
KZN	Salt Lake City, Utah..	Mis. and 485 meters (Mountain)		3:00, 8:00	3:00, 8:00	3:00, 8:00	3:00, 8:00	3:00, 8:00	3:00, 8:00
KZV	Wenatchee, Wash.	Agricultural news, concert.....	9:00	9:00	9:00	9:00	9:00	9:00	9:00
KZY	Oakland, Cal.	Concert, news	11:00, 3:00	3:30, 6:45	3:30, 6:45	3:30, 6:45, 7:30	3:30, 6:45	3:30, 6:45	3:30, 6:45, 8:15

Commencing Time Only is given. Light Face Figures denote A. M. Time; Dark Face Figures denote P. M. Time.

EASTERN STATIONS HEARD ON COAST

KSD	St. Louis, Mo.	Mis., 400 and 485 meters (Cen.)	8:15	4:00, 8:00	4:00, 8:00	4:00, 8:00	4:00, 8:00	4:00, 8:00	4:00, 8:00
WBAP	Fort Worth, Texas.....	Mis. and 485 meters (Central).	11:00, 3:30, 6:45	5:15, 6:30, 9:30	5:15, 6:30, 9:30	5:15, 6:30, 9:30	5:15, 6:30, 9:30	5:15, 6:30, 9:30	5:15, 6:30, 9:30
WHB	Kansas City, Mo.....	Mis. and 485 meters (Central).	8:00 to 10:00		8:00 to 10:00		8:00 to 10:00		
WSB	Atlanta, Ga.	Mis. and 485 meters (Central).	11:00, 5:00	4:00, 7:00, 10:45	4:00, 7:00, 10:45	4:00, 7:00, 10:45	4:00, 7:00, 10:45	4:00, 7:00, 10:45	4:00, 7:00, 10:45
WLAG	Minneapolis, Minn.	Miscellaneous, Central	4:30, Church	3:30, 6:00	3:30	3:30, 6:00	3:30, 6:00, 8:00	3:30, 6:00, 8:00	330, 6:00, 8:00

INDEX TO SCHEDULE

KNT Aberdeen, Wash.—Grays Harbor Radio Co.
KGP Altadena, Cal.—Altadena Radio Laboratory.
WSB Atlanta, Ga.—Atlanta Journal.
KDZR Bellingham, Wn.—Bellingham Publishing Co.
KRE Berkeley, Cal.—Maxwell Electric Co.
KFAU Boise, Ida—Boise High School.
KFBJ Boise, Ida.—Boise Radio Supply Co.
KFAP Butte, Mont.—Standard Publishing Co.
KFBF Butte Mont.—F. H. Smith.
CFAC Calgary, Can.—Western Radio Co., Ltd.
CHBC Calgary, Canada.—W. W. Grant Radio, Ltd. (Albertan).
CFCN Calgary, Can.—W. W. Grant Radio, Ltd.
CHCQ Calgary, Canada—Western Radio Co. (Calgary Herald).
KDZM Centralia, Wash.—Hollingsworth Hdwe. & Radio Sup. Co.
KYW Chicago, Ill.—Westinghouse Electric & Mfg. Co.
KHD Colorado Springs, Colo.—Aldrich Marble & Granite Co.
DN4 Denver, Colo.—Colorado National Guard.
DD5 Denver, Colo.—Fitzsimmons General Hospital.
KDZQ Denver, Colo.—Wm. D. Pyle.
KFAF Denver, Colo.—Western Radio Corporation.
KLZ Denver, Colo.—Reynolds Radio Co.
KUY El Monte, Cal.—Coast Radio Co.
KDZJ Eugene, Ore.—Excelsior Radio Co.
KFAT Eugene, Ore.—S. T. Donohue (Pacific Radio Co.)
KNI Eureka, Cal.—T. W. Smith.
KDZZ Everett, Wash.—Kinney Bros. & Siprell.
KFBL Everett, Wash.—Lees Bros.
WBAP Fort Worth, Texas—Star Telegram.
KFAC Glendale, Cal.—Daily News.
KDYS Great Falls, Mont.—Tribune.
KFU Gridley, Cal.—Precision Shop.
KGC Hollywood, Cal.—Electric Lighting Supply Co.
KDYX Honolulu, Hawaii.—Star-Bulletin.
KQP Hood River, Ore.—The Hood River News.
WHB Kansas City Mo.—Sweeney Auto & Tractor School.
KGY Lacey, Wash.—St. Martin's College.
KFI Los Angeles, Cal.—Earle C. Anthony, Inc.
KHJ Los Angeles, Cal.—Los Angeles Times.
KJC Los Angeles, Cal.—Standard Radio Co.
KJS Los Angeles, Cal.—Bible Institute of Los Angeles.
KLP Los Altos, Cal.—Collin B. Kennedy Co.
KNN Los Angeles, Cal.—Bullock's Standard Radio Co.
KOG Los Angeles, Cal.—Western Radio Electric Co. (Herald).
KON Los Angeles, Cal.—Holzwasser, Inc.
KYJ Los Angeles, Cal.—Leo J. Meyberg Co.
KWH Los Angeles, Cal.—Los Angeles Examiner.
KFAY Medford, Ore.—Virgin Radio Service.
WLAG Minneapolis, Minn.—Cutting & Wash. Radio Corp.
KLN Monterey, Cal.—Noggle Electric Works.
CJCB Nelson, B. C.—James Gordon Bennett.
KZY Oakland, Cal.—Atlantic-Pacific Radio Supplies Co.
KLS Oakland, Cal.—Warner Brothers.
KLX Oakland, Cal.—Oakland Tribune.
KZM Oakland, Cal.—Preston D. Allen.
KLB Pasadena, Cal.—J. J. Dunn Co.
KFCB Phoenix, Ariz.—Nielson Radio Supply Co.
KGF Pomona, Cal.—Pomona Fixture & Wiring Co.
KFEC Portland, Ore.—Meier & Frank Dept. Store.
KGG Portland, Ore.—Hallock & Watson Radio Service.
KGN Portland, Ore.—Northwestern Radio Manufacturing Co.
KGW Portland, Ore.—Morning Oregonian.
KQY Portland, Ore.—Stubbs Electric Co.
KYG Portland, Ore.—Radio Service Bureau.
KFAE Pullman, Wash.—Washington State College.
KMC Reedley, Cal.—Lindsay, Weatherill & Co.
CKCK Regina, Sask., Can.—Leader Publishing Co.
KFAS Reno, Nev.—Motor Supply Co.
KNJ Roswell, N. M.—Roswell Public Service Co.
KVQ Sacramento, Cal.—J. C. Holbrecht (Sacramento Bee).
KFBK Sacramento, Cal.—Kimball-Upson Co.
KFCD Salem, Ore.—Salem Electric Co.
KDYL Salt Lake City, Utah—Salt Lake Telegram.
KZN Salt Lake City, Utah—Deseret News.
KDPT San Diego, Cal.—Southern Electric Co.
AGI San Francisco, Cal.—Signal Corps, U. S. A. (Presidio).
KDN San Francisco, Cal.—Leo J. Meyberg Co.
KPO San Francisco, Calif.—Hale Brothers, Inc.
KUO San Francisco, Cal.—San Francisco Examiner.
KQW San Jose, Cal.—Chas. D. Herrold.
KDZE Seattle, Wash.—The Rhodes Co.
KFC Seattle, Wash.—Northern Radio & Electric Co. (P.-I.).
KJR Seattle, Wash.—Northwest Radio Service Co.
KTW Seattle, Wash.—First Presbyterian Church.
KZC Seattle, Wash.—Public Market & Department Store Co.
KFZ Spokane, Wash.—Doerr-Mitchell Electric Co.
KOB State College, N. M.—College of Agl. & Mech. Arts.
KSD St. Louis, Mo.—Post Dispatch.
KWG Stockton, Cal.—Portable Wireless Telephone Co.
KJJ Sunnyvale, Cal.—The Radio Shop.
KGB Tacoma, Wash.—Wm. A. Mullins Electric Co. (Ledger).
KMO Tacoma, Wash.—Love Electric Co. (Tacoma Times).
CFCB Vancouver. B. C.—Daily Province.
CJCE Vancouver, B. C.—Vancouver Sun.
CKCD Vancouver, B. C.—Vancouver Daily Province.
KZV Wenatchee, Wash.—Wenatchee Battery Co.
KDZI Wenatchee, Wash.—Electric Supply Co.
KFV Yakima, Wash.—Foster-Bradbury Radio Store.

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"FADING"

By W. A. LEIDIGH, JR.

It is perhaps best to first define fading. This can best be done by citing an example. Supposing that we are listening to a long-distance broadcasting station and at this instant we have him tuned in so that his music is at normal intensity. Now as we listen, the music gradually becomes louder and louder. About this time the new operator will begin praising his set, or his ability to tune a station in. But in the next few moments we experience a new sensation. The music has gradually faded out until it is hardly audible; however, in the course of a few minutes it comes back to normality, only to begin the procedure anew.

This undesirable instability of signal strength may continue during an entire concert, the rapidity of the swinging in and out depending upon the location of the receiving station doing the broadcasting. This phenomena has no scientific name, and is just called "fading," or "radio fading," and in the abbreviated language of the wireless amateur is desgnated by the three letters "QSS." Neither has it a known cause, though many theories have been suggested, some of which have partial proofs based on experience, and on tests conducted in various parts of the country where its effects are most pronounced. As far as can be proven, the fault lies neither in the transmitter nor in the receiver, but somewhere in the space between the two.

In short wave work, that is, on waves under 500 meters, fading seems most prevalent. It is probably not noticed on the longer waves as much, since the respective stations are generally well within the working range of each other. Due to this fact, not much thought was given to the subject until the amateur began working over long distances in about 1914.

In November, 1920, the Bureau of Standards at Washington, D. C., working in conjunction with some 4,000 amateurs in all parts of the United States, and with the assistance of the American Radio Relay League, conducted a series of very interesting tests. Many "fading curves" were plotted at various distances, and in all directions from certain transmitting stations, by recording the comparative strength of successive letters of the alphabet sent in rotation by the transmitting operators. Thousands of these charts were collected, classified and studied, with very puzzling results. In some cases charts recorded at receiving stations less than seven miles apart, both listening to the same broadcasting station, showed almost opposite maximum and minimum strength peaks.

The most striking feature of the test was the fact that no cases of fading revolving around the transmitting station were to be found, though inverse curves were noted on opposite sides of many transmitters, and also in two or more directions on the same side of a transmitter. This last feature, called *progressive fading*, was an occurrence of certain phenomena moving successively along a certain general line from the transmitter. All of this data proved interesting, and was enlightening on the way in which fading took place, still it did not aid in arriving at a conclusion of the cause.

Fading does not take place between all parts of the country alike, nor is it so prevalent in some parts as in others. Nor does it prevail the year around to the same extent in any locality, or even from night to night. For example, we might mention a few general conditions that exist between various sections on the Pacific Coast, on which data has been obtained from the experience of the writer. During times when there is no local interference Portlanders may enjoy an entire concert broadcasted from a station in San Francisco, or that district, with little or no difficulty, while in Los Angeles the reception of the same concert will be very poor, with slightly more than half the distance for the music to go. On the other hand, it is only at certain times of the year that concerts from Seattle are received with satisfaction at Portland, still stations in and around San Francisco have no difficulty in listeing to these same concerts. Still more freak conditions exist even nearer home, at distances of a hundred or so miles from Portland.

As a summary, it can only be said that signals *do* fade, though no one really knows why.

Elementary Principles of Radio Telegraphy and Telephony

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but this would not be distinctive enough to be recognized. Therefore, some other method must be employed.

A common method where only a crystal detector is used to receive undamped waves is by making use of an interrupter in the receiving circuit. This is ordinarily a buzzer arranged to vibrate at a suitable frequency. The vibrations of the buzzer interrupt the circuit and thus breaks up into pulses the current flowing through the telephone. Each pulse produces a vibration of the diaphragm and the successive pulses produce the note heard.

Another method is by use of the tikker. The circuit is shown in Figure 28. The condenser *C'*, shunting the telephone receiver, has a very large capacity compared to the variable condenser at *C*. The tikker is a specially designed interrupter. No detector is needed. The action of the tikker circuit is as follows: When the tikker "makes the circuit, only a very small part of the current passes through the telephone. Most of the current passes into the condenser *C'*, thus charging it. When the tikker opens the circuit, the charged condenser discharges through the telephone. As the condenser has a large capacity, the discharge gives a current large enough to actuate the telephone diaphragm. A discharge occurs each time the tikker interrupts the circuit. This is at audio-frequency, so that a note is heard in the receiver.

Some Notes on Radio-Frequency Amplification

Continued from Page 249

former; added means of tuning necessitates additional controls and complications of tuning. So we must seek a means of broadening the frequency range of this coupling.

Introducing iron into the magnetic field of the coils will tend to broaden the frequency range, but also reduces energy transfer, due to eddy currents, etc. This undesirable feature is more than made up for, though, because the iron will confine the field to certain limits and by proper core design and the use of special high-frequency iron, very little loss occurs.

We now come to another defect which has caused considerable agitation among users of multi-stage amplifiers —inter-tube oscillation. It is a well-known fact that when the grid and plate circuits of a tube are tuned to the same frequency, the tube will oscillate. To overcome this tendency where more than one stage is used, we use transformers of a slightly different frequency, but of ranges broad enough to overlap and permit energy transfer from tube to tube.

Concluding, we might state that while no method is perfect, for best results the iron-core transformer of proper design is to be recommended.

If the trade is wise, it will triple its efforts to provide novelty and "class" in the broadcast music.

Inventive genius, too, must be intensified on improving radio apparatus, especially for eliminating static.

J. B. Weed Buys Sorsinc Store

Three years ago the Ship Owner's Radio Service transferred Mr. J. B. Weed from New York to Portland to assume the duties of manager of their ship service station, located here at that time. Shortly after this the "Sorsinc" ventured into the retail business, catering to the amateur, and later to the radio-broadcast fan. Two years ago last October the necessity of a more convenient store became apparent, resulting in the removal of the company's office and store from the Worcester building to 310 Oak Street, where they have done business since. In December, 1921, the service station for Shipping Board ships was discontinued, and all attention turned to the radio trade, both wholesale and retail.

With the beginning of the year, the Sorsinc has abandoned the retail business throughout the United States, and will confine its selling activities to wholesale trade. With this change in policy has come the closing of the Portland store. However, Mr. Weed, well known in radio circles in Portland, has decided that the store shall not be closed, and to demonstrate the fact has bought out the remaining stock of the Ship Owners' Radio Service.

Mr. Weed will confine his dealings to the retail trade only, and will maintain his store in the same location, and under the name of "Weed's Radio Shop." The new concern is in no way affiliated with the Ship Owners' Radio Service, which will continue to maintain its wholesale stores in Seattle and San Francisco. Ship service stations are also maintained at these two ports.

The August issue of RADIO WAVES contained a sketch of Mr. Weed's radio career, from which we learn that he first became acquainted with the radio art in the latter part of 1904, and since that time has been in the "game," first in the Navy, then with the United Wireless Company, later with the United States Revenue Cutter Service, which later became the Coast Guard Service, and finally with the Ship Owners' Radio Service. He also installed the first *Oregonian* broadcasting station, and served for some time as operator of that station.

In 1914 every true amateur could name all of the manufacturers of radio apparatus, could recognize the make of any standard piece of apparatus, and read most every publication on radio.

But that was in 1914.

January 26 Meeting of the N. R. A.

Time and time again some long-time resident of Portland has expressed surprise on learning that there has been a radio association existing in Portland for the past ten years. A brief summary of the Northwestern Radio Association is given elsewhere in this issue of RADIO WAVES, together with notes on the association's last banquet. The following is a review of events taking place at the last meeting, held in the regular meeting hall on the mezzanine floor of the Journal building:

President Walt Russ called the meeting to order at 8:45 P. M., and proceeded with the regular order of business. Communications to and from the radio inspector at Seattle relating to violations of the quiet hour on the part of broadcasting stations as well as amateurs were read, and action deferred until later during the meeting. Along this same subject came the report of the Interference Committee, the members of which had been instructed to obtain data on what amateur and broadcasting stations transmitted during the listening periods, or quiet hours and half hours. The names of those amateurs so "logged" were read, and those present asked to give account for themselves, it being announced that their names were being sent to the United States radio inspector at Seattle for his consideration and action. Two local broadcasting stations were also reported, one of which has arranged a regular program during the Friday night—7 to 7:30 P. M.—quiet period. A member of the committee stated that the announcer at that station had declared that they did not recognize the schedule or *any* division of time, for that matter.

Mr. C. L. Austin, president of the Northwestern Radio Manufacturing Company, requested of the club that the half-hour of his broadcast time allotment, from 7 to 7:30 P. M., which he had previously turned over to the association for quiet or listening purposes, be returned to him, since it was not being used as such. Action was taken and the request granted, together with a vote of thanks. Mr. Austin then announced that he would use this time to broadcast a series of talks, lecture and reports, together with music and other entertainment, possibly starting the following Monday.

A discussion followed on the rights of broadcasting stations, or any other class of stations, to lay claim to any definite period of time. It was plainly brought forth that no station had any legal claim, and that practically every broadcasting station was licensed to transmit any time in the 24 hours that it saw fit; however, it was also stated that the Department of Commerce, through the office of the radio inspector, was very much in favor of a definite schedule of broadcasting, and co-operation between the broadcaster and amateur. A strong point was also made of the fact that the amateur was not confined to certain hours any more than the broadcasting station, and could operte 24 hours a day if he saw fit. This discussion ended by the passing of a resolution enjoining all members of the association from violating the previously existing schedule until such action could be taken that would eliminate violation on the part of broadcasting stations.

On action of the association, the secretay was ordered to write a letter to the Stubbs Electric Company, informing them that they were making a practice of running their programs beyond scheduled time, and inviting their investigation into the matter.

The accuracy of the time signals as sent from the Hallock and Watson station, KGG, were discussed. Mr. Watson told why the Journal chimes sometimes proved inaccurate, and stated that efforts were being made to correct this fault. The cost of Western Union time signals was discussed, together with the question of who would foot the bill for such service.

The Monday night meetings of the Oregon City Radio

Club were reported on by Mr. John Julian, who expressed the desire of that organization ot co-operate in every way with the N. R. A.

The topic of long calls came up, and both the C-W and spark sides of the argument were aired. Final decision seemed to be that the spark station has just as much legal right to make a long call as has a C-W station, or, rather, that neither have a legal right to call or sign more than three times, insofar as the present radio law is concerned. The point was also brought up that one class of station continually violating the law was no excuse for violations on the part of others.

Discussion of the Oregonian's proposed "Hoot Owl" schedule from 11 to 12 P. M. on Monday and Friday nights brought to light the fact that many amateurs were incensed to the point of abandoning the present existing "gentlemen's" agreement between amateurs and broadcasters, by which the amateurs stand by from 7 until 10 P. M. in return for freedom from concerts after that time. Action was taken empowering the president to appoint an unbiased committee to confer with officials of the Oregonian on this subject. In connection with this there came the question of the amateur's right to violate the listening period should the broadcaster do so. This was answered by the statement that since the amateur had made an agreement, he must maintain it unless broken by formal action on the part of the association.

At this point the business meeting was closed, and a general open-house discussion followed.

Mr. Austin, on request that he tell something about the latest product of his company, the radio-frequency amplifier, stated that three years ago he had made a resolution that as long as he was a member of the association he would never discuss before its meetings any of his products. However, on further persuasion he told the fellows some of the difficulties encountered in building a radio-frequency amplifier, and how such things might best be overcome. This dealt considerably with the location of wires, the selection of amplifying transformrs, and the inductive relations of the various pieces of apparatus in this class of receiving apparatus.

Crystals? Yes, galena is generally considered the most sensitive, yet the most delicate to keep from burning out. Silicon is also sensitive and more stable. Iron pyrites is not quite as sensitive, but stable, and carborundum is the stablest single crystal, though is not as sensitive.

"I Tappa Kee" Radio Fraternity

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commercial radio station. The three subordinate grades are "Brass-pounder," "Ham" and "Student," and are also based on code speed and experience.

Further information concerning the organization may be obtained from either the president, Mr. Don Smith, or the secretary-treasurer, P. W. Jones, either of which may be communicated with through the O. I. T. Radio School, fourth floor, Y. M. C. A. Building, Sixth and Taylor streets, Portland, Ore. The "Conductor of the Wave-train," Mr. P. R. B. Walls of the Lighthouse Service, Radio Division, also stands ready to answer all questions regarding membership and eligibility of applicants.

Considerable interest is now being manifested in wireless telephony. The first wireless telephone to be established will communicate between Fukuoka in Kyushu and Fusan, Morea. It is planned to connect this line with land lines. Considerable delay has been experienced in its installation, but the station, from latest reports, should be in operation at this writing. The next installation planned by the Department of Communications of Japan are from Kyushu to Fromosa and from Kyushu to Tsushima in the south and from Hokkaide to Saghalien in the north. A company is now being formed to establish a wireless telephone system between Kagayo and Osaka, a distance of about 120 miles.

We Are Read in Germany

This letter tells its own story. It is interesting to note that the envelope in which the letter arrived carried postage stamps totaling 80 marks, or what amounted to nearly $20 before the war.

January 9, 1922.

RADIO WAVES PUB. CO.,
306 Davis Street,
Portland, Oregon.

Gentlemen: I am on a visit in Germany and would not like to miss RADIO WAVES, so please forward said magazine to my address here.

Thanking you in advance, I am,

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