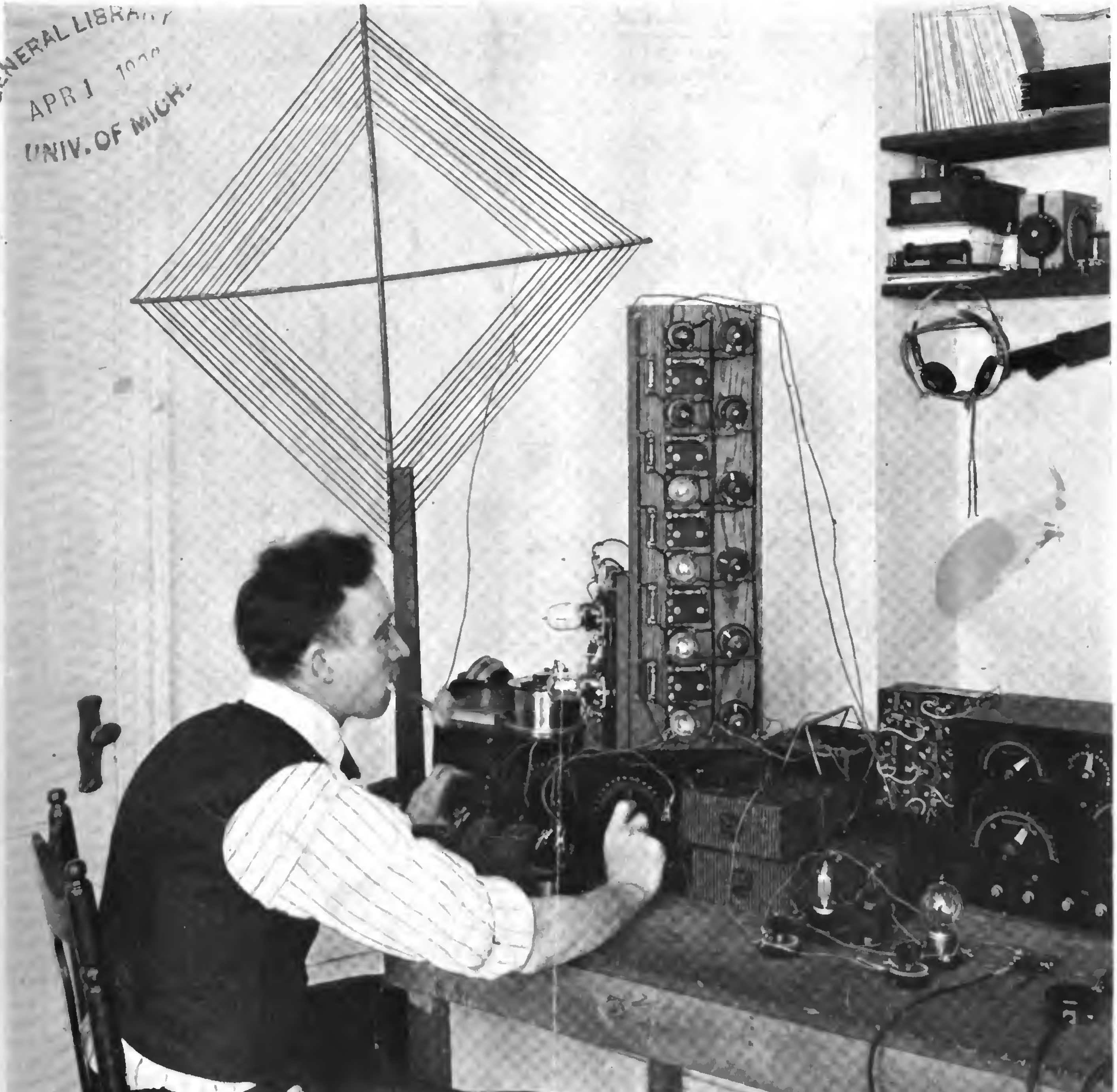
February, 1920

20 Cents

The WIRELESS AGE

Volume 7

Number 5



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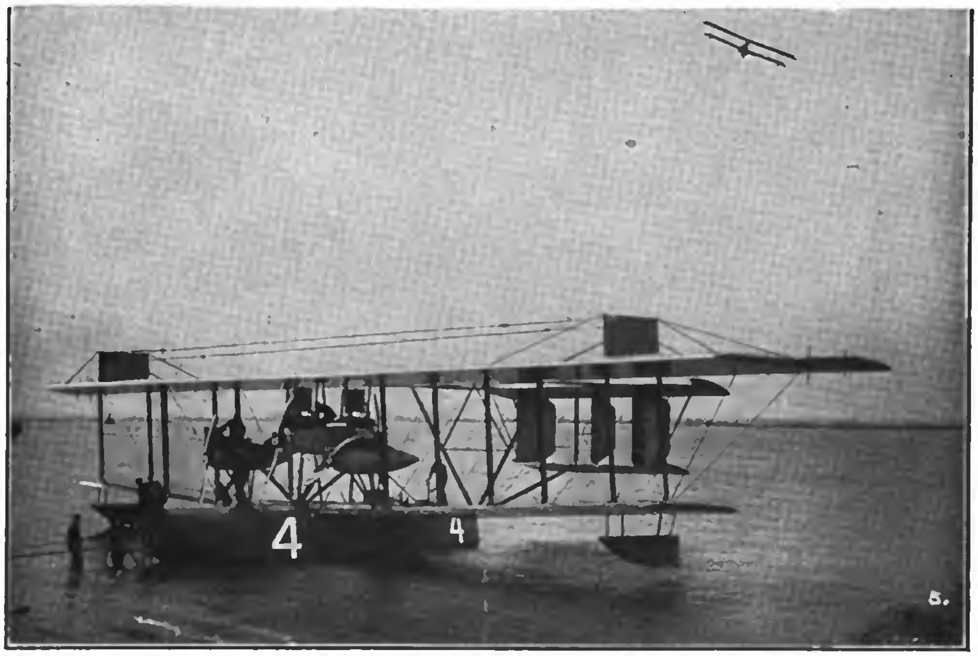

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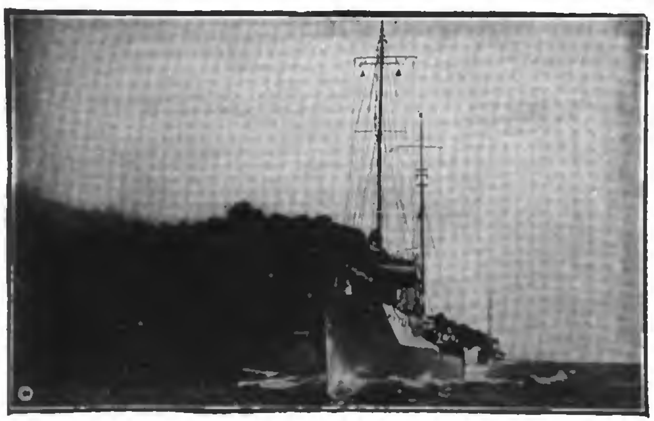

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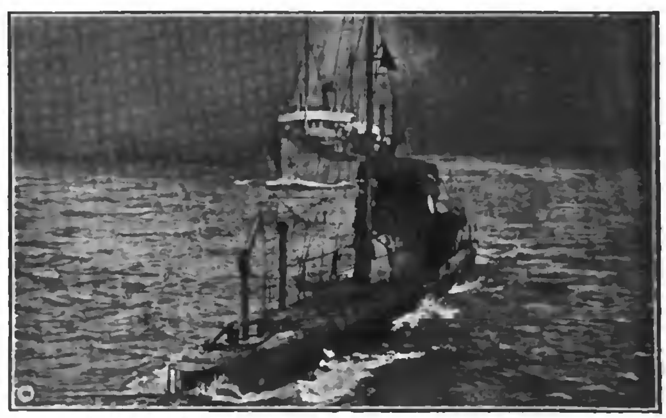

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The Wireless Age

Edited by J. ANDREW WHITE

Vol. 7 — Contents for February, 1920 — No. 5

Contents for February, 1920

Index of Equipment

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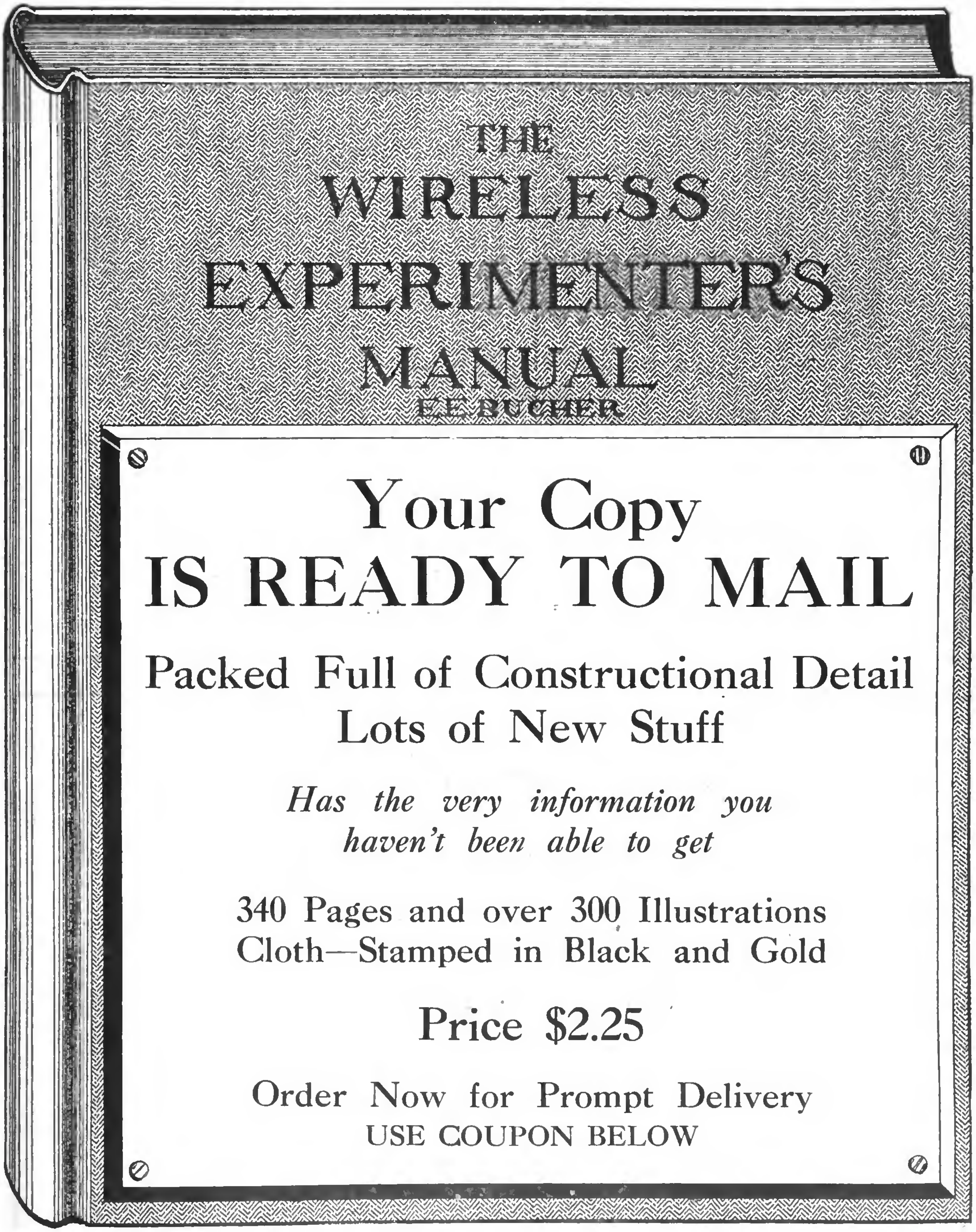
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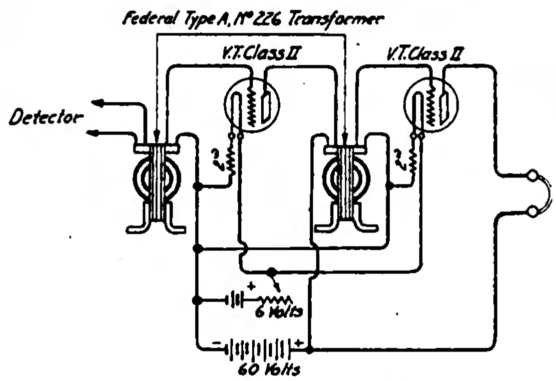

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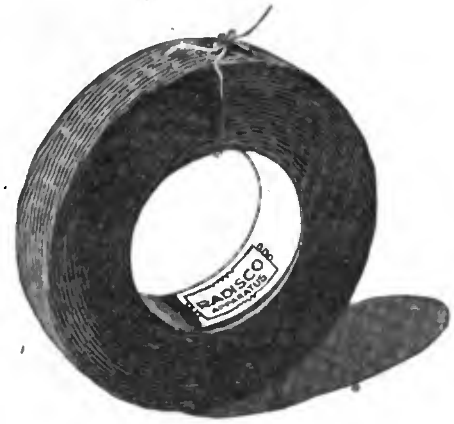

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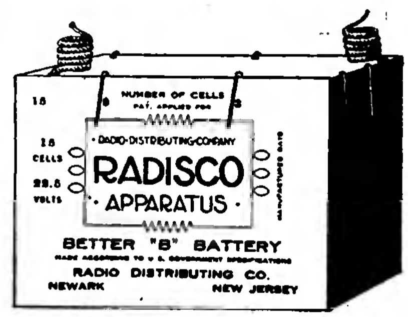

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If this page is cut out and appended to the same page cut from the editions to follow, a complete file of very interesting information will soon be available. (No. 2)

Vol. 7. No. 5. FEBRUARY, 1920

THE WIRELESS AGE

WORLD WIDE WIRELESS

Navy Ordered to Release Radio Stations. Seized in War

NAVAL operation or control of all private radio stations, assumed during the war emergency, will be relinquished at midnight February 29, under an executive order made public by Secretary Daniels.

All stations taken over by the Government at the outbreak of the war are to be returned to their owners and all new stations built during the war by private concerns and which could not be operated because of the wartime restrictions, can be operated after February 29.

Under the order wireless communication reverts to pre-war conditions, and is subject to regulations of the act approved August 13, 1912.

Nine high-powered stations controlled by the Radio Corporation of America were taken over at the outbreak of the war. They are at Marion and Chatham, Mass.; New Brunswick, Belmar and Tuckerton, N. J.; Bolinas and Marshall, Cal., and Kahuku and Koko Head, Hawaiian Islands.

Transoceanic Radiophone in the Near Future

MARCONI prophesies that in the immediate future conversations between Great Britain and the United States will be carried on by wireless telephones and that the cost will be not more than 24 cents for one minute.

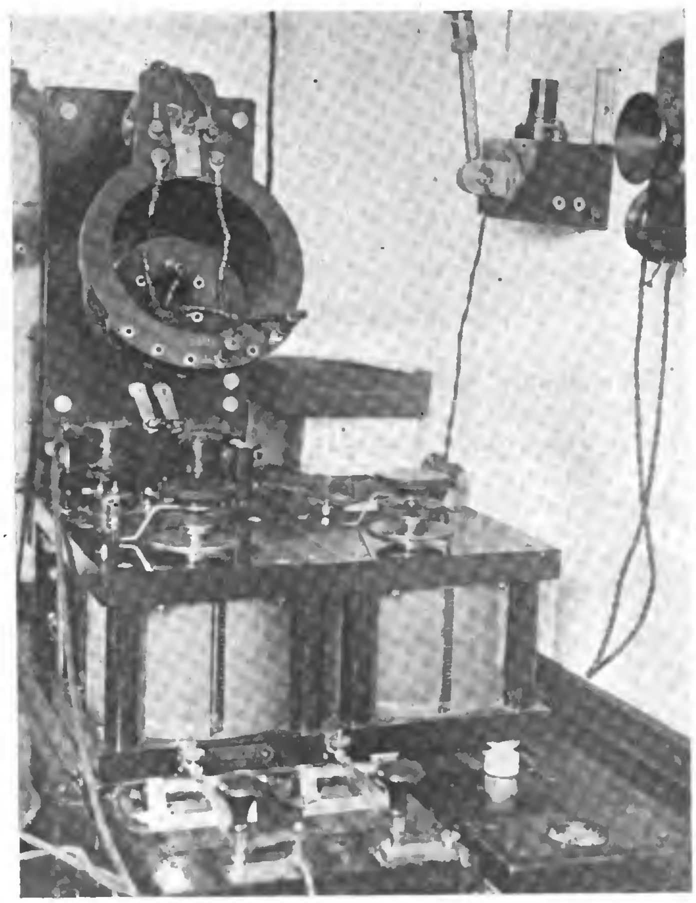
The inventor states that he has spoken directly to Canada from London, and adds: "It is only a matter of time when we shall be able to speak to New York from London. Already we have carried out many successful experiments between London and the Continent and we hope that we shall be able soon to announce the installation of a worldwide wireless telephone system in all countries interested. Our plans are developing rapidly."

Transoceanic conversations will be carried on through an ordinary telephone, the sending exchange being connected with the wireless station; at the receiving end the same method will be followed. Marconi already has applied for permission to erect a station in Norway to demonstrate his ability to talk across large expanses of water.

The cabled interview with Signor Marconi in London, in which the inventor of wireless was reported as saying that wireless telephone communication with New York would be shortly established, was shown to officers of the Radio Corporation of America.

"Every station in the country is under government operation," said David Sarnoff, commercial manager. "Until the stations are returned to us there can be no commercial arrangements made. I think the rate will be much higher than 24 cents a minute, as it will require a tremendous amount of power to send the voice across the Atlantic."

He said that the experiments referred to by Mr. Marconi were being made between the British and Canadian stations, which were no longer under government operation. Extensive plans have been made for some time for the establishment of transatlantic wireless telephone communication to be inaugurated as soon as possible after the great transatlantic wireless stations are returned to the private companies. These plans include radio exchanges which will transfer the voice from the ordinary land line telephone to the wireless telephone automatically. Under this arrangement it will be possible for a subscriber in New York to converse with a subscriber in London while using the ordinary telephone in the home or office.



The wireless set of the S. S. Alban, which accomplished unusual results in long distance receiving recently

Marconi's statement has provoked considerable discussion in London. A prominent official of the Central Telegraph Office pointed out that the Central Telegraph Office was handling on an average 12,000 messages more daily than in 1919. "All I can say beyond that," he added, "is that we have not yet ordered a hearse for the funeral."

The managing director of a cable company, mentioning that statements similar to Marconi's cropped up from time to time, said, "all we can do is to wait and see."

British Wireless Device Has Varied Uses

A REMARKABLE series of wireless experiments, just completed at Chelmsford, England, is the basis of an assertion that by a new wireless device big guns or hidden stores of explosives can be fired or exploded at long distance.

The original purpose of the Chelmsford test was to demonstrate a new device for giving aid to ships in distress at sea. The apparatus in its simpler form is intended to ring bells on board every ship within the wireless radius of the vessel sending out the distress call. It is with the extension of this idea, however, that an official of Marconi's Wireless Telegraph Company declared that such an apparatus in Paris could cause an explosion in Berlin. Also, it was asserted that an apparatus in an airplane could hover over an approaching enemy until his troops were over a previously hidden store of explosives and then destroy them.

It was stated that the instrument was used in experimental ways during the latter part of the war when fog guns some fifteen miles from shore were fired in the Channel by wireless rather than by a party of men despatched to the scene.

However, the principal use to which the device will be put is in merchant shipping, and the experiments at Chelmsford centered about such application.

Cable Delays to Be Relieved by Wireless Service on Pacific Coast

IMPORTERS and exporters in San Francisco are complaining that delay in transmission of their cables is costing a tremendous financial loss.

It is contended that cables to Honolulu are delayed from four to six days; to the Orient sixteen to eighteen days, and twelve to sixteen days to Australia. Some of the foreign traders here overlook the fact that radio service is now available to the Orient.

Importing and exporting firms have been advised to use radio instead of cable wherever possible. Arthur A. Isbell, division superintendent of the Radio Corporation of America, calls attention to the fact that the Japanese government station is open only ten hours a day for commercial business and that causes much of the congestion from that end.

Using radio instead of the cable would expedite messages; besides, radio is less costly.

Spanish Steamer Guided to Port by Wireless

GUIDED only by positions furnished from wireless stations ashore, the Spanish Royal Mail liner Leon XIII. arrived in New York, the first of a fleet of twenty-six vessels held up by a storm to get through quarantine.

When off the danger zone in the vicinity of Cape Hatteras the storm obscured the sun so that Capt. Francesco Murot, commander of the vessel, was unable to get his location. Grouping blindly along the treacherous coast the vessel was in constant danger of piling up on the rocks until the captain took advantage of the facilities for getting his position from the shore wireless stations.

Communication once established, the officers had no further difficulty in determining the whereabouts of the steamer.

Wireless Phone Talks Held Between Spain and England

SUCCESSFUL wireless telephonic tests have been made between the station at Arancuz, near Madrid, and Chelmsford, England, a distance of 700 miles. Conversations were carried on without difficulty.

New Orleans to Get Three Compass Stations

THREE compass stations are being built at the mouth of the Mississippi River. These will direct ships through raging hurricanes and fogs to New Orleans, the second port of America.

The installation of this apparatus will add millions of dollars to the shipping facilities of this port. It will revolutionize the handling of ships. Above all, the lives of men, who go down to the sea in ships, will be safeguarded more thoroughly than ever before.

Wireless Brings Aid to U. S. Navy Tug

A THRILLING tale of a battle with mountainous seas and 70-mile-an-hour gales, in which the Mexpet Company's giant oil tanker, George E. Paddleford, Capt. G. Duncan, turned to and went to the assistance of the disabled United States navy tug Undaunted, which was floundering around 20 miles east of Cape Hatteras, was learned on the arrival of the tanker at Providence.

Darkness added to the dangers in the attempt to rescue the helpless tug, which had lost its propeller. Twice, a steel hawser was gotten aboard the tug by means of floating a smaller line with the aid of a barrel.

Each time the heavy hawser was snapped by the plunging of the buffeted vessels. Only after a wireless message was received that the United States revenue cutter Yamacraw was coming to assist the disabled craft, did the tanker turn and proceed on her voyage to Providence.

Capt. Duncan received a radiogram from Capt. Tarbell of the Undaunted, expressing warm appreciation for his assistance about an hour after the attempt to rescue had been made and the tanker had proceeded on her way.

Navy Adopts Inter-Allied Wireless Procedure

A BULLETIN from the office of the Director of U. S. Naval Communications, Washington, D. C., announces that there will soon be placed into effect a new operating procedure. As a result of an inter-Allied conference, the Navy Department has decided to adopt as a basis for its radio procedure the so-called Inter-Allied W/T Procedure, which is indicated in M. P. L. Document No. 2, entitled "Inter-Allied W/T Instructions." The Fleet is using this procedure now.

The assignment of wave lengths for all stations, in accordance with the Inter-Allied Radio Conference, is being made. It is expected, in the future, that merchant ships and other commercial radio interests will have more wave lengths at their disposal. This can only be accomplished by reducing the navy's. However, it is believed that it will be some time before these wave lengths for shore stations will be effective, because it will mean doing away with the compensating wave on the arc, and adoption of a more selective transmitting apparatus than the spark.

The changes will be incorporated in a revision of the Communication Regulations.

Naval Stations Out of Commission

OWING to the continued shortage of radio personnel at Arlington Station (NAA) its radio activities these days is hardly worthy of mention. Naval men state, however, that they are trying to do their best under the circumstances to keep from being entirely forgotten by those who have been in the habit of listening-in and working with NAA, and hope that the proposed increases in pay will have the desired effect of bringing many of the old radio operators back to the service.

It will be noted that this station's work has been reduced to a point which is next door to going out of commission. The operators have not been standing watch for the reception of signals.

On account of the recent storm, Arlington has suffered the loss of all antennae. The reconstruction, it is said, may cover a period of at least two weeks.

Three of the four high-power naval radio stations on the Atlantic coast were out of commission as the result of the recent storm. The Radio Corporation of America's New Brunswick station was the only one in operation, it was said at the Navy Department, the Arlington, Annapolis and Sayville stations all being "down" as a result of ice forming on the antennae and the dislocating effect of the winds.

Repair of the Sayville station is going ahead. Considerable damage to ship and small shore radio stations also was reported. The damage was not sufficiently widespread to in any way threaten the safety of ships at sea.

British Marconi Companies Declare Dividends

AT a meeting of the directors of Marconi's Wireless Telegraph Company, Ltd., held on December 17th last, a dividend of 7 per cent., less income tax, was declared upon the cumulative participating preference shares, on account of the year ending December 31st, 1919. An interim dividend of 10 per cent., less income tax, was also declared upon the ordinary shares.

These dividends were payable on February 2, 1920, to the shareholders registered on the books of the company on December 17, 1919.

With a view to the more equal distribution of the dividend on the ordinary shares, the Board decided to increase the interim dividend from 5 per cent. to 10 per cent.

On the same date the Directors of the Marconi International Marine Communication Company, Ltd., London, declared an interim dividend of 5 per cent., equal to one shilling per share, less income tax, upon the capital now issued and paid up. This dividend was made payable on January 15, 1920, to the shareholders registered on the books of the company on December 17, 1919.

Ship Message Covers 6,339 Miles

A FAR-FLUNG radio message has been received by the Goat Island wireless station from the Pacific Mail liner Ecuador.

According to the message, the Ingleside station, near Los Angeles, picked up a message from the Ecuador giving her position as a few miles from Woo Sung, China, 6,339 miles from San Francisco.

Rivalry between ships of the Pacific Mail line for wireless supremacy has recently resulted in the Venezuela sending a message from a point 600 miles from Kobe, Japan, or a little less than 6,000 miles from San Francisco.

Hawaiian Station Picks Up Nauen Ten Thousand Miles Away

THE wireless station of the Radio Corporation of America at Koko Head, H. T., recently picked up and distinctly heard the station at Nauen, Germany, about twenty miles outside of Berlin, a distance of some 10,000 miles from Oahu. At the time a message in German signed "Ludwig" was being transmitted.

In addition to improvements which have been made in the receiving apparatus, the Weagant static arrester has been installed enabling the station to operate in practically any condition of weather. It will also do away completely with any intereference from Pearl Harbor or Kahuku. Equipment whereby Kahuku station will hereafter be operated by a land line from Koko Head is also being installed.

"Hullo, Hank! How's yer wireless workin'? Get any flashes this mornin'?"
"Sure did, Patsy! Got one from three planets."
"What'd they say?"
"Wanted ta know what was good for the flu."

Armstrong Sues De Forest

THE suit entered against the De Forest Radio Telephone & Telegraph Company by Edwin H. Armstrong, originator of the regenerative circuit, promises to be the most interesting and important radio litigation since the Fleming valve case was decided by Judge Mayer. The complaint charges the De Forest Company with infringement of the regenerative circuit patent.

Major Armstrong, a former student under Prof. Pupin at Columbia University, served in the A. E. F. as Chief of the Radio Laboratories of the Signal Corps and was awarded the Legion of Honor in recognition of his distinguished services. His invention was used, under licenses, at the German radio station at Sayville before the war to receive trans-Atlantic messages from Nauen, Germany, and also by the Marconi Wireless Telegraph Company of America, now the Radio Corporation of America, which company is a licensee under the regenerative or feed back circuit patent. The invention was very widely used during the war by the U. S. Army and Navy.

French Station to Work 12,500 Miles

A GREAT wireless station five times the strength of the Eiffel Tower station, with a sending radius of 12,500 miles, or half way around the world, is to be built at Croix d'Hins, near Bordeaux, France. Its sending capacity will be 72,000 words a day.

Suits Begun on Vacuum Tube Infringements

ALLEGING that the Fleming patent covering vacuum tubes used in wireless telegraphy has been infringed upon, the Radio Corporation of America has filed a bill of complaint and order to show cause why a preliminary injunction should not be granted restraining Rudolph Schmidt & Company, Inc., of Rochester, from manufacturing the tube. The case will be heard in equity in United States District Court in Buffalo.

Several cases in which the right to the patent by the Marconi Company is affirmed by the courts are attached to the bill of complaint.

Two Buffalo firms, the Bison Electrical Co., Inc., and McCarthy Bros. & Ford, Inc., are defendants in action for alleged infringement on a wireless apparatus patent. Papers have been filed in the office of the federal court clerk here by the Radio Corporation of America.

The bill of complaint charge the defendants with "making, using, offering for sale and selling apparatus" which in part, it is alleged, are copies of the patent.

Portuguese Government to Buy British Radio Station

THE Portuguese Government is planning to buy from the British navy the wireless installation at Madeira for Porto Santo and procuring more powerful apparatus for Madeira.

Sweden Wants Powerful Wireless Station

A MESSAGE from American Minister I. N. Morris at Stockholm states that Sweden wants a wireless station powerful enough to communicate with the world at large, and with the United States particularly.

The Swedish High Commissioner, Axel Robert Nordvall, who was in Washington at the time of the war, is at the head of the movement. The details have been worked out and the whole matter handed to the Government of Sweden, which it is understood will present a request to Parliament for $2,500,000 to erect this wireless station.

The promoters are anxious to have from the United States asurances that definite hours every day will be assigned to the Swedish wireless stations for sending and receiving messages from stations in America.

Wireless Press Service to Rome

A SPECIAL wireless service between England and Italy for the use of the newspaper press was opened on January 6th by the English Marconi Company. This service, authorized by the Italian Government and the British Post Office, was instituted particularly to assist the Italian press in obtaining prompt reports of the Italian Prime Minister's visit to London. The Marconi high-powered station at Carnarvon is being used for the purpose and three hours daily have been allotted for this particular traffic.

German Wireless Messages Barred

ANNOUNCEMENT is made from Berlin that radio press dispatches to the United States can no longer be forwarded through the radio stations at Nauen and Elsenore on the ground that provisions of Article 197 of the Peace Treaty prohibit the forwarding of political, military or naval news. It is stated that the Interallied Naval Commission which recently arrived in Germany notified the German Government that the article was effective. As a result press dispatches to America have been returned and notice given that others dealing with the specified subjects will not be accepted.

The ruling creates a unique situation, so far as the United States is concerned, in view of a recent Washington report that relations between the United States and Germany will still be governed by the conditions of the armistice, under which the wireless stations were at the disposal of Americans.

While it is stated at the Foreign Office that Americans will be permitted to wireless commercial news, this will first be subjected to a careful scrutiny, which will involve long delays. The German Government's daily wireless report has also been abandoned.

Radio Compass Stations Along Pacific Coast

EIGHT radio compass stations are in course of construction along the coast from San Diego to Alaska. The radio compass station on the Farralone Islands is practically completed and will be in operation in the near future.

Stations are under construction at Pt. Reyes, Bird Island, Pt. Montara, Pt. Hueneme, Avalon, Pt. Firmin and Imperial Beach.

Colombia to Have Two Radio Stations

THE Colombian Government has contracted for two powerful radio stations and a submarine cable from Colon to its north coast.

12,500 Ships to Report Daily by Wireless

THROUGH an arrangement made by the Navy Department with the State Department, United States Consuls at the various ports throughout the world will send by radio or cable daily a report on various matters relating to ships. The Government agents will pay particular attention to the entrance and clearance of American ships in foreign ports and will expedite news of marine casualties and other items of interest to the shipping world. The information will be forwarded to New York and embodied in the daily shipping bulletin which is published by the United States Naval Communication Service.

At the present time the Navy Department is trying to keep track of 12,500 ships, flying the flags of all nations. Of this number 3,991 are American vessels. Under the new arrangement the American consuls will use the radio and cables to keep the shippers informed as to the operation of all vessels, so that it will be possible to tell at any time where any ship is located, whether she be discharging her cargo at Karachi or is on the high seas bound for some remote port.

A communication has been sent out to the various steamship companies asking them to assist by having each master report by wireless to the nearest station the position of his vessel once a day.

No charge will be made for either the radio or land wire service. At various intervals during the day, the naval radio stations send by direct land wire the positions of the ships, and all of these reports are incorporated in the bulletin, which is available to all shippers.

High Amplification at Short Wave Lengths

A Complete Description of Armstrong's Latest Contribution to the Radio Art, the Short Wave Amplifier

By Paul F. Godley

REGENERATIVE circuits, as adapted for amateur use, have gained wide and unusual popularity among amateurs, but there can be no question of the equal or greater attractiveness of the latest invention of Edwin H. Armstrong. He has developed a very effective means of amplifying short-wave signals and thereby opened up new fields of communication to amateurs who are in a position to supply themselves with the materials necessary to place the scheme into operation.

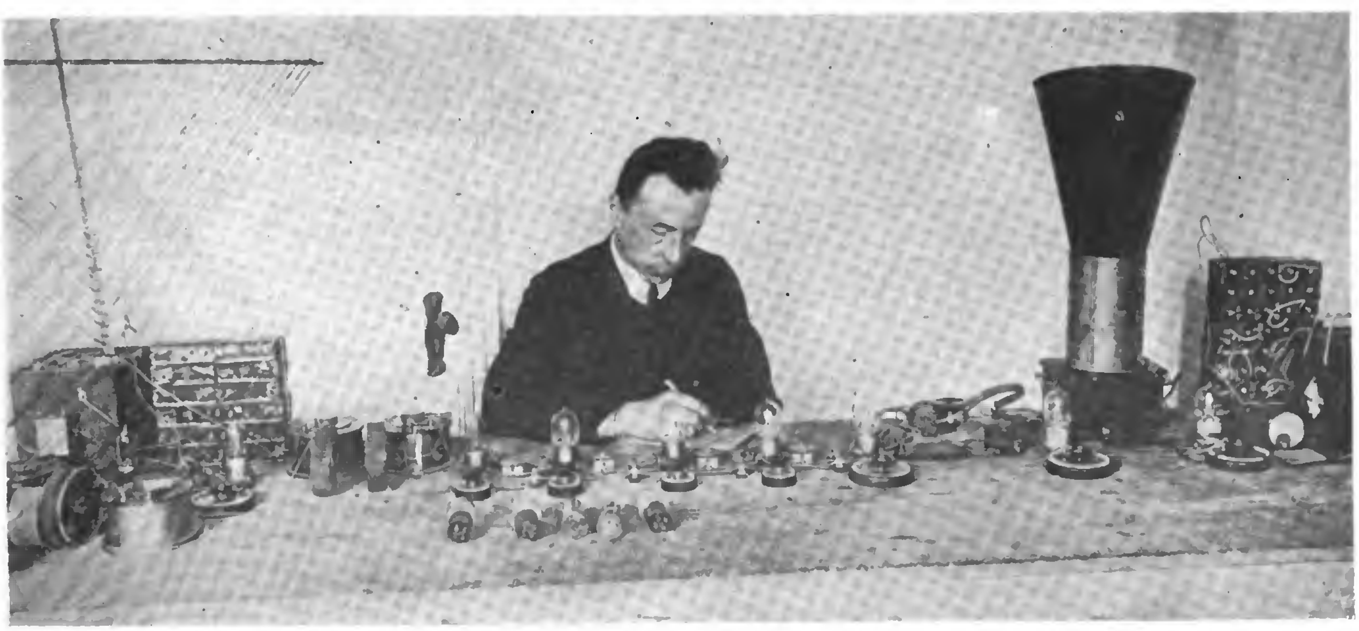
A great deal of progress was made in the various branches of radio during the war. Yet we now find, months after the lifting of the ban on transmission, that amateurs are still employing the circuits which were in use during 1915. These circuits are contained in a popular short wave regenerative receiver and a two-stage amplifier. It is well known that many attempts were made to further increase the sensitivity of amateur receiving equipment secured with this combination, and some very remarkable results were obtained by the use of three short-wave regenerative receivers in cascade, followed by two stages of audio-frequency amplification. But this arrangement, although extremely sensitive, was an impractical one, due to the complexity of adjustments. Even so, it is a fact that an eighth district station was consistently copied in the second district during the daytime.

More than two stages of audio-frequency amplification were not used because difficulties were encountered in getting more than two to function normally. When the third stage was added, tube noises and induced currents from local supply lines reached a volume which made it impossible to read weak radio signals.

The spirit of progress ever stirs uneasily within the amateur and developments made by the Allied Armies during the war were not overlooked; as a result, stories came into circulation some time prior to the armistice, that the British were using 19-, 29- and 36-stage amplifiers! It was reported that it had been found possible to copy, at London, the deck buzzers of the German fleet that lay in the Kiel Canal. Subsequently it was learned that this amplifier had been consummated at the 19th stage.

Since hostilities ended a great deal has been written about multi-stage amplifiers having resistance and transformer coupling for amplification at audio and radio frequencies, several different combinations and arrangements being possible. It was argued that the usable number of stages of audio frequency amplification was limited, for the reasons which have been mentioned, and the construction of a radio-frequency, transformer-coupled amplifier was also rendered difficult because the interactions which took place between the various tubes set up undesirable oscillations at both audio and radio frequencies. A seven or eight stage amplifier, therefore, became a very complicated affair, involving the use of four or five stages of transformer-coupled, radio-frequency amplification, a rectifying tube, and two or three stages of transformer-coupled, audio-frequency amplification. The construction of the tubes was an exacting task, as was also the construction of the transformers and the set as a whole. For this reason considerable attention was given to a resistance-coupled amplifier which had been developed.

This type of coupling, it appeared, could be easily adapted to the high capacity tubes that were being supplied from the United States, since by the use of these small coupling resistances stray electromagnetic and electrostatic fields of any great strength were elimin-



Complete arrangement of apparatus used in the Armstrong short wave amplifier, showing nine VT'S, one used as a detector, one as an oscillator, five as radio-frequency amplifiers and two as audio-frequency amplifiers

ated. It also made possible a material reduction in the physical dimensions of the amplifier unit. Unfortunately, however, resistance-coupled amplifiers were not adaptable to radio-frequency amplification at the higher frequencies.

It was at this point that Major Armstrong developed the idea of changing the frequency of the incoming oscillations so that they could be satisfactorily handled by a resistance-coupled amplifier. This was accomplished by the use of a radio-frequency oscillator, so arranged with reference to the receiver circuit that oscillations were set up in the receiver circuit by the oscillator. These oscillations were of such frequency as to produce, in conjunction with the incoming oscillations, *radio*-frequency beats of an order that insured satisfactory passage through the resistance-coupled amplifier. This resulting frequency was then fed into the amplifier, and upon passing through several stages and reaching a sufficient strength, was automatically rectified and finally passed as an audio-frequency signal into two or more stages of an audio-frequency amplifier.

At first glance, one might be apt to conclude that the use of this external heterodyne for the production of beats would annul the natural spark tone of the transmitter. This is not the case. The beats produced take place at a radio-frequency rate, and are thus inaudible, the beat-frequency current being, for all practical purposes, identical in form with that of the original incoming impulse. Thus, the outfit works equally well on spark and radio-telephone signals and is something which will be employed with wonderful success by the foremost amateurs.

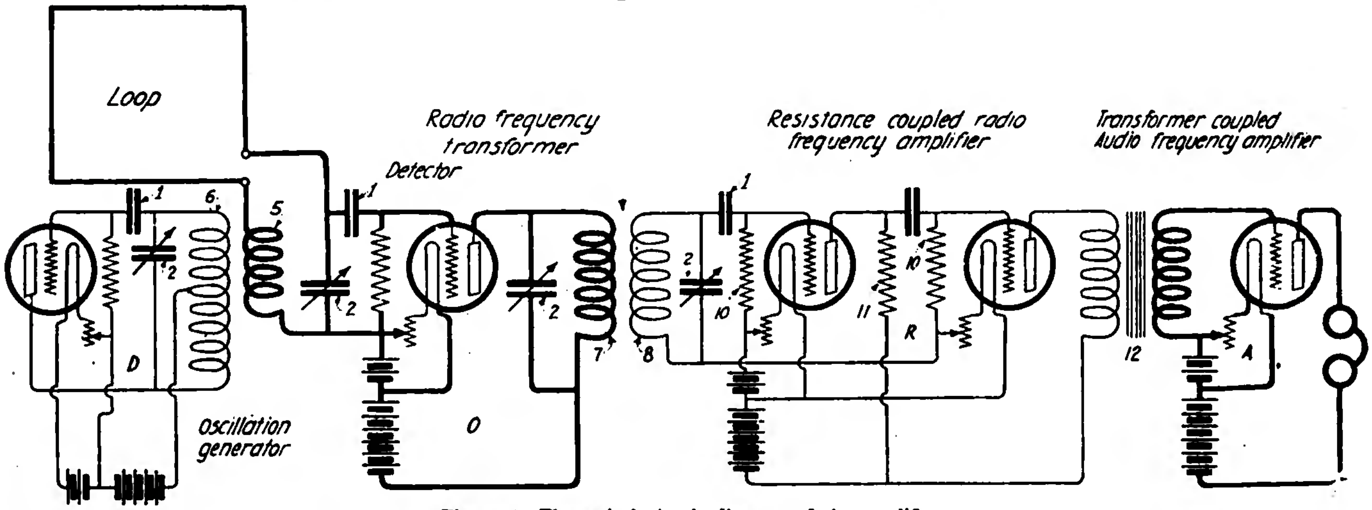


Figure 1—Theoretical circuit diagram of the amplifier

The scheme makes it possible to amplify at high frequencies to an extent hitherto unthought of. This is evidenced by the fact that in the vicinity of New York City, on an eleven-turn loop about three feet square, stations in the fifth, eighth and ninth district may be picked up at the same strength as obtained by the use of an antenna, a short-wave regenerative receiver and a two-stage audio-frequency amplifier. It can be shown that the EMF generated in the three-foot loop is only about one per cent of that generated in the average amateur antenna. This makes apparent the possibilities of the scheme, when used in conjunction with an antenna.

Figure 1 shows a theoretical circuit diagram of the amplifier, where D is the detector tube, O the oscillator or external heterodyne, R the radio-frequency amplifiers, and A the audio-frequency amplifiers. In general, the action is somewhat as follows: The heterodyne O is so adjusted that beats between the incoming oscillation and the local oscillation take place at, say, a 50,000-cycle rate. The primary and secondary of the oscillation transformer 7, 8, are tuned to 50,000 cycles, and the impulses are passed to, and amplified by the radio-frequency amplifier. After sufficient amplification the potentials of the signal impulse reach a value so that one

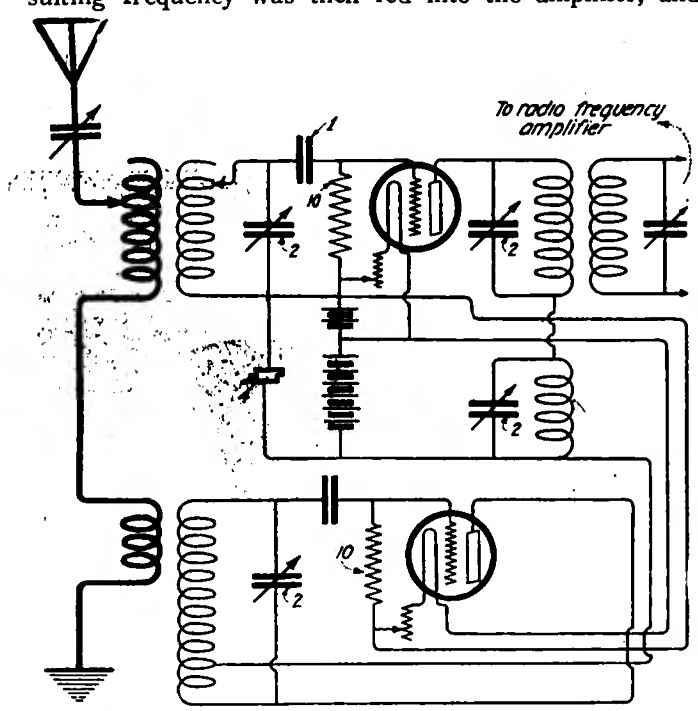


Figure 3—Scheme of connections for use with an antenna

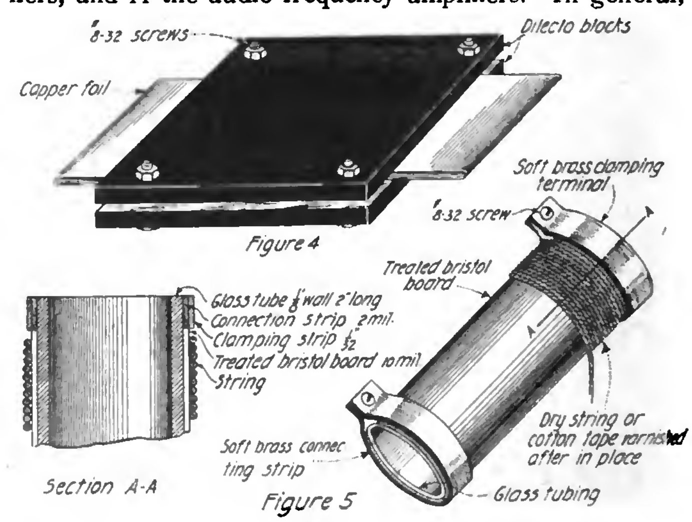


Figure 4—Grid condensers. Figure 5—Construction and assembly of the grid leak

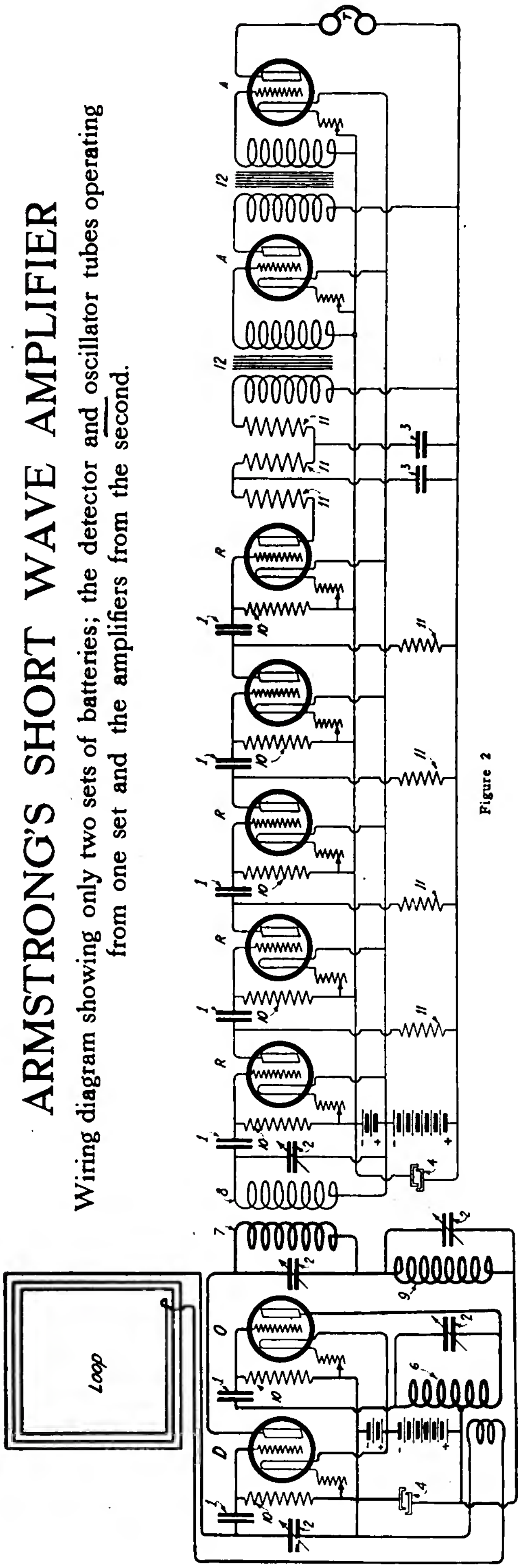


Figure 2

ARMSTRONG'S SHORT WAVE AMPLIFIER

Wiring diagram showing only two sets of batteries; the detector and oscillator tubes operating from one set and the amplifiers from the second.

of the amplifier tubes acts efficiently as a rectifier. If the initial impulse is sufficiently strong this rectifying action may commence in the first tube of the amplifier, the succeeding tubes acting as both audio and radio-frequency amplifiers, or, as would be the case with weak signals, no rectifying action takes place until the last tube of the radio frequency bank is reached, whereupon the impulse is passed to the audio-frequency amplifier through an iron core transformer.

Figure 2 shows a schematic circuit diagram where only two sets of batteries are required for the whole system, the detector and oscillator tubes working from one set and the amplifiers from a second. As in figure 1, D, O, R, and A represent respectively the detector, the oscillator, the radio and audio-frequency amplifier tubes. Grid condensers (1) have a capacity of .00025 mfd. Figure 4 gives a suggestion for their construction. The use of 2-mil mica, two-foil plates 0.7 inch square will give approximately this capacity. Variable tuning condensers 2, as used by the writer, had a maximum capacity of .00075 mfd. Condensers in the filter circuit 3 are of the paraffin paper type and have a capacity of .005 mfd. By-passing condensers 4 have a capacity of 2 or 3 mfd. They are shunted around the battery and offer a low resistance path for the high frequency currents. Any resistance in the common battery will, in the case of several stages, result in self-oscillation in the amplifier.

Suggestions for the construction of the coupling inductance 5, and the oscillator inductance 6, have been given in figure 6. The former may consist of 10 turns of No. 18 DCC wire wound on a 3-inch tube 1½ inches in length. No taps need be taken off. The oscillator inductance consists of 40 turns No. 18 DCC wire, wound on a tube 4 inches in diameter and 3 inches in length. The tap is taken off 25 turns from the grid end of the coil.

The primary 7, and secondary 8, of the oscillation transformer may consist most economically of a 500-turn "honeycomb" coil arranged in each case so that coupling is variable.

The inductance 9, in the plate circuit of the detector, may be made by winding 30 turns on a 3-inch tube. Three or four taps, equally spaced, should be taken off. This inductance, with its condenser, is used for getting regenerative action—at the frequency of the incoming signal—in the detector tube. This regenerative action increases the signal strength to a very great degree and also makes the system considerably more selective. The inductance with its condenser may be replaced by a variometer.

Resistances 10 and 11 have values of 2,000,000 and 100,000 ohms respectively. Figure 5 gives suggestions for the assembly of the latter. Coat a strip of bristol board 2 inches wide with a solution made up by mixing six parts Higgins India ink with one part powdered graphite shaved from a grade H pencil. The mixture should be put on with a camels-hair brush, the brush being passed across the strip from side to side—not from end to end. After coating one side the strip is placed in a warm oven until dry, whereupon the remaining side is coated in the same manner. When thoroughly dry, a piece 1½ inches long is cut from the 2-inch strip and carefully wrapped around a glass tube ½ inch in diameter and 2 inches long on the ends of which two strips of thin, soft brass ⅜ inch wide, have already been placed (see figure 5). The paper is now clamped in position with a second strip of soft brass about 1/64 inch in thickness and ⅜ inch wide, as shown in figure 5. The space between the connector clamps is then covered with two layers of cotton or silk tape, varnished with Sterling or Ajax insulating varnish, and again baked until dry. The inner and outer connector strips are connected together. A strip of this same paper, coated only on one side and ⅛ inch wide by 1½ inches long, will serve for the grid leak 10. It should be so mounted as to be protected from moisture.

The two .005 mfd. condensers 3, and the three resisttances 11, form a barrier beyond which the radio-frequency currents will not pass. Such a barrier is necessary in the case of many stages in the amplifier. Without it, self-oscillation due to inter-linkage of electrostatic and electro-magnetic fields of the radio and audio-frequency amplifiers respectively, will very likely take place, particularly when the operator wears the telephones and attempts adjustments of the apparatus.

The amplifier transformers 12 may be any of the types on the market. Although as many as eight stages of radio frequency may be used successfully, depending upon the class of tube employed, more than two stages of audio frequency cannot be used with success. In each case the limit is reached when tube noises, or noise due to induction from power lines, has reached a point where it is louder than the signal which one is after.

Figure 7 suggests a layout for the radio-frequency amplifier. As stated above, it need not be limited to five tubes, although in general five tubes of the kind that it is possible to procure on the market are all that can be conveniently used in connection with an antenna. The various units should be mounted in such a way that there is no leakage one to the other. In other words, the insulation resistance of the mounting should be high. This may be insured by the use of a dilecto panel, or if this is not possible, by mounting each unit on a small dilecto base of its own, and the various units on a hardwood board. Leaks, faulty batteries, faulty resistances and poor connections will give rise to noises which will rapidly multiply. Some tubes will be found to be noisy, too, and best results will be had only after tubes have been carefully selected or located where they will cause the least disturbance.

So much has already been published concerning loop construction that nothing will be said here as to details. For wave lengths between 200 and 600 meters, a flat spiral of 11 turns, whose outside turn is three feet square and whose turns are spaced ¾ inch will fill the bill. No. 18 lamp cord may be used.

Figure 3 shows a scheme of connections for use with an antenna. Here the oscillator is coupled to the system through the antenna circuit. To one who is not familiar with the operation of the outfit it may be well to start out with the antenna connection. The telephones may be inserted in the plate circuit of the detector tube until it is certain that the detector tube and the regenerative feature (if used), as well as the oscillator, are operating properly, or the primary of the first audio-frequency amplifier transformer may be connected in the detector plate circuit. The operation of the oscillator will be evidenced by a change in the spark tone of any incoming signals when the oscillator circuit is in resonance with the detector circuit. If no signals are available the system may be excited by a wavemeter. When the detector and oscillator have been brought into operation the radio frequency amplifier is placed into action. Very close coupling is used between 7 and 8 and the oscillator wavelength is varied for the best reception of signals. When signals become audible by means of this adjustment coupling at 7 and 8 is reduced and the two circuits are tuned. The oscillator is now readjusted for maximum signal, and the coupling between the oscillator and the system is varied for the hest value; filament temperatures of tubes are adjusted, and the usual details looked after. Once a good value of coupling and adjustment for 7 and 8 has been found no change will be necessary over quite a wide range of wavelengths, and when once the signal is coming in on any wavelength it may be brought up to a remarkable degree by the use of the regenerative circuit (inductance 9).

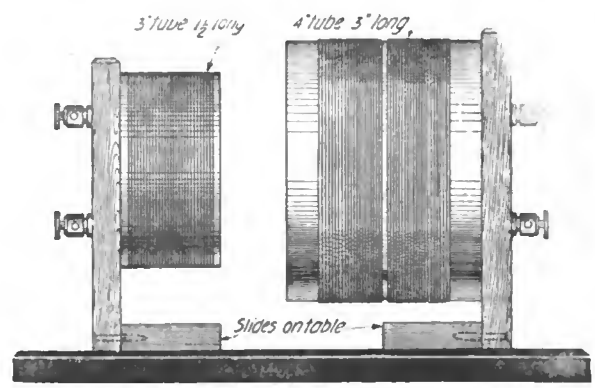


Figure 6—Showing method of mounting the coupling and oscillator inductances

While none of the Chinese amateurs have as yet been heard in New York City with this set-up, C. R. Runyon, Jr., and Minton Cronkhite, in suburban New York, report that eighth and ninth district stations are about "ten times as loud" as with a regenerative receiver and a 2-stage amplifier, while on "good" nights the writer, in Montclair, N. J., has heen ahle to get fifth and ninth district stations on the loop with the same strength as was possible on an antenna and a regenerative receiver and 2-stage amplifier. When conditions are such that the last mentioned system brings in no distant stations, the connection of the antenna to the Armstrong amplifier system can be depended upon to bring them in numbers.

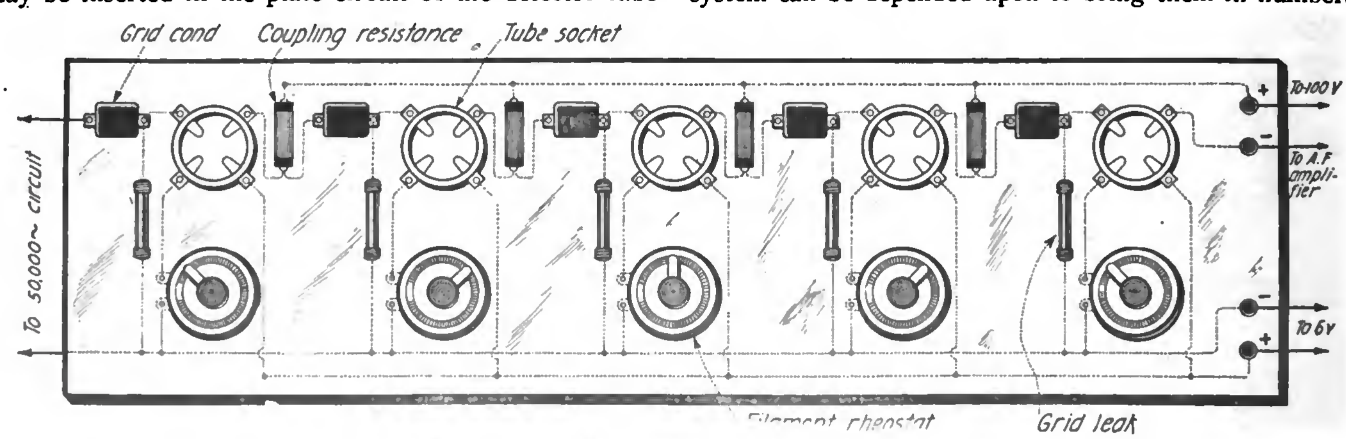


Figure 7—Panel layout for the radio frequency amplifier

Prior to the war we had one case of direct communication between amateurs from coast to coast. It is to be hoped, and expected, that coast to coast communication will now become the rule. It will not be at all surprising if we are soon conversing with fellow amateurs in Holland and the British Isles.

Heterodyne Wavemeter

By R. W. Goddard

Dept. Physics & Elec. Engineering New Mexico College Agriculture & Mechanical Arts

THE wavemeter and high frequency ammeter are the principal measuring instruments used in radio work. The former is by far of greater importance and wider application. In principle this instrument is a simple radio or oscillatory circuit of known dimensions with some current indicating device inserted, attached, or coupled to it. Various designs of wavemeters, their theory and operation are shown in paragraph 30 of "Radio Instruments and Measurements," published by the Wireless Press, New York City, and will not be taken up here. With the recent introduction of vacuum tube oscillator and beat receiver systems these wave-meters fail to function as a universal instrument, being useless on sustained high frequency waves. A new type of instrument has to be used.

It was during the war while training soldiers for radio work that the attention of the writer was directed to this fact. As a result after three months of experimental work, a wavemeter was developed that fills the requirements of this new field and performs all the functions of the older type. The ideas and principles made use of are not new and the writer wishes to take no credit for any discovery. The aim of this article is rather to give to the amateur and experimenter a practical design of a new and necessary instrument, thus saving many the cost and labor of duplicating the experimental development work.

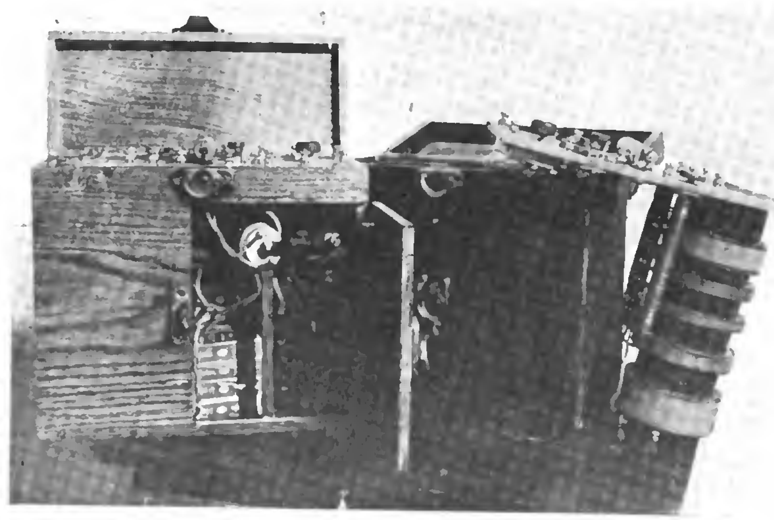
In principle this instrument is a vacuum tube oscillatory circuit of standardized dimensions. Oscillations of known frequency or wavelength are set up in the circuit by the tube. By placing the inductance of the meter in inductive relation with any other oscillating circuit, oscillations from it are induced setting up beat currents which within the range of audibility may be heard in the telephones of the meter. As the frequency of the meter oscillations is brought nearer to that of the unknown induced oscillations, the beat note lowers in pitch and finally disappears when the two oscillations are of the same frequency or wavelength. If the meter oscillation frequency is varied beyond this point, the beat note appears again and rises in pitch. As wavelength measurements are made by the nil method rather than the maximum as formerly, this instrument gives an accuracy impossible to obtain with the older type even with an experienced operator. By setting the meter to oscillate at any desired wavelength and reversing the procedure above, any oscillating receiver set or transmitter may be tuned in.

Not only does this instrument function as a meter, but it may be used as a beat receiver set or undamped transmitter. To illustrate the possibilities along these lines it might be mentioned that with a single wire antenna, 100 feet long and 20 feet high, connected to one end of the meter inductance, the other being grounded, YN (Lyons, France) and IDO (Rome, Italy) have been heard at State College, N. M., in the daytime, while all of the high power stations in this country are heard at any time. Using a 325-foot two-wire antenna 95 feet high connected with a ground wire across the inductance and tube, with a B battery pressure of 110 volts, signals were regularly sent a distance of two miles with a received audibility of 350. The receiving set used for this was of the static coupled regenerative type without amplifiers.

The material for the construction of the meter is given below:

One piece clear lumber 6 ft. long, 12 in. wide, ½ in. thick, preferably of oak; six 1x1 in. brass hinges with screws; 2 brass sash locks; 1 brass sash handle; 4 dozen 1 in. No. 7 brass flat head screws; Bakelite, hard rubber or fiber: one piece 13 x 5 x ¼ inches; one piece ¾ in, diam. 8 in. long; one piece 6½ x 2 x ¼ inches; one tube $\frac{3}{16}$ in. hole, 1½ in. long; one 11-ohm, 2-ampere, back mounting, miniature rheostat; 1 potentiometer switch arm, graphite sector, and clips or instrument switch arm and 9 switch points; 1 vacuum tube; 1 vacuum tube adapter, holder or base; 1 piece 3 in. orangeburg fiber conduit 1¼ in. long; one 31-plate variable condenser in metal case; 1 piece spring brass or phosphor bronze, 2⅛x 2½ in.; 1 piece sheet copper 1½x8½ in.; 3 dozen 1 in. No. 8x32 round head brass machine screws; two 1½ in. No. 8x32 round head brass machine screws; 4 Hex nuts No. 8x32; 2 lbs. No. 24 B&S D.C.C. magnet wire; 1 pint orange shellac; ½ yard oiled linen or empire cloth; 12 No. 531 3-cell flash light batteries; 1 Exide or similar type 3 ZA 5 motorcycle storage battery; 1 pair 2000-ohm radio phones; 1 piece fiber sheet ⅛ in. thick 4x2⅜ in.

Figure 1 shows the construction of the case with compartments for the meter, telephones, B battery and A battery. Figure 2 indicates the location of the various parts of the meter. All apparatus is attached to the panel and forms a unit easily removed from the case for inspection or repair. The tube and holder shown is an Audiotron. The Western Electric V.T.1, DeForest V.T.21, and the new Marconi V.T. tube have all been used in these meters with negligible change in calibration. If the latter tubes are to be used, the four binding posts and



The heterodyne wavemeter, which may also be used as a heat receiver set or undamped transmitter holder shown may be omitted and a standard base mounted on the rear of the panel with the barrel projecting through. The cover of the case must then be made 2¼ in. deeper to accommodate the tube. The A battery rheostat is the ordinary 11-ohm, 2-ampere, miniature rheostat. The B battery potentiometer is a 5000-ohm graphite sector such as is supplied by all dealers of wireless goods. If desired, a circle of switch points can be used instead of this, with every other point connecting with battery taps. The binding posts may be of any variety, but a double post with a hole to receive the tip of a telephone cord is to be preferred.

The tuning condenser is of standard make, having thirty-one plates; fifteen 2½ in. diameter semi-circular movable plates, and sixteen 3 in. diameter semi-circular stationary plates. The bearings are mounted on hard rubber blocks bolted to the outside stationary plates. As purchased, these condensers have circular hard rubber panels to which the condenser body and stamped copper container are fastened by screws. By dissembling and using the condenser panel as a template, holes can be drilled and tapped in the meter panel to hold the condenser and metal container. A knob constructed of material cut from the drum switch

the fiber conduit in a vise and start winding at the bottom. Using No. 24 D.C.C. wire, put on 50 turns, shellac it and cover with a piece of empire cloth, passing the wire through the lap and then put on 50 more turns in the same direction, but progressing from the upper end to the bottom. Shellac this and cover with another layer of empire cloth. Continue until eleven layers have been built up. Then proceed to the next coil of 18 turns, eleven layers, and then to the middle coil of 10 turns, eleven layers. From this coil a tap should be taken out at the end of the sixth layer. From the end of this coil proceed on to the

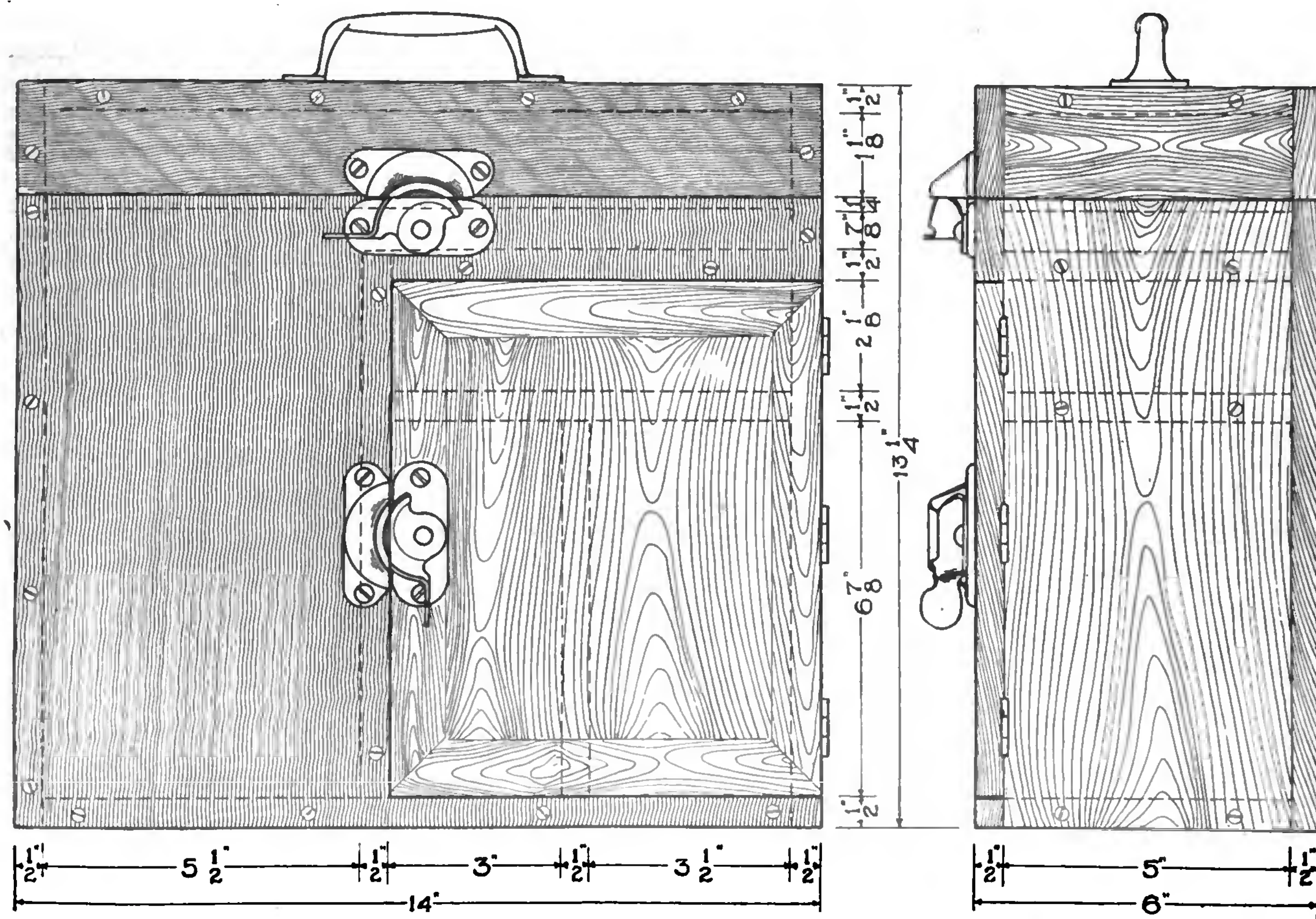


Figure 1—Construction of the case with compartments for the meter, telephones, B battery and A battery

The drum switch and bridging condensers are shown in figure 3. The switch body is constructed of ¼ inch fiber or bakelite; the drum is turned from the same material; the contact fingers are of sheet phosphor bronze and the contact plates are of sheet copper. The latter are fastened to the drum by pins at the corners driven into drilled holes. The bridging condenser is built up of two pieces of sheet copper separated with oiled linen or empire cloth, and are clamped between two thin pieces of fiber to the rear of the panel.

body is utilized in place of that supplied.

The inductance is wound upon a piece of 3 in. orangeburg fiber conduit such as is used by electric light and power companies for underground conduit work. Any electrical supply house can furnish this. Having obtained a proper length, place it in a lathe and turn out one end to a taper fit with the condenser container as shown. Holes should be drilled and tapped to bolt the drum switch to it so that the whole assembles together on the panel firmly and squarely. Then place

others as shown. A good way to secure the ends of the coils to prevent them from unwinding is to place about the wire a piece of linen or friction tape about 1½ in. long, doubling it back on itself forming a tab. The winding is then started, each turn passing over the ends of the tab and holding it in place. At the end of a coil place the tape loop in position fifteen to twenty turns before the last with plenty of length and the tape ends protruding. Then wind over the tape as before, passing the last turn through the loop. Pull the loop up tight by the

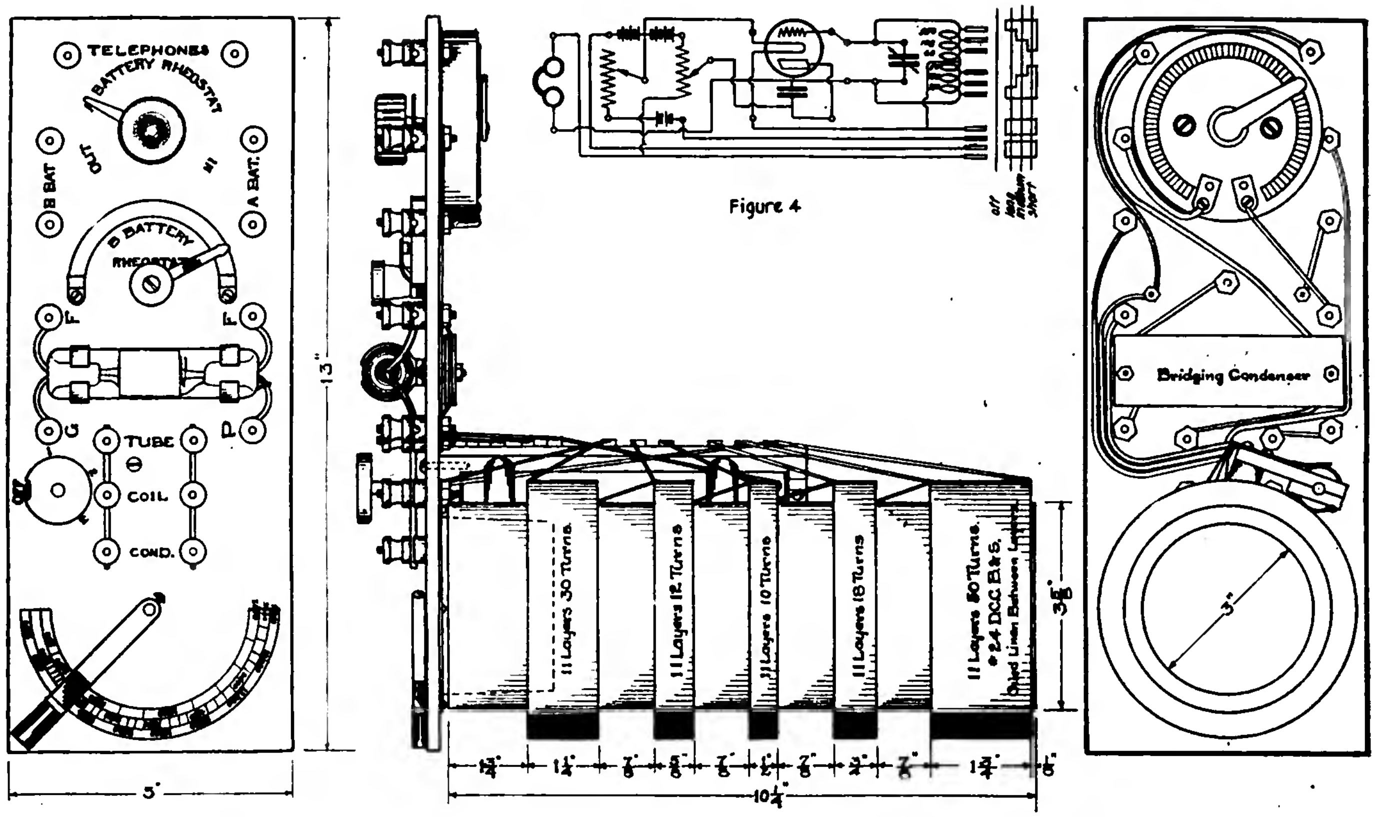


Figure 2—The location of the various parts of the meter according to scale. Figure 4—Wiring diagram showing all connections

ends and cut them off flush with the winding. After the shellac has hardened the ends cannot be pulled loose without tearing the tape in two.

The wiring diagram, figure 4, shows all connections. All joints should be well soldered and taped. The use of cotton sleeving or empire cloth tubing on the connections improves the appearance. Make all connections as short as possible.

Before finally assembling the panel should be marked. The wavelength scales under the condenser handle will have to be scratched in with dividers as four semi-circles, the calibrations to be placed later. The lettering is best done with steel stamps such as are used in machine shops for marking tools, etc. The letters may be filled in with white ink to make them appear plainer, if desired. When all is finally assembled the meter should be calibrated by comparison with any other wavemeter, or sent to one of the various State Universities or the Bureau of Standards for calibration. If constructed as shown, no trouble will be experienced with a good tube in producing strong oscillations throughout the range of the meter, as the windings have all been carefully worked out for the best results.

With modern ratio apparatus this instrument must of necessity be fundamentally important. Yet to my knowledge there is none on the market at the present time. For the earnest experimenter of limited means, no single piece of apparatus could be more highly recommended, since it is not only fundamentally a wavemeter, but it may be used as a receiver or transmitter for both damped and undamped waves in telegraphy or telephony. The wiring is also arranged so that the tube and its accessories, the inductance, or the condenser may be used independently.

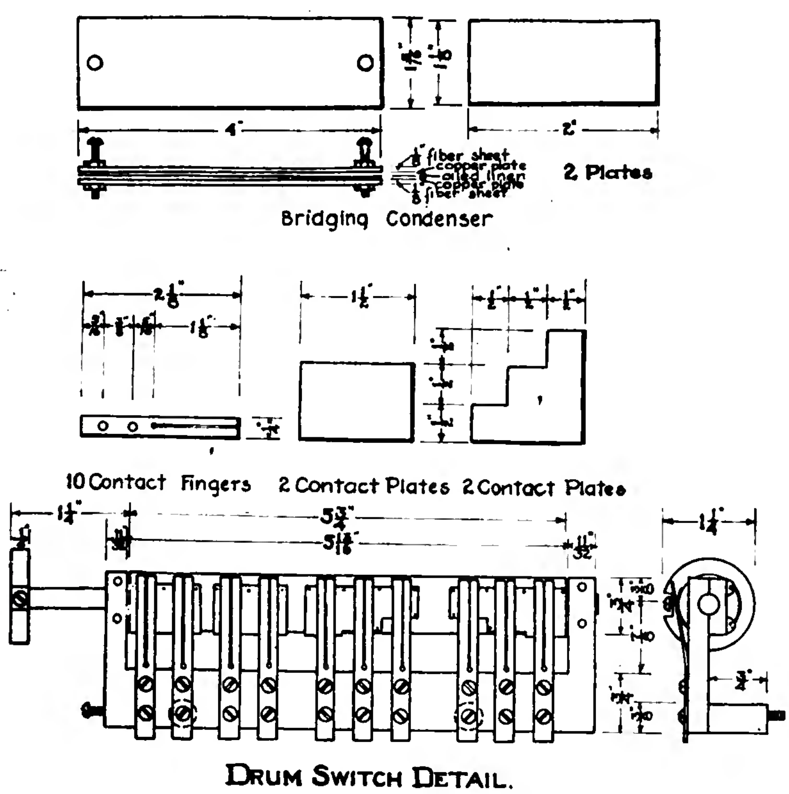


Figure 3—Detailed constructional plans of the bridging condenser and the drum switch

Combined Kick-Back Preventer and Switch Panel for Experimental Radio Stations

By J. A. Weaver

SOME form of a kick-back preventer is a necessity in every well appointed radio station, and as pointed out in the article, "The Fire Underwriters' Rules Applied to Amateur Stations," which appeared in the

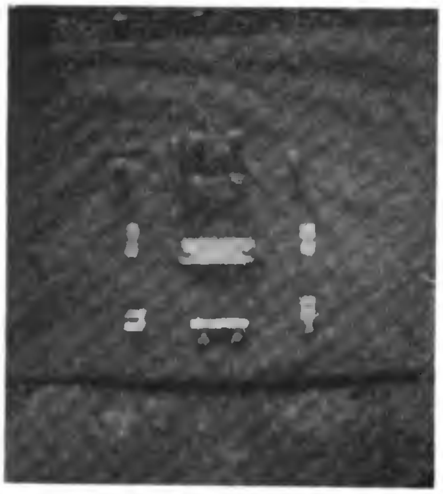


Figure 3—Front view, showing finished panel

March issue of the WIRELESS AGE, the code calls for a transformer in the circuit, or two condensers across the line in series. However, the high resistance shunt is entirely satisfactory, is in general use in commercial stations, and also seems to be the type in general favor amongst amateurs. It is also relatively cheaper and easier to construct and occupies less space than any other type. For these reasons it has been selected for use on the panel about to be described. The form of the resistance elements here suggested is somewhat novel, as will be seen when we take up their construction later on. The idea of grouping the kick-back preventer and several circuit switches on a single panel will be found to have many advantages, as it not only follows good electrical practice and presents an attractive appearance, but also is very handy from the operating point of view. The panel is intended to be mounted in a sheet-iron cabinet with hinged cover to conform with standard practice, and this cabinet can then be mounted in the handiest position available, either upright on the floor or inverted on the under side of the operating table close to the front edge, so that the circuit switch may be used to start the rotary gap motor with ease and dispatch. Of course, if more than two circuits are desired, the panel may be easily designed to accommodate the desired number, but two switches, one for the transformer circuit and the other for the rotary gap circuit, are usually all that will be desired, and they make a symmetrical design. The concentrated and individual control of the rotary and transformer circuits will be greatly appreciated in use, as it allows one to instantly cut out either circuit while adjusting the gap or making other adjustments, thus avoiding the danger incident to the accidental closing of the key. Having the circuit separately fused, and the fuses close at hand will avoid much annoyance when one happens to blow, as it can be instantly located and removed without journeying to the basement or other remote fuse location. If this panel is fed by a separate pair of feeds direct from the meter it will make current supply to the radio set entirely independent of the rest of the house and allow complete control of the circuits from the handiest single location possible.

The material necessary for construction is as follows: One piece of polished slate 18½ inches long by 9 inches wide by 1 inch thick. One piece of hard drawn copper tubing 7 inches long by 5/16 inch outside diameter. One piece of hard copper strip ½ by 1/16 inch and 5 feet long. Two 30 amp. two-pole spade handle, panelboard knife switches. The hinge jaws of the switches should be equipped with lugs for attaching to fuse clips, and the other set of jaws should be also equipped with lugs for taking a binding post thumbnut. Some makes of switches do not have

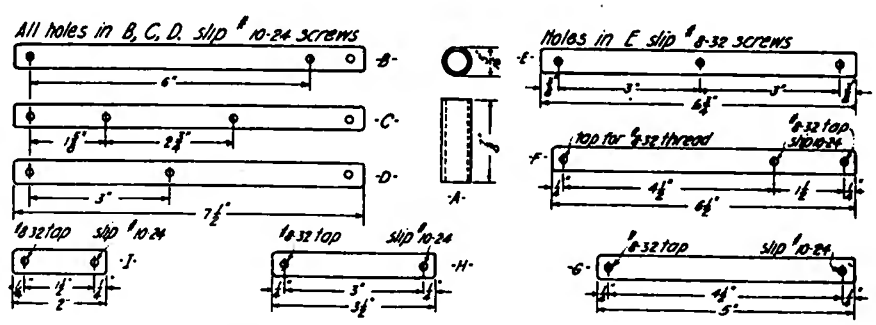


Figure 1—Detailed construction of various parts

these lugs stamped out of the same piece as the switch jaw, but use separate little pieces of copper strip for the purpose. In buying this type be sure to get four for each switch; six individual switch jaws, three with lugs for attaching to fuse clips and three without will also be needed; fourteen 30 amp. fuse clips; seven cap nuts 10-24 thread; seven machine screws, either iron or brass 10-24 inch and a half long round head; half dozen 8-32 battery nuts; two dozen brass or iron machine screws round head ¾ inch

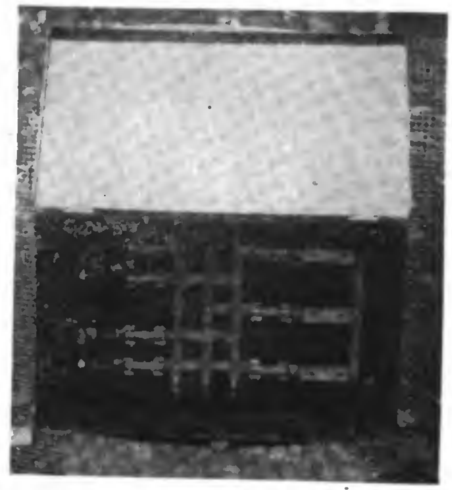


Figure 3—Rear view of panel, showing all parts in place

long; four like the last, but 1 inch long; four thumb-nuts 8-32 thread; three lugs for busses. Some burrs and a little sealing wax complete the list, exclusive of the fuses and resistance elements.

The first thing to do is to cut the copper tubing up into seven pieces with a length of ⅞ inch as shown in the sketch at "A," figure 1. These pieces should have the ends cut square and if available a lathe should be used for the purpose, but if they are cut with a hack saw be careful to cut square and finish up with a file. If the tubing is held in a vise while cutting, a piece of iron rod should be inserted in the tubing, where it is gripped by the vise jaws to prevent crushing. These pieces are the pillars to support the buss bars. Now cut the copper strip up into pieces of various lengths as indicated in the drawings, figure 1. Make two like "G," two like "I," and one of each of the rest. "B," "C" and "D" are buss bars, "E" is the connecting bar for the three resistance unit clips, "F" is the lower circuit connecting bar, "G" shows the two inner circuit connecting bars, "H" is the center ground terminal

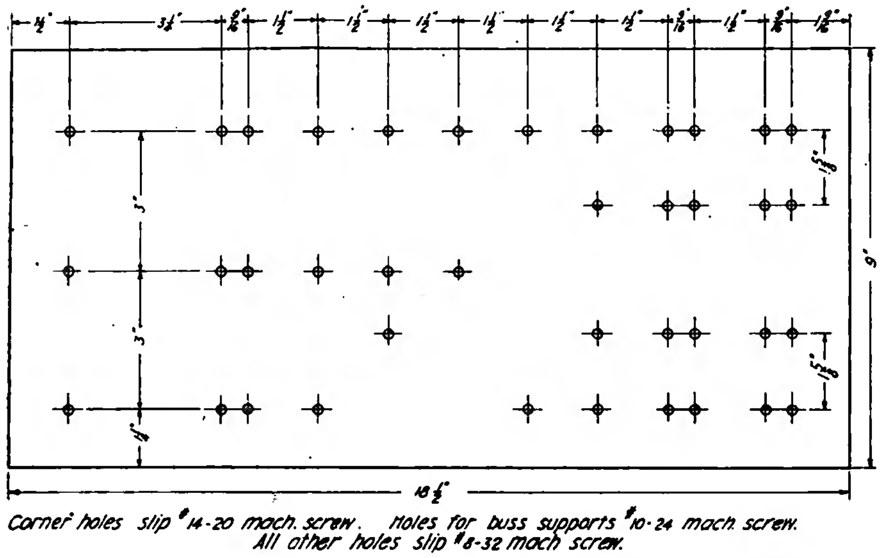


Figure 2—Dimensions for constructing the slate panel

connecting bar, "I" shows the two upper circuit connecting bars. The ends of the bars should be filed smooth and square, and the corners slightly rounded. The location, size of holes and those which should or should not be tapped are clearly given in the dimensions on each piece shown in figure 1. After all the parts mentioned and shown in figure 1 have been made, they, with the rest of the copper parts, should be polished and lacquered. In buffing the parts do not bend the bars. To avoid this it is best to drive a small brad in a piece of board and place the bars on the board with the brad protruding through a hole to hold them when they are brought against the wheel. This will allow you to use as much pressure as necessary without bending. Clear lacquer should be used, as gold lacquer does not look well on copper. The parts should be slightly warm when lacquering, but not so hot as to scorch the lacquer. If no means are available for polishing the copper parts it will pay you to have it done at some plating shop, because the whole appearance depends on nicely polished metal, which, contrasted with the glossy black finish of the slate panel, makes the whole job "a thing of beauty and a joy forever."

While the lacquer on the metal parts is drying you can turn your attention to the laying out and drilling of the slate panel.

Procure a sheet of thin cardboard or heavy paper and cut it to the dimensions of the panel. Lay out the location of each and every hole to be drilled as shown in the drawing, figure 2. The drawing is complete and dimensions are also given, so it should not be difficult to lay out the template. After the template is laid out arrange the various parts on their respective locations and check up the accuracy of the holes as they are marked on the template. Remember, a correction can be easily made on the template, but when a hole has been spotted or drilled in the slate or marble board it is another and a sadder tale! If the template is of cardboard, as in this case, it is laid directly on the front face of the panel and clamped in position. Take a prick punch, or a center punch ground to a sharp point, and mark through the cardboard onto the panel with a light tap of a ham-

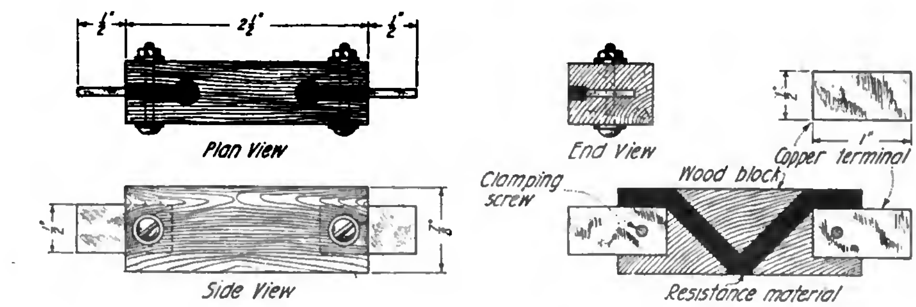


Figure 4—Constructional plan of the resistance element

mer. The cardboard template is removed and the punch marks spotted. After "spotting" the panel is ready for drilling, which can be done best on a drill press, but if necessary a breast drill can be used. Lay the slate on a flat board and drill on the "spots." Use a drill having the cutting lips ground at a short angle and run it at very slow speed, using water as a lubricant. Use moderate and steady pressure. When nearing the completion of a hole release the pressure and let the drill come through by the weight of the drill press handle or with a very light pressure. This will prevent a jagged hole on the other side. Drilling slate or marble is like drilling wood unless you strike a metal vein. Then it is worse than the hardest steel, and drill after drill will be caught and nicked or broken in getting through. It is customary to bush a hole if the vein is bad. When the panel has been drilled from the front clean it off and turn it over on a clean piece of tissue paper laid on the wood board, and with a ½-inch drill or larger countersink all holes but the corner ones for a depth of about ⅝ inch. The edges of the slate, if rough, should be filed smooth with a large flat file having rather coarse and single cut teeth.

After the filing is finished the parts may be mounted. Mount the switches first. Each screw should have a burr slipped on it to give a good bearing to the screwhead in the bottom of the countersunk holes. The panel should be propped up on edge so you can get at both sides at once, thus making the mounting an easy matter. After the switches are mounted make sure they work smoothly before finally setting up tight on the screws. In mounting the fuse clips snap a fuse in place to keep the clips in proper alignment when tightening the holding screws. In mounting the clips for the resistance elements follow the same procedure, using a piece of metal to keep them in line. The buss bars are put into position by inserting the long 10/24 screws through the holes in the slate and connecting bars from the back of the panel. Slip a copper pillar over the projecting end of the screw and place the buss bar in position with the ends of the screws through the holes in same, and then screw a cap-screw on the end of each screw. The upper pillar of the central or ground buss should have several burrs placed under it to account for the thickness of a connecting bar which is lacking here, as this pillar is only for mechanical support of the middle buss. By referring to the photo in figure 3, which shows the finished panel with all parts in place, the proper position for each part will be clearly seen. When all parts are mounted the countersunk holes are filled with sealing wax.

The material necessary for the construction of the resistance elements follows: One strip of hard wood (maple preferred) 7/8 x 5/8 x 7½ inches long; one piece copper strip ½ x 1/16 x 6 inches long; six battery screws and 8-32 nuts; some burrs and a small quantity of plaster of Paris and lamp blank.

Cut the wood strip up into three pieces each 2½ inches long. Slot the ends of each piece with a thin bladed saw for a distance of half inch, as shown in the drawing, figure 4. After the copper strip has been cut up into the six pieces, each one inch long, a piece is driven into the saw slot in each end of the wood blocks. A hole to slip an 8-32 battery screw is drilled through the wood and the copper piece from the side of the block, the screw is inserted and a burr and nut put on the projecting end and drawn up tight. Now, on one of the narrow sides of the block mark the center, and drill through it on an angle with a quarter inch drill, so it will come out on top a half inch from the end, or right beside the inner end of the copper terminal piece. This is made clear in the sectional view of the resistance element in figure 4. Each end of the three blocks is treated in the same way. On each of the blocks where the two holes meet at the center on the bottom of block trim the edges of the holes with a penknife so it will be a single hole and deepen it somewhat so that when the compound is pressed in, it will join the ends of the "V." Trim the edges of the holes where they come out on top and cut a slot over the top edge of the terminal piece so that the compound will get a good contact with same when filled in place. This is also shown in the sectional view of the resistance elements in figure 4. The resistance material is a compound of plaster of Paris and lampblack mixed dry and made into a paste with a little thin shellac as a binder. The resistance of the compound when dry and made into a rod four inches long by a quarter inch diameter should be about 5000 ohms or even greater. It will stay across a 110-volt line indefinitely without heating—the condition it must meet in service. No exact proportion of ingredients can be given. Much depends on how well they are mixed and only a small amount of lampblack is necessary. It is necessary to make up a few batches of different proportions for testing before the right combination is found. It may be stated that the method and ingredients for making the resistance elements is only offered as a suggestion and there is plenty of room for originality. Graphite from a very hard drawing pencil finely powdered may be substituted for the lampblack and whiting could be used instead of plaster of Paris. The method described has been found satisfactory, but another and much used method of creating a high resistance is to paint the space between the two contacts with a coat of flake graphite and alcohol, putting it on in an extremely thin coat and giving one coat after another until the right resistance is created. This method may be applied with little change in the form of the wood blocks. When the compound is dried out and perfectly hard (which will take a long while) the wood blocks can be given a coat of asphaltum paint.

The sheet iron cabinet for the panel which is shown in the photo, figure 3, is made of No. 14 gauge metal having a hinged cover and snap catch to hold it shut. The feet are made of two pieces of 2-inch light angle iron riveted to either end to keep the bottom of the box raised a short distance from the floor. Holes are provided in the end and bottom for the entrance of wires. The inside dimensions are 19½ inches long by 11½ inches wide by 4 inches deep. The panel is mounted in it with four 14-20 machine screws. It is beyond the ability of most amateurs to make the metal cabinet, so specifications sent to a sheet metal shop is the best plan. A wooden cabinet lined with asbestos or metal could be substituted if desired. In conclusion, it may be mentioned that the fuses used for the kick-back preventer should be not over 3 or 5 amp. The others should be of proper size to protect the apparatus in each particular circuit.

The Regenerative Receiver vs. Cascade Amplifier

The Relative Merits of Those Vacuum Tube Circuits for Radio Reception at Amateur Wave Lengths

By Howard W. Lewis

IN order to intelligently discuss the respective merits of the regenerative vacuum tube receiver and the cascade vacuum tube amplifier for radio reception at amateur wave lengths, it must be considered that amateurs are practically limited to the use of spark sets and that undamped wave transmitters at short waves are still in their infancy. The present question, therefore, narrows down to a consideration of damped wave reception at high frequencies. Obviously, if continuous waves are to be received, an oscillating audion circuit is required, either with or without additional audio frequency amplification.

Let us now examine the circuits employed in each system. Figure 1 shows a typical regenerative receiving circuit in which the vacuum tube is caused to oscillate by means of electromagnetic "back coupling" between the "tickler" coil (T) of the plate circuit and the secondary (S) of the receiving loose coupler. Detection, amplification and generation of local oscillations occur simultaneously in this tube and its associated circuits. Figure 2 shows the form of single step cascade vacuum tube amplifier usually adopted by amateurs. In this arrangement, tube No. 1 acts as a detector and tube No. 2 as an audio frequency amplifier. These two

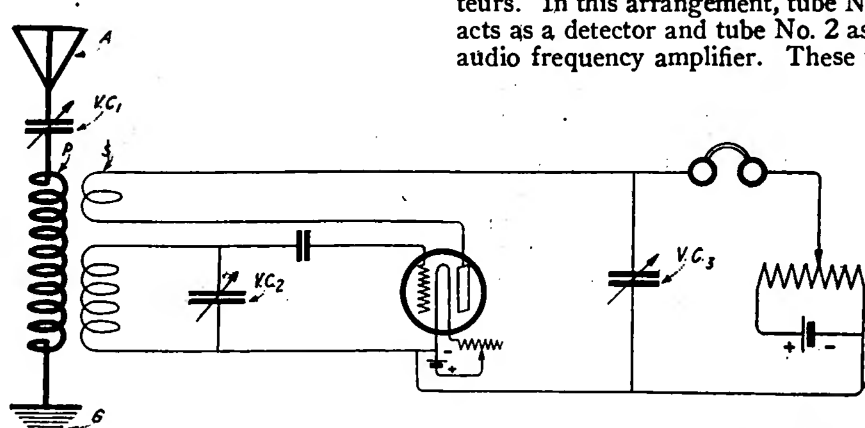


Figure 1—Typical regenerative receiving circuit in which the vacuum tube is caused to oscillate by means of electromagnetic "back coupling" between the "tickler" coil of the plate circuit and the secondary of the receiving loose coupler

tubes or stages are coupled together by the transformer (T). There should be no locally generated oscillations. The same antenna, loose coupler, and primary and secondary variable condensers are used in either case.

The following interrelated factors will be discussed in order to form a basis for comparison:

1. Results obtainable.
2. Simplicity.
3. Ease of construction.
4. Ease of manipulation.
5. Quality of signal note.
6. Interference.
7. Reliability.
8. Cost.

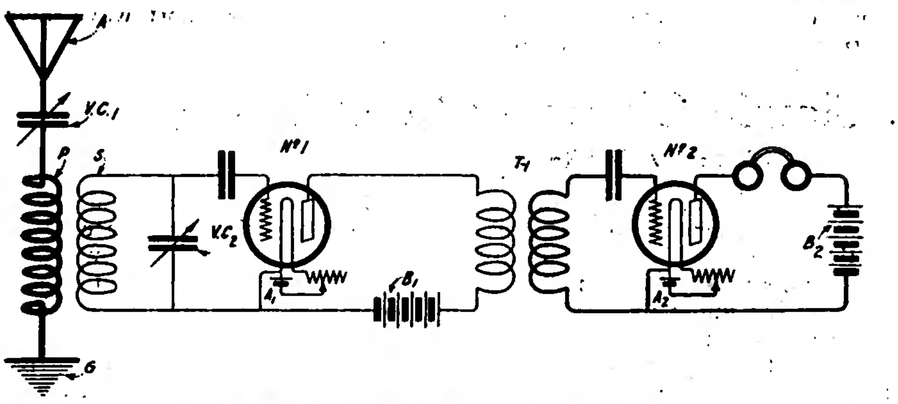


Figure 2—Single step cascade vacuum tube amplifier

In the hands of a skilled operator, particularly one who thoroughly understands all the necessary adjustments, excellent results can be had from either of these circuit arrangements. In the majority of cases, particularly for the amateur and often for the expert when time does not permit of careful tuning, much louder signals are obtained from the audio frequency amplifier arrangement of figure 2 than from figure 1.

A casual inspection of the diagrams given above would indicate that the circuit of figure 1 is the more simple. That this difference is more apparent than real, may be understood from the following.

(a) While the circuit of figure 2 is the one usually employed by amateurs, there is no reason why a much simpler one cannot be used for the same purpose. More than one filament battery and rheostat, and more than one plate battery are not necessary. Circuit diagrams, recently released by government authorities, show as many as five vacuum tubes operated from one A and one B battery.

(b) The transformer T, between the detector and amplifier, is not always necessary and in some cases is of no help at all.

In figure 3 is shown a recent form of cascade amplifier which is simpler than the arrangements usually employed, and which gives excellent results. It will be noted that two batteries, one transformer, and one filament rheostat have been eliminated. A small audio choking iron core inductance has been inserted in the plate circuit of the detector tube. This arrangement is no more complicated than the regenerative circuit of figure 1 and has two less adjustments which will be explained further on.

The regenerative circuit requires a greater number of variable elements than does the amplifier. In addition to the usual primary and secondary tuning condensers and loose coupler adjustment, variable coupling is required between the "tickler" coil T and the loose coupler secondary S, figure 1. A variable condenser is required to by-pass the radio frequency around the telephones and plate battery. In many cases also, it is necessary to provide a means of adjusting the plate potential—see potentiometer of figure 1. It is true that the amplifier of figure 2 or 3 requires two vacuum tubes instead of one as well as a choke coil, but these are easier to provide than the ordinary instruments required for a successful regenerative receiver.

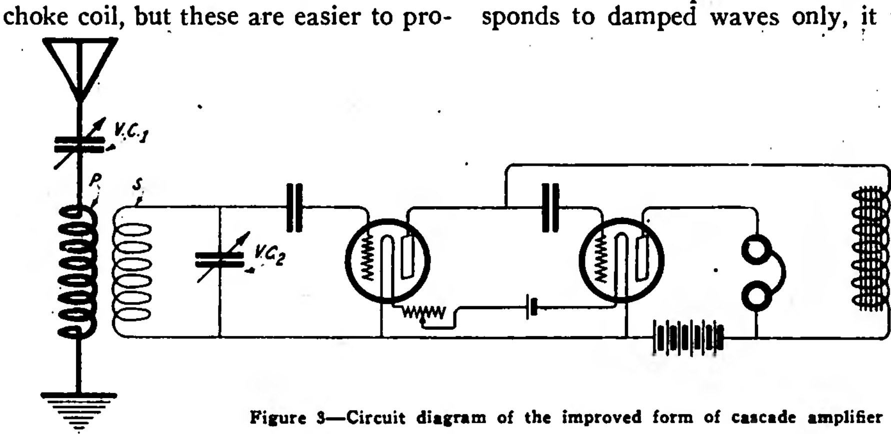


Figure 3—Circuit diagram of the improved form of cascade amplifier

When ease of manipulation is considered, the superiority of the amplifier circuit becomes at once apparent. After the filaments are lighted and suitable plate potentials applied, no further adjustments are required, leaving the operator free to devote all his attention to tuning the primary and secondary circuits and copying the messages. With the regenerative receiver, however, not only are these adjustments necessary but the "back" coupling and the variable bridging condenser VC3 must be regulated. It frequently happens that these two latter adjustments must be repeated if the tuning is changed. For the maintenance of steady oscillations and the prevention of "spilling," it becomes occasionally necessary to adjust the filament temperature and the plate potential. These numerous adjustments are particularly "cranky" at the short wave lengths used by amateurs.

When an oscillating regenerative receiver is used for the reception of damped wave trains, the characteristic tone of the spark note is lost and all signals heard in the head telephones are harsh, hissing sounds irrespective of whether the transmitter employs an open or rotary spark gap or a quenched gap. This not only nullifies the well-known beneficial effects of a high spark frequency, but renders identification of the sender by recognition of his spark note impossible. On the other hand, when a cascade amplifier is used, the detecting action of the first tube is not interfered with and that of the received note is determined solely by the spark (group) frequency of the transmitter, the same as with a mineral detector.

The question of freedom from interference will continue to be of growing importance as the number of stations attempting intercommunication within a given area increases. When it is noted that the oscillating regenerative receiver responds to both damped and undamped waves, while the cascade amplifier receiver responds to damped waves only, it will be apparent that the latter is more free from unwanted signals than the former. Amateurs will find this particularly true since the war, inasmuch as a number of very powerful undamped wave transmitters have been established whose higher harmonics are especially troublesome to short wave oscillating receivers. These difficulties are accentuated by the fact that individual spark transmitters cannot be recognized by their peculiar spark note when an oscillating regenerative receiver is used.

If the apparatus is properly constructed and carefully wired together using stranded rubber covered wire and soldered joints, and if due attention is paid to maintenance of A and B battery voltage, these circuits are equally good from the point of view of reliability.

For the man who makes his own apparatus, the cascade amplifying receiver will probably cost a little more, due to the fact that two audion bulbs must be provided instead of one for the regenerative receiver.

Last but not least, it is to be remembered that the cascade amplifier is not limited to a single step as indicated in figures 2 and 3, but that two or even three additional steps may be attached thus producing enormously amplified signals suitable for the operation of loud speaking devices as used in Signal Corps and Naval operations during the war.

From a thorough consideration of the foregoing factors, particularly those of the signal note, interference, and ease of operation, there is no doubt but that the cascade audio frequency amplifying receiver is to be preferred to the regenerative oscillating receiver for short wave amateur use.

An Unusually Simple Circuit for Long Waves

By Elliott A. White

AN oscillating regenerative circuit of extreme simplicity for the reception of long damped or undamped waves is shown in Figs. 1 and 2. The only variable elements are a variometer V and a feedback condenser C2 (Fig. 1), or a variable inductance L and tuning condenser C1 besides the feedback condenser C2 (Fig. 2). Tuning is done entirely by V or by L and C1, the strength of the feedback being adjusted by C2, for which (with a loss of flexibility) a small fixed condenser may be substituted, though the latter is not recommended. The circuit is very stable in operation. Its lack of sharp tuning is no disadvantage with the long waves, where there is practically no interference. Further stages of amplification may be added by substituting the primary of a second amplifier transformer for the telephone P; but the set is not adapted to give efficient results with more than two stages of amplification. The circuit gives particularly good results with the Signal Corps two-stage audio-frequency amplifier SCR-72, a detector bulb being supplied, the clips marked "Radio" being connected in the detector plate circuit, and the feedback connection being made to the third telephone binding post from the left on the panel.

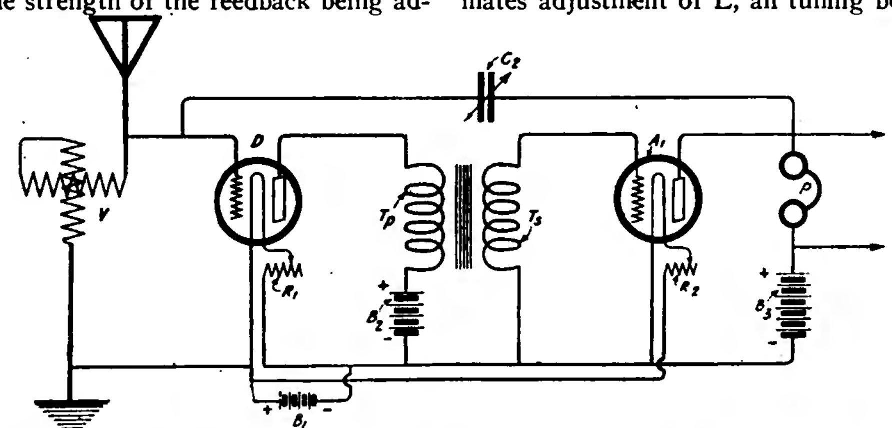


Figure 1—Diagram of an oscillating regenerative circuit containing a variometer and a feed-back condenser

The dimensions of the variable elements are as follows for wavelengths up to the longest (NSS-17000 meters): V-175 to 250 millihenrys maximum inductance, depending on the size of the antenna. L-60 to 125 or 175 millihenrys maximum inductance, depending on the capacity of the antenna. For this the largest or second largest sized honeycomb coil (175 or 125 millihenrys respectively) is generally sufficient, and may conveniently be supplied with three or four taps, at 1/8", 1/4", 1/2" and 3/4" from the inside edge, measured on the face of the coil. This practically eliminates adjustment of L, all tuning being done with C1. The Condenser C1 may be of either .0005 or .001 microfarad maximum capacity (17 or 43 plate as usually manufactured). The smaller size of .0005 microfarad is sufficient for C2. It will be noted that the capacity of C1 is added to (in parallel with) that of the antenna to determine the wavelength. The variation of C2 has only a slight effect on the wavelength adjustment. Since, with a given antenna, the sharpness of tuning depends on the resistance of V or L and on the capacitance of C1 compared to the inductance of L, C1 should be kept relatively small and the resistance of V or L kept as low as possible. The tuning may be made still sharper with corresponding increase of L or V by placing a series condenser in the antenna circuit. To reduce induction noises and improve stability a small fixed or variable condenser may be connected in parallel with V in Fig. 1. No detector or amplifier grid condensers or leaks are necessary.

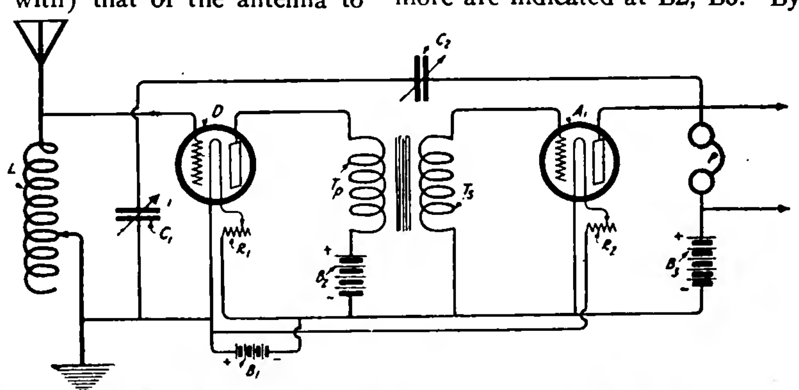


Figure 2—Diagram of an oscillating regenerative circuit containing a variable inductance and a tuning condenser in addition to the feed-back condenser

Outside of these variable elements the rest of the circuit comprises the vacuum tubes D and A1, detector and amplifier respectively, preferably of the high vacuum type (VT-1, VT-11, VT-21, etc., Class II VT). A battery B1 of 4 or 6 volts supplies all the tube filaments in parallel. R1, R2 are the filament rheostats. For the high vacuum type of tube these may be fixed. With a 4-volt battery no filament resistance is necessary for the VT-11; for the VT-1 fixed resistance may be used of 1.05 ohms or a little more for the detector and 1 ohm for the amplifiers. The detector grid is connected to the positive side of B1 and the amplifier grids to the negative side of B1 through V or L and the amplifier transformer secondaries respectively. The plate batteries of 22½ volts or more are indicated at B2, B3. By inserting a condenser in the grid of A1, it is possible to use one set of batteries for the plate circuits, but it is not recommended. B2, B3 may be of fixed voltage. The filaments are grounded.

EXPERIMENTERS' WORLD

Views of readers on subjects and specific problems they would like to have discussed in this department will be appreciated by the Editor

Variometers and Their Construction

By Thos. W. Benson

THE variometer is used extensively at present in regenerative receptors but has received little consideration as to construction details. Invariably they are of the ball secondary or

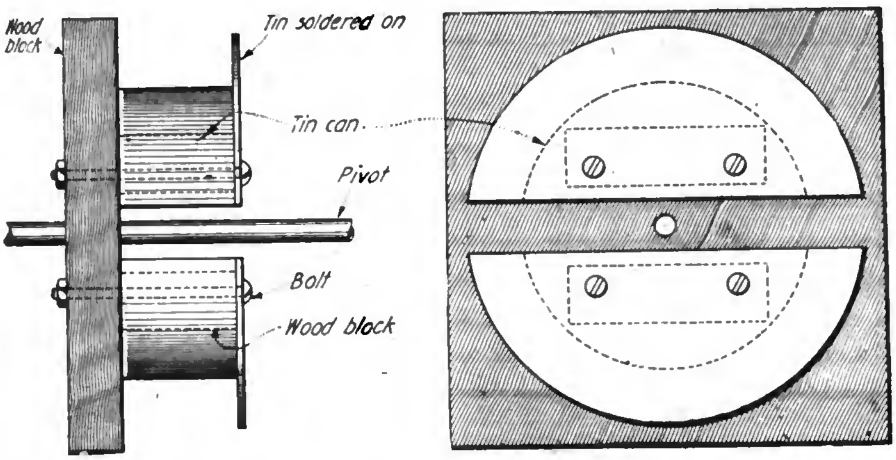


Figure 1—Construction of the form upon which the coils of the variometer are wound

plain tube type. In connection with some experimental work the writer has designed two types of variometers differing from the above. They are described here and are offered on the basis of being more compact, easily constructed and still capable of being built with a large range of wave lengths.

The figure 4 variometer is made on a form shown in Fig. 1. A tin can of the proper diameter, say 4", is cut off to a height of 1½" and then slit in half, removing a strip ½" wide down the sides and across the bottom. A hack saw is best for cutting the corners, shears being used for the flat metal. Each half has soldered to it a semi-circle of tin to form a side ¾" high.

A board 6" square has a ¼" hole drilled in its centre, the can halves being attached to the board by bolts or long screws so the sides of the original can form a circle.

A ¼" rod is fastened to a bench or table and the board pivoted on it. The winding is done in the form of a figure eight, the wire crossing between the halves of the can after each half turn. Banked layers to the amount desired can be rapidly wound by rocking the board back and forth with one hand and guiding the wire into place with the other. For the stationary coil the ends of the wires should come at the outside of one coil. The movable coil should have the leads brought from the center.

When the winding is complete melted paraffin is dropped in several places on the coil to hold it together while the form is being removed. If desired the coil can be taped up and used in its present form, but it can be further improved in point of ruggedness by casting in plaster of Paris.

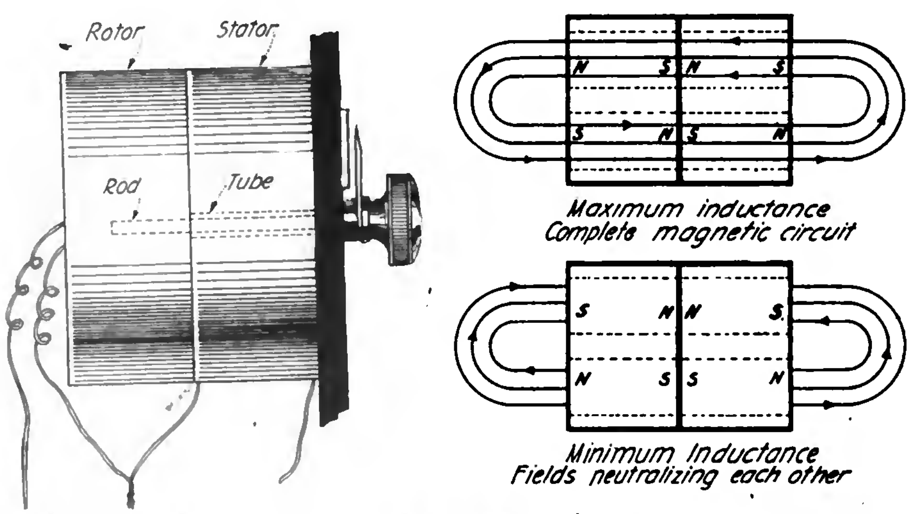


Figure 2—Method of mounting the coils and diagrammatic representation of maximum and minimum inductance

To do this lay the coil on a sheet of glass slightly rubbed over with vaseline. Make a ring of paper or cardboard to fit around the coil and come even with the top. A two inch length of brass tubing with an internal diameter of ⅛" is stood exactly in the centre of the coil. Plaster of Paris is mixed with water to a thick paste and poured into the form. Before the mixture hardens two brass machine screws are inserted so the coil can be mounted on panel. After hardening the cast may be brushed over with melted paraffin to act as a binder and lubricate the rubbing surfaces.

The movable coil is treated in the same manner except that a ⅛" brass rod long enough to reach through the movable coil and the containing case is inserted in the centre to form a means of turning the coil.

The coils are mounted in the case as shown in figure 2, being connected so that the current will flow in the same direction in adjacent halves of the coils when the pointer rests on 180° or maximum inductance. A word as to the theory of operation. Each half of the coil possesses a magnetic field, the two halves of each coil forming a magnetic circuit. In one position the fields of both coils will be in the same direction. Turning the secondary through 180° causes the fields to oppose each other, giving minimum inductance. This is shown diagrammatically in Fig. 2. This type of variometer can also be used as a short wave coupler, a 90° turn varying the coupling from minimum to maximum.

It is extremely rugged, can easily be

built with coils of equal inductance without calculation or experiment and will be found to have a wide range of adjustment.

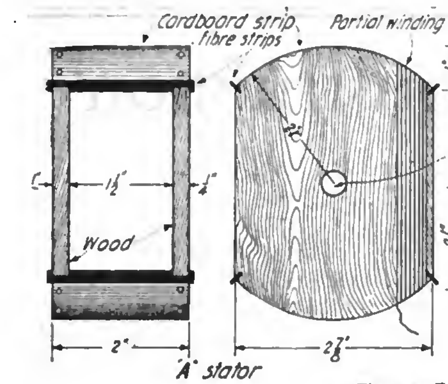
The second type of variometer is made as shown in Fig. 3. At A is shown the form for the stator made of wood sides and heavy cardboard strips at top and bottom. Slots cut into the wood at the ends of the strips have strips of fiber forced in them to prevent the winding from slipping off. The winding can be done in single or banked layers, the turns being pushed aside at the centre to permit the rod to pass.

The rotor is cut from wood as shown at B and the edges rounded. Here also fibre strips are inserted to hold the wires. The windings on stator and rotor should have equal values of inductance, the usual practice being to wind equal lengths of wire on both.

After assembly the rotor is fastened to the shaft by a long brass screw run in from one side. The leads from the rotor are preferably brought through holes in the stator near the shaft after wrapping the wire once or twice around the shaft to allow play. The stator is mounted in the cabinet by two strips of brass attached to the edges with small brass wood screws as shown in the illustration.

This variometer is likewise compact and rugged and still has the windings close together, thus obtaining highest efficiency in operation.

No data as to size of wire, etc., has been given, the object being only to show constructional details. The dimensions given are proportional and by retaining them the constructor has a symmetrical instrument.



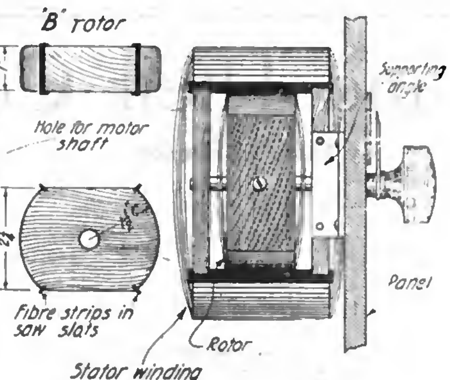


Figure 3—Plan view of the new type of variometer. Figure 4—Variometer mounted

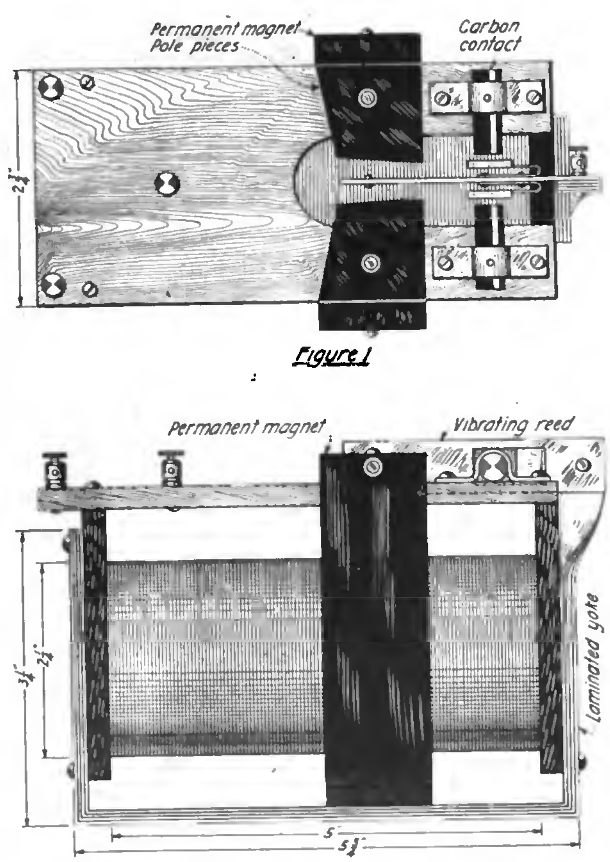
A Small Rectifier for Charging Storage Batteries

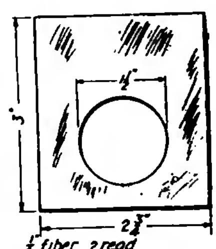
By Armo A. Kluge

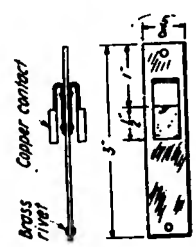
STORAGE batteries are universally used in amateur radio stations for operating the filaments of vacuum tubes and their upkeep forms one of the greatest items of expense connected with a receiving set. Nearly every station has a source of alternating current supply, however, and by the construction of a small rectifier the batteries can be charged from this source at a trifling cost. This should be of particular interest to amateurs who contemplate the use of multi-stage amplifiers and vacuum tube transmitters which require considerable current.

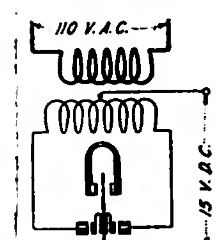
The rectifier to be described is of the magnetic type having a vibrating reed for changing the connections of the circuit so as to rectify the current. This reed is the weak point of most amateur rectifiers, as it is usually not designed for the frequency at which it must vibrate, while if designed according to principles of physics a most efficient rectifier will be produced. The rectifier here described is designed for operation on 60 cycle supply current, so that the reed must vibrate 120 times per second.

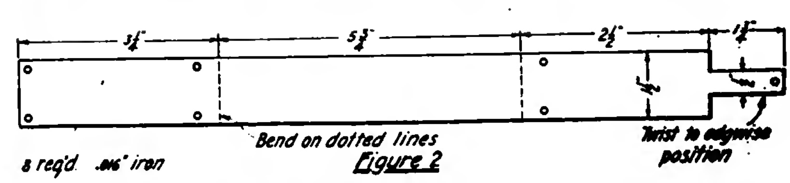
Figure 1 shows a top and side view of the completed instrument. It consists essentially of a small step-down transformer, a permanent U-shaped magnet with two small pole pieces, and a vibrating reed, one end of which is attached to an extension on the core, and the other end is free to vibrate between the poles of the magnet. This reed carries two contacts on opposite sides for alternately mak-











Detailed and assembled views of various parts of the rectifier ing contact with either of two stationary carbon contacts.

The core for the transformer is composed of a bundle of iron wires assembled in a fiber tube 5½ inches long and 1½ inches outside diameter, with a 1/16 inch wall. Annealed iron stove wire cut to the proper lengths will be satisfactory for this core. After the end pieces and the windings have been put on the core a magnetic yoke is screwed on to the end pieces to complete the magnetic circuit. This yoke is laminated of eight pieces of transformer iron, measured and bent as shown in the detail drawing, figure 2.

The secondary winding consists of two layers of 67 turns each, No. 14 D.C.C. magnet wire. About ½ pound will be required. A tap is brought from the mid-point of the two layers to a binding post on the fiber top, while the ends are connected to the stationary carbon contact posts. The primary winding which is wound over the top of the secondary, consists of four layers (520 turns) of No. 22 D.C.C. magnet wire. About ¾ pound will be necessary. The leads from this winding are brought to two binding posts at the end of the fiber top. The transformer will consume about 100 watts on 115 volts, and will deliver 15 volts, 6 amperes, on the D.C. side. In case a smaller output is desirable, the addition of two layers on the primary, making a total of 780 turns, will give an input of 50 watts and an output of 10 volts, 4 amperes.

Figure 3 shows a detail of the fiber end pieces, made of ¼ inch fiber, and having a 1½ inch hole for the insertion of the core. Figure 4 shows the details of the vibrating reed which can be a piece of clock spring with two small contact springs riveted on

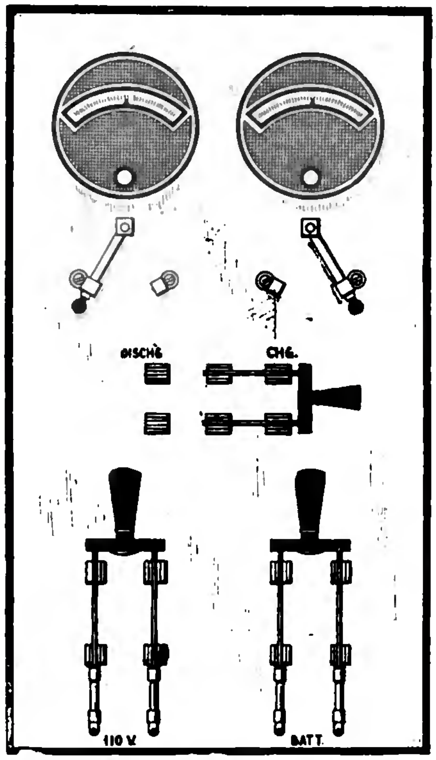


Figure 6—Suggested design for mounting the meters and switches used to connect the rectifier with supply current

the sides. These contact springs carry copper lugs at the ends for the contact faces. The small brass rivet near the free end of the vibrating reed is necessary to prevent the reed sticking to the permanent magnet on contact.

The circuit for the rectifier is shown in figure 5. At each reversal of the alternating current the magnetic polarity of the core—and thus of the reed—is changed, and the reed is attracted by the opposite pole of the permanent magnet. This results in a change of the contacts so that the polarity of the output terminals remains the same. This polarity depends upon the position of the permanent magnet and must be determined when the rectifier is first assembled. An easy way to do this is to put the two leads in a glass of water, the one giving off an excess of bubbles being the negative.

In addition to the rectifier, a small ammeter (0-10), a volt-meter (0-8), and a hydrometer should be included in the equipment for charging batteries. A suggested design for mounting the two meters and the necessary switches for permanently connecting the rectifier to the battery and supply current is shown in Figure 6. The small two-point knife switches are for throwing the meters out of circuit, the D.P.D.T. switch for connecting the storage battery to either charge or discharge, and the two fused switches for the supply current and storage battery connections.

A word with regard to the care of batteries. They should be charged every two weeks, even if only an hour's charge is necessary. Distilled water should be added when the solution gets below the top of the plates. While connected to the supply current a three-cell battery will read 7.5 volts when fully charged.

Construction of a Laboratory Transformer

By Thos. W. Benson

THIS transformer will be of interest to those who have occasion to use voltages ranging between 5 and 1000 volts. It will have constant service capacity of 250 watts, which rating can be exceeded for short runs. It may be connected directly to 110 to 220 volt supply mains, requiring no extra inductance or resistance.

The outside dimensions of the core are 6" x 8", the cross section measuring 1½" x 1½". Twelve pounds of iron will be required cut into strips and 1½" x 6½" and 1½" x 3½". Sufficient strips should be cut to make a pile of each size 3" high. Divide each pile into two equal parts, thus getting material for the four legs of the transformer. The longest strips form the winding legs. The strips should be painted with shellac.

To assemble them, provide a device as shown in Fig. 1. Two pieces of wood are mounted 8" apart on the base with a third piece arranged to form a back. Now by putting alternate pieces of core against the ends of the arrangement the core can be quickly built up. After a pile 1½" high is obtained, it should be carefully removed and tightly bound together with friction tape. The other winding leg is built up in the same manner.

Heads are now fitted to the two windings cores. They are cut from ¼" fibre to the size shown in Fig. 2 and slipped over the ends of the cores. The cores are now wound with three layers of empire cloth or paper shellacked into place.

On one leg wind 10 layers of No. 18 D.C.C. wire, tapping at each layer and tagging the leads A, B, C, etc. Each layer should be given a coat of shellac to hold the wire into place. The coil after winding should be placed in an oven to dry thoroughly. Stranded lamp cord in one foot lengths should be used for making taps.

The other leg is first wound with four layers of No. 14 D.C.C. wire (2 lbs.), tapping each layer and tagging the leads 1, 2, 3, etc. This winding is covered with three layers of empire cloth and the fine winding then put on. The latter consists of ten layers of No. 24 D.C.C. wire (1 lb.), which is also tapped at each layer, tagging these leads a, b, c, etc. After thoroughly shellacking this coil it should be baked until dry.

The transformer may then be assembled. Stand the two wound cores on their end and insert the cross pieces of core iron in the slits at the end of the cores as in the usual construction.

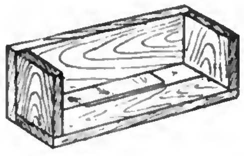


Figure 1

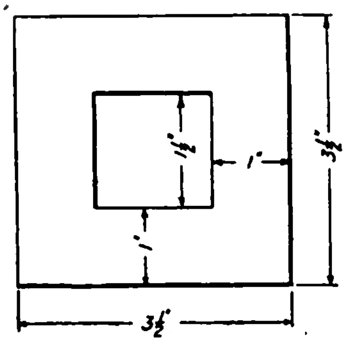


Figure 2

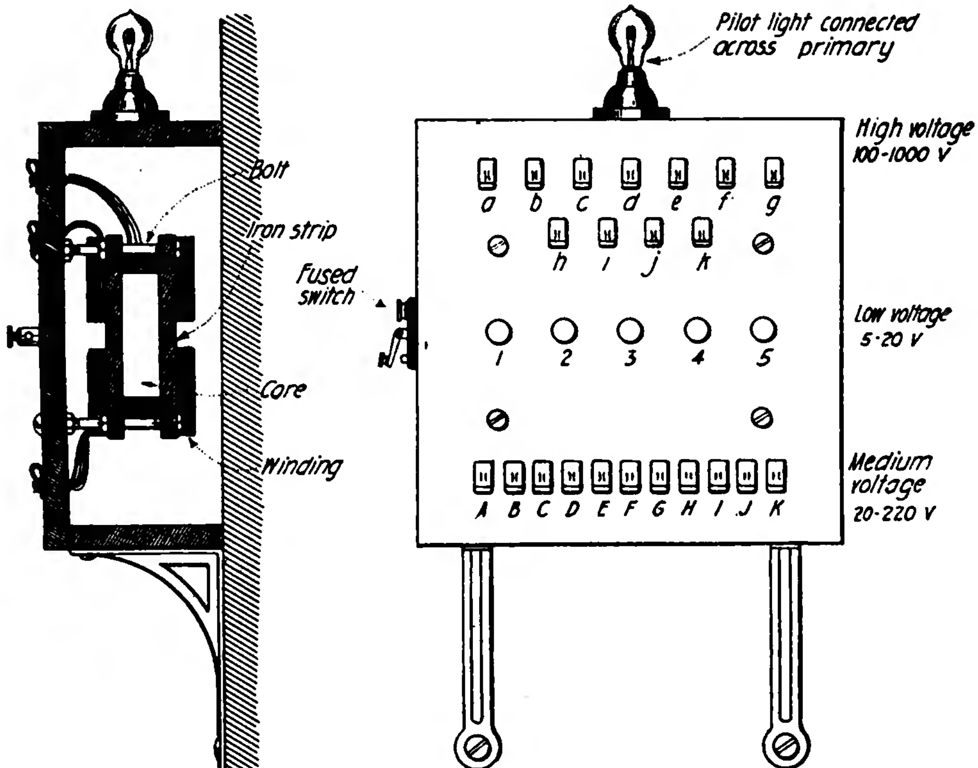


Figure 3

Figure 1—Box for assembling core. Figure 2—Dimensions of coil heads. Figure 3—Transformer completed showing interior arrangement and method of connecting leads

At Fig. 3 is shown a good method of mounting the transformer in a box on the wall. Bolts are used to support it clear of the box, which should be lined with asbestos and holes cut in the bottom and top to allow the air to circulate.

On one side a fused switch and an indicating lamp is mounted to show when the power is on and thus prevent accidents.

The front of the box has binding posts that are connected to the taps from the coils and marked accordingly. Spring binding posts obtained from old batteries will be suitable, but screw binding posts are preferred for the low voltage connections where heavy currents are drawn.

As to the voltages and how obtained: If the house service is 110 V, connect the leads from the switch to the taps A and F on the No. 18 winding. Should it be 200 V, connect to taps A and K. Between post A and K it is possible to draw from 20 to 220 V in steps of 20. This coil acts as an auto-transformer.

Between posts 1 and 5 the voltage ranges from 5 to 20 in steps of 5 volts. The fine winding will give voltages between 100 and 1,000 V by spanning the proper number of sections in steps of 100 volts.

This transformer will work direct on 60 cycle current; for 25 cycle supply insert a choke coil of the same general dimensions as the No. 18 winding on the transformer proper. On 133 cycle current the rating will be cut down to 125 watts at full load, due to the higher choking effect of the primary in the higher frequency.

It is advisable to put fuses in the primary circuit that will blow if an overload comes in on the transformer. This will effectively prevent damage to the device.

A rheostat may be included in circuit if fine variations of voltage are desired.

Use extreme care with the 1000 V secondary or a nasty shock if not a fatal accident may result.

Construction of Variable Condensers

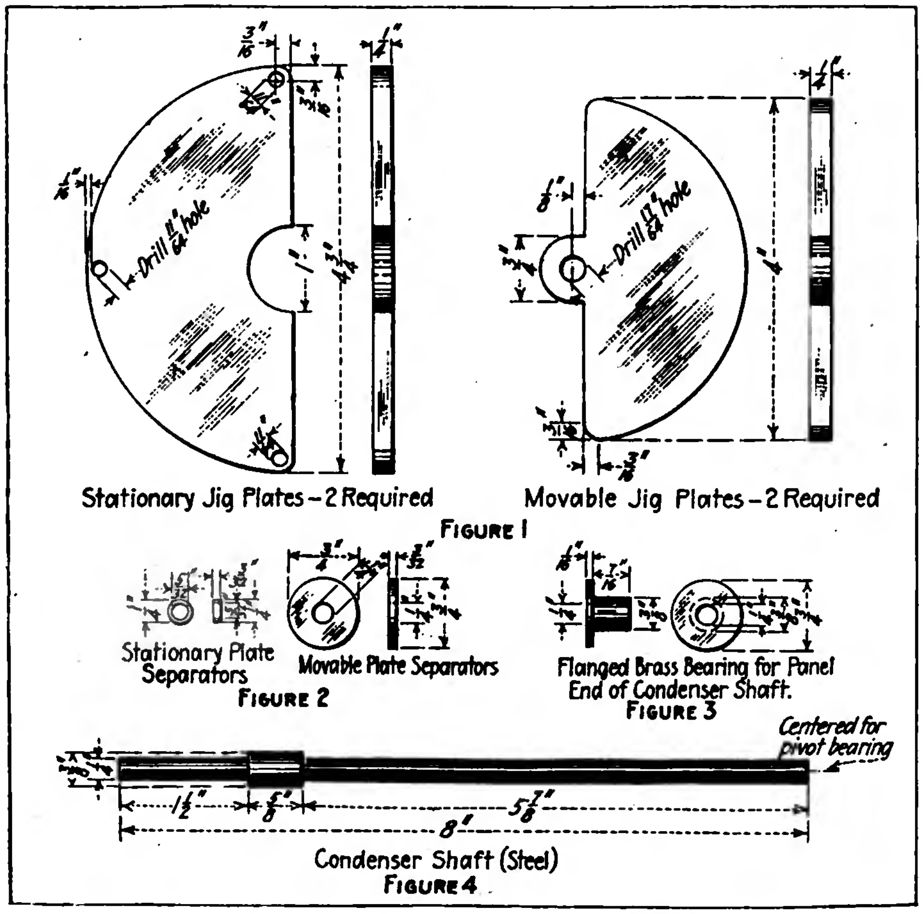
By Ernest G. Underwood

PROBABLY a great many amateurs have made more or less earnest attempts to construct their own variable condensers. In the majority of cases, however, one is apt to give it up as hopeless unless he goes about it in the proper way. The variable condenser is one of those pieces of apparatus which the amateur cannot well be without, but he has been forced in order to provide himself with a condenser which was at all satisfactory, to purchase one of those on the market.

It is the intention of this article to give a few suggestions regarding variable condenser construction which, if followed out, should enable the amateur to build his own variables for his particular purposes.

The three most important parts of a condenser, and the things which are also usually the most difficult for the amateur to construct are the plates, the spacers, and the shaft. The accompanying drawings give dimensions of jigs which were used for making the condensers which I am incorporating in a new receiver now under construction. It is the use of these jigs which makes it possible to uniformly shape the plates in order that, when the condenser is finished, it may be neat in appearance.

The size of these jigs as well as dimensions for all holes, are shown in figure 1. The jig plates were turned from "XX" Grade Steel, and should be not less than ¼" in thickness. These plates were made for me by a machinist, from drawings furnished. He shaped them, bored the holes, and tempered them. Their cost will vary according to the cost of the material and labor, and if several condensers are to be made, the initial cost will be



Detailed constructional plans for the variable condenser

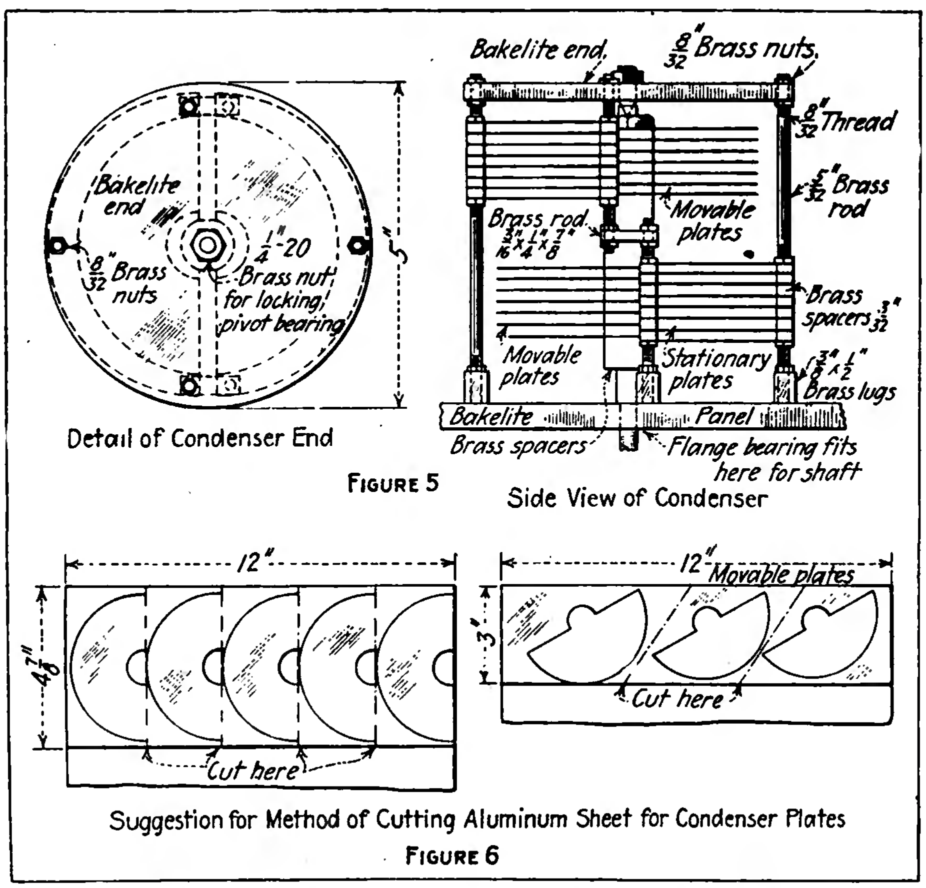
more than compensated for by the money saved, the appearance of the finished condensers, and the pleasure to be derived from their construction.

Attention is called to the fact that the front and inside edge of the movable plates is 1/8" distant from the center of the shaft hole. This spacing is desirable in order that a low zero value of capacity may be had. This distance, of course, may be increased if desired.

No. 20 or 22 gauge sheet aluminum is preferred as the material from which the condenser plates are made. A thinner aluminum bends easily and is harder to keep in shape, thus tending toward short circuits. The use of heavier aluminum simplifies assembly considerably and makes for a more rugged unit. This sheet aluminum comes in 12" widths.

Figure 6 shows the method of cutting and laying out the plates. The aluminum is first cut into pieces of about the proper size for the plates. Three or four of these pieces are clamped between the jig plates in a vise, and the holes bored. If the jig plates have been carefully aligned, the drill in passing from the hole in the front plate into the aluminum, will then pass out through the corresponding hole in the rear plate. A little care will be needed in handling these jigs but it will not be long before it is possible to use them quickly and accurately. It is well to drill all the plates first before attempting to shape them. After drilling has been done, take three or four plates and clamp them between the jigs, using No. 8-32 machine screws as clamping screws for stationary plates, and 1/4-20 machine screws in the case of the movable plates. After the plates have been securely clamped, they are again placed in the vise and as much of the surplus aluminum as possible is cut away with a hack saw. A fairly coarse file is then used to cut them down to the point where the file strikes the hardened steel jigs. After the plates are removed from the jig, the rough edges are taken off with a file and finished with sandpaper. They must then be flattened. This may be done as follows: Place the plates on a perfectly smooth board and tap lightly all over with a wooden hammer if this is available, until they lie perfectly flat.

We will next consider the brass spacers which separate the movable and stationary plates. These washers are shown in figure 2. The small ones are made from 1/4" brass tubing, the large ones from 3/4" round brass rod which has been drilled in the lathe before being cut off. In cutting off these separators, care should be taken to see that they are all exactly the same thickness. It is a rather difficult matter to get these spacers exactly the same size in the average lathe. This difficulty, may be gotten around by cutting off several more than will be required for the particular job in hand, and selecting the ones which are suit-



End and side views of the condenser and method of cutting the plates able for use, with the aid of a micrometer or gauge, or if they run somewhat over-size, they may be ground down one or two thousandths of an inch by rubbing them over a piece of fine emery cloth laid on a flat surface.

The shaft is turned up on a lathe from either steel or brass and is centered for a pivot bearing in one end (see figure 4.) A flange bearing is used for the panel end of the shaft. A gear wheel may be mounted on the large part of the shaft (which also acts as a thrust bearing for the shaft) into which a smaller gear wheel, controlled by a small knob on the front of panel, meshes. This gear reducing arrangement provides a fine adjustment for the condenser, and when used in modern oscillating circuits, is an extremely handy affair.

Figure 3 shows the flanged brass bearing used on the panel end of the condenser and against which the enlarged portion of the condenser shaft thrusts.

The assembly in figure 5 shows a balanced type of condenser with which no counterweights or friction bearings are needed. Such a condenser will always hold its adjustment. The bakelite end which holds the pivot bearing is also shown in this figure as well as the arrangement of tie rods. These tie rods are of 5/32" round brass and may be threaded 8-32. Care must be taken to make sure that the holes in panels are in perfect agreement with each other as well as with the holes in the plates; otherwise, the condenser will not properly line up and the shaft will bind. The use of a little care in laying out these pieces will prevent any such thing as that.

Finally, a connection is brought off from the movable plates by means of a flexible bronze ribbon fastened to the hub of the gear wheel or to the shaft and after having been wrapped around the shaft two or three times, terminated at a stud fixed in the panel. A stop must also be provided either in the condenser itself or on the front panel after knob and pointer have been attached, to prevent the movable plates from making a complete revolution.

These suggestions should help those who desire to construct their own variable condensers. Condensers of any size and plates of any shape may be made in this way, and the plates may always be depended upon to line up nicely when finished.

A Receiver-Transmitter

By C. C. Henderson

THIS is for the amateurs who use the heterodyne hook-ups for receiving.

I have assumed that we all know that when an audion is in the oscillating state a continuous or undamped wave is set up (generated), the characteristics of which are similar to the wave sent out by an arc transmitting station.

An oscillating circuit consists of an inductance and capacitance and this is just what we have in our receiving sets. Tune the receiver to say six hundred meters. Make sure set is oscillating. The result is that a six hundred meter undamped wave will be radiated from the antenna which—provided perfect resonance has been obtained in the receiving circuits—can be heard by another station several miles distant. The length of this wave is changed simply by tuning the receiver to any desired wave. Most operators know the approximate instrument setting of their receivers for any desired value. For those who are always changing hook-ups, resonance can be obtained by overloading bulb filament until a low hum is heard in the phones; next tune primary and secondary circuits until this note "clears up" and maximum strength of phone signals is obtained.

I have had good results on both sending and receiving with wave lengths from 124 meters up to about 8500 meters. Above this value the oscillations become feeble and good results can hardly be looked for.

There are several ways of breaking the generated wave up so as to enable the operator to form code characters. The hook-up shown in the accompanying diagram will give best results however, as it eliminates entirely any compensating or back wave. "A" is an ordinary telegraph key and shunted around the key is a small single pole, single throw switch, "B" which is opened only when operator desires to transmit on receiving "transmitter."

I was on one of the American battleships that formed a unit of the British Grand Fleet during the last thirteen months of the war. Up to the time of our departure for the other side almost every ship in the American Navy was relying on crystal detector reception for all ordinary work. We finally arrived at our base in the North Sea and discovered that Galena and other detector crystals were not going to do the work, so audion reception was started. All ships had to listen in on the same wave-length and this caused the trouble. Using a heterodyne hook-up we could hear innumerable high pitched notes in the receiving phones at all times. Another operator and myself started to ponder over the mystery. I found that by touching some bared portion of the receiver the receiving note was broken. After several days of experimenting communication was established with the battleship New York and a week later the five ships of the American squadron were having a gay old time. But, of course, every good thing has a climax and ours came with a rush. The British operators copied our stuff but they were not in on the secret. I believe a few uncomplimentary remarks were passed about British operators and one of the British flagships managed to collect some convicting evidence. Result was that several senior operators (including myself) were treated to five days solitary confinement in ship's brig for "unauthorized radio communication." It might be noted in conclusion that Admiral Beatty, British Commander-in-Chief, ordered a two day test on "receiving transmitter" work shortly after the "martyrs" to the cause had been released from confinement. Far be it from me to expect any "laurels" for the Yankee "achievement." Due credit must be given to J. McGarry, U. S. S. Florida, and an unknown operator on the New York. I also wish to extend my heartiest congratulations to the British operator who managed to get the "goods" on us. Why? Because we were never able to locate him. Probably "sunk without a trace."

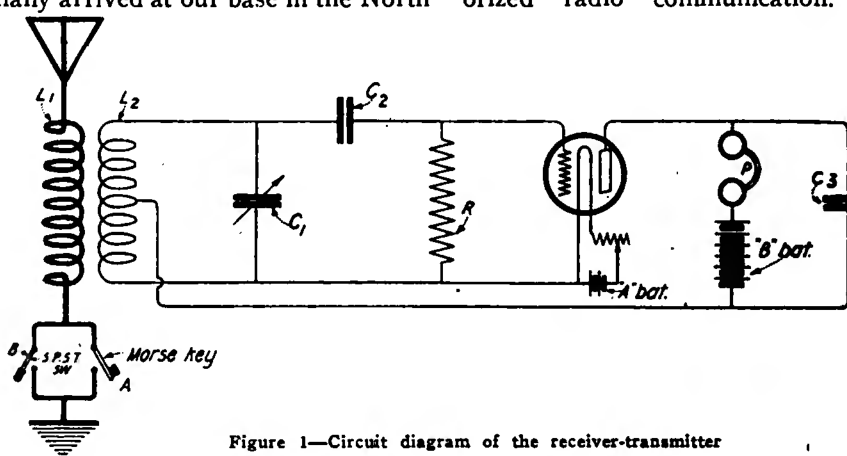


Figure 1—Circuit diagram of the receiver-transmitter

Amateurs On the Job

By Maurice Henle

A FEW short months ago occurred a little drama in the town of Greenville, Ohio, represented by a tiny dot on the map and situated not so far from Cincinnati. Belasco would probably not pause to witness it; nor would Maeterlinck; but it was a drama nevertheless, a real drama.

At a number on West Main Street a youth mounted the stairs to his room. The sun had long since disappeared from view beneath the horizon, and the mystery of the night was abroad. It was one of those nights that make the youthful American mind wander and wonder what is happening away out in the big world, the world into which he hears going those shrieking far-off moanings of the rushing locomotive. He mounted the stairs and closed the doors.

He placed the phones about his ears, threw in his aerial switch and tuned his coupler. A few buzzes; the weather report; he tuned again; the baseball score; the time—

He had now tuned down to about 200-meter wave length, and...

"Hellooo....."

He heard it as distinctly as if his own voice had uttered it. But he hadn't spoken and neither had anyone else in that room or that house. It had come from those receivers so snugly entwined about his head. It was a voice from out the darkness through the greatest annihilator of time and space!

C. H. Katzenberger, now only 19, who was thus thrilled with this revelation of wireless telephony, since has come to Cincinnati to attend a technical school. He lives at the Central Y. M. C. A. and there has installed another wireless set, for he says now his life is not complete without one.

He built the aerial upon the "Y" roof with the permission of officials and strung the wires himself to his room, No. 601. He has received from Key West, Portland, Arlington, and many other far-off places.

* * *

"And it shall come to pass in the year 1919 A. D. that there shall aris a powerful organization to whicl everyone of the more than 250 amateur wireless operators in and around Cin-

Dorman Israel, prominent wireless amateur in Cincinnati

cinnati will belong; which shall hold regular meetings to which all members may attend and discuss problems of wireless which arise so that all may benefit; that there shall be a cozy clubroom with comfortable chairs and plenty of magazines where all may drop in and chat and meet their fellow operators; so that they may thus profit in wireless and communication!"

No, patient reader, with your mind teeming with vacuum tubes, and aerials, and detectors, and loose couplers, and antennas, and one hundred and one of the vitals of wireless—this is not a parody on the Book of Books. It is a page of the unwritten Bible of the amateur wireless operator, a lore which has been learned by heart by every earnest devotee of the greatest of indoor sports, not even excepting African golf, spooning, and billiards.

Wanted: A wireless club!

Wanted! And badly wanted. It is this lack of co-ordination, and only this lack of co-ordination which is retarding the Cincinnati amateur wireless operator, and holding him back from better things. It is this lack of co-ordination and unification which made amateur wireless operating at times so miserable a pursuit, especially before the war. For the amateur who cannot send properly is a meddlesome beggar; and that is one strong reason why a club of operators is imperative.

The plan in the minds of most amateurs is to have a sort of Congress, with an upper and a lower house. In the upper branch would belong only licensed operators. They would be the more skilled; those with better equipment, and surely with a better understanding of the code and instruments in general. In the lower house would belong that great army of unlicensed operators—those who receive only and do not send.

And the two bodies, members of the one club, would meet in separate session and discuss the problems of their respective worlds. The little difficulties which arise would be ironed out, not only to the satisfaction of the operator who is perplexed, but for the benefit of the entire membership as well, which also might be puzzled with those same problems at some future time.

As soon as a member of the lower house is proficient and acquires an operating license, he would automatically leave that branch and be enrolled on the roster of the upper house, where he would immediately be thrown into contact with fellows who have had more experience and from whose gossip and debates he could obviously profit.

And not only does he want a place where he may gather with his fellows, but he also wants competent instructors from whom he may learn the latest in what he considers far more important than meals.

That is what is wanted in Cincinnati. And that is what is utterly lacking.

There can be just a certain amount

of straining at the leash before the bonds will burst. The strong man will make his muscles bulge, his face grow purple, but it is just that last scintilla of effort under which the encircling ties will snap.

And so it is with the wireless situation in Cincinnati. The old laws of supply and demand hold good. And as the club is wanted, so have rumors and even more than rumors been radiated through the air waves.

Let us go back two years or more. Amateur wireless was gaining a strong foothold in the Ohio valley. More and more young men were buying instruments. The Ohio Valley Wireless Association had been organized and had "flivvered" for lack of members and executives. Over at Hughes High School a wireless club had been formed for students of the school who owned wireless sets at home. And a complete outfit was set up at the school, so that keen interest was being displayed by the students. Then came the war.

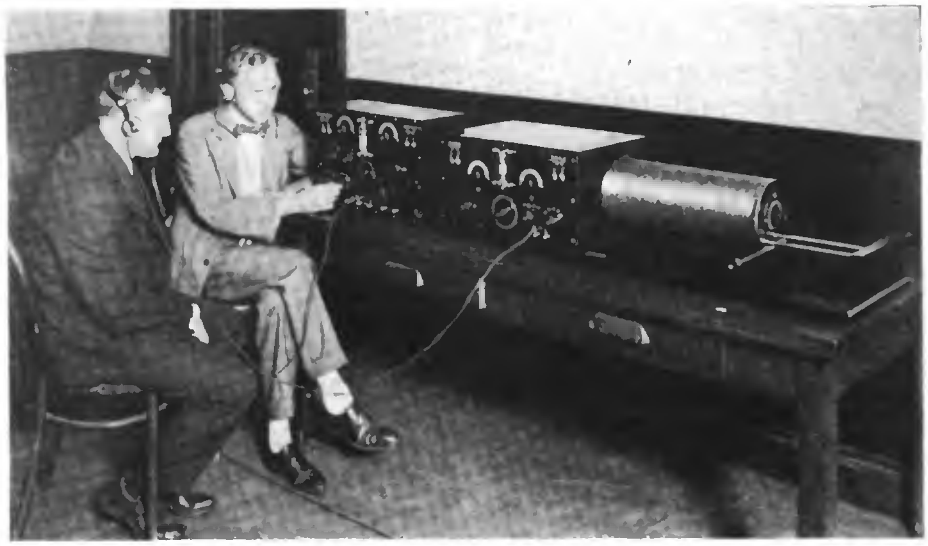
Immediately, of course, the government tabooed wireless in Cincinnati and the country. Seals were placed on the sets with heavy penalties attached for breaking them. The aerials were brought down and stowed away in the garrets to be kept there until the Germans signed on the dotted line.

But above all these activities, one effort stood out as pre-eminent. The Union Central Life Insurance Company which owns a skyscraper in Cincinnati, second in beauty and height only to buildings in New York, conceived the idea of building an amateur station. The outfit was to be installed in their building, and at the same time a Wireless Club would be formed for the amateurs in and around Cincinnati in order to stimulate and develop interest in wireless telegraphy. The company planned to have men who understood wireless telegraphy give lectures and practical demonstrations, just as the amateur would wish it. But the war stopped all of it.

Now, the ban has been lifted, for since the 15th of April last, amateurs have been permitted to break the seals of their instruments and receive messages, and with the lifting of the ban on transmitting, on Oct. 1, activity by the Union Central company was again renewed. On the very day of the lifting of the ban, the aerial was brought out and extended from the eighteenth to the thirty-fourth floor at a ninety degree slant, the tap for the lead-in being brought into the thirtieth floor where the station is located.

The coming to Cincinnati recently of a Captain J. P. Gray, of the United States Coast Guard Service, to make a preliminary survey of possible locations for a government wireless station for use by the army, the weather bureau, and other governmental departments, was the signal on the part of the management of the building and W. C. Winall, chief electrician, to endeavor to have that place designated as a government station.

The federal authorities contemplate establishing five or six stations in the Ohio Valley and to equip many government boats on the Ohio river in case of floods, or other emergencies. Captain Gray has recommended the Union Central Building, Hughes High School, the federal building, and several others.



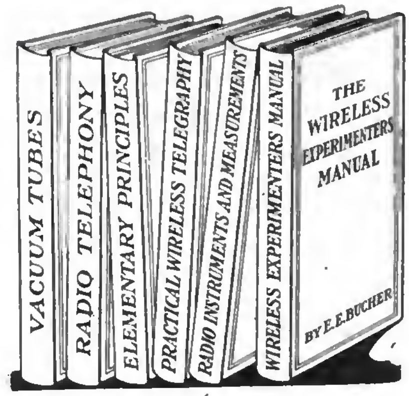
Wireless apparatus used by the Union Central Wireless Club

And—to digress—Winall, after telling of a letter he sent to Captain Gray urging designation of the Union Central Life Insurance outfit as a government station, reveals one of the most interesting sidelights of the great part Cincinnati played in the war, and the part wireless came near performing.

Rumors had been flying thick and fast that radicals planned to blow up

Which Way?

Franklin Studied Electricity via The Kite String



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not only the telephone building, but the telegraph companies as well, with the object thus of severing Cincinnati from the outside world. As soon as the rumors had been definitely traced and some truth to them found, steps were taken immediately to stave off a possible attack by the radicals, and to fortify the city if such a move were made. The Western Union was ready to remove its offices in an instant, and complete trunk lines could have been connected immediately, if the main ones had been blown up. Not only this, but Winall urged the navy officials to consider the wireless station, then dismantled, at the disposal of the government, saying that it could be put in operation in twenty-four hours.

Throughout these uncertain times there remained with Winall a man who had helped him put up the set, Ira Holden by name. He and Aaron Hubbell were pioneers in wireless operating in Cincinnati, having set up the very first instrument ten years ago, which since has multiplied until hundreds of them bind a band of unseen ears about the city. The training Hubbell received, by the way, stood him in good stead in the war, for eighteen months he served in France as an aviation wireless tester.

But to return, the idea of the Union Central Life Insurance Company establishing a Wireless Club has not been abandoned; on the other hand it has been strengthened; but until the ban on sending is lifted, nothing will be done to organize it.

The spark and arc receiving sets with a temporary aerial have been put up with good results; messages have been received since April 15th from the following stations:

Arlington, Charleston, Great Lakes, Pensacola, New Orleans, Cuba, San Diego, Cal., New Brunswick, Annapolis.

The lowest points of the permanent aerial will be not less than 250 feet above the ground and the upper will be about 485 feet above the ground. This aerial will not be vertical but will be offset about 100 feet. It will be composed of phosphor bronze stranded wire. The sending set is to be a 500 cycle equipment, 20,000 volt.

The building in Cincinnati which has an antenna strung from the eighteenth to the thirty-fourth floor

1 kw. power. They have a powerful transformer and motor generator. As yet, the company has not purchased a quenched spark gap, which is the only article needed.

This is about the most complete outfit in Cincinnati, and will undoubtedly be looked upon as the "mother station," of the vicinity.

* * *

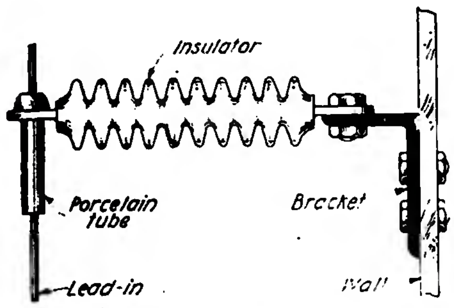
Red-blooded Americans, who helped lick the Boche with their knowledge of dots and dashes, are coming back, and with them come weird and bizarre tales of adventure. And they have brought back new ways of wireless which they will put to use in their private operation of wireless. For wireless is the one thing which is all mighty to the fiery minds of the red-blooded Americans.

A long and happy life to the hundreds of Temples of Experimenting.

Lead-in Construction

By Henry Klaus

MANY amateurs, especially in cities, are compelled to put their aerials on buildings and the lead-in must be kept clear of everything. The accompanying sketch suggests an inexpensive but efficient way to insulate the lead-in from the building.



Constructional view of lead-in

A common electrose strain insulator is bolted to a bracket fastened to the building and a porcelain tube put through the other eye and the lead-in is brought through this tube. Two or three of these will hold the wire firmly.

Sealed Detector

By L. B. Salt

THE accompanying sketch shows a very good sealed detector which I made about a month ago, and which, as far as I can see, is as sensitive today as when it was made.

Details of the sealed in detector

The main holder is the base of an automobile lamp. The glass was broken away level with the top of the base and the two wires bent in such a way that a thin piece of crystal could be inserted between them. A test buzzer was used to find the sensitive part of the crystal, and a small piece of sealing wax was melted into the base to hold the crystal and lower part of the wires. Then more wax was put in until it was level with the top of the base. The test buzzer was kept going all the time to be sure that the crystal did not move while putting in the wax.

The wax which I used was taken from the top of a flash-light battery.

The socket into which the base fits can be bought at any automobile supply house for a very little, and burned out lamps can probably be picked up at any garage for nothing.

Several of these detectors can be made up of different crystals, and any one of them inserted in the set in a second.

If one desires to cover the crystal completely, different color sealing wax should be used to designate a certain kind of crystal.

This detector makes a neat looking one on a set, and is small and rugged for a portable set.

Prize Contest Announcement

The strike of the printers, which placed this magazine eleven weeks behind its scheduled publication date, so multiplied the difficulties with the prize contests that no manuscripts have been received on several of the selected subjects. It is clear that the situation is entirely due to the unexpected series of printing delays. For example, the closing date for the March issue contest was set at February 14th, whereas the magazine was not delivered to readers until this date had gone by. Similarly, February 29th, as the closing date for contests originally announced for the November and December issues, did not provide ample opportunity for contestants to send in their manuscripts.

These contests are run for the benefit of our readers, to provide them with funds to continue their experiments. It, therefore, seems fair to all to make the following new offer:

The subject for the April issue will be:

"Mast Construction for the Average Amateur"

Closing date March 17th.

The subject for the May issue will be

"Design and Construction of a Low Power Transmitter for Local Use"

Closing date April 3rd.

Contestants for the prizes are requested to submit articles on either of these subjects, or both of them, at the earliest practicable date. An additional contest subject will be announced in the March issue.

PRIZE CONTEST CONDITIONS—Manuscripts on the subjects announced above are judged by the Editors of The Wireless Age from the viewpoint of the ingeniousness of the idea presented, its practicability and general utility, originality, and clearness in the description. Literary ability is not needed, but neatness in manuscript and drawing is taken into account. Finished drawings are not required, sketches will do. The contest is open to everybody. The closing date is given in the above announcement. The Wireless Age will award the following prizes: First Prize, $10.00; Second Prize, $5.00; Third Prize, $3.00; *in addition to the regular space rates paid for technical articles.*

All manuscripts should be addressed to the Contest Editor of The Wireless Age.

An Indoor Loop Antenna

By L. W. Van Glyck

ALTHOUGH the simple antenna herein described is now quite common it is seldom used by experimenters in general. This antenna possesses both advantages and disadvantages when compared with the usual amateur type. It possesses the advantage of picking up less static. It is portable, compact, and easily constructed at a much lower cost than the elevated type. It is highly directive, receiving best from stations lying in its plane, and practically not at all from stations at right angles to its plane. If it is turned so that its plane is parallel to the surface of the earth it receives equally well from all directions. On the other hand the antenna herewith described will not pick up as much energy from the transmitting station as the average out-door antenna, but what does that matter in this age of vacuum tube amplifiers?

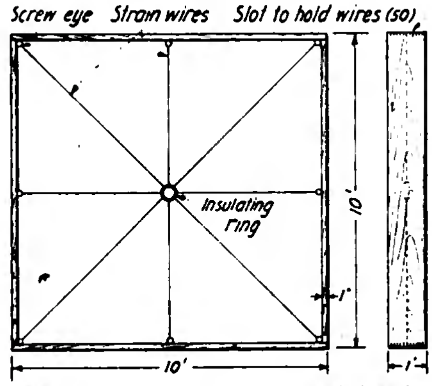


Figure 1—Construction of the insulating ring

The frame is constructed of any soft, light wood, such as basswood. It is wound with 60 turns of No. 20 or No. 22, single silk covered wire, the wire running through the slots in the corners of the frame. These slots may be made with a fine toothed saw. The two ends of the wire are brought to binding posts in the frame at any convenient point and connected to the loose coupler as shown in figure 2.

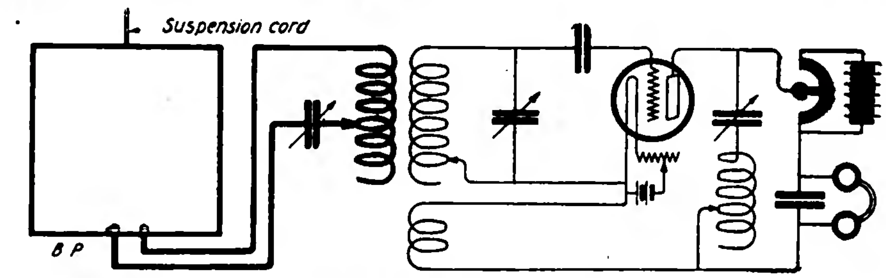


Figure 2—Diagram showing the binding posts and connection to the loose coupler

The method of connections is optional, but I have found the hook-up as shown to work very well. It is advisable to use a one-step amplifier for distances over two or three hundred miles.

The Monthly Service Bulletin of the

National Amateur Wireless Association

Founded to promote the best interests of radio communication among wireless amateurs in America

Guglielmo Marconi, *President* — J. Andrew White, *Acting President* — H. L. Welker, *Secretary*

Headquarters, 1868 Woolworth Bldg., New York

Ambitious Program for Bayonne

PLANS for one of the most powerful amateur radio telephone sets ever erected in the Atlantic seaboard section of the country are being considered by members of the Peninsula Radio Club, 17 West 31st Street, Bayonne, N. J.

The club has installed a receiving set of the latest type obtainable; an efficient amplifying set also has been installed.

Members of the club are desirous of interesting Jersey City wireless "fans" in their work, and Secretary Oliver, in behalf of the club, extends to all Jersey City amateurs an invitation to communicate with him and to visit the clubhouse and inspect the plant. It is hoped that some of the Jersey City enthusiasts will join the local organization. Especially is it desired that young men who have never taken an active part in wireless experiments interest themselves in the meetings of the club, which take place each Monday night. At each meeting experiments are made with different types of bulbs and code is practiced.

New Facilities for Amateurs

LOUIS G. PACENT, well known to New York amateurs, has organized an electrical company, through which he expects to serve amateurs to "a greater extent and in a better way than ever before."

Mr. Pacent spent the past ten years with the Manhattan Electrical Supply Company, in charge of their radio departments and all their radio activities.

In his new capacity he will deal in radio and other electrical apparatus for electrical, laboratory, and communication purposes. Every piece of apparatus will be thoroughly tested before it is offered for sale.

Radio men, experimenters, professors, instructors, government authorities and all other interested persons are at all times invited to visit the rooms at 150 Nassau Street, New York, where a complete line of all the latest equipment will be on exhibition. A radio reference library, files of current technical periodicals, special reports—these and years of experience will be at the disposal of all interested persons.

Radio Intelligence Post of the Legion

THAT wireless men will stick together in peace time and keep alive the friendships which grew out of association in the war was demonstrated in the enthusiastic meeting of the Radio Intelligence Post of the American Legion, held at the Berkley Hotel, New York City, on February 3. An unusually entertaining evening was enjoyed and a very attractive program was outlined for the future. The Secretary is eager to communicate with men who served in the Radio Branch of the Military Intelligence Division, both overseas and in the U. S. The Secretary is Arthur L. Bernhard, 1679 42nd Street, Brooklyn, N. Y.

Marconi Expresses Gratitude

T. COMMERFORD MARTIN, chairman of the electrical committee which is raising, in honor of Marconi, a special fund for the Italian War Relief Fund of America, has received a very interesting letter from the distinguished president of our association.

"I cannot tell you how deeply touched I am at this unexpected proof of the sympathy of the American people for my country," Mr. Marconi says, "nor how greatly honored I feel that my American friends should wish to associate my name with a praiseworthy and noble object. Please allow me to express to you and to all who have contributed to this scheme for a special fund, my sincerest and most heartfelt gratitude.

"With regard to the sum of $2,500 which you state is immediately avail-

The style of this wireless set indicates in a manner the high type of the present-day wireless amateur able, you may send it to me and I will arrange for its distribution in Italy."

Mr. Marconi added heartfelt thanks "for the great honor which you and all other American friends have done me."

As previously stated in these columns, each subscription is accompanied by an autograph card, with the object of assembling all these cards later in a memorial album to be delivered to Mr. Marconi. Such cards can be obtained from the Committee at 29 West 39th Street, New York City.

"Y" Courses for Ex-Service Men

EX-SERVICE military and naval men, many of whom spent their last months overseas in taking up their educational work, are to have their opportunities continued at home in plants already well equipped and most readily adjusted to suit the needs of soldiers. The facilities of the Young Men's Christian Association and its complete organization in all parts of the country will be at their command for practical education, through free scholarships, as soon as local arrangements in the various cities can be completed.

The army's responsibility for educating the uninjured soldier ceased as soon as the red chevron appeared on his sleeve; but his need for training did not vanish in civilian life. Thousands of men who were interrupted in their life plans by enlistment in the Service, as well as hundreds engaged in the war industries, need further educational opportunities.

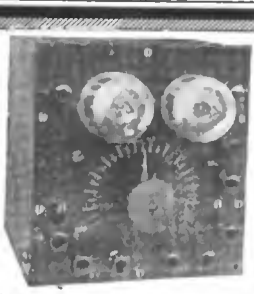
These are among the reasons which led to the decision to continue the educational service of the camp and cantonment. The cooperation of nearly two thousand Associations in the United States makes possible the completion of these plans. The enterprise, which will interest thousands of men in these groups, enlarges and extends the educational opportunity of many communities, and by its extension division reaches out to thousands of communities where no Young Men's Christian Associations exist. In addition, in a more limited way, it opens the portals of technical and collegiate instruction to young men properly qualified.

It is the aim of the United Young Men's Christian Association Schools to give the ex-service man just what he most needs, whether it be a short course initiating him into a new occupation, or a longer day or evening course preparing him for more technical efficiency. Because many will feel that they cannot go away to study, or give time during the day, the Association Schools will offer most of their courses at night in the cities where the students live.

For the correspondence courses, of which there is great need, the work will be conducted from one center.

Among the courses (correspondence or resident) that will be of direct interest to WIRELESS AGE readers are:

Radio Telegraphy,
Electricity and Magnetism,
Electric Storage Batteries,
Electric Wiring,
Electric Lighting,
Electric Testing,
Direct Current Machinery,



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Sparking is almost entirely eliminated, so that the energy lost in light and heat in the operation of other buzzers is here conserved and radiated in the form of oscillating energy.

This buzzer maintains a constant note and is recommended as an exciter for checking wave-meters where pure note and ample energy are required.

List No.		Price
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Send for Our Manual N 12

WIRELESS TELEGRAPHY

You should have it even if only superficially interested. Around about you every day you read of some marvelous occurrence in which wireless played a distinguished part. It may not be entirely clear to you. The Manual will explain it. To the student of Wireless Telegraphy, the Manual contains much that is indispensable to a proper understanding of the art. The Manual will contain about 200 pages, fully illustrated on high-grade paper stock with a two-color cover, and will be ready for mailing about May 1.

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Part of these scholarships will be available in the nearest United Y. M. C. A. School. A large number will be open through correspondence courses conducted by highly qualified experts. A small number will be offered in special technical schools.

The Extension Division of the United Y. M. C. A. Schools has decided to also help those who live where no organized "Y" exists, and who are not eligible for scholarships, by selling the same high-grade courses at a very nominal price. This school is not operated for profit.

Further information can be secured from the nearest "Y," or by addressing Headquarters, United Y. M. C. A. Schools, 347 Madison Avenue.

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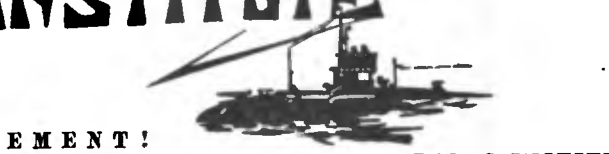

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Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with India ink. Not more than five questions of one reader can be answered in the same issue. To receive attention these rules must be rigidly observed. Positively no Questions Answered by Mail.

T. C. R., Montgomery, Ala.

We regret that we are unable to inform you as to where it will be possible to secure a design for a 2 KW. arc set.

* * *

H. S. B., Huntington, N. Y.

Reference to the use of closed loops for reception of radio messages was made in June, July, and September issues of the WIRELESS AGE. Further articles in this connection will appear at an early date.

* * *

J. P. S., Buffalo, N. Y.

For the construction of a condenser suitable for use with a 1½" spark coil, you are referred to articles which will be printed in early issues of this magazine. We are unable to give you the inductance value of your antenna but its fundamental wavelength is somewhere in the neighborhood of 230 meters. For the construction of an oscillation transformer for 200 meter work, we refer you to prize articles printed in recent issues.

* * *

J. G., East Orange, N. J.

It will be all right for you to use condensers of .0008 mf. and .001 mf. instead of the 21 plate condensers recommended by Mr. Sterns in his description of the "Universal Receiver." The receiving range of this receiver on 200 meters compares very favorably with the range when the average amateur short wave receiver is used. The "Paragon" mentioned is, however, very much more sensitive than any other receiver of which we know.

J. R., New York City.

A license of any sort is not required for the operation of a receiving outfit.

* * *

G. N. G., East Orange, N. J.

As far as we know, there are no loose couplers on the market having a maximum wavelength range of 300 meters. From what you say we gather that you are after a super-sensitive and extremely selective receiver for amateur wavelengths. The construction of receivers of this type has been described in recent issues of this magazine, or such a receiver may be purchased.

In the construction of a vacuum tube the amount of energy which any vacuum tube will furnish depends entirely upon the value of energy put into that tube. The problem then resolves itself into a problem of designing a tube which will stand high voltages and high currents. Power is measured in watts, not in amperes and the power is the product of the current and the voltage. With regard to the use of vacuum tubes for receiving work, the spacing of the elements is not the only consideration. The degree of vacuum has a great deal to do with the value of plate voltage required to bring the tube into sensitive condition. The audiotron is a tube of low vacuum, whereas the Marconi V T and the Westinghouse tubes have been thoroughly exhausted.

For a discussion of damped and undamped waves, we refer you to "Practical Wireless Telegraphy" by E. E. Bucher (Wireless Press, Inc., N. Y. C.). You will also be able to find in this text book a discussion of the oscillating audion.

As you will learn after referring to the above mentioned book, damped waves are emitted in groups at an audible frequency. The frequency of the waves themselves, however, is so high as to be inaudible. It is apparent, therefore, that if we wish to superimpose impulses at speech frequencies upon an electro-magnetic wave, we should choose that wave which on its own account produces no audible frequency at the receiving station, for, otherwise, the sound produced due to the discontinuity of the wave itself would interfere with the sound produced by the voice modulation.

The induction-like noise to which your receiving set has been subject is, we gather, due in all probability to the fact that somewhere in your vicinity a high tension line is discharging to the branch of a tree or to the earth, due to faulty insulation at some point. If, as you say, you are able to get it with the aerial disconnected entirely, it is probably nearby. If you can rig up a few turns of wire on a loop 2 or 3 feet square and arrange your receiving set so that it is portable, it will be possible for you to follow the electric light lines in your neighborhood and locate this discharge merely by moving always in that direction in which the strength of the signal increases. Upon locating the fault, if you will point it out to the Public Service people, they will, no doubt, remedy the matter. This procedure has been followed in many cases by amateurs.

* * *

H. T., Presto, S. D.

Probably the interference which you experience is due to the discharge of lightning arresters at the power station. Your proximity to this station is unfortunate. You will probably be able to do more for yourself by experimenting in an effort to learn the source of this interference than by listening to any suggestions which we might be able to make.

J. F., Jr., Danville, Ill.

If you are using an audion detector and a sensitive receiver, you should be able to get fair results with the antenna which you sketch. Your transmitting range, however, will be limited. It would be much better if you were able to stretch an antenna between the top of your galvanized iron pole and the roof of some nearby house or a tree.

* * *

C. N., Valdosta, Ga.

The instrument which you have in mind is called a telegraphone and consists of a steel wire traveling between two electric magnets. The messages are recorded upon this steel wire magnetically and upon running the wire through between the magnets a second time the message is reproduced. This instrument costs several hundred dollars.

* * *

B. J., Canton, China.

The design of the aerial of which you forward a sketch is as far as we are able to say O. K. If you have it available, you should, however, use copper instead of galvanized iron. Owing to the fact that you failed to tell us the length of this aerial, we are unable to give you the fundamental wavelength. You may figure this roughly for yourself by multiplying the overall length of wire (from the apparatus to the end of the antenna) in meters by 4.

* * *

C. P., Hartselle, Ala.

For the purchase of a small tape recorder, we refer you to J. H. Bunnell & Co., New York City.

* * *

W. H. O., Ridgewood, N. J.:

If you wish to increase the range of the set shown in figures 108 and 109 of "How to Conduct a Radio Club" to 18000 meters, a variable condenser having a capacity of .001 mf. should be substituted for C_2 and a like condenser shunted from the antenna to the earth. With reference to figure 109, increase C_1 and C_4 to .001 mf. and shunt a like condenser, antenna to earth.

* * *

R. J., Woodhaven, L. I.:

The April and May issues of THE WIRELESS AGE, contain diagrams and working drawings for construction of amateur receiving apparatus that will meet all your requirements.

The secondary voltage of a transformer for amateur work should lie between 15,000 and 18,000 volts.

Any electrical supply house in New York City can put you in touch with manufacturers that will construct special taps, binding posts, bushings, contacts, etc. for you.

Book Reviews

The Outlook for Research and Invention. By Nevil Monroe Hopkins, M. Sc., Ph. D. Cloth binding, 241 pages. Van Nostrand. Price $2 net.

With the expressed purpose of developing efficiency of research, Dr. Hopkins has prepared this book for the guidance of those who have the inventive turn of mind, but lack the facilities to determine the status of the prior art and the needs of the world in the broad field of technological development. The author has quite evidently designed his book for "tens of thousands of men working upon problems, in the history and conditions of which they are ignorant," noting moreover that "they are frequently working upon problems they are not educationally equipped to develop." The mere fact that inventions are patented at the rate of nearly 50,000 a year, but very few Americans are advancing the sciences at all, illustrates the need for a text such as the present one.

Eight chapters guide the reader to an understanding of the limitations of research, as well as its productive channels, equipment and methods, the canons being largely based upon the first-hand experience of the author. Every observation made is pertinent and clearly expressed; the guide posts set up are sharply defined and easily comprehended by the most inexperienced. It is refreshing to find a book with so serious a mission written from cover to cover with a simplicity of style that makes its reading less a task and more a pleasure. Contributing materially to its usefulness also is an appendix listing and describing problems awaiting solution in physics and chemistry, including a generous section on electricity and its application to radio.

This book is obtainable through the Book Dept., The Wireless Age.

Airplane Photography. By Herbert E. Ives. Cloth binding, 422 pages, 208 illustrations. Lippincott. Price $4 net.

The utility of the camera in association with flight has been obviously underrated, due to its military origin and cessation of the war-time demand. Future developments are certain, however, and it is one purpose of this volume to define the general principles which will apply to all uses and purposes which photographing from the air may be put. One of the lines of quickest development is described in a chapter devoted to pictorial and technical uses; it is in recording to best advantage the entire form and location of buildings, pictures which are destined to be extensively used in the study of architecture. The vertical aerial photograph, too, has such apparent advantages over any ordinary surveyor's map. that one logical use will be in advertising real estate developments. Landscape gardening, geological surveying, city planning, progress in engineering projects, the characteristics of wrecks, fires and floods for insurance underwriters, are among the uses the author selects as available for the peculiar merits of the view from the air.

A large portion of the book is devoted to a discussion of the fundamentals of photography, and to scientific methods of study, test and specification, so that the reader may understand the most advanced methods and perhaps contribute to future progress. A final chapter is devoted to future developments in apparatus and methods, prophesying the next steps in lens design, camera suspension, color photography and practical photographing at night.

To those who are seriously interested either in the practice of aerial photography or in its development, this volume will prove both informative and inspirational.

This book is obtainable through the Book Dept., The Wireless Age.

Inventions of the Great War. By A. Russell Bond. Cloth binding, 337 pages. Illustrated. Century. Price $1.75 net.

The more important and interesting inventions which were war-born or highly developed during the period of hostilities are described in simple language in this book. The story of research and development is fascinating in itself, but a great deal has been gained by the author's manner of including the human interest which lay behind solution of each problem. Of special interest to wireless men is the chapter, "Talking in the Sky," in which vacuum tube wonders are referred to, long distance radio is explained, airplane transmitting equipment is discussed in initial and later stages, high speed telegraphing methods are reviewed, and the utility of the radio compass described.

This book is obtainable through the Book Dept., The Wireless Age.

The Realities of Modern Science. By John Mills. Cloth binding, 321 pages. Illustrated. Macmillan. Price $2.50 net.

For those who have been unable to comprehend the isolation of the electron, which has been discussed in numerous learned treatises by radio engineers, this volume offers an easy means to an understanding of the new terms by which scientists are explaining the phenomena of all physical science. To students of electricity who have not had the advantages of the more advanced courses Mr. Mills' book is invaluable, for most of the phenomena of electricity are treated in elementary texts without reference to the electron, now universally recognized as the fundamental entity.

As an introduction to the study of science the volume is particularly welcome. In chronological order it develops fundamental concepts, gradually leading up to important chapters on molecular and electronic motions.

This book is obtainable through the Book Dept., THE WIRELESS AGE.

Electricity at High Pressures and Frequencies. By Henry L. Transtrom. Cloth binding, 240 pages. Illustrated. J. G. Branch. Price $— net.

This volume bridges a gap for practical electricians who are interested in the subject of high pressures and frequencies but, due to the highly technical language employed by the average author, have been unable to get a real grasp of the subject. The high frequency currents of radio communication are clearly explained in principle and effect, not with the thoroughness demanded by the scientist, perhaps, but quite adequately for those who have not had the advantages of higher technological education.

This book is obtainable through the Book Dept., THE WIRELESS AGE.

Principles of Radio Transmission and Reception with Antenna and Coil Aerials. Bureau of Standards, Scientific Paper No. 354.

The functioning of the two principal types of radio aerials is worked out quantitatively from fundamental electro-magnetic theory. Experiments have verified the formulas and conclusions presented. Formulas for the current received in either antenna or coil aerial in terms of current in either type of transmitting aerial are given, as well as comparison formulas giving the relative performance of antenna and coil aerials under various conditions. The advantages of the condenser type of aerial are presented. The theory and nature of radiation are discussed, and applied to the elucidation of some current fallacies. The basic principles of design of aerials are given. Desirable lines of future research are pointed out. The use of the coil aerial as a direction finder, interference preventer, reducer of strays, and submarine aerial are *not* among the subjects treated.

The Determination of the Output Characteristics of Electron Tube Generators. Bureau of Standards.

Owing to saturation and rectification effects in three-electrode vacuum tubes, the currents which they deliver to any type of output circuit, when used as a generator, are heavily loaded with harmonics. Experimental results indicate that the frequency of the oscillating currents generated is the natural frequency of the output circuit. Hence this circuit behaves as a filter in series with the tube and the D. C. power system, and the useful output current is approximately sinusoidal, whatever the distortion of the tube currents, depending in amplitude solely upon the fundamental constituents of the tube currents. General expressions are derived for the power and current output in terms of static characteristics of the generating tube, and are corroborated by experimental results obtained with a particular tube.

These papers are now ready for distribution. Any one interested may obtain copies by addressing a request to Bureau of Standards, Washington, D. C.

Fleming Pat. No. 803,634
De Forest Pat. Nos. 841,387-879,532

A WARNING

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United States Letters Patent to Fleming, No. 803,684, November 7, 1905, has been held to be valid by Judge Mayer of the United States District Court for the Southern District of New York, and by the United States Circuit Court of Appeals for the Second Circuit.

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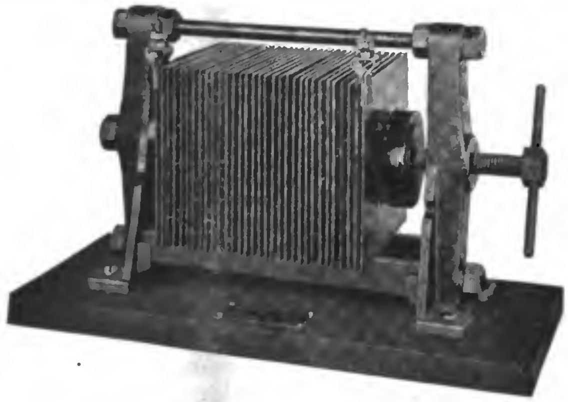

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