RADIO AMATEUR NEWS

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OVER 100 ILLUSTRATIONS

Edited by
H. Gernsback

"The 100% Wireless Magazine"

GRAND OPERA BY WIRELESS

See Page 106

In This Issue:

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RADIO AMATEUR NEWS

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RADIO AMATEUR NEWS
H. GERNSBACK — EDITOR

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Government Radio Control—Once More

ON July 24th, Secretary of the Navy Daniels addressed a remarkable letter to the Speaker of the House of Representatives, which communication is reprinted in full on another page.

We had thought that Government radio control was at a rest for a while when certain radio bills were defeated last year. It seems, however, to be a favorite pastime in Washington to sponsor Government Control of radio every month or so, at least so it looks to us. The writer has pointed out in his previous articles that the Radio Act of 1912 has been found ample for all requirements, be they Government, commercial or amateur. Mr. Daniels speaks in his letter of *"assigning certain belts of wave lengths for the exclusive use of these services."* He immediately corrects himself by saying that *"as a matter of fact, such allotment of wave length is coming about thru International Agreement."*

Aside from this, there has been practically no interference before the war because the commercial stations, by agreement, operated on certain wave lengths and got along very well. Further down, Mr. Daniels says *"standardized practises are being worked out so that a ship off any shore in the world will work without difficulty with the closest shore station."*

If all this is so, why does Mr. Daniels desire radio control at all? Again the Secretary reminds us that *"during periods of strained relations, as well as during the war, direct Government control and operation would be the only safe and effective control and operation, as the personnel would be subject at all times to Government supervision and discipline."*

We heartily agree with Mr. Daniels, and the past war has shown that the Navy Department certainly knew its business when it took in hand the entire radio situation in the United States, BUT THIS WAS DONE WITHOUT GOVERNMENT CONTROL, and this phase was fully covered by the Radio Act of 1912. If there were another war, the present radio law would again work as well as in the past war.

After carefully perusing the Secretary's communication we fail to find any new argument in favor of Government ownership, or control of radio communication in the United States. The same ground was gone over very carefully last December, and the committee who then investigated the radio situation found that the Radio Act of 1912 was ample in all its provisions and that new legislation was not required nor wanted.

As the Radio art progresses, laws to regulate the art become of less and less import, and if radio cannot work out its own salvation, it certainly will never amount to much. When the telephone first appeared, there was more interference than there is today in Radio. It was found that wires running parallel to each other, due to induction, caused untold interference; it was then almost impossible to talk to anyone ten miles away without hearing six or seven people all talking at the same time. Placing fifty wires in a small cable was an impossibility. Suppose the Government had then stepped in and said, "The telephone situation is intolerable. There is too much interference, and, to do away with it, the Government proposes to take over all wires!" The Government could readily have done so, but wisely refrained. The telephone art worked out its own salvation and today there is no interference.

In radio, exactly the same situation prevails. As far as the bug-a-boo interference is concerned, radio will work out its own remedies. Great strides have been made in the past few years, particularly during the war, and the next ten years will certainly show a complete revolution. The word "interference" will be laughed at.

The whole radio situation is so obviously simple at the present time that we cannot comprehend why the powers that be in Washington do not realize this and forget all about Government radio control for a while. The amateurs are using the lowest step in the wave-length ladder. Next come the commercial stations covering small distances. After them come the long distance trans-oceanic stations with their long wave lengths necessary due to the great distances. There is now very little interference between all of these, and what interference there is is mainly due to inefficient personnel, or inadequate apparatus, or both.

As to Government control of radio, we are certain that the country wants none of it at present after its unsatisfactory experiment in Government ownership of the telegraph, telephone and cable lines just returned. And after its more or less disastrous experiment in Government control of the railroads of the country, we believe our legislators will think twice before attempting radio Government control at present.

If the country is sensitive about anything, it certainly is so to a high degree of radio, which has such unlimited possibilities, and which has caught the popular fancy more than anything else in recent years. We are certain that when the radio fraternity reads Secretary Daniels' letter an instant howl of distress will go up and Washington will be deluged with letters of protest, the same as happened last year when amateur radio was threatened with extermination. And exterminated the amateur surely will be if Mr. Daniels has his way.

As for ourselves, we feel not disturbed as to the future outlook. We addressed a communication to the Senator from New York, Hon. J. W. Wadsworth, Jr., and his answer to our inquiry as to the next step of the Government re Mr. Daniels' recommendation was as follows:

"The Committee on Merchant Marine of the House of Representatives, to which Secretary Daniels' letter was referred, does not expect to take any action on radio control in the immediate future."

We sincerely trust that this may be the case, and we hope to report before long the abandonment of Government control of radio.

H. GERNSBACK.

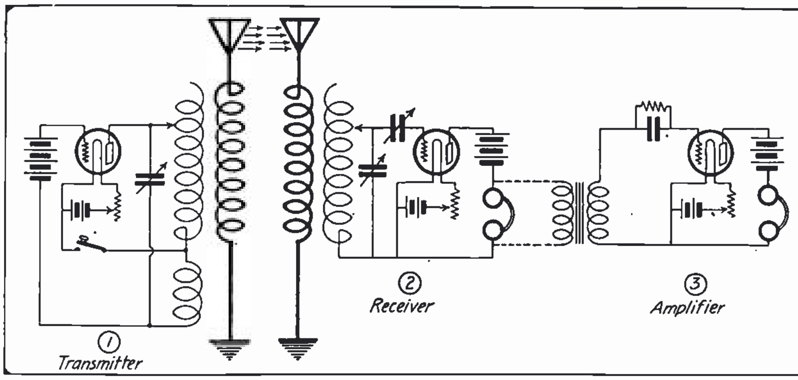
Reviewing American Radio History

By LEE DE FOREST, Ph. D., D. S. C.

THE Great War, just ended, has given us many renewed reasons for pride in our country, pride in what America has accomplished in scientific achievement as well as in noble self-sacrifice for the common cause of liberty. We all are justified, therefore, in reviewing what contributions in invention has been especially the work of Americans, in what fields of work we have been pre-eminently pioneers, and not only pioneers but, better yet, have kept at the head of the procession.

The world admits that two American boys, the Wright brothers, were the first of all mankind to fly, to wrest from the birds the secret which baffled human ingenuity since the beginning of history. But, to our shame be it said, we Americans did not follow up this splendid beginning as we should have done. The French and British sportsmen, perhaps because of more enthusiastic and far-sighted support by their governments learned the lessons which Wilbur and Orville Wright first taught, better than did Americans, so that at the beginning of the war the Allies' bird-men knew far more about aviation, about planes, about engines, than we did. They were far ahead and had we not swallowed our pride and diligently gone to school to the Allied aviators, we would never have been able to make even the belated showing which during the last weeks of the war began to prove our American-trained aviators and our American-made planes of use to General Pershing's mighty army.

So it was with especial pride that we hailed the big Navy NC-4 seaplanes the first aircraft in history to cross the wide Atlantic.



Any Boy with Three Audion Scientific Toys Can First Produce a Beautiful Musical Note, Pick It Up and Reproduce This Note in the Receivers and Finally Amplify the Sounds Until They Can Be Heard for Blocks.

America's Part in Radio

The history of the part America has played in wireless telegraphy has been different. There, it is true, an Italian, Marconi, was the first pioneer; but hardly had his early experiments on the English Channel attracted attention before American engineers and scientists, instantly grasping the far-reaching possibilities in this infant art of signalling without wires, began to study and experiment to improve over the slow and cumbersome apparatus which was being used abroad.

Early Days

There were four of us in those early days, John Stone, Prof. Fessenden, Harry Shoemaker, and the writer, who started all about the same time, far apart, without knowing of each other's work. Yet, strange to say, each saw the same big defects in the European system, and conceived somewhat similar lines of improvement. The first was with the receiver, to do away with the slow-acting *coherer,* a little glass tube with nickel-silver filings, and to find in its place some more sensitive detector which would permit the use of a telephone receiver, in place of the Morse sounder, or inker, which Marconi used. The next problem was with the transmitter—how to employ alternating current from a dynamo, and use a transformer similar to those used on electric light circuits in place of the old induction coil with its hammer interrupter.

When American wireless pioneers had sufficiently perfected these new appliances for wireless telegraphy we found that the ships and shore stations thus equipped were capable of working many miles farther, and handling far more words per minute than were even heard of abroad. Of course, the greater distances which were regularly covered by our best apparatus in those early days, say in 1903, were very small compared to those which are covered today by many a smart amateur's set. *The average boy's wireless set today contains far more perfect instruments than the most elaborate station could boast of in those pioneer days.*

Our tuning devices were very crude and cumbersome, and inefficient. We used big, noisy spark transmitters, and required very tall masts and large power to do what thousands of bright young fellows can do today, silently and working with a small aerial running up to the top of the flag-pole on the roof or over to a tree top in the front yard.

Undamped Waves Make Their Appearance

If there is any one thing in wireless telegraphy more than another which has made possible the great differences between the perfected apparatus of today and the crude "junk" of those pioneer days, it is the use of continuous, or "undamped" electric waves for signalling, instead of the short, sharp "splash" waves which were sent out from the old noisy spark transmitters.

Today no up-to-date "amateur" operator wants to be restricted to the old spark type. And the U. S. Navy and the radio companies whose service used to be so awfully "jammed" by the "kid's spark sets" are all eager to see them hasten the time when the undamped wave transmitter alone shall be employed, all over the land. For it makes it so much easier to cut out interference between several messages sent simultaneously from a number of stations, if all of these are using the "continuous wave" principle.

Mr. John Stone is really the Father of undamped wave telegraphy. He was the first, in America, and in the world, to point out the great advantages in tuning, both at transmitter and receiver, of this type of signalling. He patented it and showed methods for doing this great and novel thing. Fesenden also designed other methods. Later Poulsen, a Danish engineer who had already given to the world the novel discovery of the telegraphone, discovered how to use the electric arc (similar to an arc lamp) in a magnetic field and surrounded by hydrogen gas, to produce the undamped electric waves, which we already knew were so desirable. But he followed lines first laid down by Nikola Tesla and this principle made possible for the first time the wireless telephone. In 1907 I equipped the American battleship fleet with the radio telephone—the first practical application of the 'phone to wireless signalling. This historic voyage was made memorable to radio men for another reason: It heralded also the first practical application of the audion detector. I had discovered this little "listening lamp" two years before, but it took a long period of experimentation and development to make it sufficiently reliable and sensitive, so that it could at last replace the crystal detector, which at that time was being used everywhere. The audion made its first bow as a simple detector of spark telegraph signals, then for wireless telephony. Next it proved itself to be the long-looked-for telephone amplifier, or repeater. The Bell telephone engineers took it up, in 1912, and developed it specially for use on their lines, so that when the Panama-Pacific Exposition was opened at San Francisco in 1915 it was possible for the first time in history to telephone from the Atlantic to the Pacific.

Enter the Audion in Telephony

Not content with the achievement of telephoning across the continent by means of the audion on their wire lines, telephone engineers in 1915 began tests at the big naval station at Arlington to see if it would be possible to telephone without wires across the continent, then across the Pacific to Honolulu, and then on the east across to the Eiffel Tower in Paris. They used as a telephone transmitter a small audion, amplifying into a bank of larger audions, and these in turn controlling a very large bank of powerful oscillating audions or oscillions. The entire energy from these large bulbs, representing 20 H.P., was put into the gigantic aerial wires at Arlington and was perfectly controlled by a tiny microphone like that what you talk into every day on the telephone. The wireless speech thus generated in Washington was first picked up at Jupiter Inlet, then at the big naval station at Darien, Isthmus of Panama. A few days later the operators at the station of Mare Island at San Francisco heard the voice from Washington, and finally the engineer, who had been sent to Honolulu with his little audion detector and bank of amplifiers, reported that he heard the Washington voice very clearly. Then finally tests were made with Eiffel Tower, Paris, where also the Washington speaker's voice was plainly identified.

The war necessarily interrupted the

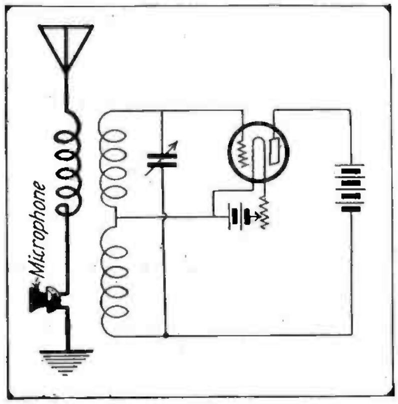
prosecution of these excedingly interesting tests, but it is safe to prophecy that *within the next few years we will see this work resumed on a commercial scale, so that it will be possible in the near future for any speaker on the telephone anywhere in the United States to communicate with some friend connected to a telephone in Paris.*

The Oscillion

Even since I had observed how well the electric arc acted as a wireless telegraph transmitter I had a thought, back in my mind, that some day the *incandescent* lamp could also be made "to talk," and that it would be as far superior to the arc light in that respect, as an incandescent lamp was superior to the arc as a light—simpler, quieter, neater and in every way more desirable—at least for small power. Consequently, when about the same time I was working on the audion lamp as a telephone repeater I observed that it was, at times, a source of undamped electric currents. I recognized then that I was at last on the track of the future development in radio which would be of very unusual interest and importance. Two years later we had sufficiently perfected the oscillating audion as a generator of high frequency electric currents, and found a ready interest in it on the part of the U. S. Navy. I named this oscillating audion "The Oscillion."

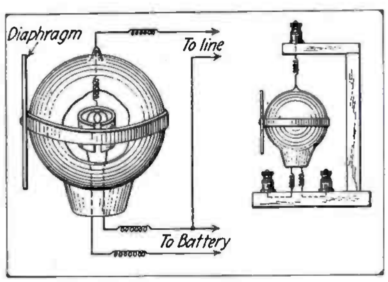
The Oscillion had gradually forced its way into the wireless transmitting field, so that before the great war had progressed many months, the British, and particularly the French Army Signal Corps, recognized that it was a great value as a small light transmitter which could be used in very large numbers on the front line trenches to communicate with the artillery firing line. The French used these little oscillion transmitters, the bulbs not larger than 2½" in diameter, literally by the thousands every day. The entire system was an incandescent lamp system, the little lamps used as oscillators at the transmitter, the same little lamp, used as a wireless detector at the receiver, and five or six of the same sort used as amplifiers in tandem, each one amplifying the signals as received from its predecessor. So the final signal in the telephone receiver was sometimes a million times stronger than that received in the first stage.

This arrangement enabled the French Army to maintain communication from every hundred yards of French front, back to the appropriate firing zone, without interference between the great number of communications. All this was in addition to the wire telephone and telegraph systems which were maintained by wires stretched over the ground; but these wires were constantly being broken by shell fire or by passage of troops or wagons across them. So that it was absolutely necessary to rely on wireless signalling, telegraph and telephone, either through the air or, as was frequently the case, by earth currents through the ground.



By Placing a Transmitter in the Ground Lead Any Boy May Talk to His Friend Without Wires.

When America entered the war in 1917 our Signal Corps very soon came to the conclusion that the wireless telephone could be made of far greater usefulness than the telegraph for short-line communications.



Recently the Audion Has Been Put to Many Uses. This depicts One of the Latest—the Audion-Transmitter. The Heavy Plate Maintains Its Position As the Vibrations of the Voice Impinging On the Diaphragm Causes the Bulb and Filament to Vibrate Likewise.

It, therefore, threw itself whole heartedly into the problem of developing a small wireless telephone set, not only for communicating between front lines and artillery fire, but between airplane observers and ground receivers. Development along these lines was very rapid. In fact the efficiency and success with which this work was carried out contrasts very strongly with the shameful waste, delays, and confusion which characterized the development of our machine gun, Liberty motor, and aircraft production generally.

America Always to the Front

America had always been at the forefront in wireless development since 1900, and she has maintained that position right up to date. A very large factor producing this result was that we were pioneers in the invention of the audion or three-electrode vacuum tube for receiver, amplifier and transmitter; and we, in sharp contrast to our attitude regarding the development of the airplane itself, never allowed the foreign nations to catch up with our development of the audion.

No one acquainted with the facts can deny that the astonishing development of wireless communication during the last five years has been due chiefly to the entrance into the field of the audion or three-electrode tube. It is really astonishing, the number of uses this simple little device can be put to. It repeats the voice currents in telephony perfectly and amplifies them as far as desired, so that, for example, an aviator in an airplane two miles above the earth has actually addressed large crowds of people on the ground. The wireless waves generated by an oscillating audion in his plane were picked up by an audion detector on the ground and amplified through four or five other audion amplifiers, until the voice currents were strong enough to put through a battery of "loud-speakers," or horns, which blared out the voice, so that it could be heard several feet from the receiver.

Scientific Toys for the Boy

Then again the ease with which any boy can duplicate most of the operations, at least on a small scale, which radio engineers are now producing with the audion, makes this the most interesting scientific toy which the American boy can possibly play with today. With three audion bulbs, one used as a transmitter, one as a receiver, and one as an amplifier, there is no limit to the amount of experimentation, fraught always with a sufficient amount of success to elate and not discourage the young experimenter. He can make the transmitting bulb oscillate say a million times a second and make the receiving tube oscillate a little less or a little more rapidly. Then in the telephone receiver connected to the detector audion, he can hear a musical note which is due to the difference in the frequencies of the two bulbs. He can vary this receiver frequency

(*Continued on page* 143)

Value of Wireless Demonstrated on Trip of R-34

By Lieut. REX F. DURRANT, R. A. F.

The epochal voyage of R-34 demonstrates fully the inestimable value of directional and ordinary wireless.

Never during the whole journey were we out of touch with either side of the Atlantic—this with a comparatively small wireless set makes the possibilities of larger sets on larger craft apparent. The wireless functioned all the way across, easily reading the messages from the powerful stations at Bar Harbor and Boston.

In the first ten hours of the trip we did fifty-five knots an hour, a wonderfully favorable thirty-five knot tail wind aiding us. We were using only two engines. We talked with the battleships in New York harbor as we circled over brilliantly lighted Broadway and Times Square.

The only mishap of the trip came Saturday when the pistons flew thru the cylinders of one of the engines. This slightly lessened our speed. Otherwise it had no effect. The breakdown was so bad that it was not possible to make repairs.

I saw two ships on the way over, the San Florina, bound for Mexico, and the Cumberland, bound for England. The wireless operator on the Cumberland picked our call and asked "who are you?"

We answered: "We're a British airship."

The operator apparently was so dumbfounded and surprised that he was unable to reply for several minutes.

We carried a message from President Wilson to King George, one from the governor of Newfoundland to the king and another from the Mayor of New York to the Lord Mayor of London.

A world's record for long distance wireless from an airship was established on this trip. We talked with the air ministry in London Friday midnight from a distance of 1,600 miles.

Guarding the Ether During the War

By P. H. BOUCHERON

FEW persons realize that from April 3, 1917, until November 11, 1918, Naval radio operators, especially trained for this work were constantly on watch at listening-in stations erected in various parts of the United States for the purpose of carefully listening to all radio activity, and all signals which could not be readily identified by Naval communication experts as the official transmission of Allied radio stations were immediately investigated and traced to their source of origin. In fact a regular department was established which worked in cooperation with all United States Naval radio stations in the country. Operators at the listening-in stations soon became experienced in recognizing allied from enemy radio transmission. *In order to effectively censor all signals, these listening-in stations covered a receiving range of as much as 6,000 miles and a tuning range of from 50 to 50,000 meters, several operators being required to cover various sections of these wave lengths simultaneously.*

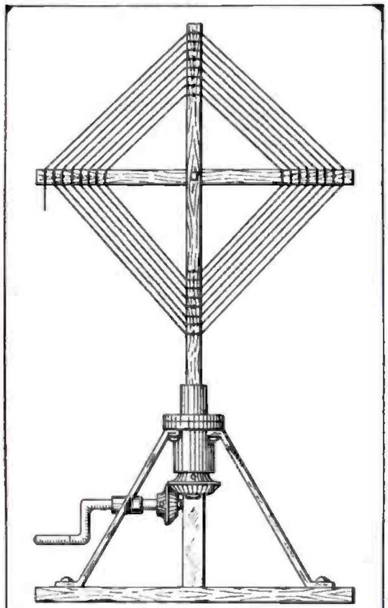


FIG.1

The New and Valuable Aid to Navigation, the Radio Compass Played an Important Part in the Rounding Up of Illegal Radio Activity.

That new and valuable aid to nagivation —the Radio Compass shown in figure 1— played an important part in this work of investigating illegal radio activity; in fact, it was owing to the timely necessity of having a reliable means of ascertaining the direction of strange signals that the Navy Department developed the radio compass to its present stage of efficiency. The manner of operation was simple. As soon as a listening-in operator became suspicious of a certain signal or spark, he immediately communicated the fact to the radio compass operators stationed at various points of the district in such locations as to form a triangle, and they in turn secured the approximate location of the suspicious signal by plotting a point at the line of intersection resulting from the three different directions secured by each of the three radio compass operators forming the triangle.

After having ascertained the aproximated position of a strange or suspicious signal, Naval investigators would immediately reach the spot in fast automobiles. It must be understood, however, that very few radio compass directions are ever secured so accurate as to give the exact spot from which signals emanate, but it does give the location within a mile. It is then a comparatively easy matter to search the particular neighborhood given by the direction finder and investigate any suspicious-looking overhead wires which might be employed for transmission.

It is surprising to what lengths young men of a playful turn of mind went in using substitute antennæ; some of these were unused telephone wires, clothes-lines where the rope had been substituted with flexible stranded wire, insulated iron fences, chicken netting, etc. In this connection it may be said that after the executive order had been sent out by the authorities instructing all amateurs and private owners to dismantle their radio apparatus and store them away, many, being of a perverse turn of mind, attempted to see for themselves just how far the Government officials were prepared to locate those who had failed to comply with instructions *by persisting in sending to each other, using prearranged call letters not known to anyone else, or, as was detected in one case, simply sending out unintelligible signals.* Much to their surprise, however, they were soon located by the investigators, who, in the case of New York State, would be on the spot in a very short time, and having discovered them would confiscate their complete installations as well as give them a good scare, inferring what might befall them and their friends were they ever heard from again by radio until after the cessation of hostilities. **While some of these boys did not exactly act as all law-abiding citizens should, their number was very small indeed as compared to the large body of amateurs in the country.**

Under these circumstances, and by giving wide publicity in the press to the cases detected, it was comparatively a short time before all radio stations not under the direct supervision of the Army or Navy had been effectively dismantled and closed for the duration of the war. Running down receiving stations, however, was not so easily accomplished since there was little external evidence of anyone doing this, the only possible clues being in the accidental discovery of secret antennæ.

For a considerable period of time trained observers, *many of them former amateurs* who were familiar with the various tricks anyone might resort to in order to keep their receiving station open and thereby copy all important cipher and plain language communications between allied stations, were constantly traveling about the country on the lookout for any indication of secret receiving or sending apparatus. *In this way, many innocent-looking telephone and telegraph wires were often found to lead to elaborate and very business-like receiving outfits.*

One interesting case in particular was that of two young electrical engineers living in an apartment house in the Bronx section of New York City, and who had cleverly installed an elaborate system of receiving antennæ. These enterprising young men had erected a series of very fine enamel wires which circled two high apartment houses in such a manner as to be practically invisible. This was accomplished by installing the wire on small insulated tacks driven into the brick wall at the top of the roof and under the terra cotta cornices, making it impossible for anyone to detect it either outside or inside the roof.

Eventually the wire was accidenly discovered by an electrician who was repairing the electric bell system of the house. In leaning over the terra cotta railing of the roof, his hand unconsciously wandered under the railing where he had felt the wire, and upon investigating he discovered that it led to a window on the third floor. It happened that this electrician had a slight knowledge of radio telegraphy, and suspecting his find to be a secret radio installation he immediately reported the fact to the authorities. When the investigators walked into the apartment of the two young men they found a complete long-distance undamped receiving set employing three steps of application installed on a table and along with it an accurate log of the signals transmitted by European stations, including Eiffel Tower, France; Nauen, Germany, and Rome, Italy. Of course, these young men had no intention of making unlawful use of the information they were securing in this fashion, and merely were using the set for experimental purposes, at the same time probably exulting over the fact that they were "putting one over" on the authorities supervising radio activity. Had they not been able to furnish indisputable evidence of their citizenship, loyalty and character, things might have gone different with them, and they might have reflected over their lack of foresight while safely interned in a Southern interment camp.

It must be said in fairness to the amateurs in general, that incidents of willful and deliberate attempts to engage in illegal radio activities were small compared to that large body of men. As a matter of fact, the greater part of these young men immediately enlisted at the entry of the United States in the war, in either the Army or the Navy, to serve their country in the best way known to them, making use of the practice and experience gained while amateur radio operators.

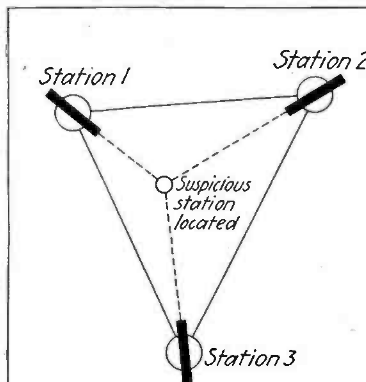


FIG. 2

Three Receiving Stations Forming a Triangle Would Adjust Their Direction Finders for Maximum Strength and Immediately the Suspicious Station Was Located.

The radio activities of German submarines which happened to be in the vicinity of the Atlantic Coast did not escape the

(*Continued on page* 141)

Static Eliminator of Considerable Merit

By EDGAR TERRAIN JOHNSTONE

THOSE of us who have scanned the horizon from time to time in vain for that over-ripe little "static eradicator" can now put our glasses away, for a New Orleans Radio Expert, E. L. Commagere, has been employing of a little mysterious "*Black Box*" (as the southern radio men know it), which does not entirely eliminate static, but does more than any other scheme has afforded to this date, and the following is a description of the device as the author knows it:

The merits embodied in this new device will be easily recognized by the practical man when he is confronted with static storms which prevail in that location during the summer months; and there are important messages to be gotten thru the clatter and downpour of bullet-like shrapnel on the diaphragms.

Another striking feature worthy of note, which is accounted for in what follows, is the absolute elimination of low frequency spark systems such as the 60 and 240 cycle sets, and better rectification of the higher frequencies such as produced by the 500 cycle quenched and synchronous rotary gaps.

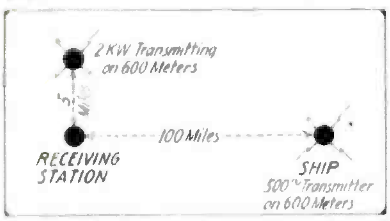


Fig. 1—Receiving High Frequency Damped Signals From Distance up to 100 Miles Thru a Local 2 KW Non-Synchronous Transmitter Proves the Value of this "Static Eliminating" Device.

This achievement, while very simple, demonstrates clearly how inventors are liable to pass over the most important and valuable claims or advantages of their scheme, dealing mostly with the complicated and totally ignoring the simple technicalities. This was the case of Marconi, who patented the double and triple crystal receiver, when actually *the Commagere arrangement makes use of but one mineral, and the results obtained are four-fold*. These will be taken up in sequence as the article progresses.

Mr. Commagere followed up the early work of Marconi, who employed two and three crystals, which had the disadvantages of being unstable, especially when so many detectors were involved. The idea of using one mineral and obtaining the same results presented itself and immediately he began experimenting with the device. The results of these experiments follow:

Mr. Commagere's "Mysterious Black Box."

It was possible to copy ships employing 500 cycle apparatus 100 miles or more distant, thru a local 2 Kw, non-synchronous rotary gap Marconi transmitter, working on the same wavelengh. See Figure 1.

From the above it can be estimated before trial that static of general nature, such as "grinders" and downpour of bullet like static will be eliminated to such an extent that *high frequency* signals will *ride over* the static, and again, that most of the static is generally lower in frequency than the 240 cycle non-synchronous station cited.

The kind of static which did cause some little trouble, and which at times rendered the circuit inoperative, was what is known as *frying static*, resembling the sound of signals received by the tikker method (escaping steam), but of much higher frequency, sometimes producing a whistling noise. This, of course, was consistent with the functioning of the circuit as aforementioned; i. e., higher frequencies were permitted to pass while lower frequencies were prohibited.

The results of this arrangement are very worthy of consideration, in that the detector operates in the opposite direction for radio currents of higher frequencies; and as the general belief amongst experimenters is that detectors so connected in the circuit have to follow *one standard of polarities*. This will undoubtedly prove of interest to those who were accustomed to being told that carborundum must be connected a certain way, in respect to the battery current flow thru the mineral.

Quite contrary to what would be surmised in respect to the sensitiveness of this device for the reception of high frequency signals, when properly adjusted by a critical potentiometer, the signals compared very favorably with those received from the same frequencies but with the mineral connected as is the usual practice. Therefore the mineral rectified higher frequencies equally well in both directions.

This makes a device highly desirable for use in the Tropical climates, where the static is so bothersome and which at times makes communication impossible. Under the most severe tests this arrangement has proven its value beyond a doubt.

Figure 2 gives the usual connections, and in order to employ the Commagere method, simply reverse the leads of the detector and get a new point on the crystal, readjusting the potentiometer until the static comes in MUSHY—on the regular method of connections the static will be audible all over the room, but upon changing to Figure 3 the static will not be audible further than several inches from the ears. There is a certain kind of crystal to employ in this circuit and it must be of the following kind.

1. Carborundum.

2. A yellowish gray color, resembling somewhat fools gold and lighter yellow-grey (resembling steel).

3. A very stiff and short point must be employed.

From the foregoing the following practical conclusions may be drawn:

1. Carborundum, with its present acknowledged state of unilateral conductivity will give practically equal volumes of energy to the receivers when used so that rectification of very high frequencies takes place in either direction. In the usual method, the detector is so connected in the circuit that it permits the current to pass several hundred times better in one direction than in the opposite for the rectification of lower frequencies.

2. But when used in the opposite direction for the reception or rectification of the High Frequency oscillations, it results in delivering practically the same volume of current to the telephones as was had for both frequencies in the usual manner of connection, but does not allow signals of lower frequencies to pass.

3. This can be accounted for in the manner suggested here.

a. That the resistance offered the higher frequencies is greatly reduced in comparison to that offered by the same crystal to the restification of lower frequencies such as the 60 and 240 cycle transmitters, and consequently results in a greater strength of signal being received from higher frequencies, such as the present-day 500-cycle quenched and synchonous rotary gaps.

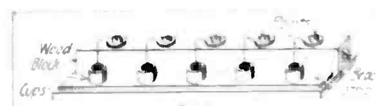


Fig. 4

The "Insides" of the "Mysterious Black Box" Which Kept Many a Radio Enthusiast Wondering.

b. The considerable decrease in resistance as offered to higher frequencies causes less heat at the terminals of the junction and consequently less loss as is the case when employing the same mineral for the reception of lower frequencies. This, too, has a considerable effect on the larger amount of current furnished the telephones as explained.

c. The skin effect may cause higher frequencies to traverse the outside surface of the crystal under observation and not thru its cross-section or part thereof, and thereby reduce the H.F.R.

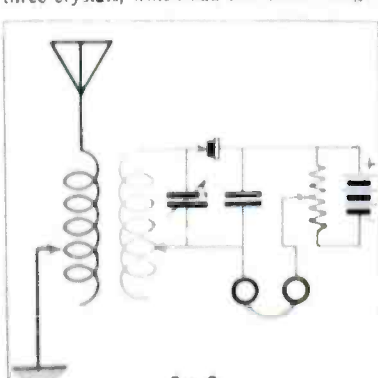


FIG. 2

The Regular Connection Employed with Carborundum Crystals, Which was Believed Absolutely Necessary.

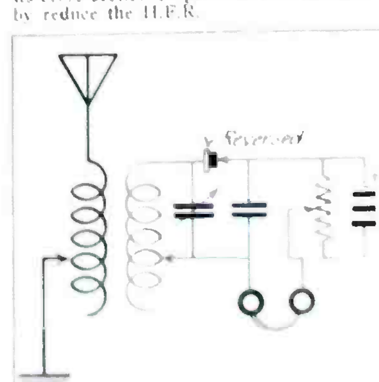


FIG 3

Now We Have Reversed the Detector Leads and Readjusted Our Potentiometer and the Static Has Vanished.

Grand Opera By Wireless

By H. GERNSBACK

A RECENT newspaper report from Chicago brought the not at all surprising news that grand opera music had been transmitted by wireless telephone for over one hundred miles. Sensitive microphones placed on the stage of the opera house caught the sound waves; the impulses then being stepped up in the usual manner by means of a transformer were then led into an amplifying vacuum tube. Here the current was impressed upon the radio telephone transmitter in successive stages and then sent out over the aerial on top of the opera house. Wireless amateurs all about the surrounding country were thus able for the first time to hear grand opera. While this was only an experiment, grand opera by wireless will soon be an accomplished fact.

During the next few years it will be a common enough experience for an amateur to pick up his receivers between eight and eleven o'clock in the evening and listen not only to the voice of such stars as Caruso, Tetrazzini, McCormack and others, but also to the orchestra music as well, which is picked up by the sensitive transmitters along with the voice of the stars. The surprising thing is that it is not being done now.

The reason probably is due to the fact that as yet no means has been found to reimburse the opera companies for allowing everyone to listen in. While of course listening to the music is not as satisfying as witnessing the performance in person, still many music enthusiasts would rather stay home listening to the music alone than to witness the performance itself. To your true, dyed-in-the-wool opera fiend the performance is of secondary importance, the music always coming first.

But we must give a thought to the management, which cannot subsist on an empty opera house if everyone could listen in to the actual rendering of the opera without paying for the privilege. Needless to say that the producers would soon find themselves bankrupt. For this reason we cannot expect that grand opera by wireless will be an accomplished fact until some means has been found to reimburse the producers, and, as every wireless man knows, this is very difficult to do. Anyone with suitable radio apparatus can "listen in" to the music without much trouble. No matter on what wavelength the music would be rendered, every wireless man would find a way to listen to it without serious inconvenience.

Probably the only logical way out would be for the management of a grand opera company to advertise in the newspapers, stating that no grand opera via radio would be given unless a certain amount of revenue were guaranteed by radio subscribers before "radio performances" would be given. This would mean that probably ten out of one hundred radio stations, amateurs and otherwise would pay monthly or yearly dues to sustain the management, which then would not have to care how many were listening in.

This is the only practical solution. As for technical difficulties, there are of course none. All that is necessary for the producing company is to install a high-class wireless telephone outfit which can be bought on the market right now and which is immediately available. The rest is up to the wireless fraternity, which has nothing else to do but listen in.

At the receiving end, the future up-to-date radio opera enthusiast will, of course, have a first-class receiving outfit, using vacuum tube amplifiers, and a loud talker such as depicted on our front illustration. Then it will be a simple matter to listen to Caruso himself, tho he be a thousand miles distant. His voice will come out loud and distinct and the amateur's family will be enabled to "listen in" to their hearts' content.

There is still another novel scheme recently originated by the writer.

The underlying idea is not only to give grand opera by wireless, listen to the music and to the singers only, *but to actually see the operatic stars on the screen as well.* This is how it can be readily accomplished *by means which are available today,* and without the slightest technical difficulty.

Let us say, by way of example, that the opera "Aida" is filmed in its entirety. This may mean a four or five film feature. The opera will be filmed just like any other photo-play.

Our large illustration shows what happens next. The stars, singers, players, the chorus, orchestra, conductor, etc., are then assembled in a moving picture studio and in front of them is the usual screen. The opera "Aida," which had been filmed before, *is now repeated on the screen* while the entire cast follows the screen picture closely. Each performer, every star, every member of the chorus has his or her own microphone in which he or she sings the regular score, watching closely the film-play as the action is unreeled on the screen. The moving picture opera thru the film operator keeps time with the singers, and the singers themselves must keep exact time with the performance as it is unrolled on the screen before their eyes. Inasmuch as the identical cast has been filmed, it will not be difficult for them to keep time with their own performance, as may readily be imagined. *In other words, when Caruso*

(*Continued on page* 145)

A Low-Priced Radio Telephone Set At Last!

Amateurs are about to realize one of the dreams which has fascinated them ever since, in the early days of the war, when they began to read about the wonderful little oscillion radio telephone transmitters which the U. S. Air Service was introducing for interplane work and for communicating between planes and ground. A set very similar to this elaborate Government radiophone has at last been produced, but its design is so simple that it can be acquired for a sum of money which will be within the reach of thousands of amateurs. It operates on a 60 cycle 110 volt alternating current—no motor generator is required. Plug the power leads into any lamp socket; connect to the antenna and earth. Connect a small battery for the microphone and talk away. The wave length is from 200 to 600 meters. The articulation is surprisingly clear, decidedly better than over an ordinary wire, and the circuit is so cleverly designed that no troublesome noise whatever is experienced from the 60 cycle supply at the transmitter. The telephone range of the set is from 10 to 20 miles, depending on the various conditions, heights of masts, nature of terrain, etc.

The transfer switching is effected by means of a little relay with a push button in the microphone base, so that when two parties are each equipped with this new transmitter and any good audion receiver, it is possible to telephone back and forth as rapidly as over a land wire.

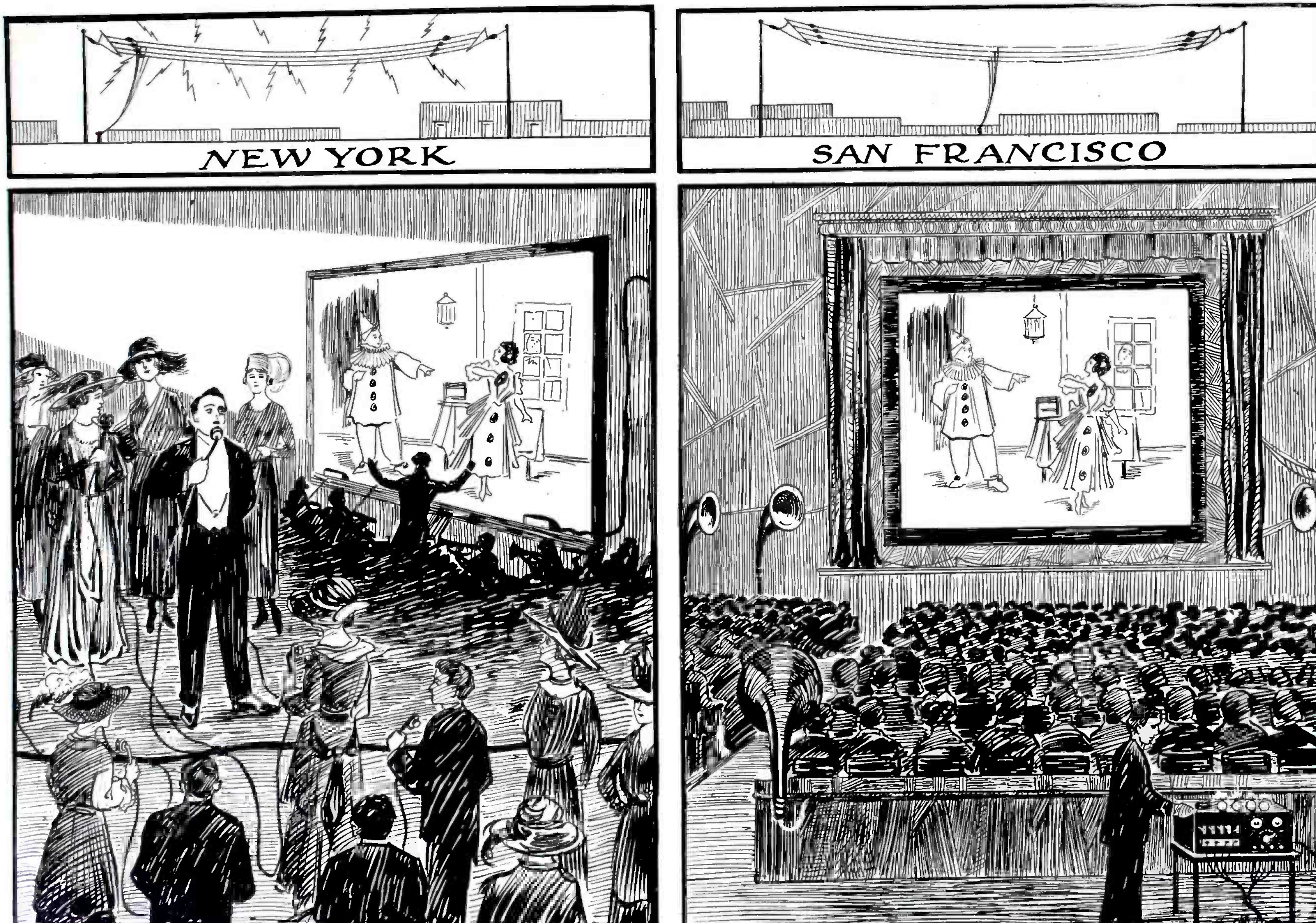
The commercial world as well as the amateur field has long awaited such a serviceable low price radio telephone transmitter, and the quality of speech plus the good workmanship and thoroughness of design of this new set is said to be such as to render it perfectly acceptable for a large number of commercial installations where large power and longe range of transmission are not required.

The New Radio Telephone Set Which Operates from Your 110-Volt A. C. Supply.

The entire outfit is mounted on a bakelite panel 14" x 20" and on a baseboard attached thereto. Two rectifier bulbs and four small transmitter or oscillator bulbs are employed. If shorter distances of transmission are sufficient, then two oscillator bulbs only are needed. A Morse key is provided with the set so that it can be used as an undamped wave telegraph transmitter as well. When so used with an ultraudion receiver, distances up to 100 miles can be readily covered.

The entire transmitter weighs less than 50 lbs.

With the introduction of this practical low price radio telephone we will shortly expect the formation of radio telephone clubs in a great many localities, every member of each will be equipped with such a transmitter so that community conversations can be carried on among the fortunate members without any longer paying tolls to the Telephone Trust. This new transmitter should indeed cause a lively awakening of interest in radio circles all over the country, especially among those who have never had the time to require a really working knowledge of the Morse code.



(Patents Pending)

Grand Opera Movies by Radio in the Very Near Future Will Be Conducted along the Scheme Outlined in the Accompanying Article and the Above Illustration. Caruso and His Co-stars Will Sing to the Accompaniment of Their Own Film Opera in New York, While the Identical Opera Will Be Shown in Thousands of Moving Picture Theatres All Over the Country at the Same Moment. By Means of Loud Talkers Placed in the Movie Houses, the Voices of the Stars Will Be Heard in Theatres All Over the Country. All the Moving Picture Operator Has to Do Is to Keep Step with the Incoming Music, a Scheme as Feasible as It Is Simple.

Government Radio Control

Views of Navy Department on Radio Communication

Letter from the Secretary of the Navy transmitting views of the Navy Department in connection with certain aspects of radio communication.

July 28, 1919.—Referred to the Committee on the Merchant Marine and Fisheries and ordered to be printed.

Navy Department,

Washington, July 24, 1919.

MY DEAR MR. SPEAKER: I have the honor to transmit herewith the views of this department in connection with certain aspects of radio communication, which have become so acute as to demand action by the Congress at the very earliest opportunity.

In connection with naval operations during the war this department was confronted with the urgent need to develop, as fully as possible, transocean, ship to ship, and ship to shore radio communication. Without going into details, your attention is called to the extraordinary technical development of radiotelegraphy and radiotelephony during recent months.

There is every indication that radio communication is to be extensively used within the United States and that the manufacture of radio apparatus will become a great industry. With this domestic use of radio this department has no immediate concern except as it has a bearing on transocean and ship to shore communication. However, it may be well to point out that the experience of this department teaches that for the full utilization of radio for internal communication the enactment by Congress of a comprehensive system of regulation and control is necessary. From the very nature of the case, unsystematic development of internal radio spells confusion and means a check on its use.

This department is immediately concerned with transocean, ship to shore, and shore to aircraft radio communication. As much communication is solely dependent upon radio, needless interference by stations carrying on internal communication must be prevented. This can be done very readily by assigning certain belts of wave lengths for the exclusive use of these services. As a matter of fact, such allotments of wave lengths is coming about thru international agreement based on the need for world-wide uniformity of practice.

It is apparent that the department must maintain and operate a comprehensive set of radio stations for naval purposes, radio forming the very basis of present-day naval operations.

Naval radio stations must be kept fully manned and in the highest state of efficiency, ready to respond instantly to any call.

The naval radio stations fall roughly into two classes—ship-to-shore and transocean. I say roughly, as the transocean stations are used to communicate with ships in distant waters.

The entire coast line is now provided with shore radio stations, owned and controlled by the Government (Navy Department), for the convenience and safety of commerce and as part of the protection of our coast. The organization for handling this, as well as transocean service, is in actual operation. These stations are vital for communication with naval vessels at sea and with naval aircraft. The short stations broadcast weather reports, storm warnings, time signals, notices of wrecks, etc. A recent development is the radio compass, by means of which a navigator is enabled to obtain his location by radio. This adds materially to safety at sea and minimizes delays due to bad weather. Standardized practices are being worked out so that a ship off any shore in the world will work without difficulty with the nearest shore station.

I wish to call your attention especially to the need for regulations that will effectively prevent other stations interfering with the operation of these shore stations and with desirability of the Government adopting a policy of exclusive government ownership and operation of such stations. This is a very practical, common-sense matter, having no relation to any abstract considerations of government ownership. For commercial and naval purposes the entire American coast line must be furnished with radio stations. Left to private enterprise, tations will only be established near the great harbors. It is precisely around these harbors that the Navy, for purposes of naval operations, must have radio stations. It is apparent that there should be unified and standardized operation of all coastal stations and that this can only be brought about by having all such stations Government owned and operated by the Navy.

Government Radio Control—once more, threatens not only the American amateur, but commercial interests as well. It is our firm belief that this country does not want Government Radio Control at the present time. The reader is respectfully referred to our Editorial on Page 101.

In an interesting interview with Dr. Nikola Tesla, the Father of Wireless, he expressed himself quite strongly on the subject. Dr. Tesla thinks that Government radio control at the present time would be one of the calamities of the ages. Nikola Tesla assures us that we have absolutely no conception of the future of radio. As is well known, he is the greatest exponent in the belief that radio for power transmission will revolutionize the world.

Transocean radio (high power, long wave length) development presents a highly complicated set of problems. Owing to the possibility that all transatlantic cable communication might have been shut off, the department was charged with the task of providing transatlantic radio communications sufficient to maintain contact under all circumstances with American military and naval forces abroad. This was done successfully and as one result this department has had a wide experience in transocean radio communication.

No one thing indicates more clearly the closeness of contact that is surely coming in the world than the fact that it is now quite within the practical to erect a radio station so effective that its signals can be intercepted in every village in the world. Such an instrumentality can be of incalculable value in bringing the world together and furthering common understandings. The same instrumentality, however, gripped by evil-minded government or private enterprise, is just as available for selfish and dissentious purposes. Yet the risk must not be overlooked and such control must be provided as will lead to its use for social and not antisocial purposes. From the very character of radio its development and control must be considered from a world viewpoint. Messages in the air recognize no boundaries. The full utilization of radio requires world organization and coordination.

From an American commercial point of view, it is evident that the permanent extension of American foreign trade is largely conditioned upon cable and radio communication. Orders are placed and ship movements are directed largely by cable and radio. If other countries have better communication services with lower rates, their nationals have a distinct trade advantage. Further, it has become clear that if the American reader is to have full news reports from all parts of the world, and if American news—the publication of which has very definite commercial and political advantages—is to be printed throughout the world, America must have a highly efficient communication contact with all parts of the world.

As high-power radio is going to play an important part in future commercial development, it is incumbent upon the United States to give immediate consideration to this fact. It would be very detrimental to the interests of the United States were the ultimate control of high-power radio to become lodged in a foreign corporation or in any foreign country or if the United States lagged behind in the utilization of radio.

The Navy Department is required, for purposes of communicating with its ships at long distances and with its outlying bases, to maintain and operate high-power radio stations. These stations are a naval necessity for purposes of national defense. In normal times it is inconceivable that all the available time of these stations will be utilized for Government messages. It seems a common-sense view that the spare time of these stations should be utilized for the benefit of the American people by handling personal, commercial, and press messages.

Whether the Government should own and operate all transocean radio stations is a subject on which the department, on the basis of its experience, has decided views. Especial considerations enter into radio communication between the United States proper and American possessions. Naval operations and assurance of uninterrupted communication with outlying possessions make essential the further development of these facilities and the maintenance of stations and personnel at highest efficiency. Radio communication at low rates will go far toward linking our outlying possessions to this country. Certainly under no circumstances should such radio communciation be allowed to pass into the control—direct or indirect—of foreign corporations or countries.

The immediate problems in connection with transocean radio are: (1) To make available to American commerce and press the present Government-owned stations; and (2) to further the development of transocean radio for the benefit of this country.

Since the Government must have a high-power radio system for its control of the fleet and for other Government business, which includes communication with Army transports, Coast Guard vessels, aircraft, lighthouse tenders, lightships, weather reports, storm warnings, time signal service, hydrographic information and safety of life at sea, it is a needless duplication of capital and effort to permit private stations to operate where they might interfere with each other and with the military and other Government work of stations, and where the Government stations can easily handle commercial work in times of peace; one control only can efficiently manage the variety of communications required.

Radio communication should be considered not alone from the point of view of

Government ownership of utilities, but chiefly from the point of view of the best interests of the United States in its international relations. The governments of many of the great powers control wireless either directly or indirectly. The Marconi Wireless Telegraph Co., a British organization, has endeavored to establish a British-controlled wireless circuit of the globe. The high-power Marconi stations in the United States and Hawaii form a part of this system. The high-power stations at Sayville and Tuckerton, as well as those in certain parts of South America, were constructed by German corporations.

The Navy Department is the principal user and the most extensive buyer of radio apparatus in the United States. It has had the strongest influence in developing apparatus since the early days of the use of radiotelegraphy in this country. It has gained large experience concerning the operative features of radio apparatus, and it is convinced that Government operation and control of all transocean and ship-to-shore stations used for commercial purposes, is necessary on account of present interference between stations, and for other reasons given below:

(*a*) To permit the greatest amount of business, Government and commercial, being done through consistent changes in apparatus, through systematic apportionment of any prompt and frequent changes of wave lengths, and through standardized methods of operating, one management is necessary.

(*b*) Radiotelegraphy has been looked upon as a natural Government monopoly. Since only by the closest regulation can the best use of this art be obtained, not only for commerce and safety at sea, but for military purposes, radiotelegraphy is a strict Government monopoly with the larger number of foreign nations; and, in those countries where commercial stations are permitted, the Government control is generally so strong as to amount to monopoly.

It seems therefore admitted that:

(*a*) Efficient radio communication for military (naval) and other Government purposes is a necessity.

(*b*) Efficient radio communication requires effective control; effective control requires a monopoly and the Government should exercise that control.

(*c*) Military (naval) necessity demands not only efficient and rapid communication, including effective control, but protection of the radio stations from destruction.

(*d*) During periods of strained relations, as well as during war, direct Government control and operation would be the only safe and effective control and operation, as the personnel would be subject at all times to Government supervision and discipline.

(*e*) The commercial interests of the Nation will be served best by having its radio communication facilities under a control that is non-partisan, and one which precludes the possibility of foreign domination or of private domestic monopoly, with consequent liability to preferential treatment by such agencies, of the interests controlling them.

(*f*) The dissemination of news to all countries can be accomplished best and mutual international understandings can be arrived at with more facility through national control of radio.

Radio traffic is very much congested at present; but on account of the centralized control by the Navy at the large ports, there is more traffic being handled than ever before. To return to the old method of separate control by competing private companies would be disastrous to the merchant marine and the general public.

One central control facilitates the co-ordination of the various systems, *i. e.*, coastal, aircraft, medium power and high power. It enables the proper concentration of radio as an aid to navigation and other radio developments designed to render the life of the mariner more safe.

High-power radio is international in character because it causes interference throughout the world. It is much easier for the Government to regulate international interference than it is for private companies to do so. Most of the countries of the world already own all radio stations within their boundaries, and it is more or less a simple matter for the United States Government to come to an agreement with foreign administrations regarding technical details.

Also, as the art advances and new apparatus is constructed, that will lessen the amount of interference, the international conventions will be modified accordingly. A private radio communication company might not be able, on account of financial reasons, to adopt the more modern apparatus. This might result in complications with foreign countries, and further handicapping of the radio service for the general public might ensue.

In certain localities there are several high-power stations within a small area. When they operate independently the business of all is seriously handicapped. But, on the other hand, when they are operating from a central control, business is expedited, and the general public is able to file more messages. In this connection, it might be said that a station running at full load and handling a maximum amount of traffic is able to give cheaper rates to the general public than those stations which are not running at full capacity on account of interference. The only way to handle transocean radio traffic efficiently is to control all the stations from a central point. A few radio stations controlled in this way will handle more traffic than several cables.

In the above I have endeavored to advance proper arguments which would seem to show the desirability of Government ownership of all radiotelegraph stations which are engaged in ship-to-shore work or long-distance transocean work, and particularly that these should be under the jurisdiction of the Navy Department, which Government department alone has the means and facilities to carry on this work efficiently.

This question of national and international communication by means of radiotelegraphy is particularly prominent at this time, when, on ratification of the peace

(*Continued on page* 146)

Coast Artillery Radio School

The above photograph shows the float which the Coast Artillery Radio School of Fort Monroe, Va., employed to give it adequate publicity.

It is understood that the Government needs thousands of wireless operators and has begun a drive to secure students in the various schools set aside for such purposes.

This is a great chance for young men interested in radio to obtain a course and receive pay at the same time.

Our Government is ready to spend thousands and perhaps millions in order to have an adequate supply of radio personnel on hand the next time Uncle Sam finds need for such an advanced branch of scientific students.

The truck itself displays enough apparatus to provide several complete stations and is a good sign that the student will have an abundance of apparatus to "listen in" on in the school proper, and that he will undoubtedly emerge from this school a full-fledged "practical" radio man.

Notice the small antenna, but the men listening in are not suffering from a lack of signals—*and loud ones, too,* for the apparatus is of such modern design that even with the small loop antenna seen supported on the rear of the truck, signals from all over the country can be easily picked up.

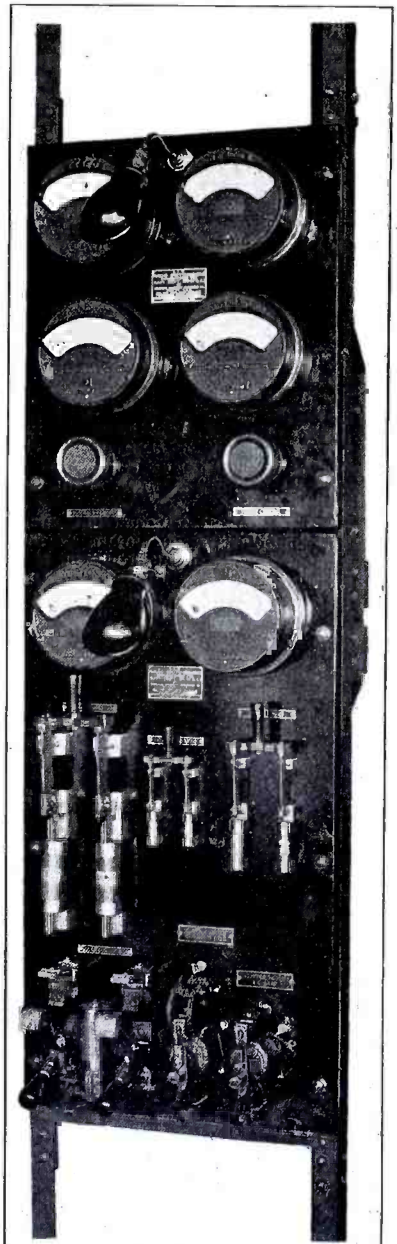
Also—notice the abundance of 'phones; these are supplied for those desiring to get a "listen" at *what's passing by* and cannot be seen.

5-KW. Navy Transmitter

By W. H. PRIESS*

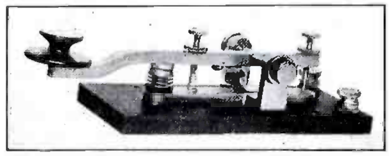
THIS type of transmitter is used in a large number of navy ship and shore stations. During the war several hundred of these transmitters were built for the Navy Department.

In this design the apparatus is arranged on two panels, one of which contains all the high frequency circuits, while the other is composed of the low frequency and prime mover controls and meters. The motor generator, automatic starter, relay



The Type of Switchboard Which Meets with Approval at all Radio Stations. Instant Control of Any of the Primary Circuits Can be Had.

and hand keys, antenna switch, antenna ammeter and lightning switch are supplied for separate mounting. This permits the location of the motor generator outside of



The Key That was Designed with the Operators' "Hand" in Consideration.

the radio room, and thus allows remote control of the stations.

Low Tension Panel.

The low tension control panel consists of two ebony asbestos panels mounted upon a suitable angle-iron frame. Upon the upper panel are four A.C. meters, which indicate the voltage, current, output, and frequency of the 500-cycle generator. A pilot lamp is mounted on the top, lighting the faces of the meters. A power control rheostat is connected in the generator field circuit and a frequency control rheostat in the motor field circuit.

Upon the lower panel are arranged the D.C. voltmeter and ammeter, the D.C. main line and auxiliary switches, the A.C. line switch, the D.C. line circuit breaker, and the generator line field contactor. The magnet coil of the latter is fed from the 110-volt line and is connected in series with contacts on the antenna switch. It opens the A.C. line and the generator field simultaneously when the antenna switch is in the receive position.

The motor is a 120-volt D.C. shunt interpole machine. It drives a single-phase, 250-volt, 500-cycle inductor type alternator at a speed of 1,765 r.p.m. *The machine is started by an auto starter consisting of a 3-step accelerator enclosed in a sheet-iron case.*

The transformer is of the closed core, minimum leakage type, in which special care is taken to secure a high insulation safety factor. The primary and secondary are separated by heavy micanite tubes and the individual sections of the secondary are separated by heavy micanite discs. The reactance is mounted in the same case with the transformer, and is provided with five taps *for varying the value to allow for small changes in the synchronous impedance of the generator.*

Radio Frequency Unit Panel.

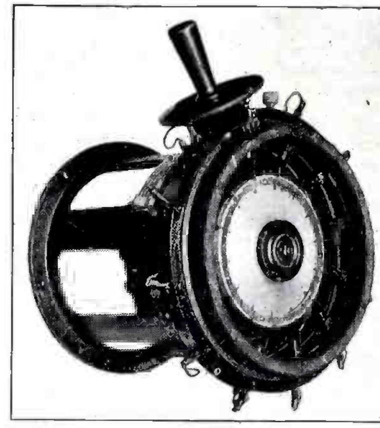
The radio frequence unit consists of a bakelite dilecto panel with primary coils, primary condenser, quenched spark gap, coupling coil and antenna loading inductance. These units are assembled with a wave-length shifting mechanism which allows adjustment to the following eight wave lengths: 300, 476, 600, 756, 952, 1,200, 1,510, 1,905 meters.

Control of wave length is obtained by the rotation of a single handle, which automatically varies the period of the primary, the coupling between primary and antenna, and the antenna inductance. Continuously variable fine control of coupling is provided by means of a lever handle. Variometer tuning of the antenna on each wave length is arranged so that the tuning of any one wave length alone will not disturb the adjustment of any of the remaining wave lengths. This is accomplished by the handle protecting from the antenna inductance coil.

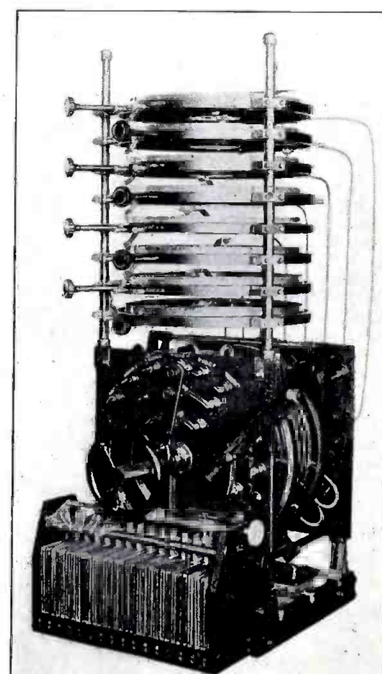
The quenched spark gap consists of fifteen units of the self-cooling Navy type, with a switching mechanism for varying the number of gaps in the circuit. The primary transmitting condenser consists of eight Faradon mica condensers of .004 mfd. each.

Rotary Spark Gap.

The rotary spark gap shown in the following illustrations of the auxiliary separate unit type was designed for use on spark transmitters up to 5 kilowatts. Its main advantage over the quenched spark gap is one of reliability and operation. Since the gap is designed with broad paral-



A Rotary Gap Which Bears Out its Name. It Embodies These Features: Broad Parallel Sparking Surfaces, Operates at High Breaking Speed and Can Be Adjusted to Synchrony with the Motor Generator.

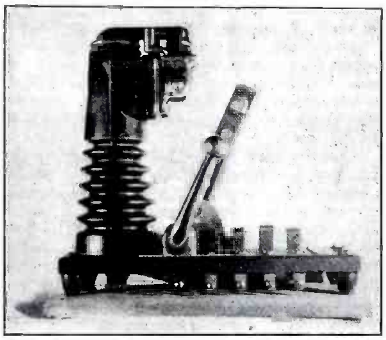


The Radio Frequency Unit Panel Which Affords any of the Navy Standard Transmitting Waves Instantly by the Operation of a Single Handle.

lel sparking surfaces, and operates at a high breaking speed, which can be adjusted to synchrony with the motor gen-

*Chief Engineer, Wireless Specialty Apparatus Co.

erator, its operation is essentially the same as that of the quenched spark gap of the ordinary parallel plate type. The efficiency of the rotary gap is of the order of magnitude of the usual quenched spark gap. The gap was mounted with its rotor shaft on vertical axis. The rotor consists of an aluminum wheel upon which are mounted fourteen hard-drawn copper electrodes,



The Antenna Transfer Switch Which Also Controls the Primary Power Circuits.

held in place between two steel clamping rings. The stator consists of twelve stationary electrodes pivoted between two insulated rings and arranged so that rotation of one of the rings varies simultaneously for all electrodes, the sparking distance between the stator and rotor. The stationary electrodes are connected by a flexible connection to a collector ring. An insulated handle on one side of the unit permits adjustment and clamping of this adjustment while the gap is in operation.

The spark chamber, encased in an aluminum housing cast with heat radiation flanges, transparent window, affords a view of the spark.

The motor consists of a ¼-H.P., 120-volt direct current motor, operating at a speed of 4,000 revolutions a minute. This produces 5,600 parallel breaks per second between electrodes 180° apart. The two terminals are the aluminum casing for the unit and the collector ring. On our 5-KW. equipment the gap is operated at 17,600 volts in a condenser circuit of .032 mfds. The 2-KW. equipment is operated at a voltage of 16,000 volts in a condenser circuit of 0.6 mfds.

Reliability offered by this type of gap has caused the Navy to specify it as an auxiliary in all 5-KW. and 2-KW. radio installations.

Relay Key.

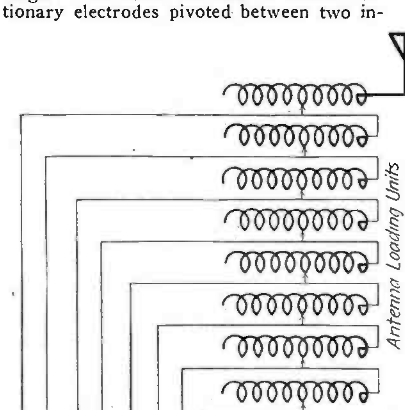
For remote operation of transmitters or in cases where high currents at medium high voltages are to be broken, a relay key offers the best solution. The contacts of the relay key shown are ⅜-in. fine silver, and will handle currents up to 60 amperes without arcing or overheating.

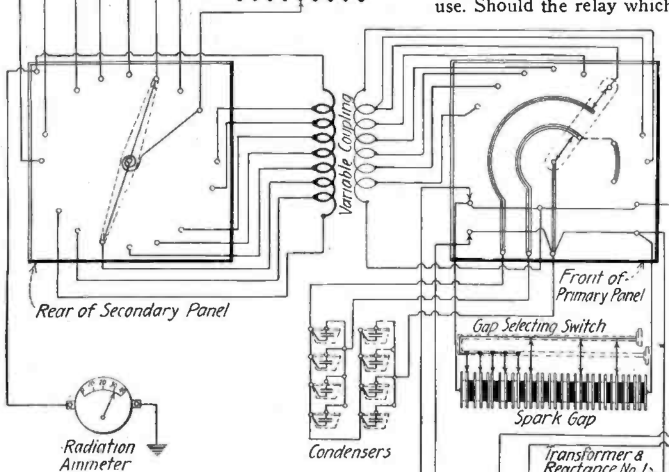
The relay key is designed with a very *small time constant, and will operate at a reliable breaking speed up to forty words a minute.* The armature is of the double-break type, thereby causing a hammer break in the circuit, and eliminating the possibility of a lingering arc. The solenoid coil is equipped with external resistance, and has binding posts which permit operation at 80, 110, or 220 volts.

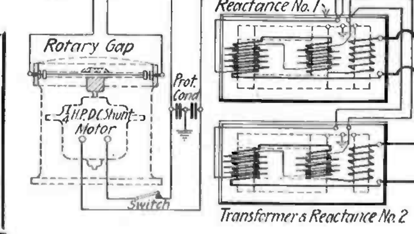
The base is of heavy bakelite dilecto and drilled for vertical mounting.

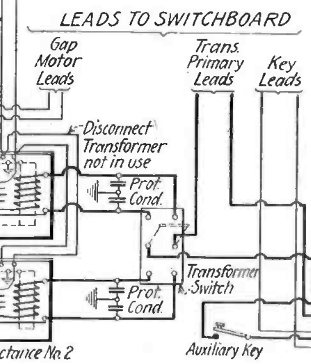
Hand-Operated Key.

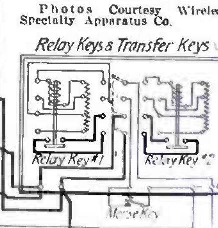
This key is furnished for emergency use. Should the relay which is controlled by an ordinary Morse key become inoperative, the operator can complete his transmission by resorting to this hand-operated large contact key until the trouble is located and remedied.







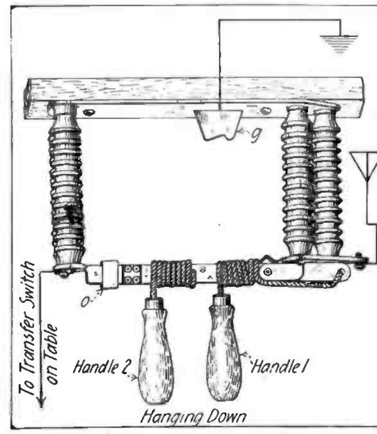




Connections of the Radio Frequency Unit Panel Showing the Antenna Load Coils and How They Are Cut Into the Circuit. Note that Both Switches Are Operated by the One Handle.

Lightning Switch.

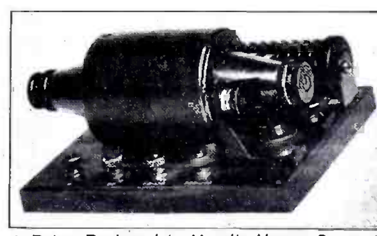
As shown in the sketch, the *"antenna grounding"* or *"lightning"* switch is placed above the operator, generally on the ceiling, and same is controlled by pulling the handles, which in turn causes the switch blade to place the antenna in *"operating"* or *"grounded"* position. By pulling handle



The "Lightning Switch" Which Permits Grounding of the Antenna from the Operating Table. The Switch is Located on the Ceiling.

1 the antenna is grounded. When it is desired to resume operation handle 2 is grasped and the switch blade can be brought in connection with post 0. Connection is made from post 0 to the antenna control or transfer switch placed on the operating table proper.

Armatures and field windings of the alternator and motor and low-tension wind-



A Relay Designed to Handle Heavy Currents Up to 5-KW.

ing of the transformer are protected by mica condenser units against radio frequency surges.

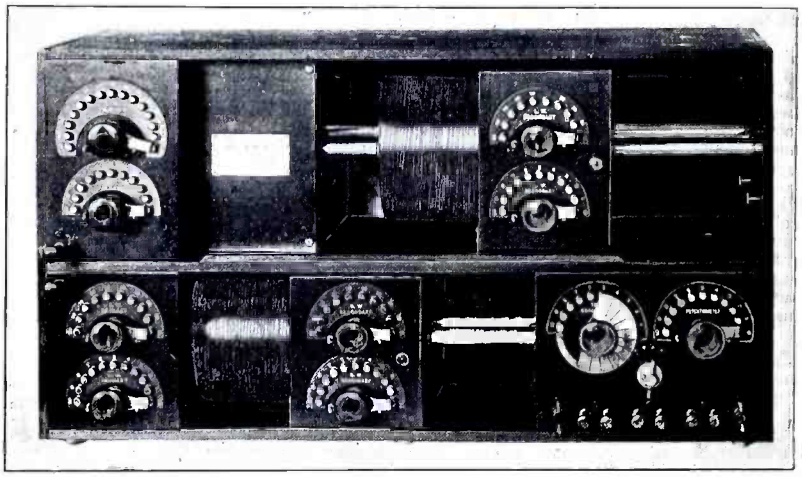
As shown in the wiring diagram the outfit is arranged with duplication of relay keys and transformers, together with the necessary transfer switches. A spare part box is provided which contains spare fields for both motor and generator, spare brushes, spare contacts for the motor starter keys, three spare spark gap units, with spare gaskets and a spare Faradon condenser. *These spares are sufficient for at least five years' operation.*

Photos Courtesy Wireless Specialty Apparatus Co.

The Pickard Double-Deck Receiver

By Walter J. Henry*

THOSE who are acquainted in the field of radio operation are aware of the unusual efficiency of the radio equipment of the steamers of the United Fruit Company's "Great White Fleet." This



The Double-Deck Receiver Which Permits One Operator to Listen In on Two Wave Lengths Simultaneously. The Long Wave Coupler Secondary Is Seen at the Upper Right Hand Corner of the Panel.

Photo—Courtesy Wireless Specialty Co.

marked efficiency is due on the receiving end entirely to the double-deck I-P-76 receiver shown below. This receiver was developed and manufactured by a Boston concern and supplied to the steamers of the "Great White Fleet" and the land stations of the United Fruit Company's radio communication network in the Caribbean. The striking feature about this type of receiving equipment is that it allows an operator to listen in simultaneously on two wave lengths; for example, a ship wave length of 600 meters and a shore station wave length of 1,500 meters. This greatly increases the speed of handling traffic and reduces the time required for calling a station.

The germ of this receiver was embodied in a system patented on October 14, 1902 (Patent No. 711,174), by Mr. Greenleaf Whittier Pickard. This system was designed for the reception of two waves on a single antenna. In 1911 a "listening key" was designed for the U. S. Navy. This consisted of two separate receivers with a three-position switch, which could connect one receiver separately to the right hand head telephone and the other separately to the left telephone, or both at the same time to their respective telephones.

The 1914 double-deck receiver embodied all the best features of previous experimenting.

The receiver consists of two receiving oscillation transformers with accessory apparatus mounted in a bakelite dilecto box. A two-stand detector is furnished equipped with perikon and silicon-antimony detector combinations. Binding posts are provided on the receiver panel for connecting the antenna, ground, detector and two pairs of telephones. The connections in this type receiver are shown in the accompanying wiring diagram, figure 1.

By means of the four-point multiple switch located on the lower right hand part of the panel, the receiving circuits are arranged for the reception of short waves, long waves, or short waves and long waves simultaneously. The upper part of the receiver is occupied by the long wave receiving transformer and the lower section by the short wave receiving transformer. The amount of inductance in the circuit is varied by means of two rotary control switches, one of which varies the inductance by tens of turns and the other by single turns. Each primary and each secondary is individually controlled by this arrangement. Coupling is permitted by a sliding motion of the transformer secondaries, which are designed to allow very loose coupling and thus obtain a maximum selectivity.

When the 4-point multiple control switch is in position No. 1, both primaries are connected in parallel between the antenna and ground and the two secondaries are in series across the detector as shown in the circuit diagram. This position allows the simultaneous reception of long and short waves. The longer wave is adjusted on the upper or long wave transformer and the shorter wave on the lower or short wave transformer. This is an excellent arrangement for stand-by use.

With the circuit control switch in position No. 2 the short wave transformer only is connected in the circuit and a small fixed value air condenser is placed in series with the primary circuit. This connection is for receiving short wave lengths of the order of, or shorter than, a natural period of the receiving antenna, for example something between 200 and 600 meters.

When the circuit control switch is in position No. 3 the circuit remains the same as in position No. 2, with the exception that the series condenser in this case is cut out of the circuit. This allows the reception of longer wave lengths than in the previous case. For an antenna with a natural period of 400 meters this arrangement of circuits will permit the reception of waves from 500 to 2,400 meters.

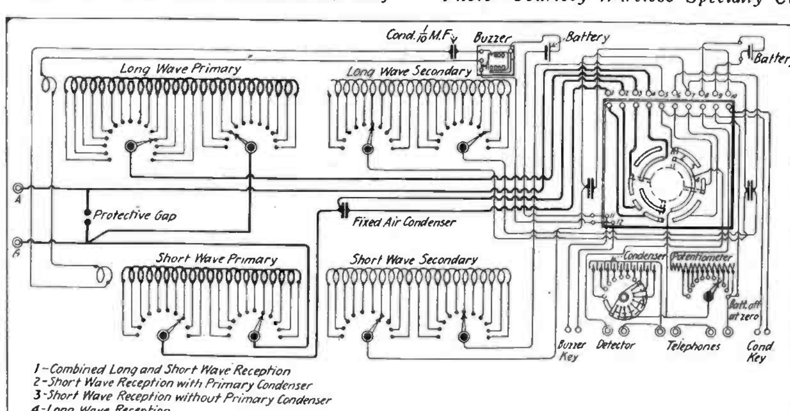
With the circuit control switch in position No. 4 a long wave transformer only is cut in the circuit. This allows reception of waves of a length ranging from 1,100 to 7,000 meters.

This receiver has a wonderful flexibility and allows the reception of signals of widely varied range without sacrificing its ability to quickly pick up a station while standing by.

A variable telephone condenser mounted above and to the left of the circuit control switch is used for group tuning the telephone circuit to different spark frequencies. A low pitched spark requires more condenser, while a high pitched spark requires less, so that when the condenser is properly adjusted a materially increased response may be obtained for musical spark signals.

To the right of the telephone condenser is located a ten-step potentiometer for adjusting the battery potential in the telephone detector circuit. This materially increases the sensitivity of the perikon and silicon-antimony detectors. A test buzzer controlled by a small key switch is used for adjusting the detectors in the absence of station signals. The buzzer test excites the receiving circuit through a coil which is inductively coupled to both transformer primaries.

This receiver is highly popular with radio operators and is without question one of the most sensitive and selective spark receivers in use on commercial ship stations. This is attested by the remarkable work done by the steamers of the "Great White Fleet" plying in tropical waters which present that peculiar combination of physical and atmospheric conditions most adverse to successful radio communication.



Wiring Diagram of the Connections Employed In the Double Deck Receiver.

ANNOUNCEMENT.

Dr. Pickard informs us that due to extended patent prosecution the article covering the use of the Crystal detector as an oscillator cannot be released, but hopes to be in a position to do this shortly.

* Sales Manager, Wireless Specialty Co.

A. B. C. of Wireless Reception

By H. K. DUNN*

INSTRUCTIONS for building and operating wireless stations are described profusely in the RADIO AMATEUR NEWS each issue, yet I have never seen an attempt at a correct explanation, intended for the amateur, of the nature of wireless waves and how we are enabled to hear them. Such instructions

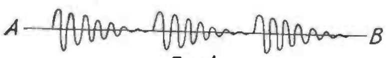


FIG. 1

A Series of Oscillations Produced by One Spark Discharge. It Can be Seen That They Decay Rapidly.

usually state that the spark of our transmitter sets up waves in the ether, and that these in turn set up electric currents in any receiving apparatus within range. This is, of course, true, but it is only a general statement, and should not satisfy the amateur with an enquiring scientific mind. In this article I shall try to give an explanation which can be easily understood by the average amateur, and which is, I think, in accordance with the best modern theories. Nothing will be said of tuning, since most amateurs are very well acquainted with that part of the wireless.

It is assumed that the reader is familiar with the theory that all space is filled with *ether*, a substance that we cannot weigh, nor, in fact, detect in any way except as a medium for certain radiations. The fundamental theory of wireless is that any electrical vibration or oscillation sets up *waves* in this ether. Thus, light waves are caused by the vibration of tiny electric charges, called electrons. These vibrations are very rapid, and the waves are therefore very short. The alternating current in our electric light lines also sets up waves in the ether, but since the current changes only sixty times a second, while ether waves travel at a rate of 186,000 miles per second, each of these waves is about 3,000 miles long. Between these two extremes are wireless waves, which are neither too long nor too short to be made audible in the receiving instruments.

The most common method of producing wireless waves is by the electric spark. Now a spark is not a simple passage of

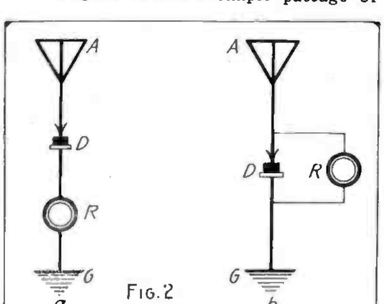


FIG. 2

Two Very Simple Forms of Receivers. a—Shows the Receiver and Detector in Series and b. Both in Parallel.

electricity from one point to another, but each discharge is made up of a great number of oscillations. This may be best illustrated by the old analogy of allowing water to flow from one side of a U-tube into the other. More water flows over the first time than is necessary to equalize the water level, on account of the momentum of the moving liquid. Therefore some water must flow back into the first arm of the tube, and so on until friction with the wells of the tube brings the water to a standstill with the level the same in both arms. An electric discharge behaves in the same manner. The electricity flows back and forth, the effect becoming less each time until the oscillation ceases. This takes place so rapidly that the whole spark with its many oscillations seems instantaneous. If one side of the spark gap be connected to an aerial and the other to the ground, an electric oscillation, or alternating current, is set up between the aerial and the ground, thus producing waves in the ether. This current between the aerial and the ground alternates for each oscillation in the spark gap; then, since a number of discharges cross the gap each second, each discharge being composed of many oscillations, the ether waves produced are of a moderate length. A common wave length for the amateur is 200 meters or about 650 feet. The character of the waves set up is of very great importance. Fig. 1 is an attempt to visualize a series of these waves. Since each oscillation in the spark gap is weaker than the one preceding, the amplitude of the wave set up is correspondingly less, until a new discharge begins. Such waves are spoken of as *damped*.

> **DOLLARS FOR IDEAS**
>
> **Amateurs, we want your ideas! Tell us about that new stunt you have meant to write up right along, but never got to. Perhaps you have a new idea. Perhaps you have a new hook-up or perhaps you made your old clockworks do something new. If so, we want that idea, and want it bad. For every contribution which we accept, for every idea, we will pay $2.00. This refers only to simple ideas, and does not by any means refer to long articles, for which we pay much higher rates. Why not get busy at once? Address Editor, this publication.**

We shall now pass to the receiving end. Whenever an ether wave strikes an electric conductor connected to the earth, an alternating current is set up in this conductor exactly like that which produced the wave, except that it is much weaker, depending on the distance the wave has traveled. If we have an aerial connected to the ground, with our receiving instruments connected between them, this alternating current is made to flow thru our instruments. Fig. 1 may also be used to represent this current. When the curve is above the line AB the current is flowing in one direction, and when it is below AB the current flows in the opposite direction.

Let us now examine the telephone receiver or "phone" in which the currents are made audible. Its construction is known to most amateurs, but it would be well to review it here. A soft iron diafram is attracted by a permanent horseshoe magnet, around each pole of which is a coil of wire, which in the more sensitive receivers is of a high resistance. Any change in the current flowing thru these coils changes the strength of the magnetic field, and so the diafram moves either toward the magnet or away from it. Note that this motion is caused, not by the *amount* of current, but by a *change* in the amount of current. Thus a rapidly alternating or pulsating current causes a vibration of the diafram, resulting in an audible sound. The diafram requires a little time, however, to respond to the change in the magnetic field, and

FIG. 3

The Detector Being a Rectifier, Permits Only That Portion of the Waves Shown Above the Horizontal Line to Affect the Receivers.

also the change in the field lags a little behind the change in current. Hence when a current such as is illustrated in Fig. 1 passes thru the receiver, the direction of the current is changed and the previous effect completely neutralized before the diafram has time to respond, and so no sound is heard. A very slight vibration may take place, but even so the pitch of the sound is so high that the human ear cannot detect it.

Something else, then, is needed, and the need is satisfied by the detector. There are many forms of detectors, but the principle in all is that they conduct a current in one direction, but do not allow a current in the other direction to pass. Fig. 2, a, shows a simple, yet complete receiving outfit. Suppose an ether wave strikes the aerial, A, tending to set up a current like that of Fig. 1. The detector, D, allows only the current in one direction to pass, hence all the curve below the line AB is removed, leaving only the upper part. Although the current repeatedly falls to zero, it rises again in the same direction, so that the virtual effect is that shown in Fig. 3. This is a pulsating, direct current, of a frequency low enough to be heard in the phones, R. In this way we are able to hear the dots and dashes of the code as correspondingly short and long buzzes. Another simple and usually more efficient connection is that shown in Fig. 2, b. Here the current in one direction passes easily thru D and hence does not pass thru R, which is of high resistance. In the other direction D blocks the passage of the current, so it must go thru R. The effect is the same as in the first case. More complicated outfits involving loose couplers, etc., can be easily explained from this fundamental principle by the use of the principles of induction, resonance, etc.

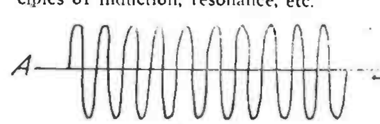


FIG. 4

A Series of Undamped Waves Produced by an Arc Transmitter. They Decay Very Slowly Therefore Travel Further.

It is possible by means of the electric arc, and by other methods, to produce an *undamped* series of ether waves, i.e., one in which each wave has the same amplitude (see Fig. 4). Such a wave cannot be heard in the ordinary receiving apparatus, for when the detector has rectified the current the virtual effect is that of a *constant* direct current, while it requires a change of current to be heard in the phones. It may be rendered audible by connecting in some kind of device for interrupting the current. Many large stations now use undamped waves exclusively.

* Assistant in Physics, Miami University.

Fundamental Operation of Vacuum Tubes

By DAVID S. BROWN

When the old audion was in common use it was customary to connect it up in one standard circuit and to operate it (in respect to applied voltages, etc.) in one so-called "only correct" method. Modern developments and experiments have so far shown what goes on inside and outside the tube that a thoro understanding of certain principles of theory enable the operator to use a great variety of circuits for a great many purposes. And altho the theories have all been bottled up in books, nevertheless the average man is somewhat in the dark even yet, mainly because of his limited understanding of the technial expressions and theories used in those books. With the hope of giving the "average man" a fair knowledge of vacuum tube operation, this article is undertaken. No attempt will be made to give theory and hence no apology is necessary for the omission of the customary explanations found in most articles on the vacuum tube. However, it must be remembered that only thru a clear understanding of the action of the tube can come intelligent operation.

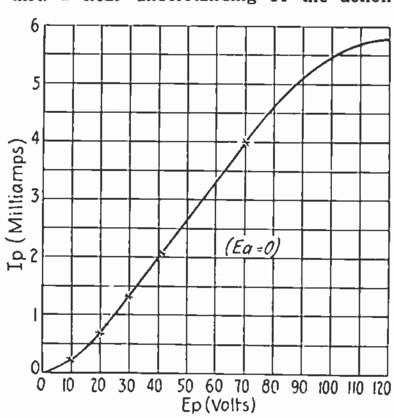


Fig. 1. A Simple Graph for Those Not Familiar with the How and Why of It.

It is assumed that nearly everybody understands how to read graphs or curves. For the benefit of those who may be in doubt, refer to Fig. 1. The heavy horizontal line is called the "abscissae"; the vertical one the "ordinate." They are also referred to as the "axes." Where the two lines intersect is the point which represents zero (whether it be volts, amperes, seconds or any other measure of dimension). Positive values are to the right of zero on the abscissae and above zero on the ordinate. To the left and below zero are the negative or minus values. The units used are always designated on each curve.

"I" stands for *current.*
"E" stands for *voltage.*
"P" stands for *plate circuit.*
"F" stands for *filament circuit.*
"G" stands for *grid circuit.*

Thus "I" means *current flowing in the plate circuit.* "E" means voltage or *potential of the grid.* This latter is measured, considering the filament as zero and the grid as so many volts "positive or negative with respect to the filament."

Old type audions were not very uniform. It was necessary to "juggle" the plate voltage and the filament current for best results. On the other hand, the more recent "high vacuum" tubes are made so nearly uniform that definite instructions can be given for any type tube.

When the filament of a tube is heated, a current will flow thru the circuit consisting of the plate, the plate battery, the phones (or any other instruments used in connection therewith) and the filament. This current varies with the temperature of the filament and also with the voltage of the plate battery. As was previously mentioned, with old audions it was necessary to adjust and readjust the filament current and plate voltage until the proper relation was obtained. With all the tubes now being built for army, navy and amateur use, these figures are fixed because of the design and nearly uniform construction of the tubes. The VT-1 (Western Electric "J") operates on 1.1 amperes filament current. Other tubes are rated as follows:

VT-11 (General Electric)	1.1 amps.
VT-21 (DeForest)	1.1 amps.
Marconi (Moorehead)	0.7 amps.
VT-2 (W. E. transmitter)	1.36 amps.

It should be noted that of these only the Western Electric tubes are burned at a dull red heat. All the others have tungsten filaments and are heated to a bright light. However, care should be taken not to burn them above their rated currents, as the filaments burn out quickly when overheated.

Fig. 1 shows a curve representing the values of plate current I_p obtained when E_p is varied and I_f is kept constant. This curve does not represent any particular tube. *As E_p increases, I_p also increases up to a certain point (called the point of saturation) beyond any increase in voltage will cause no further increase in current.* This is shown by the top part of the curve which ceases to go up but flattens out.

ACTION OF THE GRID

Without attempting to explain theory, the action of the grid in an audion is simply that positive charges on the grid *increase* current in the plate circuit while negative grid charges *decrease* the plate current. Both of these actions are limited. If the grid is made positive to a certain degree, the "saturation" point is reached similarly as in the E_p-I_p curve. More plate current can be obtained, however, by increasing the plate voltage and also by increasing the filament current. The grid may be made so negative that the plate current will be nearly or, sometimes, entirely stopped. Fig. 2 shows the circuit used for obtaining the static characteristics of tubes. The filament is lighted by the usual "A" battery and the current shown by the ammeter marked "I_f". The plate or "B" battery is variable, the voltage registering on the voltmeter "E_p". Plate current is indicated by the milliammeter "I_p". The potential of the grid is shown by the voltmeter "E_g" and is varied by means of the potentiometer. This grid battery is arranged so that the positive or the negative terminal may be applied to the grid (the reversing switch not being shown).

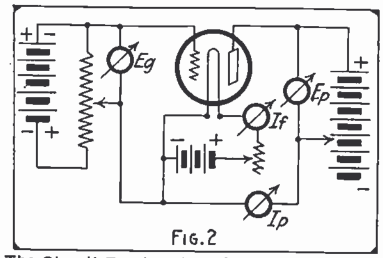
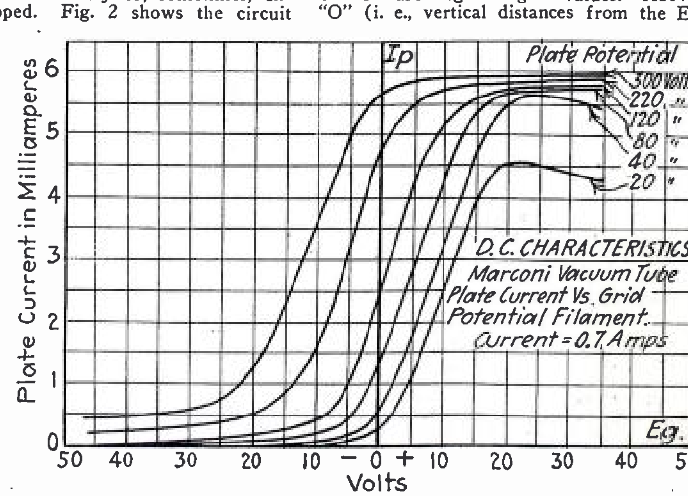


FIG. 2
The Circuit Employed for Obtaining the Static Characteristics of Tubes. Note the Meters in the Various Circuits.

Suppose now that we have a circuit containing one of the Marconi-Moorehead tubes. We adjust I_f to 0.7 amperes and the plate voltage E_p to 20 volts. Next we move the potentiometer slider all the way up so that there is no voltage on the grid. The grid is then said to be at zero volts with respect to the filament. The plate ammeter will indicate about 0.3 milliamperes. Now we will adjust the potentiometer so that the grid is five volts positive to the filament. The I_p jumps to about 1 milliampere. At 10 volts grid potential, I_p increases to 2.5 milliamperes. We take a few more such points and then reverse the grid battery to make the grid more negative than the filament end. This decreases our I_p below 0.3 milliamps. At 10 volts (negative) on the grid, the plate current is practically zero. If we plot all these points, we will get a curve similar to curve "a" in Fig. 3. There the various distances to the right of "O" represent positive values of grid potential. Distances to the left of "O" are negative grid values. Above "O" (i. e., vertical distances from the E_g



Curves At Different Plate Voltages In Respect to Changes of Grid Voltage Showing the Plate Current Flowing In That Circuit.

axis) are positive current values corresponding to each value of grid potential.

If we now change our E_p to 40 volts and repeat all of the preceding processes, we will get a curve like "b" and likewise other plate voltages as shown by "c," "d," "e" and "h".

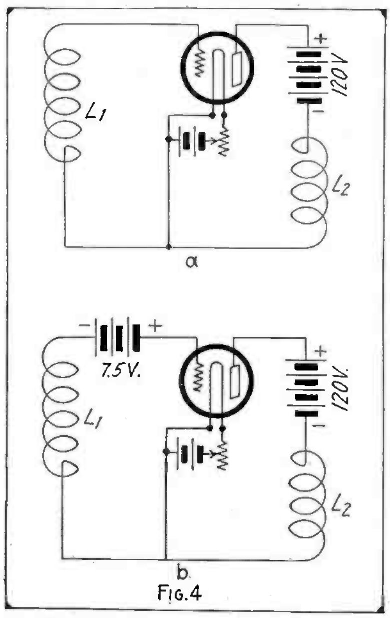
From such a family of curves it is possible to see just how and where to operate the tube for the various purposes, e. g., amplifying, detecting, etc. This particular set of curves represents the characteristic action of the Marconi-Moorehead tube as shown in the Marconi Company's booklet. However, they hold good for *only* that one style of tube and then only when the filament is heated by 0.7 ampere. Curves will be given later for other makes of tubes. As these characteristics differ in each make of tube, any tube can not well be used hit-or-miss in place of another. The circuit should be made to accommodate the particular tube at hand. In only one particular are all present-day tubes practically alike. They may generally be used as detectors on 20 voltes plate, as amplifiers on 20 to 80 volts, and as power oscillators on from 200 to 300 volts.

One important feature for efficient operation is that the impedance, i. e., alternating current resistance of the plate circuit should approximately equal the internal impedance of the tube. For example, in all sets made by the Western Electric Co. for the army the VT-1 was used as both detector and amplifier. The VT-1 has an internal resistance (resistance between plate and filament) of about 20,000 ohms. They therefore made their telephone receivers and the primaries of the amplifying transformers about that same resistance. The VT-1 would then operate most efficiently when used with the W.E. phones or amplifying transformer (or with others of equal impedance). Note, however, that each different make of tube has a different internal resistance and also that the 20,000 ohms above mentioned does *not* mean D.C. resistance. The D.C. resistance of phones is generally from 2,000 to 3,000 ohms per pair. Sooner or later manufacturers will probably advertise the impedances of their various head sets, amplifying transformers and vacuum tubes so that the purchaser may be able to balance up his apparatus for best results. For example, the writer recently saw a standard make of phone on the back of which was stamped "Resistance—D.C. 3,200, 800 cycles 13,500."

The adjustment of the grid potential is very important for effective operation. It varies for each make of tube, for each voltage used on the plate, and for each use to which the tube is put.

THE V. T. AMPLIFIER.

The simplest action of the vacuum tube is probably that of amplifying. Suppose the tube connected as in Fig 4a. The filament is at normal heat, the grid at zero volts and there is no current in the filament-grid circuit. Consider now curve "d" in Fig. 3. From this curve it will be seen that the plate current is a steady, direct current of value 2.5 milliamperes. Now



By Providing a Grid Voltage Such That the Tube Is Operated About the Middle of the Straight or "Steep" Part of the Curve You Can Have Your Tube Amplify As Well On 40 Volts As When Using 120.

suppose an alternative current of small magnitude to be impressed on the *input* transformer secondary L_1. This will cause the grid voltage to vary, becoming alternately positive and negative as the induced current varies. The changing grid voltage will automatically control the current in the plate circuit, I_p, as indicated by the curve. For example, let the grid vary from plus 5 volts to minus volts. At plus 5 volts, the coresponding I_p (from the curve "d") is about 4 milliamps. At minus 5 volts, I_p is 1 milliamp. Hence a current in L_1 which causes the grid to alternate from plus 5 volts to minus 5 volts will cause the plate current to vary from 4 to 1 millamps. *The best amplifier then is, obviously, the one which will give the largest variation in plate current from the smallest given variation in grid current.*

Suppose we had employed 40 volts E_p instead of 120 volts. The grid changes from plus 5 to minus 5. Curve "b" shows the corresponding change in I_p to be 0.2 to 1.8 milliamps. This is not nearly as large as the variation obtained with the same tube using 120 plate volts; and 40 volts would then appear to be not as good for amplifying. But let us connect a 7.5 volt battery with its positive terminal to the grid and its negative terminal to L_1, as shown in 4b. Now our plate current goes away up; curve "b" shows it to be 2.5 milliamps. Let the grid again vary 5 volts up and down. The grid is already at 7.5 volts, so therefore, such a variation will make the grid alternately 7.5—5.0 and 7.5+5.0, that is, the grid will vary from plus 2.5 to 12.5 volts. That causes a variation in I_p of from 1 to 4 milliamperes, which is the same as was formerly obtained with E_p of 120 volts. In other words, we can get the tube to amplify as well on 40 volts as we did on 120 volts *provided that we make the grid voltage* (without incoming signals) *such that the tube is operating about the middle of the straight or "steep" part of the curve.* In Fig. 3, the curve is steep for 120 volt plate when the grid is at zero potential; for 20 volt plate when the grid is at plus 10 volts; for 220 volt plate when the grid is about minus 5 volts. These, then, are the voltages necessary on the grid for using the tube whose curves are shown, as an amplifier.

(*Continued in next issue.*)

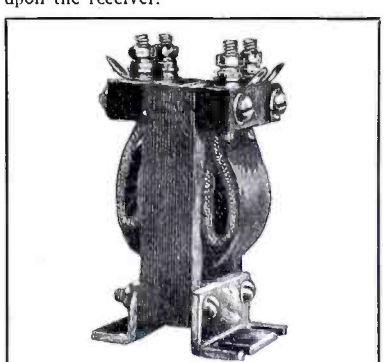
For fundamental theory of vacuum tubes and the "electron current" between filament and plate, the reader is referred to the following texts:

"Vacuum Tubes"—Bucher.
"Principles Underlying Radio Communication"—U. S. Signal Corps, No. 40.
"Wireless Telegraphy"—Stanley.
"Radio Communication"—Mills.
Articles by Armstrong and Languinio in "Prac. Inst. Radio Engineers," Vol. III (1915).

Audio Frequency Amplifying Transformers

The up-to-date wireless experimenter will be satisfied with nothing less than the best the art can afford. He will want to duplicate the results obtained by the Allied governments during the recent war. Hence it is safe to predict that he will experiment with indoor loop aerials for long and short wave reception, with underground antennae and direction finding apparatus. He will want a receiving equipment that will permit him to copy signals from high power stations in foreign countries or will allow reception at the wave length of 200 meters over distances up to 2,000 miles. Such results he is already aware can be obtained only by use of the three-electrode vacuum valve detector commonly known as the "Audion."

The striking ranges of transmission secured in wireless telegraphy and telephony during the past three years may be directly attributed to the perfection of the cascade vacuum valve amplifier, which when operated in several stages gives current amplifications of one million or more. This accounts for the remarkable distances spanned by low power wireless telegraph and telephone sets during the war. With antenna currents of less than one ampere at the transmitter ranges over 200 miles have been obtained. In other words, a good share of the burden has been placed upon the receiver.



An Amplifier Transformer Especially Designed for Use with the Modern Vacuum Tubes.

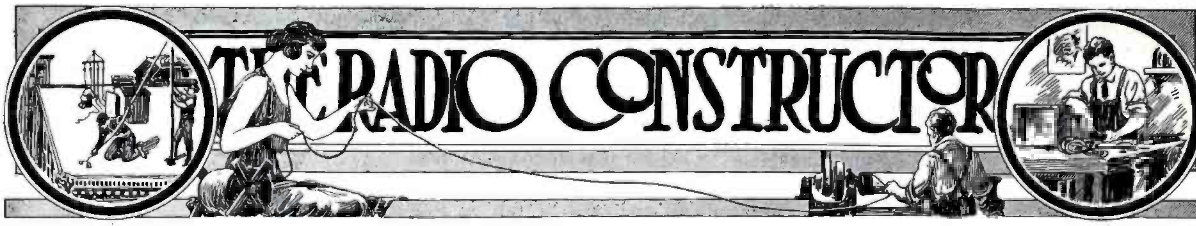
The wireless experimenter is often dissatisfied with the results obtained from home-made intervalve transformers for cascade vacuum valve amplification. The feeble amplifications secured with the unscientifically constructed intervalve couplings are due to the designers' lack of knowledge concerning the relations of the impedance of the transformer to the internal impedance of the valve under test.

A correctly designed audio frequency amplifying transformer will give astounding magnification, it having been computed that two intervalve couplings with suitable valves will give current amplifications of more than 10,000.

Such results are secured by designing the coupling transformers with an impedance equal to the internal impedance of the tube at the normal or operating spark frequency. This provides the maximum amplification and calls for very careful design of the transformer.

After a special study of audio frequency amplification, a Buffalo concern developed an amplifying transformer especially adapted to the Marconi V.T.

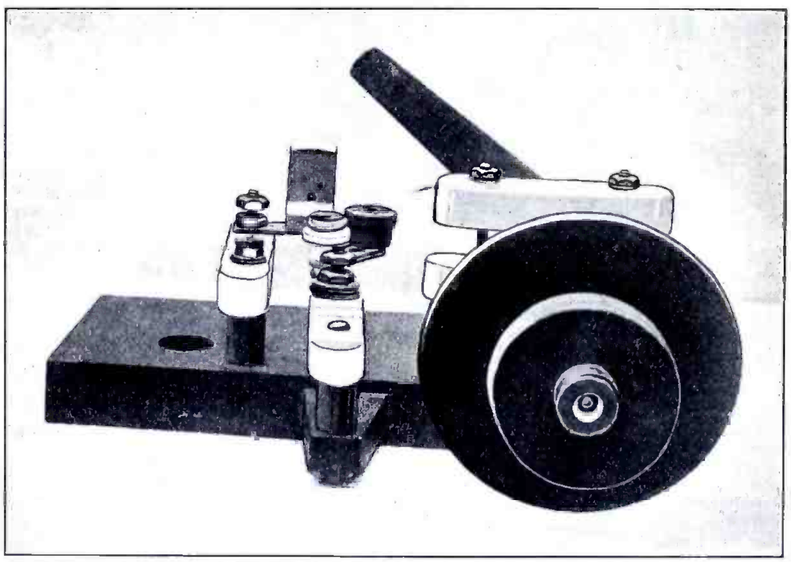
(*Continued on page 147*)



The Latest Design in Antenna Switches

By E. T. JONES, Associate Editor

Now that Amateur Radio Activity has been renewed, and practically every housetop is fairly bedecked with poles and wires of all dimensions and lengths, the demand for a good antenna transfer switch is evident, *and it is the object of this article to furnish the very latest thing in antenna switch design,* one which not only functions in a very simple and efficient manner, but can be economically constructed. The author believes the last quoted item will make this efficient type of switch appeal to the many experimenters with limited pocketbooks.



Here It Is! An Antenna Switch of Latest Design. Embodies Many Valuable Features and Takes Up a Minimum of Table Space.

Before going into details regarding its construction it may not be amiss to explain briefly the function of an antenna transfer switch for the benefit of those who have recently entered this fascinating field of experimentation and research.

An antenna transfer switch is provided for the purpose of permitting the operator, at will, to change from sending to receiving and vice versa. In other words, due to the fact that the high tension current surging up and down the antenna during transmission, if permitted to enter the receiving apparatus, would result in either the destruction of the apparatus or the death or serious injury of the operator, and as can be clearly seen from the diagram depicting the position of the switch in the two circuits: the transmitting inductance would form a short-circuiting path around the receiving apparatus and this would render it impossible to obtain any response in the receivers from the passing waves. Therefore, the object of the transfer switch is to cut out the receiving apparatus when transmitting, and likewise the sending apparatus when receiving.

The photograph shows the switch constructed by the author, and a plan view is also given in figure 2. However, as pointed out, hard rubber was employed for the base of this particular instrument and the same material for the handles. This advanced description is given only to convey the points of construction as clearly shown in the photograph of the particular switch constructed by the author. For the sake of economy, the switch can be built as shown in plan view figure 3. In the drawing, figure 2, E, G, and I, J, K, are cleats (employed for wiring purposes) while A is the switch knife-blade, and B the contact point. F and H are two fiber bushings measuring ½" wide by ¾" high and serve to support cleats E and G. The blade A is connected to the receiving apparatus proper while the contact point B goes to the antenna direct. When blade A is down in the (receiving) position it strikes the hard rubber knob C which forces the contact strip D away from the bottom of B. This serves to open the (secondary transmitting inductance side) when receiving, which would otherwise form a path to ground thru the inductance. When it is desired to transmit, the switch blade A is thrown up by moving the handle Q, which has a protective shield P; this also greatly improves the appearance and gives it a more commercial aspect.

The three cleats I, J and K are employed to hold the brass support or axle for the arm O, which controls the blade A.

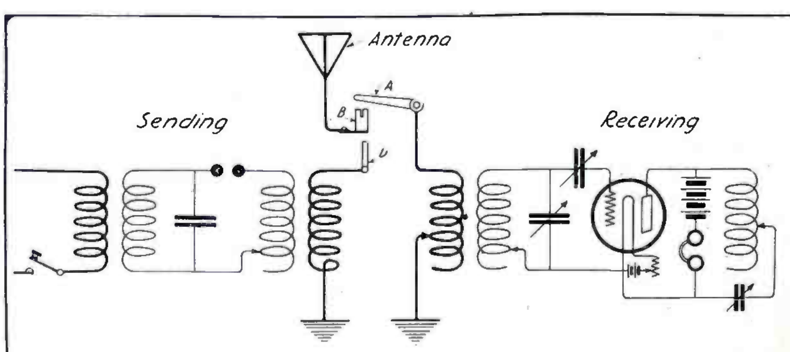
It can easily be seen that when the blade is up the receiving apparatus is disconnected from the antenna and this permits the whole arrangement C and D to spring up against the bottom of B and thereby connect the transmitting apparatus to the antenna.

For convenience sake the connections are shown in an elementary sketch, see Fig. 1, where A, B and D represent the blade, contact point and transmitter connection proper. D, of course, is made of phosphor bronze or spring brass and must make good connection when transmitting. This is accomplished by having the contact D to fit true or flat against the bottom of the contact B.

The base is of pure hard rubber and measures 3½" x 7" x ⅝", the hard rubber shield P is 3" in diameter by ⅛" thick and the handle measures 2" in diameter by ½" thick. The arm O is 7" long by ¼" in diameter brass rod. The switch blade measures 4" long ⅛" thick and tapers from 1" at the support to ⅝" at the end.

Now that a detailed description of the switch shown in the photograph has been

(*Continued on page* 140)



The Position of the Switch in the Sending and Receiving Circuits Clearly Depicted in this Diagram Show How Simple the Complete Arrangement Is.

Construction of an Audion "B" Storage Battery

By HERBERT WEBB

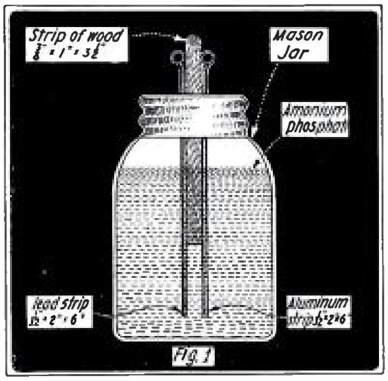
LIKE every other amateur trying to graduate from the "kid" class, I felt the need of an audion. Now, to operate one, it is necessary to have two sets of batteries, one with a voltage of about six, and the other of about fifty. The first may be most satisfactorily taken care of by a six-volt storage battery, and it is my object to describe a "B" battery, or high voltage battery which has been actually built, tested, and found to be a complete success.

If you have direct current in your home, there is no need to build a rectifier such as described here, but for the majority of amateurs it will be found necessary, on account of the fact that alternating current is more widely used. It is a means of changing A. C. into pulsating D. C. The D. C. is then used to charge the small storage batteries that will be described later.

It is no trouble at all to make a rectifier if you will just follow a few general directions.

Procure four one-quart Mason fruit jars and do not bother to cut the necks off, as they are quite wide-mouthed. Then get four pieces of aluminum sheet, 1/32"x2"x 6", and four pieces of lead the same size. Of course, the thickness does not matter, as there is very small loss of material in the operation of the rectifier. Nail or screw them to pieces of wood 3/8"x1"x3½", as shown in the figure 1. I have tried all distances of the two plates and have found 3/8" the most efficient distance. Be sure that the nails, or screws, holding the plates to the blocks of wood do not touch each other. Note the method of mounting. Obtain a saturated solution of ammonia phosphate, sodium phosphate, or potassium phosphate. I used amonium phosphate, as it was the cheapest. As it is not such an important commercial article, it may not be kept by your dealer, but have him make it up of phosphoric acid and amonium chloride.

Solder wires to the lead plates, and fasten the wires securely to the aluminum plates by the nails or screws that hold them to the blocks of wood—that is, if you have no aluminum solder. Then connect up the plates as shown in figure 2. Pour the solution in the jars and add oil to keep the solution from evaporating. Always use lamps connected as shown in Fig. 2 at a, as the rectifier would blow a fuse if used witohut resistance. Also your batteries would charge too fast.

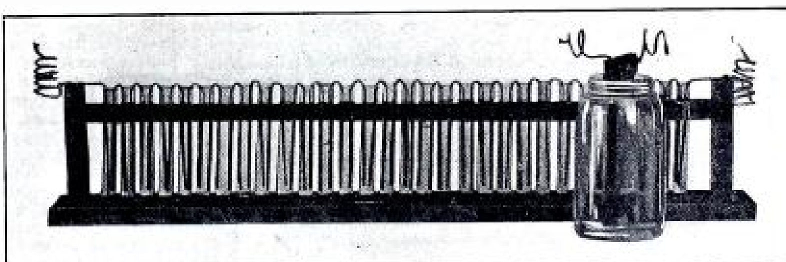


Detailed Construction of the Amonium Phosphate Rectifier. It Permits the Charging of Batteries From an A. C. Supply.

Now for the "B" battery. Obtain twenty-five ¾"x5" test tubes from your dealer. These will cost 60 or 75c. Then get a piece of sheet lead from a plumbing shop (see Fig. 3-c) 1/32" or 3/64"x9⅜"x10½". Then cut this into twenty-five strips ⅜"x10½". Cut *one* of the strips in half, each half to be used for the two end plates. Try to have the lead perfectly clean. It will pay you to sandpaper it if it is not. As a suggestion—I used my rotary gap motor to do my sandpapering, which otherwise might be a little tedious. After thoroughly cleaning the strips in order to furnish pockets in which the active material will set in during the formation process (or first charge) with a sharp tool or penknife cut slits in the surface of the lead, as shown by the cross-lines in 3-d. This is very necessary in respect to the resultant capacity of any cell of the storage type.

The rack is the next piece of apparatus to construct. Make a base ½"x5"x31", and two supports for the cross piece as shown in Fig. 3-a. The cross piece is ¼"x1½"x28". Drill 13/16" holes in it to hold the test tubes. After all of the test tubes are in place bend each strip of lead to a U shape and insert one-half the U in one test tube, and the other half of the U in the next test tube. This eliminates any connection between each test tube, which might be attacked by the acid. The two end strips are the 5¼" pieces of lead that you made out of one whole piece; b in Fig. 3 shows the completed rack. They are put in place and flexible wires soldered to them. I do not like the idea of binding posts on the battery because they would be spoiled by the acid. Just fasten wires to the ninth and the seventeenth plates as they are to be used temporarily in the first charge. Fill each test tube to about one-half inch of the top with sulfuric acid, H_2SO_4. This acid should test around 1.150 by the hydrometer, or if you haven't a hydrometer add one part of concentrated acid to four parts of rainwater. Then put two drops of machine oil in each cell. Do not put more than this as it will foam all over. This is done to keep the electrolyte from evaporating. Now for the charging.

As the plates are formed in the initial charge, they must be charged until the positive pole turns red or dark brown. The way that I did was to connect the rectifier in series with a bank of four 50-watt lamps in multiple and then connect the two direct-current leads to the first and ninth cells. Leave it turned on for about eight hours. Do the same with the other two sets. Before retiring at night I turned them on, and then left the next set on all day and finished the last set that night. Always be sure to put the wires on correctly, viz., the positive wire on the positive pole of the battery and the negative on the negative terminal. It is well to mark one of the wires from the rectifier so that you will know which is positive. After the initial charge, the temporary wires to the ninth and seventeenth tubes are removed. Then the whole battery may be completely charged in about eight to ten minutes, using the four lamps in the lamp bank.


The Completed "B" Battery and Rectifier. Note the U Shaped Lead Strips Employed in the Battery Construction.

As the plates in this small battery are almost as thick as the plates in an ordinary large battery, they are necessarily very rugged. If at the first charge, a white solid is precipitated, this shows that you have not cleaned the lead well enough. Remove the units and clean them thoroughly.

The advantage of this battery over the common type of flashlight cells is the fact that they will last for years, while the others will only last a very few months. They will keep their charge for at least 36 hours, and

(*Continued on page* 151)

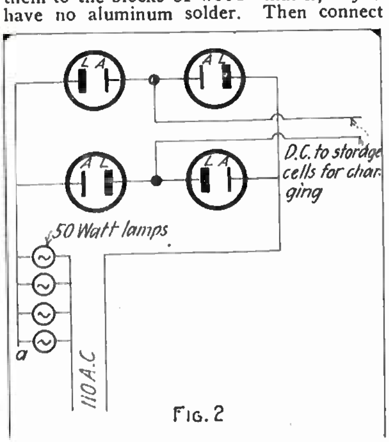
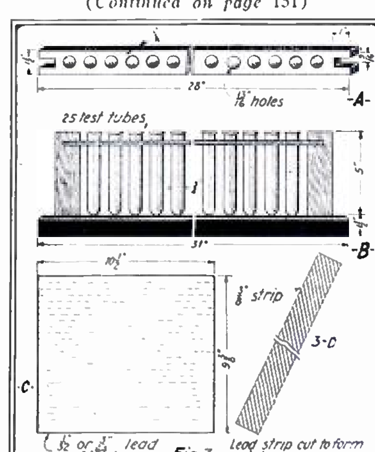


FIG. 2

Connections Employed by the Author to Charge His "B" Storage Battery From Alternating Current House Supply.



Detailed Construction of the Battery Parts Showing Method of Mounting Test Tubes and Cutting Pockets in Lead Strips.

Some "Real" Ideas

By "ZIP"

TALKING of ideas, well, here are some real practical ones which almost any radio bug should be able to put into working shape.

At the time the writer was attacked by these voluminous ideas he was too busy pushing wires under the ground to prove that Doc Rogers was correct and meddling with two, three, and six step amplifiers, for his nibs, Uncle Sam, and now that he is busier than ever, you readily understand that the time to solve the many problems

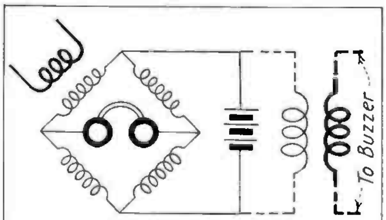


FIG. 1

This Shows How the Circuit is Supposed to Function. Incoming Oscillations Trip the Bridge Circuit Which Permits the Buzzer or Batteries to Affect the Phones.

involved are beyond his reach. Therefore, ye bugs, get ye ter-gether and see whats-in-it.

As shown in Fig. 1, the main idea is to have a circuit similar to the Wheatstone Bridge, substituting for the resistance units, variable or fixed inductance coils, microphone contacts, or any other form of electrical units subject to change when acted upon by currents of very small values. As is shown, the battery can be replaced by buzzer excitation, which seems to be more desirable in connection with radio circuits. It is to be noted that the head telephones are connected in place of the usual galvanometer, or if desired a double pole double throw knife switch can be provided to change from one to the other.

How the Apparatus Is Expected to Functon: After carefully adjusting the various values of inductance, resistance (or other material) so that no current flows thru the head phones or galvanometer, a slight change in any of the four units will allow a corresponding larger value of current or induced oscillations (from the buzzer) to pass thru the phone circuit. From the above it will be seen that should such a circuit prove of value practically, that not only would it prevent interference (to hinder reception of signals), but that the amount of current as well as the tone of the

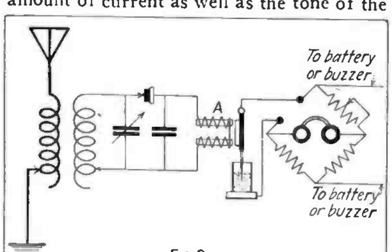


FIG. 2

By Employing a Sort of Fessenden Amplifier It May be Possible to Cause the Circuit to Become Unbalanced in Proportion to the Incoming Oscillations.

signals in the head phones would be a matter of local preference. Besides, if the system is so adjusted that it only responds to a certain wavelength, even tho the ordinary circuit used to actuate this balanced system would more or less respond to nearby broad waves, the values of current received would be the greatest when the receiver is adjusted to resonance, i. e., to the desired station; therefore, the balanced circuit can be so arranged as to actuate only thru the influence of the stronger signal. Another feature in connection with such a circuit is foreseen in the fact that no current will be passing thru the head phones until actuated upon by the incoming signals. In the case of the buzzer excitation method, current will be used to operate same, even tho no signals are being detected. The foregoing statements are only based upon the assumption that enough current can be transferred to the balanced circuit in order to create the changes necessary to permit a corresponding amount of current to flow thru the head circuit, as a whole, acting more or less as a valve or trigger. The following circuits are suggested in order to make the circuit better understood, and toward offering a circuit or circuits which will function under the above conditions. Even tho none of these circuits prove successful, it may be possible to perfect a circuit which will actuate quite similar to the suggestions contained herein.

The first circuit which is shown in Fig. 2 is one composed of the following instruments: First we have the ordinary antenna and ground-in series with the primary of the receiving transformer, the secondary shunted by a variable condenser is inductively coupled to the primary, and in series with it are the detector and fixed condenser,

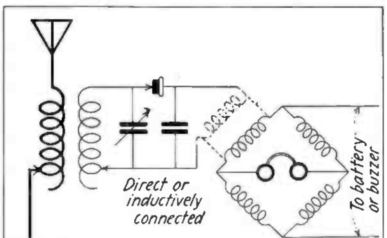


FIG 3

It May be Possible by Employing Inductances Instead of Resistance Units to Cause the Balance to be Overthrown by Direct or Inductive Coupling to One of the Four Inductances in the Bridge Circuit.

where the telephones are usually connected (across fixed condenser) leads are brought to a circuit much the same as Mr. Fessenden's microphone contact amplifier (A), which actuates the dipping needle (B) which dips into a cup of carbon granulars and is in turn connected in series with a number of cells and the headphones. In this case, however, the headphone and battery circuit are omitted and the function of the apparatus is in this circuit to vary the resistance of the circuit, thereby throwing same out of adjustment or balance and allowing a corresponding large current to flow thru the headphone circuit. The remaining three values of resistance are of the non-inductive, two of which can be fixed units while the remaining two variable in order to obtain a balance. A more simple circuit follows, but in my opinion this circuit will work easier, and from a practical standpoint seems to be the most feasible.

In the circuit shown in Figure 3 the antenna is inductively or directly connected to the balanced circuit. I cannot speak authoritively, owing to the fact that prior to the discovery of this system little has been said in regards to the changes brought about in an inductance coil when acted upon by radio frequency oscillations. Therefore I am unable to say whether the change would be great enough to trip the balanced circuit and admit the larger flow of current thru the headphones from the battery or buzzer. Nevertless, in order to bring the main idea out more clearly the circuit mentioned above follows:

What seems to be a more practical system is shown in Figure 4. The balanced circuit is used in conjunction with the audion as an amplifier ultraudion, or cas-

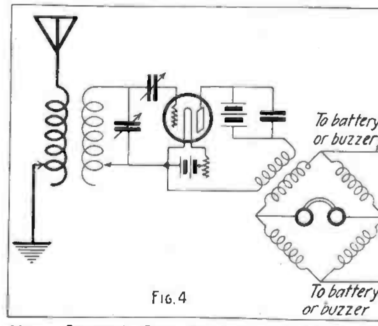


FIG. 4

More Current Can be Imposed Upon the Bridge Units by Employing an Audion or Possibly an Amplifier.

cade circuits. In connection therewith it seems feasible to state that enough current could be available to actuate the balanced circuit and in turn let enough current pass thru the phone circuit (possibly enough) to actuate a buzzer or telegraph sounder, thereby doing away with the headsets now worn by every radio operator, which alone would be the solution to a long-felt want. If this is not possible it could be used in conjunction with a loud speaking telephone transmitter and receiver which would bring the incoming signals to such a value as to make it unnecessary to wear the headset. For convenience sake the simple audion circuit is given in connection therewith.

However, should all the previously described schemes prove of no avail, the original idea will have not decreased in value, for, if it is possible to bring about these results a great improvement will have been brought about in connection with the reception of signals; and in my opinion this balanced circuit in connection with the above suggestions and any other new circuits brought about by experiments, to change the value of the units used in said circuit, in order to release a corresponding local larger current to flow thru the head-

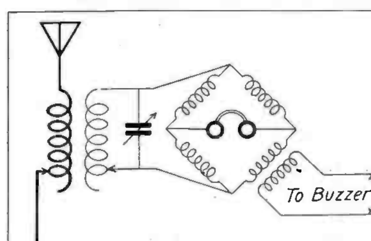


FIG. 5

The Whole Bridge May be Connected in the Receiver Direct and a Buzzer Inductively Connected to One of the Units.

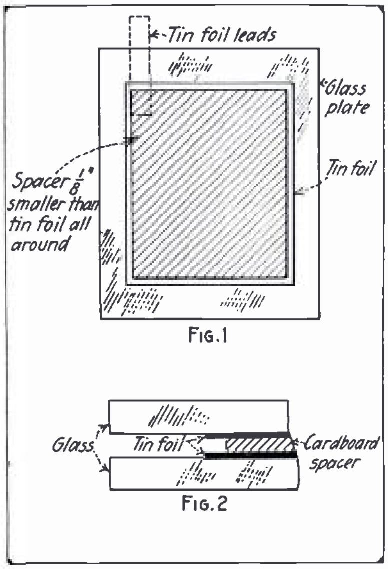
phone circuit is well worth trying. None of the aforementioned circuits have been tested, and they are purely theoretical suggestions. This, however, does not pertain

(Continued on page 138)

Moulded Condensers for the Amateur

By L. A. BARTHOLOMEW

MOULDED and oil-immersed condensers have long been the standard for transmitting in the best amateur stations, because of their freedom from breakdown and the absence of brush discharge around the edges of the conducting plates. Of the two types, the oil-immersed has usually been adopted by the amateur, because he could construct it himself, whereas the moulded condensers on the market were a rather expensive luxury. The oil type had the disadvantage, however, of being greasy and bulky, making them entirely out of the question for portable sets, but the moulded condensers herein described are free from these objections and can be constructed at small cost by any experimenter.



Above: Assembly of Glass Plates, Tinfoil and Cardboard Spacer.
Below: Cross Section of the Above.

The principal advantage of both these types of condensers lies in the fact that the edges of the conducting plates are not exposed to the air, but are sealed in by insulating material, thus preventing any losses due to leakage at this point. For this purpose transformer insulating compound is employed and can be obtained from any electrical supply house at nominal cost. This compound is in the form of a wax that has high insulating properties, and melts at about 200 degrees Fahrenheit.

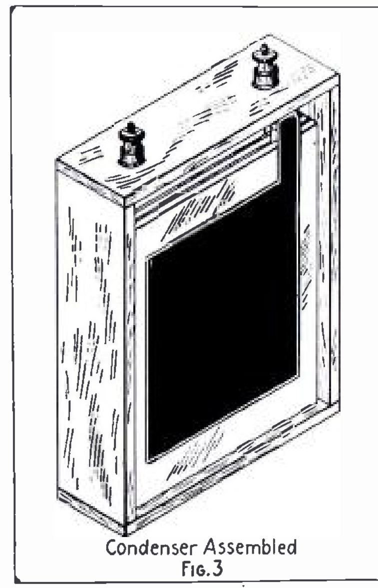
The condenser itself is best made up in sections of about .002 mfd. capacity, as this is a convenient size and the total capacity can then be readily varied by using different numbers of sections. For the dielectric, 5 x 7 photographic plates will be found entirely satisfactory, as these contain a good quality of glass and can be obtained at small cost. *Eight of these plates will be required for each section.* After the emulsion has been thoroughly cleaned off with hot water, and the plates are perfectly dry, coat both sides of each plate with a piece of tinfoil 4 x 5½ inches, leaving a 1-inch margin on one edge where the leads are taken from. See Fig. 1. For the leads use thin copper or brass stripes, ½ inch wide and about 3 inches long.

Spacers must now be provided for separating the adjacent plates sufficiently so that the insulating compound can readily surround the edges of the tinfoil, for therein lies the advantage of this method of construction. These spacers are cut from 1/16-inch cardboard, ⅛ inch smaller all around than the tinfoil, and are then dipped in the melted compound to drive out the moisture. When dry, the condenser can be assembled, placing the spacers exactly in the center of the tinfoil sheets, and alternating the leads in the usual fashion, Fig. 3.

A container for each section can be made of wood, 8 inches long, 5½ inches wide, and 1½ inches deep, inside measurements. If desired, cigar boxes form appropriate containers, but in any case *one end should be replaced by a piece of ⅛-inch bakelite for the terminals.* Two pieces of plain glass that will just fill a side of the box should be obtained for the top and bottom of the assembled plates, cardboard spacers also being placed between them and the plates adjacent.

After making certain that there is no moisture or conducting substance of any sort on the edges of the dielectric, the entire condenser may be assembled in the container. One of the plain glass plates is placed in the bottom of the box, the condenser proper on top of this, the leads connected to the terminals, and we are ready to pour on the insulating compound. If the container has been made large enough, there will be at least a ¼-inch space all around, which should be filled with the compound, and the top plate then put on. The cover is screwed on and the section of moulded condenser is complete, *at about one-tenth the cost of the factory-made article.*

Four or five of these sections will be required for the average amateur transmitter, unless the voltage exceeds 10,000, in which case it is best to connect them in series-parallel, using a correspondingly greater number of sections.



The Completed Condenser Mounted in Its Case. Note That All the Right Hand Strips Go to the Right Hand Binding Post.

A Very Sensitive Detector

The material necessary can be found among the junk of any radio bug.

The material required is as follows:

1. A piece of hard rubber or fibre rod ¾" in diameter and ½" long.
2. Two small brass wood screws about ¼" long.
3. A small piece of tested galena.
4. A small piece of scrap aluminum.

Directions for assembling:

Saw your piece of hard rubber or fibre rod in half.

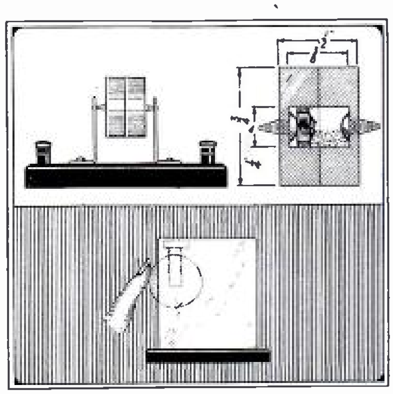
In each half counter base a ¼" hole about 3/16".

Then bore two small holes in the center of each half and fasten the small wood screws in.

Secure your piece of galena against one of the brass screws with woods metal.

Make enough aluminum filings to fill half the space and fasten the two halves together with a good grade of furniture glue.

Your detector is now complete and you may place it in a stand as in Diagram 1 or any other way suitable to you.



A Very Clever Scheme—A Revolving Unit Comprising the Mineral and Some Filings Makes a Very Sensitive Detector.

To adjust the detector turn with the finger until the most sensitive spot is found.

This detector, owing to its small size, is very suitable for pocket and portable sets.

Contributed by
CHARLES ANCHILOWITZ.

POSTOFFICE TO USE WIRELESS.

The post office department at Washington has contracted for the construction of three high power radio stations, the first of a chain of wireless communicating centers in various cities to be used primarily for the direction of mail carrying airplanes handicapped for fog, it was announced here today by Emil J. Simon, manufacturer of radio apparatus for the war and navy departments.

Stations will be established at Bellefonte, Pa., and Cleveland, with a third at some point on Long Island or Newark, N. J. Appropriations for them already are available. Others will be erected at Washington and Chicago as soon as Congress provides funds.

A Radio Experimenter's Receiving Cabinet

By THOMAS BENSON

DESPITE the fact that a vast number of well designed receiving sets have been described from time to time, it is noticeable that few, if any, were intended for the use of the true radio experimenter. They usually employed one circuit that could in some cases be slightly altered by throwing switches, but the experimenter demands a more flexible set. With this in view the cabinet described was designed and will, I believe, come up to expectations.

For experimental work it has been the practice to mount the instruments separate and wire them as desired. The disadvantage of this mode of procedure lies in the untidy condition of the set and the great possibility of poor connections. On the other hand this cabinet will give perfect freedom in the selection of circuits and the apparatus will always appear at its best with good connections assured.

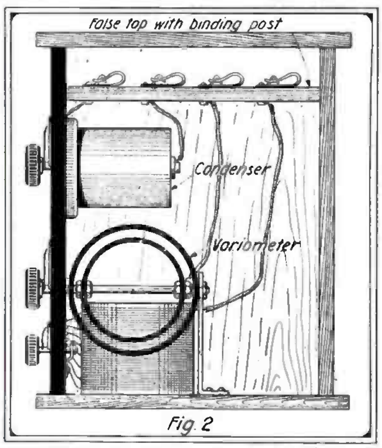


Fig. 2
Side View of the Cabinet Exposing the Method of Arranging the Various Units. A Very Compact and Valuable Unit.

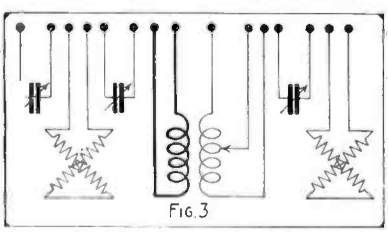


Fig. 3
Diagram of Connections Used in Bringing Out the Connections from the Instruments to the Binding Posts on the Cabinet.

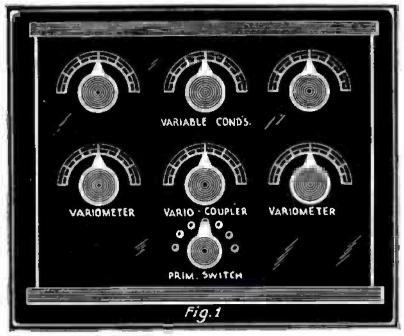


Fig. 1
The Completed Instrument with Its Various Condenser and Variometer Handles Symmetrically Arranged.

For the sake of compactness the set is arranged to give a maximum wavelength of 2,000 meters. For wavelengths greater than this it is better to connect extra loading inductances in the circuit rather than include them in the cabinet.

The instruments used consist of a vario-coupler, two variometers and three variable condensers. These will suffice to give the majority of the circuits in use by the amateurs where simplicity is the keynote, if not absolutely essential. The dimensions of the various instruments may vary slightly from those given without affecting the working qualities of the cabinet.

The vario-coupler consists of a primary wound on a tube 4½ inches in diameter and 4 inches long wound with 300 turns of No. 20 S. C. C. copper wire in a two-layer winding tapt every 50 turns. The leads are brought out to a multipoint switch, as shown in the diagram of the circuit. The secondary of the vario-coupler turns on a pivot to vary the coupling and is made from a tube 4 inches in diameter and 1½ inches wide wound with 25 turns of No. 24 S. C. C. wire. No taps are taken from this winding.

The variometers are of the usual design, being made from tubes 2 inches wide and 4 and 4½ inches in diameter, respectively. These tubes are all wound with the same number of turns of No. 24 S.C.C. wire. Constructional details are hardly necessary and the condensers are of the rotary air dielectric type, having a capacity of .001 Mf.

The instruments are mounted in a cabinet having a front panel measuring 18 by 12 inches, the cabinet being 8 inches deep. The novelty of the design lies chiefly in the false top mounted one inch below the upper edge of the cabinet. On this are mounted 24 spring binding posts in four rows of 6 each. The leads from each instrument are brought directly up to these posts, taking 15 of them. The other 9 posts are connected directly to 9 other posts mounted on the lower edge of the back of the cabinet. These are to connect the cabinet to other instruments as desired. The posts should all be clearly marked so as to be instantly identified. The top of the cabinet is hinged at the rear to make it a simple matter to get at the posts.

The audion and its rheostats and batteries may be mounted in a second cabinet possessing a similar false top.

The manifold advantages possessed by such a set for testing out circuits or developing new methods of using electronic relays are immediately apparent.

Three very good circuits for short wave amplification and regenerative receiving are shown in the attached illustration. That shown at A is simply a form of the static coupling tuner as developed by Dr. Cohen.

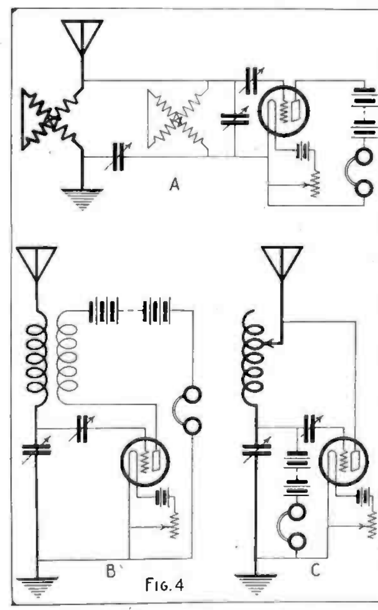


Fig. 4
Various Diagrams That Can be Employed in Connection with This Cabinet to Great Advantage.

The two variometers are used in this circuit with the straight audion hookup. This circuit is excellent for short range work with heavy QRM.

(*Continued on page* 143)

Use of Screws, Taps and Drills in Radio Construction

By J. STANLEY BROWN

In the following pages it will be the endeavor of the writer to make clear the rather hazy points about the use of wood screws, machine screws, drills and taps of the sizes and styles so much used in the construction of wireless apparatus, as well as to furnish accurate data on the diameters of their respective parts.

There is a great deal of misunderstanding as to the numbers and sizes of both wood and machine screws, so it will be well for the constructor to know from the first that they are in accord with the same gauge—the gauge of the American Screw Co. shown in table 1. The gauge runs from zero to thirty, but *the sizes of interest to the wireless man lay between two and fourteen.* Machine screws are seldom seen except in the even numbers, whereas wood screws are used in all sizes, but with the even numbers in predominance. Table 1 will be found to contain a world of information on both machine and wood screws. The number of threads per inch is for machine screws as wood screws are not made to any definite pitch.

When specifying the length of screws we refer to the effective portion; that is, the part that would protrude in from the surface of the object into which they may be screwed. See Fig. 2.

In specifying wood screws two numbers are required—the number of gauge and the length. For example, on a bill of material a No. 6 round-headed wood screw 1" long would be specified as below:

No. 6XI" R.H.W.S. Iron (or brass).

In specifying machine screws we must give the gauge number, the number of threads per inch and the length. Standard number of threads per inch will be found in Table 1.

An example of a way of specifying machine screws is given below for a No. 8-32 machine screw, with flat head and ¾" long:

No. 8-32 x ¾" F.H.M.S. Iron (or brass).

Wood screws may be had with flat, oval and round heads in either brass or iron. Machine screws may be had with round, flat and oval heads in either brass or iron and with filister heads in iron only.

Machine screw taps are exactly in accord with the screw for which they are to be used, and are specified by gage number and the number of threads per inch.

Wood screws are very often wrongly used. There is a proper place for each and every kind and the improper use of them will often spoil the appearance of an otherwise fine instrument.

Oval head wood screws are the thing for holding on panels and thin covers while the bulkier wood parts are held together by round-headed screws, except where a "flush" job is required. For ¼" "Formica" panels not more than one foot square No. 6 x ⅝" oval H.W. screws should be used. For larger panels the length may be increased to ⅞" or 1". Small panels ⅝" in thickness call for No. 8 x ⅞" oval head wood screws and larger panels call for No. 10 x 1" screws of the same style of head.

AMERICAN SCREW CO.'S GAUGE

No.	Threads	Body	Rd. Head	Flat Head	Fil. Head
0	80	.060			
1	72	.073			
2	48. 56, 64	.086	.1544	.1631	.1330
3	48, 36	.099	.1786	.1844	.1561
4	32. 36, 40	.112	.2028	.2158	.1772
5	32. 36. 40	.125	.2270	.2421	.1984
6	30, 32, 36	.138	.2512	.2684	.2195
7	30, 32	.151	.2754	.2947	.2406
8	30, 32, 36	.164	.2996	.3210	.2617
9	24, 30, 32	.177	.3238	.3474	.2828
10	24, 30, 32	.190	.3480	.3737	.3040
11		.2026			
12	20, 24	.216	.3922	.4263	.3462
13		.229			
14	18, 20. 24	.242	.4364	.4790	.3884
15		.2552			
16	16, 18, 20	.268	.4806	.5316	.4307
17		.282			
18	16, 18, 20	.294	.5248	.5842	.4729
19		.308			
20	16, 18	.320	.5690	.6368	.5152
21		.334			
22	16, 18	.346	.6106	.6895	.5574
23		.360			
24	14, 16, 18	.372	.6522	.7421	.5996
25		.387			
26	14.16	.398	.6938	.7421	.6419
27		.413			
28	14, 16	.424	.7354	.7948	.6841
29		.439			
30	14, 16	.450	.7770	.8474	.7264

Odd sizes from No. 10 on are for wood screws.

TABLE 1

Tap or Screw	Tap Drill	Body Drill
14-20	10	¼"
14-24	6	¼"
12-24	15	1
10-24	23	9
10-32	20	9
9-32	24	13
8-32	28	18
7-32	30	22
6-32	33	27
5-40	36	29
4-36	41	31
3-48	44	37
2-56	48	42

TABLE 3

Sizes of machine screws for different pieces of work vary so much that no set rules for their proper use can be given. It is the policy of radio engineers, however, to keep iron screws out of the field of all inductances.

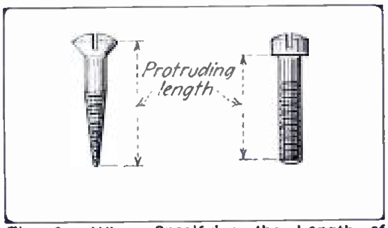


Fig. 2. When Specifying the Length of Screws Always Refer to the Effective Portion As Shown.

Table 3 gives the size of clearance drill and the tap drill for the ordinary run of machine screws used in radio instrument construction:

STEEL WIRE DRILLS

The wireless amateur makes one of his greatest strides toward shop efficiency when he ceases to buy his small drills by 32nds and 64ths, and orders them by number. The Stubbs Steel Wire Gage is standard in this country for small drills. Its numbers run from one to eighty, but the radio man seldom uses any drill finer than No. 60. These drills can be bought in racks of sixty with a numbered hole for each drill for about $4.00 a set. Replacements cost but a few cents.

Table 4 gives the diameter of all drills from one to sixty. Many workmen have a chart like it within easy reach at all times, and by constant use of the micrometer and the chart they soon have all the more useful sizes memorized.

STUBBS STEEL WIRE GAUGE

No.	Diameter	No.	Diameter
1	.228	31	.120
2	.221	32	.116
3	.213	33	.113
4	.209	34	.111
5	.205	35	.110
6	.204	36	.106
7	.201	37	.104
8	.199	38	.101
9	.196	39	.099
10	.193	40	.098
11	.191	41	.096
12	.189	42	.093
13	.185	43	.089
14	.182	44	.086
15	.180	45	.082
16	.177	46	.081
17	.173	47	.078
18	.169	48	.076
19	.166	49	.073
20	.161	50	.070
21	.159	51	.067
22	.157	52	.063
23	.154	53	.059
24	.152	54	.055
25	.148	55	.052
26	.147	56	.046
27	.144	57	.043
28	.140	58	.042
29	.136	59	.041
30	.128	60	.040

TABLE 4

A Pocket Size Receiving Set

By JOSEPH E. AIKEN

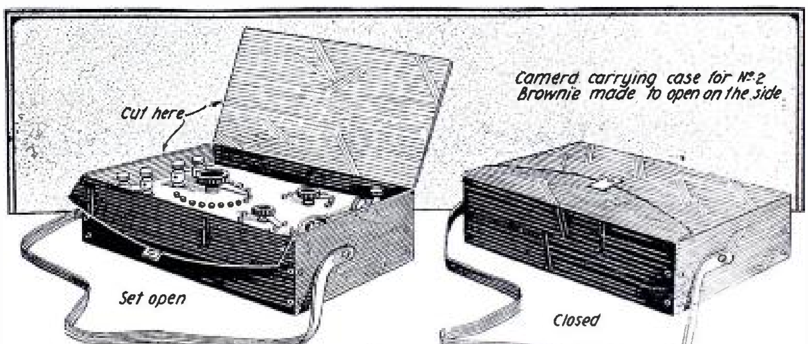
This is a description with drawings and a photo of a small pocket receiving set which I constructed some time ago.

I have obtained remarkable results with this set considering that it is small enough to slip in a coat pocket.

The set measures about 4" x 6" x 2", and will slip into a coat pocket.

Connected to a single-wire aerial 140 feet long and 40 feet high in southern Illinois, Arlington (NAA) came in clearly enough to be copied thru considerable static. Key West (NAR) and a large number of ships and stations on the Atlantic coast have also been received. It has a maximum wave length of 3,500 meters.

The set is mounted in a small leather-covered camera carrying case with shoulder strap (No. 2 Folding "Brownie"), which has been arranged to open on the side.



Left: Set Open Ready for Operation. Right: Set Closed Ready to Be Carried.

The receiving transformer is of the ring wound or doughnut type. The secondary coil is wound upon a wooden form 2¾ inches in diameter and is about an inch wide. After the secondary is removed and wound with tape, the primary is wound on top of the secondary, and then the two are wrapt together. The primary winding has 342 turns of No. 24 S.C.C. wire. Every other turn of the first eighteen is brought out by leads to a nine-point switch. The remainder is tapt every eighteen turns and each tap is connected to a point of an eighteen-point primary switch. This method allows fine tuning.

The Complete Instrument Showing How Small Its Over All Dimensions Are in Comparison to the Headband Set Alongside.

The secondary coil has 400 turns of No. 28 S.C.C. wire, divided into ten equal sections, which are connected to the ten-point secondary switch.

A fixt condenser to connect across the phones is made from two sheets of tinfoil, 2" x 6", which are separated by waxed paper and folded into a small bundle.

The detector is shown in the diagram and is of the catwhisker type, using galena.

Binding posts for aerial, ground and phones are provided. A very small watch-case buzzer and the smallest size two-cell flashlight battery are included with which to adjust the detector. A small push button

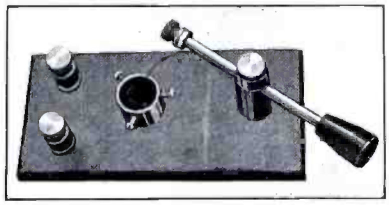
(*Continued on page* 141)

Crystal Detector

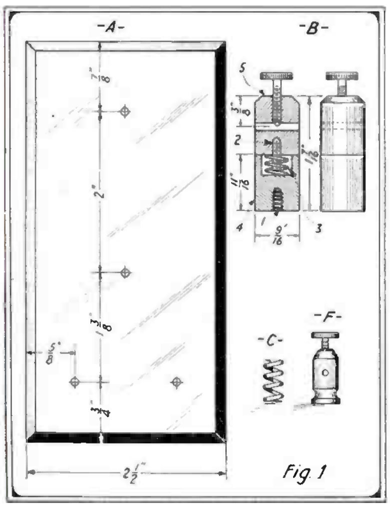
By J. A. Weaver

The materials necessary for the construction of this detector are as follows: One piece of hard rubber, bakelite or fibre, 5"x2½"x⅜" thick. Two binding posts, one piece of brass road ¾" dia. by ¾" long, three 4-36 round head machine screws ½" long, one piece of brass rod 9-16" dia. by 3" long. An extra thumb screw like that used on battery binding posts, one piece of brass rod 5-32" dia. by 3½" long, one 8-32" thumb nut, one 8-32 hexagon nut, one knob of H. R. or composition tapped for 8-32 thread, four 8-32 machine screws for mounting parts to base, a short length of spring wire and a few copper burrs complete the list.

The base is cut to size from the hard rubber or other insulating material that is to be used for this purpose. The edges are beveled and the holes laid out and drilled. There are four of them, two for mounting the binding posts, one for the mineral cup and one for the swivel support. All four are for 8-32 machine screws and are well counter sunk to allow the heads of the attaching screws to fit flush with the bottom surface of the base. It will also be necessary to make two slots in the bottom of the base in which to lay the wires connecting the binding posts with the swivel post and mineral cup. The edges should be smoothed up with very fine sand paper and oil, and then polished on a buffing wheel, using rouge as a polisher. If a buffer is not available the polishing can be done by hand with a little patience. The dimensions are given in the drawing at "A."



The Completed Instrument. A Detector Worth While Laboring to Construct.



The Dimensions of the Base as Well as These of the Detector Point Support Are Clearly Shown Here.

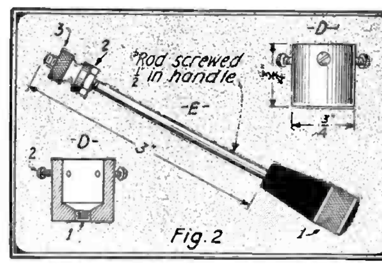
The swivel post is made from a length of 9-16" rod. It is in two sections, as clearly depicted in the drawing at "B." The lower section (4) is drilled and tapped in the bottom end for the 8-32 mounting screw (1). A stud (2) is turned on the other end and threaded with a 6-40 thread. A recess or circular depression is formed around this stud to accommodate the coil spring (3). If the parts are not turned on a lathe, the same results can be attained by boring a large sized hole in the end of post to form the recess for the spring, and then using the threaded portion of a long machine screw, screwed tightly in a hole drilled and tapped at the center of the larger hole to form the stud (2). The function of this spring, which is shown at "C," is to take up all movement between the threads of the stud and the upper or swivel section (5). This form of swivel will last practically forever with nothing to work loose and is simplicity itself.

The upper or swivel section (5) has a hole drilled and tapped in its bottom end to take the 6-40 threads of the stud (2). The top end has the edge beveled. A hole (6) to slip in the 5-32" rod is drilled through the upper section, and another is drilled and tapped in the top end to take the clamping thumb screw (7).

The mineral cup is shown at "D" and is made from the short length of ¾" rod. The ends of this piece are faced off square and the cup bored out, as shown in the cross section. An 8-32 thread is tapped in the hole drilled in the bottom (1). The three small screws (2) are provided with three holes drilled and tapped at equally spaced points of the circumference of the cup. These serve to clamp the crystal and are 4-36 thread and about a half inch long.

At "E" is shown the adjusting rod assembled. The 5-32" rod is cut to length and both ends are threaded with an 8-32 thread for about a half inch. The hard rubber or other knob (1) is screwed tightly on one end and an 8-32 hexagon nut (2) is screwed on the other. The thumb nut (3) should work loosely and serves to clamp a short piece of fine copper wire or "cat-whisker."

The form of binding posts used are shown at "F." These and the other parts are mounted with 8-32 machine screws passing through the holes in the base. When all parts are mounted, a piece of thick felt can be glued to the base to act as a shock absorber and to prevent it scratching a highly polished table top. The finished detector is shown in the photograph.



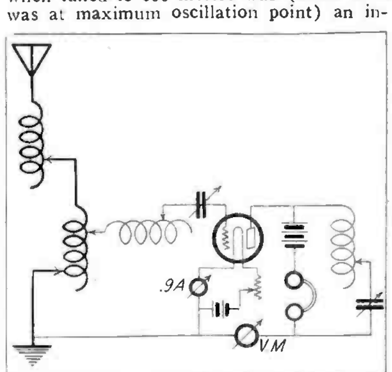
Constructional Details and Dimensions of the Cup and Contact Point Arm Are Clearly Defined Here.

Use of Audion on Long and Short Waves

In order to get better acquainted with the action of the audion bulb on different wave lengths the following experiment was carried out. With voltmeter scale 0-3 in plate circuit the following readings were obtained. Filament current maintained at .9 all thru tests.

1. With 70 volts on plate circuit and settings for 600 meters; without bulb oscillating 1-40 volt was flowing thru the head circuit—but when the bulb was made to oscillate 8-40 volt passed thru the circuit.
2. With 70 volts on plate circuit and settings for 2,200 meters; without bulb oscillating 1-40 volt was flowing, but when the bulb was made to oscillate 12-40 volt passed thru the circuit.
3. With 130 volts on plate circuit and settings for 600 meters; without bulb oscillating 4-40 volt was flowing—when bulb was caused to oscillate 10-40 volt was flowing thru the head circuit.
4. With 130 volts on plate circuit and settings for 2,200 meters; without bulb oscillating 4-40 volt was flowing—but when bulb was brought to the point of oscillating 22-40 was flowing thru the head phone circuit.

Results:—When tuned to 2,200 meters, using 70 volts, the increase of current passing thru the plate circuit over that when tuned to 600 meters was (when bulb was at maximum oscillation point) an increase of 4-40 volt was noticed or recorded.



Connections Employed in the Test. A Milli Volt Meter in the Plate Phone Circuit Registered the Current Flowing Thru That Portion of the Circuit.

When tuned to 2,200 meters using 130 volts, the bulb in a state of maximum oscillation, the increase over 600 meters was 12-40 passing thru the plate phone circuit.

During both tests it plainly demonstrated the better efficiency of valves on longer wave lengths. It is also noticed that when the bulb is not caused to oscillate at maximum the current value passing thru the plate circuit is constant regardless of wave length; this of course was due to the circuits being out of resonance or in such a condition that the bulb could not be made to oscillate. Below is the connection used for the test.

The foregoing will give us a little better understanding why our audion bulbs prefer to oscillate on the longer wavelengths, and why it is such a tedious operation to successfully maintain a state of oscillation on 200 meters and thereabouts. The plate current meter tells the tale, and you can reason the rest out with the particular tube you have at your own station.

Contributed by
EDGAR TERRAIN JOHNSTONE.

Damped-Undamped High Power Radio Stations Scattered Thruout the World

Undamped Wave Stations United States and Possessions

Location	Call Letters	Wave Lengths
Annapolis, Md.	NSS	16,900
Arlington, Va.	NAA	6,000
Balboa, C. Z.	NBA	7,000
Boston, Mass.	NAB	5,700
Cavite, P. I.	NPO	12,000
Charleston, S. C.	NAO	4,700
Cordova, Alaska	NPA	7,600
Great Lakes, Illinois	NAJ	5,700
Guam, Marianna Islands	NPN	5,000
Guantanamo, Cuba	NAW	4,500
Key West, Fla.	NAR	6,500
Marion, Mass.	WSO	Status Unknown
New Brunswick, N. J.	NFF	13,600
New Orleans, La.	NAT	5,500
Pearl Harbor, Hawaii	NPM	11,000
Puget Sound, Wash.	NPC	5,250
San Diego, Cal.	NPL	13,300 and 9,800
San Francisco, Cal.	NPG	8,600 and 4,800
San Juan, Porto Rico	NAU	5,250
Sayville, L. I.	NDD	11,600 and 9,800
Tuckerton, N. J.	NWW	9,200
Tutuila, Samoa	NPU	6,000 and 3,000

British

Location	Call Letters	Wave Lengths
Barrington Passage, N. S.	VCU	5,000
Bermuda, W. I.	BZR	5,000
Carnarvon, Wales	MUU	14,000
Christiana, Jamaica	BZQ	5,000
Hong Kong, China	BXY	5,000
Norsea, England	BYC	4,500
Ponta Delgada, Azores	BWP	2,000
Singapore, Malay Peninsula	VPW	3,400
St. John's, Newfoundland	BZM	5,000

French

Location	Call Letters	Wave Lengths
Eiffel Tower, Paris	FL	10,000
Lyons	YN	15,500
Nantes	UA	9,000 and 11,000

Italian

Location	Call Letters	Wave Lengths
Rome	IDO	11,000

German

Location	Call Letters	Wave Lengths
Hanover (Eilvese)	OUI	15,000
Nauen	POZ	12,600

Miscellaneous Undamped Stations

Location	Call Letters	Wave Lengths
Funabashi, Japan	JJC	10,000 (?)
Stavanger, Norway	LCM	9,500 and 12,000
Java, Dutch East Indies	PMM-PMX	6,100

Damped Wave Stations

Location	Call Letters	Wave Lengths
Arlington, Va., U. S. A.	NAA	2,500
New Orleans, La., U. S. A.	NJK-WNU	1,800
Apia, Samoa	VMG	2,000
Clifden, Ireland	MFT	6,000
Glace Bay, N. S.	GB	7,500
Nauru, Pacific Ocean	VKT	2,200
Poldhu, Ireland	MPD	2,800
Rabaul, Pacific Ocean	VJZ	2,900
Yap, Pacific Ocean	YAP	1,800
Coltano, Italy	ICI	6,500
Berlin, Germany	LP	5,500
Mexico City, Mexico	XDA	4,000
Petrograd, Russia	TSR	5,000 and 7,000

American Undamped Radio Stations

Location	Working Wave	Call
Washington, D. C.	6,000	NAA
Boston, Mass.	5,700	NAD
Great Lakes, Ill.	5,700	NAJ
Norfolk, Va.	5,200	NAN
Charleston, S. C.	4,700	NAO
Key West, Fla.	6,500	NAR
New Orleans, La.	5,500	NAT
San Juan, P. R.	5,250	NAU
Guantanamo, Cuba	4,500	NAW
Point Isabel, Tex.	8,500	NAY
Darien, C. Zone	7,000	NBA
Sayville, L. I.	9,800, 11,600	NDD
New Brunswick, N. J.	13,600	NFF
San Diego, Cal.	9,800, 13,300	NPL
San Francisco, Cal.	4,800, 8,600	NPG
Tuckerton, N. J.	9,200	NWW
Marion, Mass.	Status Unknown	WSO
Annapolis, Md.	16,900	NSS
Portland, Me.	5,700 (?)	NAB
Balboa, C. Zone	7,000	NPJ

NOTE:—The stations listed above are accurate up to date, but, owing to the indefinite status of present radio conditions now prevailing thruout the world, some of the call letters and wave lengths may undergo future changes in which event full information will be published.

We have compiled for the benefit of our readers a complete list of all the radio stations in the world worth while listening to and furthermore have compiled a list of the various stations transmitting time signals, giving their wave-lengths and time of transmitting periods.

Information of this kind we know will furnish a long felt want and should be maintained on the table with the apparatus, or it can be detached from this issue and pasted on a good piece of stiff cardboard and hung on the wall in front of the operator.

With this in front of you, you will not be bothered by not knowing the station you are listening to. It may seem to you a nearby station, and you leave it go at that; however, now you recollect that you have heard the same station previously, and the chart shows you that it is a foreign station, much to your surprise. Previously you were not aware of the fact that you were the proud owner of a trans-Atlantic radio receiving station. Just look them over and see how many you have heard before.

Another point of interest is this: that from the list of stations and their corresponding wavelengths you can mark off the various settings for the different stations heard and the receiver practically calibrated from these stations transmitting on a known wavelength. Then if you desire to tune for say Nauen, Germany, POZ it is only necessary to tune around the wavelengths already marked from our domestic stations corresponding to or close to that of Nauen, Germany, which is 12,600 meters.

The foregoing method of calibrating the receiver from stations picked up from time to time is pointed out merely to show how this can be done from the list of known wavelengths given. The correct method, of course, is to employ a wavemeter and set same in inductive relation to the receiver, using the former as the driver.

RADIO TIME SIGNALS OF THE WORLD

Location	Call Letters	Meters	Time Transmitted
Washington, D. C.	NAA	2500	Noon and 10 p. m. 75th Meridian Standard Time
Great Lakes, Ill.	NAJ	1515	11 a. m. 90th Meridian S. T.
Key West, Fla.	NAR	1500	Noon and 10 p. m. 75th Meridian Standard Time
San Francisco, Cal.	NPG	2400	Noon and 10 p. m. 120th Meridian Standard Time
New Orleans, La.	NAT	1000	Noon 75th Meridian S. T.
San Diego, Cal.	NPL	2400	Noon 120th Meridian S. T.
" "	NPL	9800 UD	Noon 120th Meridian S. T.
Eureka, Cal.	NPW	2000	Noon, 120th Meridian S. T.
Point Arguello, Cal.	NPK	1515	Noon 120th Meridian S. T.
North Head, Washington	NPE	2800	Noon 120th Meridian S. T.
Darien, Canal Zone, Panama	NBA	4000	1 p. m. 75th Meridian S. T.

The above listed Naval Stations transmit "Time Signals" each day for a period of five minutes, starting exactly five minutes in advance of the above specified schedules. Every tick of a standard Naval Observatory clock is transmitted as a dot, omitting the 29th second of each minute; the last five seconds of each of the first four minutes; and finally the last ten seconds of the LAST minute. The 12 noon, 1 p. m. and 10 p. m. signal is sent as a dash.

Note—NAJ, NPL, NPK, NPW:—During that part of the season in which the DAYLIGHT SAVING LAW is in effect, the time signals mentioned above will be transmitted exactly one hour earlier than the above schedules of NAJ, NPL, NPK and NPW.

FOREIGN STATIONS

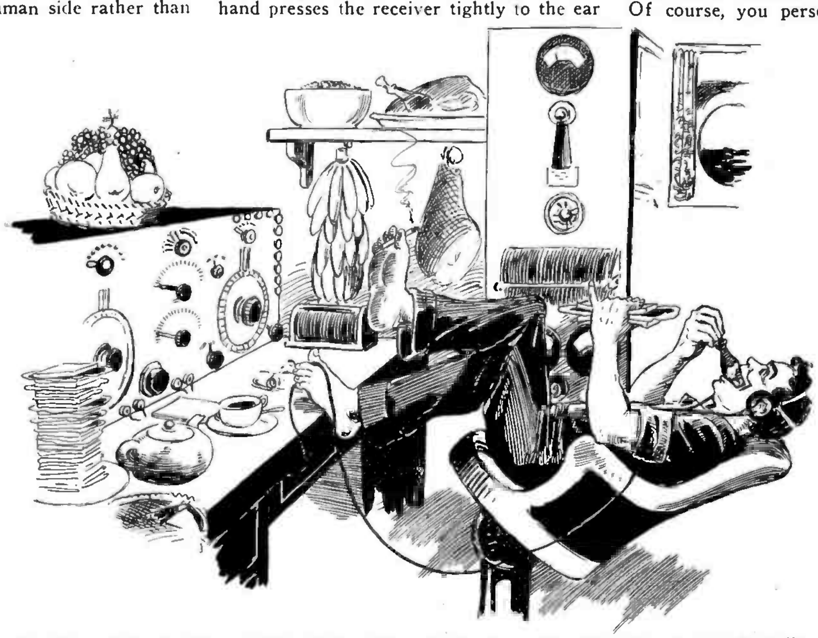
Location	Call	Meters	Time Transmitted
Darsena Norte, Argentine Republic	LIA	800	From 1:56'00" to 2:00'00" (Greenwich Mean Time) At 2:00'00" a dot lasting 0.25 second is transmitted
Choshi, Japan	JCS	600	From 8:59'00" to 9:04'00" (Central Japanese Time) (135th East Meridian) At 9:04 a one second dash is sent
Cape Town, South Africa	VNC	600	From 8:59'00" to 9:00'00" (Greenwich Mean Time) At 9:00'00" a second dash is sent

The Lure of Radio

By EUGENE DYNNER

RADIO! . . . How good that sounds! . . . What inner warmth, what splendid visions that little word conjures up for the real Radio men! . . . It is a word indeed to be cherished by us who have been "in the game" from long before the Big War; and I shall make an effort to tell something of what the word Radio means to us in its human side rather than on its coldly scientific aspect—if one can call the scientific side of Radio cold.

We Radiomen are a distinctive class of humans. There is nothing hackneyed or common about us. A psychologist would study a Radioman with exceptional pleasure. It is only necessary for an old timer to look at a wide-awake, breezy individual, one who is neat in dress, with the bloom of youth in his face, intensive intelligence in his glance . . . to know that he was an operator before. They are all alike.



Speaking of Royal Life and High Living, There Is No Occupation That Can Approach Radio on a Tramp. The Author Is Evidently Well Satisfied With the "Game" and at Peace With the World.

It is easy to account for the distinctiveness of the Radio man. His profession is one of the rare ones which is a composite of scientific depth and human sentimentalism. And in Radio the combination is decidedly effective. Consider the transmission and reception of Radio signals. A form of raw mechanical energy is transformed into a vital electric current. By various processes of various natures the electric current is made to cause disturbances in the ether about the transmitting antenna; which etheric disturbance then produce radio frequency oscillations in the receiving circuit where the phenomenon is made to act mechanically in order to cause a diafram to vibrate and so produce sound waves which are audible to a human being. Quite a simple process, isn't it? And all the various actions which take place have been recorded by eminent scientists with whom the most intricate mathematical formula is a love affair.

Then consider the human aspects. Without the aid of any solid intervening substance, a thought has actually been transferred, possibly thousands of miles from its source. A ship is in distress. The human souls aboard are no longer quenched like rats.—Their cries of despair and entreaties for assistance are audible to the listening operator on shore or a vessel which may be of assistance in the rescue. Only those who have on a cold winter evening aboard ship heard a faint . . . — — — . . . come out of the stillness of night know how it feels to hear an S O S. One second you are leaning back comfortably reading something to which you are paying very little attention. Your thoughts are outside on deck. The night is as dark as ink, there is an unusually heavy sea running, the air is muggy—though pervaded by the exhilarating tang of the salt sea—and you consider that the water is deep, the heavens high, your ship is a practical nothing in the vastiness of the universe, and your own infinitesimal smallness is wondrous in the great scheme of things. The next second you have dropped the introspective mood. Every fibre is tensely expectant, your eyes seem afire, your left hand presses the receiver tightly to the ear and your right grabs a pencil. Faintly, very fainty, you hear weak signals. You can't make them out, but they sound full of import and there is something suggestive of impending disaster in the air. You try tuning a bit, but the signals do not increase in intensity. Involuntarily an oath escapes you. The detector is out of adjustment. You make feverish efforts to quickly adjust the detector and the blooming thing seems perverse in spite of the urgency of the occasion. Finally the "sigs" come in clearly, and—yes, it's an S O S. Well, every ship in the vicinity wants to help. But you miss it all. The captain has decided to let some one who is nearer the scene of the disaster do the glorious work, and he will proceed to his destination with the minimum loss of time—as it becomes a good skipper to do. Of course, you personally think the Old Man an imbecile not to rush to the ship's assistance as soon as she called for help. It's only your first S O S; and after you have been on the water a couple of years, you will appreciate the fact that no ship at the present day can attain a speed of two hundred miles per couple of hours. . . .

A First "SOS" on a First Trip Is a Terrible Thing to the Radioman. And When the Detector Insists on Being Out of Adjustment There Are Hot Words.

But the Amateur chaps who stay at home get something of the thrill. Although they are prevented from actual participation in the case, they can be interested observers. I have seen the log of many amateurs which were faithful records of actual disasters that occurred at sea. It is within their ability to listen to everything that goes on in the air. They may trace out the steps in the drama that is being unfolded maybe hundreds of miles away. They also will experience the tenseness of the call for assistance, the reassuring replies of rescuing ships and finally the triumphant announcement from the ship that took the people off, all of whom were saved from Davy Jones' grasp. . . .

That doesn't happen every day. Yet there is a genuine thrill even in listening to an ordinary P. Nr. 1 or a dozen from John Brown to Sally at home telling that he will "arrive at New York Friday afternoon. Lots of love." Or the message to a stock broker reading "Sell all. Buy Caledonia Copper to the limit. Signed, I. M. Hopefull." Or this: "Dock Saturday morning. Baby fine. Get certified milk—Natalie." And many others like these fill the air constantly. Will any one dare to say that these things are prosaic?

Did I enjoy myself on that trip! Let me tell you all that an operator's life is the finest life in the world. On a passenger ship you are naturally sought out by the passengers as the one good fellow aboard—such is the reputation of Radiomen. When off watch, you have the freedom of the ship, in marked contrast to the other men aboard. The Radioman is always included in plans for all the gayety aboard ship, and he has as good a time as any first class pasenger—with the added advantage of incurring no cost for the things which others must buy at a high price.

For me, however, and many other Radiomen a dingy old tramp is the real lure of Radio. A Radioman aboard a tramp leads an almost idyllic life.

(*Continued on page* 138)

China On An Eighty Foot Aerial

By AUGUSTO JOSE CABEZA

YE Gods! Boy howdy! Yea verily! and then some more. It was the slickest thing ever put over; slicker than an eel in an oil reservoir.

You have heard many and many times about the gink who, with a hair pin for a loop aerial and a black bead for a crystal, has read WNU through a thunder storm with the phones on the table.

But, how about *CHINA* on an eighty foot aerial? Well, give a little listen to this. Yea, list regeneratively lest some rude strays throw you out of resonance.

It all happened at Camp Martin, Tulane University, along about the middle of last October. Radio classes were suspended as the flu had put the QRM over everything. The rookies were quarantined in the barracks, and in the Radio Building were thirty of the healthiest bean-eating radio instructors as ever thumped a key or rotated a rotary.

There was Gilson Willets—yes, the same little Gilson who had grown a misplaced eyebrow on his upper lip by massaging with asphaltum. Mighty proud of it was he, too. Then, there was Stelmach, and DeCortin, and Christianson, and Fred Stone, and Mercier, and Emberton, and Barker.

Yes, THE Barker, as fine a radio operator as ever tinkered a Ford. Why, when it came to snatching a bunch of messages from the ether, he was all there with a monkey-wrench and an oil-can. Didn't seem to need anything else, either.

In recognition of his ability as a wireless bug, he was assigned to the most delicate and scientific job in the camp; keeping the director's flivver in good coughing order; and believe me he did it, too.

While the other instructors were trying out new hook-ups and burning out vacuum tubes, he as past grand master in wireless lore, was tearing the guts out of the lizzie, cleaning the innards, and smiling with superiority while the other dummies were trying to learn something new about radio.

From the very first time that Willets revealed himself with his labial adornment it was evident that Barker manifested a negative affinity for him.

Barker had just cleaned the muffler on the chug-wagon when Gilson appeared with a beatific smile creasing his map and his hirsute ornament reaching two ways like a hobo at a free lunch counter. Barker spied him:

"Awful sorry, Gilson, but you should not have come so close, now you have smeared your face with soot. Wipe your upper lip."

"Hell!" Screamed Willets. "It's That Pie Faced Auto Mechanic and I Thought I Had China. I Bet a Plugged Nickle He Sent That French Message Yesterday."

Willets bit. Drawing out a face-rag that had visited a laundry in its youth, he gently stroked friend upper lip. Then he tumbled. "Ye Gods! man, don't you know a big he moustache when you throw your lamps on one? What's eating you?"

Well, to tune a little closer, one day Willets and four of the gang were in Room 20 at one end of the Radio Building, and Barker and the chief radio operator in Room 10 at the other end. Willets was endeavoring to coax some harmony out of a beat receiver, while Barker was in his room trying out a new regenerative hook-up.

Barker suddenly let out a volley of expletives like a roar of static in July: "For the love of Mike, chief, I wish that fuzzy faced chinaman Gilson Willets would stop tuning all over the scale. He breaks me up. Our aerials are only a hundred feet apart. There he goes again, the blankety human hair brush."

Quite accidently, Barker touched one of the taps on his tickler coil and the phones responded with one of the prettiest K's ever squeezed from a flute. Immediate action from Willets' end! Tuning from 100 to 20,000 trying to locate the imaginary station which had sent out the beautiful K.

> **YOUR STATION**
>
> **Yes, where is it? Known to you, but buried to the whole world. Now, your fellow radio-bugs want to know what it looks like. Why deny them the pleasure? We publish far too few pictures, and your Editor is sore as can be on all you station owners because you won't oblige him with a picture. Things are so bad that the department will have to be discontinued next month unless you "come across."**
>
> **Now, boys, it's up to you—wake up.**
>
> **H. G.**

Barker grinned. "Now I'll fix that bristled-face hoosier." Then he again touched the tickler tap and signed NBA.

A whoop was heard from Room 20, followed by calls of: "Professor, professor, please come here."

The chief nonchalantly strolled into Willets' room. "What's the great noise about, Gilson?" he asked.

"Just heard NBA," replied Willets. "Some stunt, hey? What do you think about your uncle now?"

The chief put on the extra phones and listened in. "There she goes again," yelled Willets, disrespectfully thumping the chief on the back. "Boy howdy."

The chief knew who was at the other end of that ethereal signal, but kept his mouth closed just for the fun of the thing.

About two days later, Willets and Emberton, all excited but pompous withal, called the chief into a secret confab. Willets opened thusly: "Chief"—he was hell on that chief stuff—"you know we are all sworn to secrecy here, but there is one grand little message I just picked up and want you to grab a glance at it."

He shoved a paper in the chief's face and fairly beamed like a leaky Tesla coil. On the paper was scrawled:

"QST de UDX—Les nouvelles de l'abdication de Guillaume ne sont pas vrais. DANNOY."

The high muck-a-muck translated the message into English: "The news of the abdication of William are not true."

"Who the dickens is UDX?" asked his nibs.

"I looked it up in the Year Book," answered Willets, "it is a French warship."

With a straight face the chief spoke to Willets: "Now, Gilson, not a word about this outside of the camp. This is the greatest feat yet put over in this school. Congratulations, old man. Give me a copy of your hook-up to send to Washington." Willets left to spread himself among the other instructors.

As soon as Gilson evaporated, friend chief made a dive for Room 10. There he found Barker grinning like a Cheshire cat, having heard all through the thin wooden partition.

"What in thunderation are you trying to put over?" whispered his nibs. "Don't you know that Willets is going to spread that message all over this burg and soon the newspapers will have it? A hell of a mess we will be in."

Barker only smiled and smiled, giving off now and then hisses like a sick rotary. Finally he said: "Tomorrow at nine get Willets back in that room and I will disillusion him. Don't worry about the rest." The following morning the chief and Willets were at the set in Room 20. Promptly at nine, a flute in the distance began: "V.....V.....V.....V.....NAA...NAA de XPK...XPK...XPK.....Official...Royal Court of China to Chinese Ambassador...Washington." "GET THAT?" fairly screeched Willets.

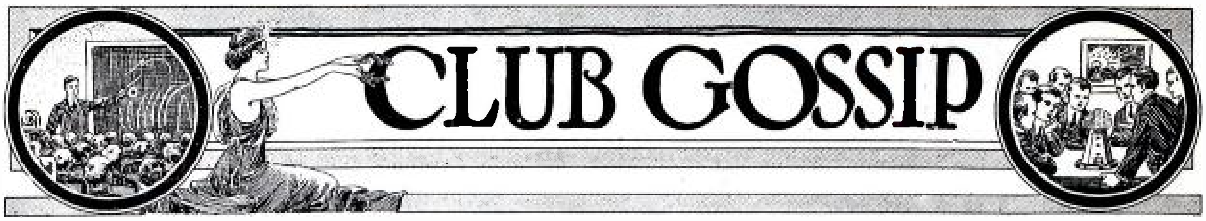
The message continued: "Locate dangerous Chinese criminal, tall, lanky, wears small moustache, generally uses name of Gilson Willets...............BARKER."

"HELL!!!" screamed Willets. "It's that pie-faced auto mechanic and I thought I had CHINA. I bet a plugged nickel he sent that French message yesterday."

"Now Gilson," said the chief, "You are released from your oath of secrecy. You may publish those two messages broadcast."

Did Gilson Willets do it? HE DID NOT.

Barker Touched His Tickler Tap and Signed NBA with One of the Prettiest "Signs" Ever Squeezed From a Flute.



RADIO CLUB.

This is to let you know that we have started an amateur club in Fairfield, Ill., and I, Cassill Porter, am the secretary thereof. I was in the act of devouring the RADIO AMATEUR NEWS and saw your Club Gossip notice.

We have only three members now, but have applications for three more on hand now. On the twenty-fifth of August you may expect another report from me. In regard to naming the magazine in question, I would rather it were named Radio News instead of Radio Amateur News.

Hoping this attracts your attention, I remain,

Yours truly,
CASSILL PORTER,
204 Douglas Street, Fairfield, Ill.

BROOKLYN JUNIOR AMATEUR SCIENTISTS.

A year ago the Association of Amateur Scientists organized the Junior Amateur Scientists, an organization for the furtherance of scientific knowledge among boys. This organization has as one of its pursuits radio.

At our headquarters we have an outfit. We have a set of 3,000-ohm receivers, a Radioson Electrolytic Detector. In the near future we intend using an audion bulb. After we can all receive well we will get a fine loose-coupler. Now we are using a small one. Our aerial is about 60 feet high and 90 feet long. It consists of four strands of the "T" type.

As soon as restrictions on sending are withdrawn we will connect up our sending station.

In the near future we all expect to be licensed amateur operators.

Anyone who is a grammar school graduate is invited down to the meetings, Saturdays, at 7:30 P.M. J. H. Lewison, chairman wireless committee.

Address all communications to Junior Amateur Scientists, 225 Lynch Street, Brooklyn, New York.

MILWAUKEE AMATEURS' RADIO CLUB.

Received my first copy of RADIO AMATEUR NEWS to-day and think it is a fine magazine, and sincerely believe that it fills a long felt want on the part of the American Radio Amateurs.

What they have always wanted was a magazine devoted entirely to general amateur radio news, and this magazine certainly fills the bill a great deal better than any other magazine so far published.

After having carefully considered the question of the title of this magazine, I think that "Radio Amateur News" is by far more appropriate than "Radio News."

Wishing you and your associates the best of luck with RADIO AMATEUR NEWS, I remain

Very truly yours,
LOY S. BAIRD,
Vice-President.
Room No. 300, Moll Bldg., 1041 Muskego Avenue, Milwaukee, Wis.

BRAZIL RADIO CLUB.

Pernambuco, July 5, 1919.

Radio League of America,
New York:

DEAR SIRS:

To our esteemed member and secretary, Mr. Alexandre F. Braga, now en route for your country on board the steamship Aidan, we have given a letter of presentation to the Radio League of America, a copy of which we herewith inclose.

Mr. Braga has gone with the view of studying the organization of the Radio clubs in your country, whose programs and progress we wish to adopt in our club. On his return to Brazil Mr. Braga will present an account of the best he has seen and heard to our society.

It is our desire that you kindly present our secretary, personally or by letter, to the Radio Clubs of America, as we could not do so owing to not having the addresses of same ourselves. We trust that you will take the necessary steps to facilitate our mutual friend in his visits of the principal clubs and amateur wireless stations and laboratories.

It is our hope that our friend's visit to your country and institutions will bring some results in wireless work and serve to form a lasting and fruitful relationship between the students of Brazil and America, the results of which will go to help the development of our club here and in Brazil through us.

In conclusion we take the opportunity of repeating our desire of high esteem and consideration for all you may be able to do for us.

Thanking you in advance, we remain, sincerely yours,

AUGUSTO J. PEREIRA,
President.

Mr. President of Radio League of America, New York:

DEAR SIR:

We have the greatest pleasure in presenting to you, by this letter, our secretary, Mr. Alexandre F. Braga, who is at present visiting your esteemed country, in business of his own.

Mr. Braga will, while with you, take the opportunity of visiting some of the amateur American Radio Clubs as well as amateur wireless stations, and we would esteem it a great favor if you could kindly do all in your favor to help him to meet with success in his and our desires.

Thanking you in anticipation for any help you may be able to give, at the same time we take the opportunity of expressing to you our desire of highest esteem.

We remain, sir, sincerely yours,
AUGUSTO J. PEREIRA,
President.

CLUBS, PLEASE NOTE

We want the latest gossip from all clubs and associations. We will be only too glad to give them the widest publicity. We ask the secretary of each club or association to send us a monthly report of the doings of his club. Such notices will be published free of charge. All amateurs, no matter where they live, should know what our clubs are doing, and what is being done to further their members' welfare and interest. RADIO AMATEUR NEWS *will be an exchange place for ideas of this kind.*

What we want particularly is: A good photo of your club-room and of the members; a copy of your by-laws or constitution, rules, etc.; if a weekly or monthly paper is read, send us a copy for publication.

Address all correspondence to Editor, Club Gossip.

THREE TOWNS WIRELESS CLUB.

7, Brandroth Road, Plymouth, England

President, Major Hon. Waldorf Astor, M.P.; Vice-Presidents, Major Malden, Rev. J. Roberton, Sir Arthur Shirley-Benn, M.P. Chairman, Mr. J. Jerritt. Hon. Secretary, Mr. W. Rose.

RULES

1. The Club shall be called the Three Towns Wireless Club.
2. The objects of the Club shall be the study of all matters pertaining to Wireless Telegraphy or connected with allied subjects, and for the intercourse and exchange of ideas between the Club Members.
3. All accepted Members shall be duly notified of their election and shall abide by the rules of the Club, and also will be expected to adhere rigidly to the terms of the G.P.O. License which they hold, or may hold, or any such License granted to the Club, and will assist the Committee in preventing all abuse of the rules of the Club or terms of License of the G.P.O.
4. The Club shall consist of Full Members and Corresponding Members.
5. The Subscription to be 3/- for the first quarter with an entrance fee of 1/- for Full Members, and 3/- for the first quarter for Corresponding Members.
6. Membership shall date from payment of Subscription and Entrance Fee.
7. The Management of the Club shall be vested in a Committee consisting of the Officers and Four Elective Members. Four shall form a quorum.
8. The Committee shall be empowered to expel from the Club any Member who may act in contravention of the Club Rules or the terms of the License granted by the G.P.O.
9. The Officers and Members of the Committee shall be elected at the Annual General Meeting of the Club in March, to hold office for one year from the date of that Meeting, and shall be eligible for re-election.
10. The Committee shall be empowered to make from time to time any new rules as they may think fit, or to amend those existing.

Meetings are held at the Club's Headquarters, Plymouth Chambers, Drake's Circus, at 7 p.m. every Wednesday. Members are invited to bring friends. Application for membership should be made to the Hon. Sec., W. Rose.

ARMY PROVIDES WIRELESS COURSE.

A chance for youngsters who are interested in wireless and radio operation and who want further training was announced today at the army recruiting headquarters, upon advices from Washington, D. C., that enlistments are now open for those who want wireless training.

The plan is to enlist for a period of three years in the tank corps, and then go thru intensive training at Camp Meade, Md.

RADIO DIGEST

SIMULTANEOUS SENDING AND RECEIVING.

Ernst F. W. Alexanderson: A system of simultaneous reception and transmission for radio telephony is described, together with the reasons for its use. It involves transferring the received speech (from a separate receiving antenna at some distance from the transmitting antenna) to the subscriber's line, and transferring speech originating at the subscriber's station to the radiophone transmitter.

Another type of duplex radio communication is considered, this being based on nearby receiving and transmitting antennas so arranged with their associated apparatus that the receiver and transmitter are in conjugate branches of a Wheatstone bridge. The wiring of the bridge receiver is given and the apparatus shown.

A so-called "barrage receiver" is then described. This is a highly directional combination of aperiodic antennas, with unilateral directional characteristic. When two aperiodic antennas are used, the phase difference of the received currents produced in them depends on the direction of the incoming signals. By phase shifting devices and differential coupling to a common receiver the signals from any given direction can be balanced out. The wiring and apparatus and its functioning are described.

(Abstracted) August Proc. I. R. E.

A SPECIAL TYPE OF QUENCHED SPARK RADIO TRANSMITTER

D. Galen McCaa: A quenched spark transmitter is so arranged that the capacity in the highly damped primary circuit is that between a special extra antenna and ground, and the primary and secondary circuits are partly inductively coupled thru a common inductance in the ground lead and partly capacitively coupled by the capacity between the special antenna and the usual secondary or radiating antenna.

Quenching effects and normal monowave radiation are secured. Experiments are described and an oscillogram shown whereby the group frequency and radiation characteristics are indicated.

(Abstracted) August Proc. I. R. E.

INDUCTIVELY COUPLED TRANSMITTER FOR EXTREMELY SHORT WAVE LENGTHS.

C. S. Franklin, of London, has devised a special transmitter in which each of the three elements (namely, condenser, inductance and spark gap) of such a circuit is arranged symmetrically about a common axis. The outer section of the spark gap is employed as one plate of a condenser, the inside of the tube employed for the inductance; the other plate and the three are connected as in the ordinary circuit, and provides extremely short wave lengths.

(Abstracted) August Wireless Age.

METHODS OF SIGNALING WITH ARC TRANSMITTERS.

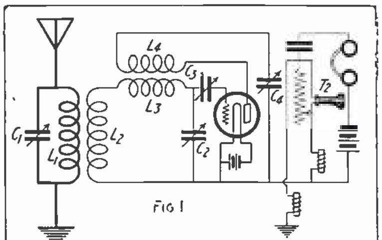
When an arc is shunted by two dissimilar oscillatory circuits, it will oscillate upon one circuit or the other, but will not oscillate upon both at the same time. It will in fact oscillate upon the circuit most agreeable to arc conditions, to the total neglect of the other. By varying the reactance of the shunt circuit, this circuit is chosen or neglected by the oscillations, and consequently the radiating circuit is either neglected or chosen according to the manipulations of the key.

Leonard Fuller accomplishes this by the use of a reactance shunted around the usual arc circuit, and this reactance is controlled by the hand operating key.

(Abstracted) August Wireless Age.

QUANTITATIVE MEASUREMENTS OF UNDAMPED WAVES.

For convenience in measuring received radio currents from distant stations the shunted telephone is used in connection with the oscillating ultraudion. The arrangement shown in Fig. 1 has been used by Austin. The shunt is used on the telephone T_2. The audibility is approximately proportional to the current in the antenna. The sensitivity is always measured at the time of use by comparison with a silicon detector and galvanometer, which combination is in turn calibrated by comparison with a thermoelement. This arrangement has been used to make quantitative measurements on undamped waves from radio stations 4000 miles away, the least high-frequency current detectable in the receiving antenna being $4x10^{-9}$ ampere. *Circular 74, Bureau of Standards.*



Oscillating audion circuits for quantitative measurements on undamped waves from distant radio stations

DAMPING OF WIRELESS TELEGRAPH SIGNALS.

Some special investigations in the West Indies by G. H. Woods, A.M. I.E.E., to endeavor to discover the cause of the extraordinary damping of wireless signals between Port-of-Spain and Georgetown are of general interest.

The damping between these two points was found to be due to two components: First, absorption due to forest, absorption due to iron in rock, the band running northeast from San Fernando, and the Moruga sandstones eighteen miles broad; second, dephasing effect of coast line, if any. This total damping is considered sufficient to prevent daylight communication.—*Abstracted from August Wireless World.*

The new wireless service on the Island of Borneo, between May, 1916, and June, 1917, the Anglo-French Wireless, Limited, a branch of the Compagnie Génerale de Radiotélégraphie Française (C. G. R.), succeeded in erecting four stations. Each of these stations comprises a petrol motor generating group charging a battery of accumulators. The latter feeds a converter group producing 500 cycle alternating current. The T type antennae are supported by two square-based metal girder poles ten meters high.

The transmitting apparatus is of the well-known "C. G. R." type, with fifty-six adjustable spark gaps in series. The capacity employed is .002. The sets resemble those in use on board French armored cruisers. The wave length employed is 1,800 meters. Transmission can also be made on 600 meters by inserting a condenser in the antenna circuit, but the former was found to be the best and was uniformly adopted.—*Jacques Bayer, August Wireless World (abstracted).*

FIELD WIRELESS SETS WITH THE ARMIES IN FRANCE.

It was shown during the war that wireless telegraphy was the only stable form of communication, especially the French "Power Buzzer," which does not require any antenna and therefore was not subject to gunfire. The front lines were veritable nests of stations, the power buzzers being employed in the front lines. These were used to communicate with divisional, battalion or company headquarters, which in turn communicated with the army corps headquarters with spark systems, the latter finally reporting the entire communications to the army general headquarters. In this article Captain Schonland awards the credit to radio, which that branch of science so honestly deserves and which was proven during the entire war.

(Abstracted) August Wireless World.

HEARING GERMAN WIRELESS STATIONS INDOORS.

With a small aerial in the attic composed of four wires 35 feet long the author claims to have copied practically all the foreign high-powered stations. The usual Armstrong regenerative circuit was employed. Wavelengths up to 10,000 meters were provided by lengthy loading coils placed in the circuit.

(Abstracted) Apgust Popular Science.

DELICATE ADJUSTMENT FOR FILAMENT RHEOSTAT.

The author describes a resistance unit composed of the following: A 6" length of No. 30 30% German silver resistance wire is stretched between two building posts and a slider is brought to bear on the wire. This is placed in series with the ordinary filament rheostat and naturally provides a more critical adjustment of the filament current.

(Abstracted) August Popular Science.

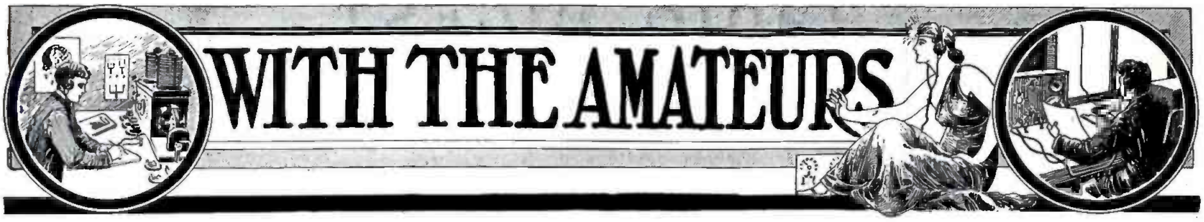
A NEW TYPE OF RECEIVING TUNER.

In discussing the new De Forest honey-comb coils and their use, it is pointed out that with a proper selection of these coils, which embody unusually low high frequency resistance and negligible distributed capacity, a receiver for damped or undamped waves can be constructed.

A set of coils of the following values were pointed out as being best suited for covering ranges from 200 to 4,000 meters, when shunted by a condenser of .0001 to .001 mfd., .04, .15, .6 and 4.5 mh. inductance. The tickler coil, it was claimed, when no bridging condenser is employed across the 'phones, should have one-sixth to one-fourth the inductance of the secondary coil, except at the short wavelengths, where the tickler can be equal to the secondary.—*M. B. Sleeper, in August Everyday Engineering (abstracted).*

TELEGRAPHY, TELEPHONY AND SIGNALS.

New High-Power Naval Radio Stations at San Diego, Pearl Harbor and Cavite.—L. F. Fuller.—The new high-power Federal-Poulsen arc stations of the United States Navy are briefly described. The motor-generator sets, temperature rises, field excitation and operating characteristics are described, and details are given of the arc converter, antenna loading inductance and wave-changing switch.—*Science Abstracts, Section B,* April 30, 1919. (Abstracted from *Inst. Eng. Proc.*, February, 1919.)

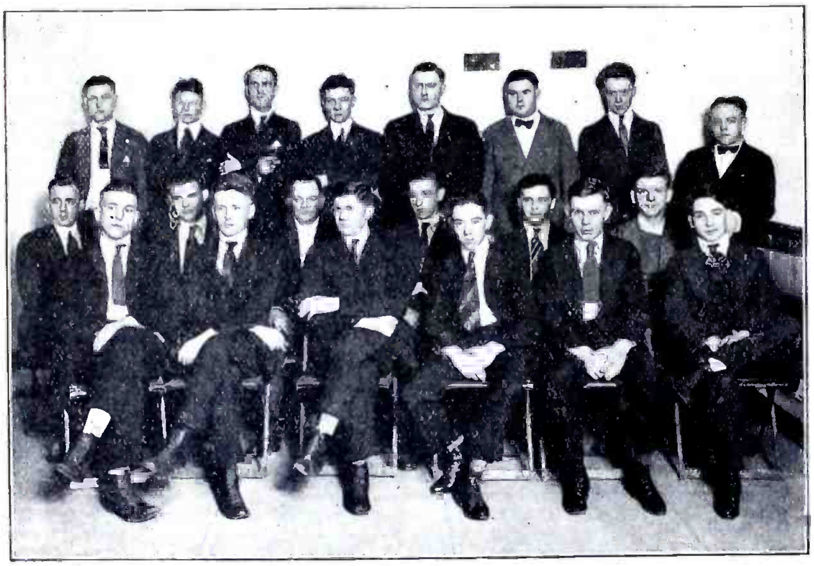


THIS Department is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we make it a rule not to publish photographs of stations unaccompanied by a picture of the owner.

We prefer dark photos to light ones. The prize winning pictures must be on prints not smaller than 5 x 7". We cannot reproduce pictures smaller than 3½ x 3½". All pictures must bear name and address written in ink on the back. A letter of not less than 100 words giving full description of the station, aerial equipment, etc., must accompany the pictures.

PRIZES: One first monthly prize of $5.00. All other pictures publisht will be paid for at the rate of $2.00.

The Pittsburgh Radio Club



Officers and Members of the Pittsburgh Radio Club.

We take pleasure in reproducing in full a circular letter sent out to radio amateurs by the Pittsburgh Radio Club. It is a model letter in every respect. Secretaries of other clubs will do well in perusing it carefully:

"Dear Sir:

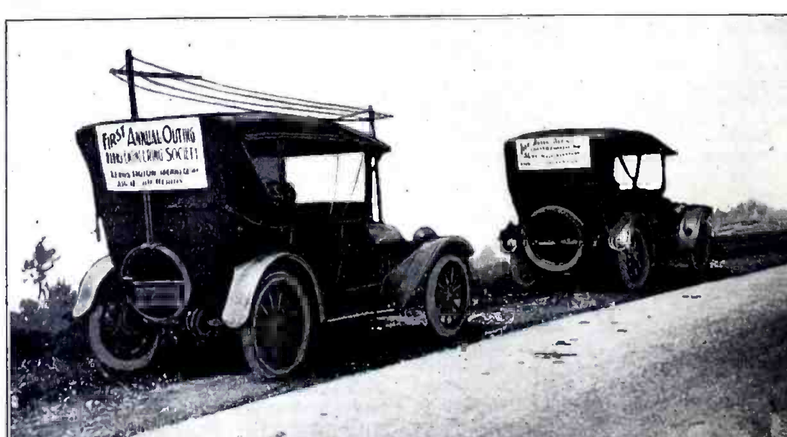
"I am enclosing herewith blank form of application for membership in the Pittsburgh Radio Club, an organization which was formed some time before the war for the purpose of banding together all amateur radio enthusiasts in and about the city of Pittsburgh in an effort to advance the art of radio communication in this section of the State.

"You will, I am sure, readily see that the benefits which can be derived from an organization of this kind are manifold. Regular meetings will be held at stated intervals, where the members can get together and discuss the various problems in which they are interested, arrange relay systems, tests of equipment, etc. Interesting talks will be scheduled on such subjects as the construction of some particularly efficient piece of apparatus, wave lengths and tuning, description and explanation of any new and interesting radio apparatus, wireless legislation, amateur's experiences in the service during the war, etc.

Another and very important function of this club will be that of teaching the international Morse (Continental) code to all those who are not now as proficient as they would like to be on account of their enforced idleness in that connection during the war. From newspaper accounts, it would seem that all amateur licenses issued by the government are now void and it will be necessary to pass a code examination of five minutes receiving at the rate of ten (10) words per minute. According to the best information we are able to obtain, the radio inspector for this district, whose office is located in Detroit, Mich., will make a trip to this city to give this examination for licenses only when enough of the radio amateurs here get together to make it worth the trouble. It therefore behooves us to make an effort to get together and prepare for this examination, and just as soon as we feel that we are ready for it, then the club will notify the inspector, sending him a petition signed by all the members, which I trust will start the ball rolling. Also, unless we are misinformed, no second grade or temporary license will be issued and every person desiring a license must first pass an actual examination.

One of the undersigned, Mr. Williams, was in the Signal Corps of the United States Army and later was Government instructor at the Government school for training radio operators, which was installed in the Carnegie Institute of Technology here, and is willing and glad to give you the benefit of this valuable experience, as well as being able to keep you informed as to the latest developments in the art of radio communication through his connection with the Institute of Radio Engineers, an international organization, of which he is an active member.

It is proposed to install complete sending and receiving equipment in the clubrooms for the benefit of all the members, the present plan being to use two aerials, one long one for receiving and a 200-meter aerial for sending. The equipment will also include an omnigraph and buzzer practice sets for code practice. It is further



On Their First Outing They Employed Portable Radio Sets Which Further Proved the Serious Intentions of the Organization proposed to subscribe for the leading wireless magazines and endeavor to have a library section. It is the present intention to locate the clubrooms as convenient as possible for the members, at the same time selecting a favorable site for transmitting range so that long distance records can be established.

The possibilities of this organization are great, but, of course, depend largely upon the size of the membership. As you probably know, legislation was recently introduced in Washington to wipe out the wireless amateur, which no doubt would have been successful if it had not been for the efforts of such organizations.

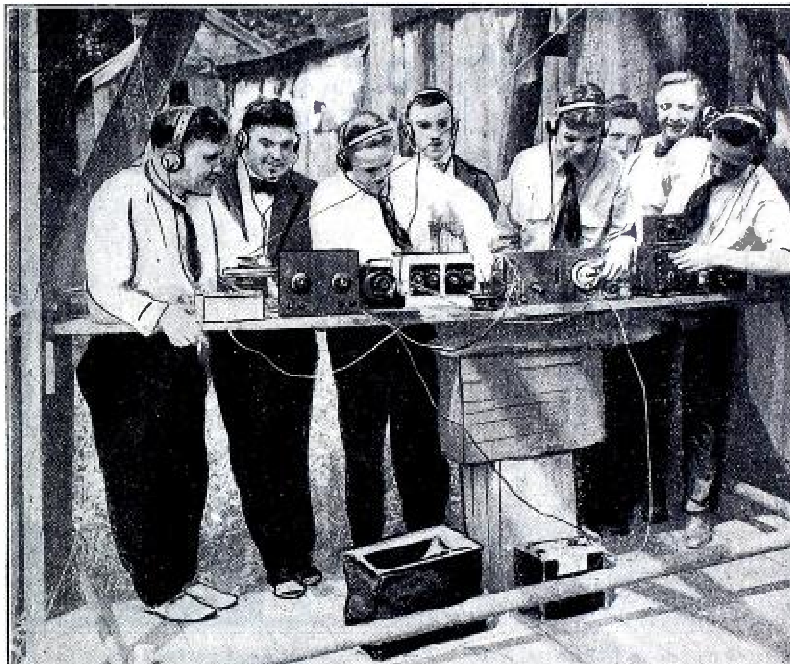
You must, of course, bear in mind that no wireless apparatus can be installed at the present time, except receiving sets, as the ban has not yet been removed by the Government for sending outfits, but it is hoped that these restrictions will be removed in the near future. It is because we believe that the time is ripe for a general reorganization of the radio amateurs that we are mailing out these applications for membership.

Therefore, in the interests of advancement in radio science, proficiency in operating, strict observance of the wireless law, elimination of Q.R.M., a wider acquaintance among serious radio enthusiasts, a real relay system for this district, and proper representation for protection of your interests in case that any unfair wireless legislation should at any time in the future be proposed. We cordially invite you to fill in the enclosed application blank and mail to the Secretary (Mr. Urban) at the address given above, at once, and it will be given due consideration at a special meeting of the club which will be held in about a week from this date. In the event your application is accepted, another meeting will be called shortly, at which you will be invited to attend, and the matter of initiation fees and dues can be decided by a two-thirds vote of the members.

In closing we wish to call your attention to just one thing more, and that is that the Pittsburgh Radio Club is not intended to be a juvenile organization, but an organization composed of serious and earnest devotees to the radio art.

Very respectfully yours,
B. P. WILLIAMS, President.
C. E. URBAN, Secretary.

(Address all communications to the Secretary.)
26 Watson Boulevard, N. S., Pittsburgh, Pa.



Instantly a Radio Receiving Set Was Connected Up And Everybody Was Eager to "Listen In"

Wireless Telegraphy With the Canadians at the Front

By J. W. CANCOR

AT the time the war commenced, wireless telegraphy in the field was very rarely encountered; it seems that only a few favored cavalry headquarter units were the proud owners of this most modern method of communication. However, when hostilities ceased not only were every cavalry and artillery formation equipt with wireless, but also, owing to the vast strides

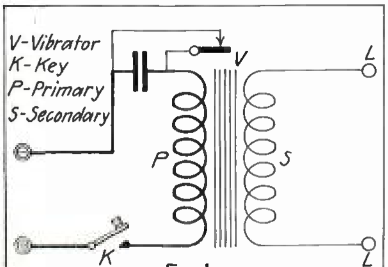


FIG.1

Connections of the Power Buzzer Originated by the French and Used in Front Trench Ground Wireless Communication.

made by the army in devising small, efficient and easily portable sets, every infantry unit, down to and including the platoon, was supplied with some form of wireless telegraph set.

A man on a forward trench wireless station must be his own lineman, his own repairman, and often his own messenger (when his signal office is not in the same dugout as the senior officer's). Though his line or aerial is only about a hundred yards long, it was almost invariably situated in an advanced and exposed position, very often being as high as 25 feet from the ground. This aerial must be maintained at all costs. The operator must mend breaks, even when the Hun is doing his worst with shell and machine-gun fire, for it is then that the metallic lines are in greatest danger and wireless most needed. *When anything should go wrong with the apparatus, it is the operator's first duty to either fix the faulty instrument or fix it so that no one else can fix it,* in which case he hooks in his spare apparatus in the place of the defective one.

At the time the armistice was signed there were four main systems of wireless telegraphy in use thruout the Canadian forces. One was for communication from forward outposts and scouts back to the front line, another was to link up the infantry company in the line with its battalion, each battery of artillery had a system to keep in touch with their forward observation posts, and the fourth was used to connect up the forward brigade with its divisional and corps headquarters. These are known as the power buzzer, loop set, continuous wave and spark set, respectively.

The power buzzer (Fig. 1), originated by the French, came into general use about the end of 1916. Its source of energy was a 10-volt accumulator. The lines for producing the earth induction "waves" fastened at the terminals marked "LL" in the figure. They were of well insulated copper wire, terminating at three or four aluminum earth pins two feet long stuck into the ground. *The length of these leads, it was found, had a direct bearing on the distance the messages had to traverse.* For a

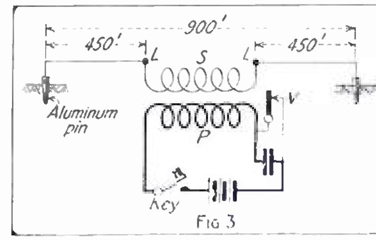
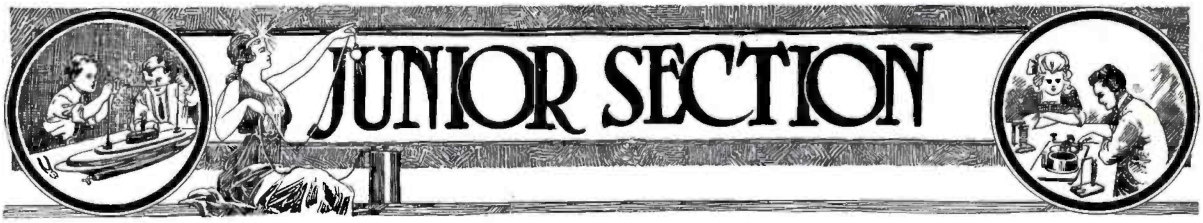


FIG 3

This Circuit, Adopted by the French for Ground Wireless Transmission, Gave the Greatest Distance Possible "Three Miles."

three-mile range (which was about the limit for good signals with this type of apparatus), see Fig. 3, the lines spread out for about 150 yards each side of the instrument, 180 degrees apart, and laid at

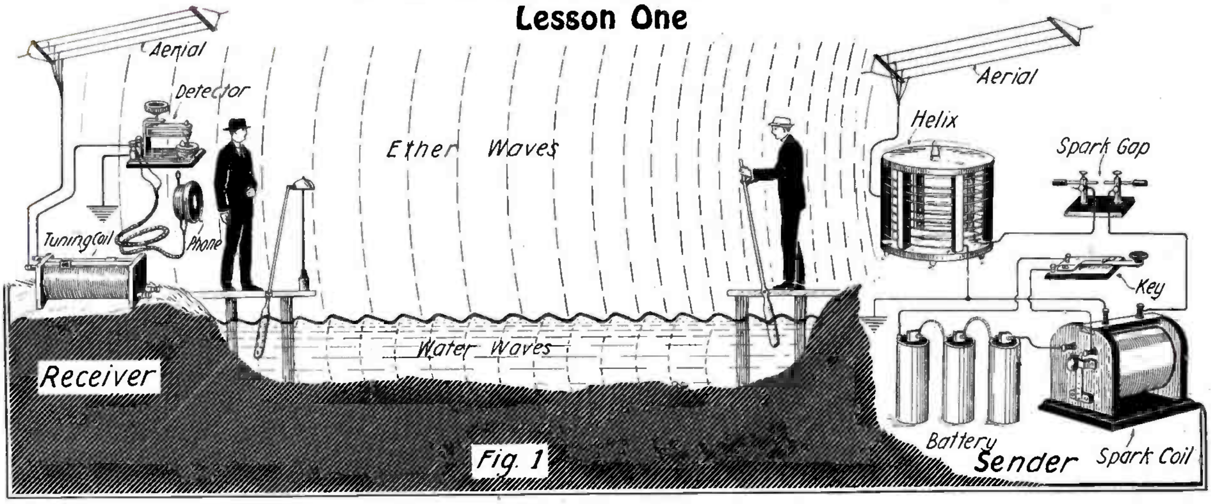
(Continued on page 148)



Junior Radio Course

By E. T. JONES, Associate Editor

Lesson One



An Interesting Analogy Between Water and Wireless Waves Explains Simply How Communication Is Accomplished. The transmitter for Water and Etheric Waves Is Shown at the Right. The Both Receiving Systems at the Left.

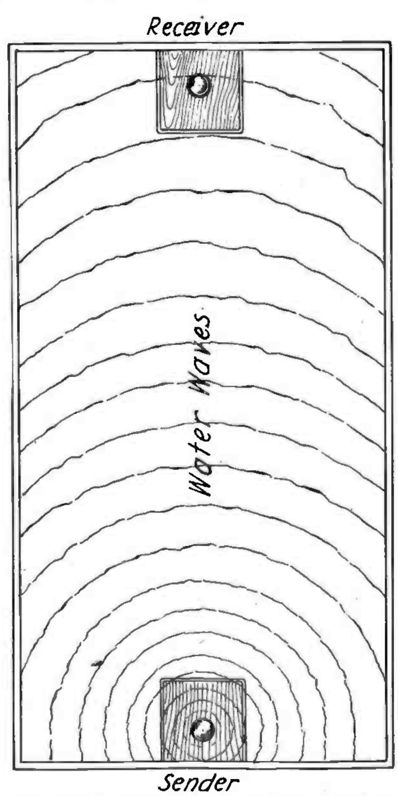
BEGINNING with this issue the author will make an attempt to place before the readers of this department a complete course on Wireless Telegraphy and Telephony explained in simple language, devoid of complicated problems, adhering to simple arithmetic and analogous explanation of the problems involved. The demand for such a course is evident when we consider the fact that the present market is flooded with books treating the subject fully but not in language applicable to this class of beginners. It is assumed the reader is familiar with the rudimentary principles of electricity, and for that reason Lesson One will dwell on the Principles of Wireless Telegraphy as an introduction, it not being our policy to converse on strictly electrical subjects since we promised you a 100 per cent Wireless Magazine.

Principles of Wireless Telegraphy

Even tho the student is familiar with elementary electrical subjects and understands the production of Hertzian waves by the application of the various pieces of apparatus employed, the principles involved in the transmission of signals is to the majority a complex problem. In order to make this explanation as clear as possible we will make an interesting analogy between water and wireless waves.

Imagine a body of water forty feet in length, and at the two opposite banks let us construct two small platforms, as shown in Figure 1. On one of these platforms we arrange a large paddle so that it may be operated, to cause a disturbance in the surrounding water by moving it back and forth as you would a boat oar, on the other platform located on the opposite side a smaller paddle is installed, and on its handle a hammer is placed which is caused to strike a gong. Now if the paddle *S* is moved back and forth a series of waves extending in all directions from the source of creation will be formed. These waves will spread further and further away from the paddle in concentrical* rings until their energy or strength is entirely expended. However, in this case, the paddle marked *S* (sender) is large enough to create quite a disturbance, and since the pond is small waves sufficiently powerful to reach the other paddle marked *R* (receiver) are created. With this arrangement (as described) we have in our possession a means of demonstrating the principles of Wireless Telegraphy to the layman in a very simple manner. It can be seen that any disturbance created at the paddle *S* by moving same back and forth, capable of reaching *R*, will cause the latter to sway back and forth in a like fashion. This paddle *R* in turn records the signals or wave motion produced by the operator manipulating[1] *S*, and by skillful manipulation of *S* it is possible to cause the gong at *R* to ring periodically[2] as desired. Then if a series of signals have been prearranged certain information may be communicated by the proper operation of the paddle *S*. For a still closer relation of the apparatus employed in Figure 1 two simple forms of transmitting and receiving circuits are shown in their respective positions. From the above we arrive at the conclusion that if we have a means of creating waves at one point in a medium[3] and a means of detecting the passage of the waves at another as at *S* and *R*, respectively, communication of intelligible signals becomes possible. The substance thru which, or on the surface of which a wave travels is spoken

(*Continued on page* 145)



Top View, Looking Down on the Pond of Water.

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*Circles of different sizes, one within another, having a common center.

[1]Controlling the action of.

[2]Acting at fixed intervals.

[3]A substance thru which an effect is transmitted from one thing to another.

A Simple Receiving Variometer

By FRED ROSEBURY

Many amateurs have heard about variometers but do not know exactly how they work or how they are made. This article deals with the construction of a simple, home-made variometer which will be a practical addition to any radio receiving set.

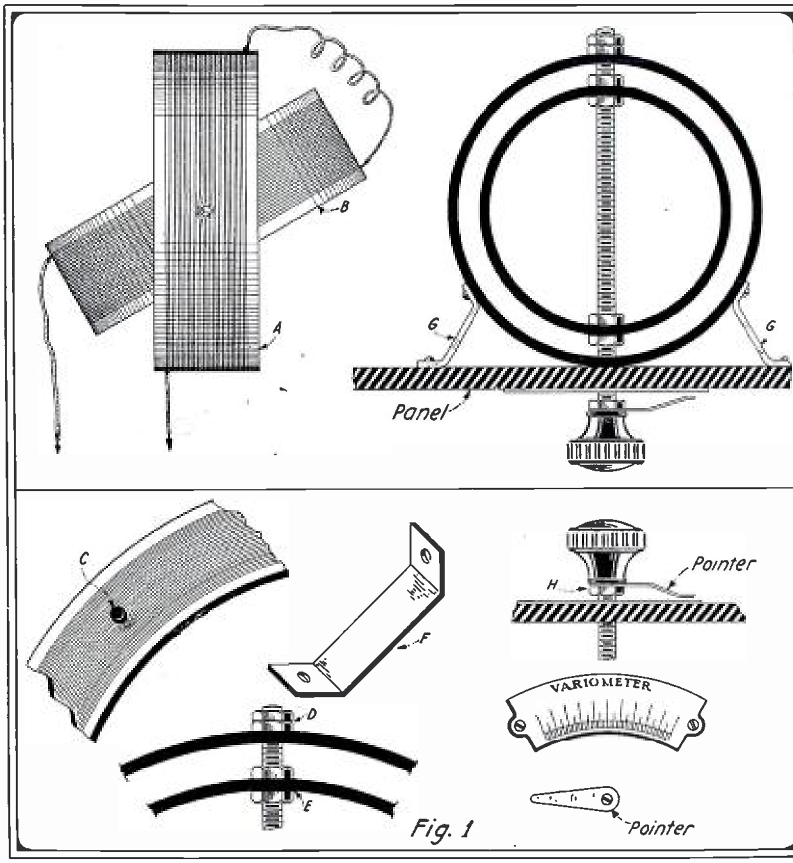
I know by experiment that a variometer has some of the properties of a variable condenser. It is an instrument by which exceedingly close selectivity can be obtained. It is used as an auxiliary to the tuning inductance, enabling very fine variations.

Fig. 1 shows two cardboard tubes, a and b. One is 6 inches in diameter, the other 5 inches in diameter. Both are 1½ inches wide. Before winding on the wire, the hole should be made and plugs of wood which project out, should be placed in the holes so that the wire will not be covering them. These plugs may be removed when the shellac on the windings becomes dry (see 1c).

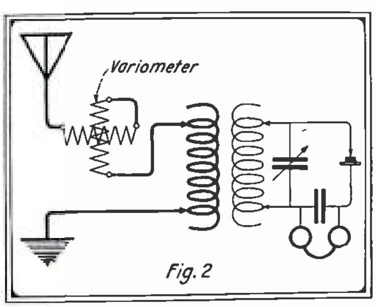
Both tubes are wound with No. 24 S.S.C. copper wire. Start to wind one-quarter of an inch from the edge of the tube and finish one-quarter of an inch from the opposite edge. The windings should be given a coat of shellac or good varnish.

Care must be taken to wind both coils in the same direction, and also to mount them that way. Connect the coils in series as per diagram, a and b. When coil b is in the horizontal position, the value of inductance is greater; when in the vertical position the inductance is less.

A threaded brass rod 3/16 inch in diameter is used for the axis of the inner coil. If the panel is less than 1 inch thick a rod 7½ inches long is used. It must project at least one-half inch thru the panel to allow for a knob and pointer. Also, it should project one-quarter of an inch thru the outer coil at the other end to allow for two brass locknuts to keep the rod in place (d).



Here is the Drawings of One Author Who Was Interested in Bringing Out the Details of the Instrument to be Constructed. The Complete Parts of a Variometer Are Shown.



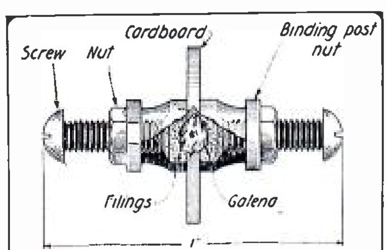
One of the Circuits in Which the Variometer Can be Employed is Shown Here.

The inner coil is fastened to the axis at e by two brass nuts, which are tightly screwed in place. The outer, or stationary, winding may be fastened to the back of the panel by four strips of brass 2 inches by ¼ inch. A hole is drilled at each end and the strips bent to the shape shown at f. The coil is mounted on the panel as at g. A knob, pointer, and scale may now be attached. A hard rubber or composition knob with an inside thread of 3/16-inch diameter is used. A pointer cut from sheet brass is attached to the rod by means of a nut (h). The scale is also cut from sheet brass and should embrace a ninety-degree angle. It is fastened on the panel with small crews (i).

This variometer may be mounted inside a suitable case with binding posts if preferred that way, altho this article describes it for panel mounting. One method of employing this instrument as a tuning device is shown in Fig. 2, altho there are numerous other methods of employing this very useful instrument.

Galena Detector

Here is a galena detector that will remain adjusted permanently. The diagram shows how it is constructed. Two nuts from a battery binding-post, two screws and two hexagonal nuts, some filings (gold, brass or phosphor bronze) and a little piece of galena about the size of a pin's head, a piece of cardboard will be needed to make this detector. A little hole is made in the cardboard and the piece of galena is fitted lightly into this hole. The nuts are then glued on the cardboard so that the galena is in the center. Some filings are put into the nuts and the screws are put in. The cardboard is used to hold the galena and keep the nuts insulated. The screws are screwed in or out until the best adjustment is found; lock nuts are screwed up against the binding-post nuts.—Cont. by F. KRAL.



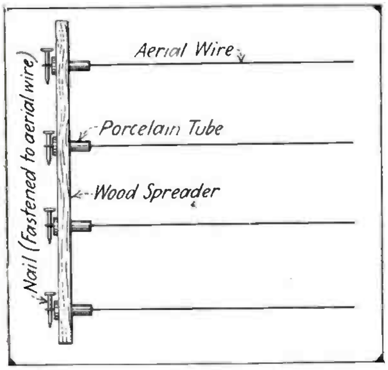
2 Battery Binding Posts: a Piece of Galena, Some Filings and a Strip of Cardboard With a Little Glue Makes a Very Sensitive and Permanent Detector.

WRINKLES FOR EXPERIMENTERS.

I am giving below some "wrinkles" which may come in handy to some of the amateurs:

Many amateurs who own audions like to turn off the lights so they can watch the bulb. I even like to turn mine out to watch my spark-gap. When I do this I then have to adjust my set by feeling, but lately I found it is a good idea to get a bottle of luminous paint and with a fine camel's hair brush go over the lettering on the panel and also make distinguishing marks on all the switches. By doing this there is no danger of using the wrong switch, and you don't need lights at all, hence, save juice.

Quite a few "bugs" find it expensive to buy insulators for their aerials and are compelled to use porcelain cleats. An easier way for small aerials is to bore holes in the spreader, one for each wire,



A New and Clever Scheme for Making Antennae by Boring Holes in the Spreader and Forcing Clay Tubes in Them. The Wires Can be Fastened Thereto and Insulated at the Same Time.

and then force a porcelain tube through the hole. The lip on the tube keeps it from going through the hole and the aerial wire can be brought through the tube and fastened to the middle of a nail held crosswise on the end of tube, as shown on sketch.—Contributed by W. HANLON.

TELEPHONE AND BUZZER HOOKUP.

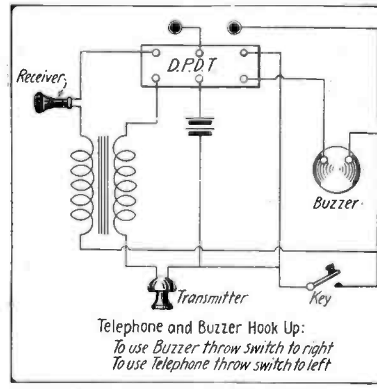
By Wm. W. Peters.

While teaching night classes in Morse and wireless telegraphy it became necessary for me to utilize the apparatus very carefully, since I had none too much. I am sending herewith a drawing of an apparatus that I used, so that students at either end of a line learning telegraphy could have recourse to the telephone, since beginners are not very exact in sending and have some difficulty in sending properly and considerable time is wasted in making trips back and forth to know what was sent. The following diagram consists of a transmitter, induction coil, sending battery, receiver key buzzer and double pole, double throw switch.

The telegraph signalling part of the apparatus consisted of a key, a battery switch and buzzer. By throwing a double pole double throw switch to the left the student was able to use the ordinary telephone for communication, which saved a great many trips back and forth when the student would wish to learn what the other party was sending. Throwing the switch to the right enabled the student to send a message which was sounded both at the receiving and his own station.

In setting up such an apparatus it became necessary to have two batteries in each circuit to actuate it. *I put one battery on the board and made the double pole, double throw switch do the rest, thus saving a set of batteries.*

The telegraph part of the apparatus I copied from a former drawing in the "Electrical Experimenter," which I take space to reproduce herewith. The drawings are self-explanatory and I guarantee they will work satisfactorily if care is used in their construction. A single wire may be used and a ground or gas pipe used as a return. When the resistance of the line circuit is large it is necessary to interpose a compensating resistance in the primary circuit of the induction coil on the talking side of the circuit and increase the voltage of the battery sufficiently. Otherwise the talking circuit would draw too much current and the line lack sufficient strength of current to operate the telegraph circuit. The telegraph signalling part of the apparatus, too, is unbalanced when the resistance of the line is large. This may be equalized by making the buzzer (or sounder if used in



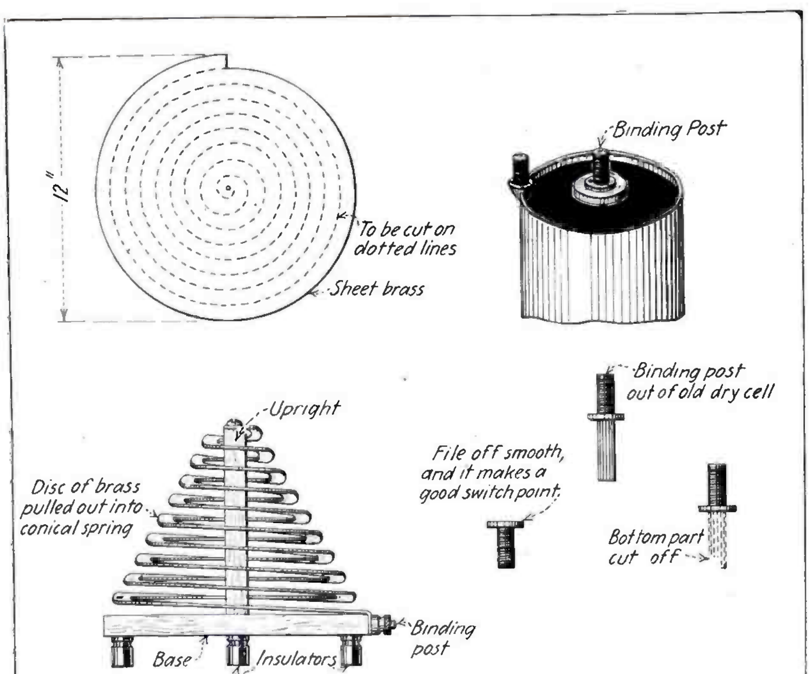
If You Miss a Letter or Word While Practicing the Code, Throw Your Switch and Converse with the Sender About It. Don't Make It Worse by "Fussing" Over the Wire.

Morse telegraphy) equal in resistance to the resistance of the distant buzzer.

ONE CENT A WORD FOR YOU

If you have a good true story to tell us about yourself and your station or any unusual radio occurrence or matter connected with radio, we want that story. We will pay one cent a word upon publication for all accepted stories. We desire you to feel that this new magazine is your magazine, and we will do all in our power to make it so. We want to make it as human as it is possible. Will you help?

Clever Stunts



Here Are Some Exceptionally Clever as Well as Valuable Ideas. Make a Conical Helix From a Sheet of Copper or Brass and Contact Points From Old Battery Binding Posts.

We have from time to time read of many schemes; however, I take liberty to furnish for the readers of RADIO AMATEUR NEWS two very clever stunts which I originated myself, and which should certainly prove of interest to those now building their sets.

Here are two wrinkles: the first one is an easily constructed helix of the conical type. You will notice that the strip can be made just as wide as is needed. All that has to be done is to cut out the spiral dotted line and stretch it out on an insulated upright as is evident from the sketch. However, the edges of the strip must be filed round to prevent excessive brush discharge and therefore considerable loss of radiation. The second idea is a cheap way of obtaining switch points as practically all makes of number six dry cells use this type of binding post. Remove the binding post and cut same as shown in the drawing, file it off and you have a good contact point.

You will note that the helix is quite a departure from the regular type of instrument and appears quite similar to the ones employed by Mr. Herold in his experiments on ground antennæ with their relation to atmospherics. Besides this affords an easy means of applying a clip or clips to the instrument.

The battery posts after being removed and filed down for use as contact points on receiving instruments can be nickelplated and thereby giving them a beautiful finish.

Contributed by ALFRED LINDSAY.

$200 RADIO PRIZE CONTEST

The most important Radio Amateur event in years

$100.00 for Photos and Descriptions of "An Ideal Receiving Outfit"
$100.00 for Photos and Descriptions of "An Ideal Sending Outfit"

1st $100.00 Radio Prize Contest

THE period of reconstruction is upon us. Now that the Government has taken off the ban for receiving radio messages, and that probably at the time when this issue appears in print the ban on sending will be off as well, it behooves us to look into the future.

In the past we grew accustomed to radio instruments which were utterly unscientific, and which were merely the outcome of a whim of the individual constructor. The whole world being under reconstruction, there is no reason why radio itself should not be reconstructed as well along modern lines.

The Publishers always having been in the lead as far as the amateur radio art is concerned, wish to go on record here with the suggestion as well as the recommendation that hereafter amateurs should operate only efficient sets. There is today no excuse for inefficient, crude, home-made apparatus that never can operate at the highest efficiency.

With this point in mind, RADIO AMATEUR NEWS is conducting a series of prize contests to bring out the best that is possible for radio amateurism in the United States.

For the first topic we have chosen will be entitled, *"An Ideal Receiving Set."*

America's foremost radio experts have graciously volunteered to act as judges of this contest. As every one of the judges will pass upon the manuscripts submitted, there can be little doubt that all contestants will be treated fair and impartial. Furthermore, we feel certain that this contest will not only bring out the best there is in the American amateur, but that it will lift the art to a new and greatly advanced level, unknown and undreamt of before the war.

Here are the men who will act as the judges of the contest. A distinguished array of the best radio talent in America:

Dr. Lee de Forest, Inventor of the Audion
Dr. Greenleaf W. Pickard, Inventor of the Crystal Detector
Dr. Louis Cohen, Ph.D., Radio expert and inventor
Fritz Lowenstein, Radio expert
Samuel D. Cohen, Amateur Radio expert
H. W. Secor, Assoc. I. R. E., Associate Editor, Electrical Experimenter.
H. Gernsback, Editor, Electrical Experimenter & Radio Amateur News

PRIZES OF $100 IN GOLD
To be Awarded for "An Ideal Receiving Outfit"

First Prize	$50.00
Second Prize	25.00
Third Prize	15.00
Fourth Prize	10.00

RULES OF THE PRIZE CONTEST
An Ideal Receiving Outfit

The receiving set to be described may be of the cabinet form, or it may be of individual instruments assembled on a table or board. The outfit must have been in operation or must be in operation now.

It is necessary to state what instruments are used, and if certain instruments have been bought, the make must be stated. A complete diagram, neatly executed in ink, is to be furnished. A good photograph (not smaller than 5 x 7") giving at least two views of the set is necessary. A photograph of the builder is desired.

It is necessary that the outfit must have some new feature which has not been described before, and the set must be strictly up-to-date in all respects. The sizes and the kind of wire used in the construction must be given, as well as the dimensions of the principal parts. More than one outfit may be entered by a contestant. The contest is open to every one except manufacturers of wireless apparatus. The manuscript should not be longer than 1,500 words. 1,000 words preferred. A further condition is that in addition not more than 100 words giving the utility of the outfit and its practical purpose are to be stated.

All prizes will be paid upon publication.

The contest closes positively in New York on September 12th, and the first prize-winning article will appear in the October issue.

Address all manuscripts, photos, etc., to "Editor Radio Prize Contest," care of this publication.

We have received many entries so far, but as we have been requested by many amateurs to delay the final announcement for at least a month in order to give them a chance to participate, the scheduled announcement is delayed by request.

2nd $100.00 Radio Prize Contest

For the second topic we have chosen, *"An Ideal Sending Set."*

The conditions, rules, etc., for this contest will be identical to those of *"An Ideal Receiving Outfit."* (See announcement in August issue.) The judges too, will be the same (see above).

RULES OF THE PRIZE CONTEST
An Ideal Sending Outfit

The sending set to be described may be of the cabinet type, or it may be of individual instruments assembled on a table or board. It may be constructed for radio telegraphy or radio telephony at the option of the designer.

It is necessary to state what instruments are used, and if certain instruments have been bought, the make must be stated. A complete diagram, neatly executed in ink, is to be furnished. A good photograph (not smaller than 5 x 7") giving at least two views of the set is necessary. A photograph of the builder is desired.

It is also necessary that the outfit embody some new feature which has not been described before, and the set must be strictly up-to-date in all respects. The sizes and the kind of wire used in the construction must be given, as well as the dimensions of the principal parts. More than one outfit may be entered by a contestant. The contest is open to every one except manufacturers of wireless apparatus. The manuscript should not be longer than 1,500 words. 1,000 words preferred. A further condition is that in addition not more than 100 words giving the utility of the outfit and its practical purpose are to be stated.

PRIZES OF $100 IN GOLD
To be Awarded for "An Ideal Sending Outfit"

First Prize	$50.00
Second Prize	25.00
Third Prize	15.00
Fourth Prize	10.00

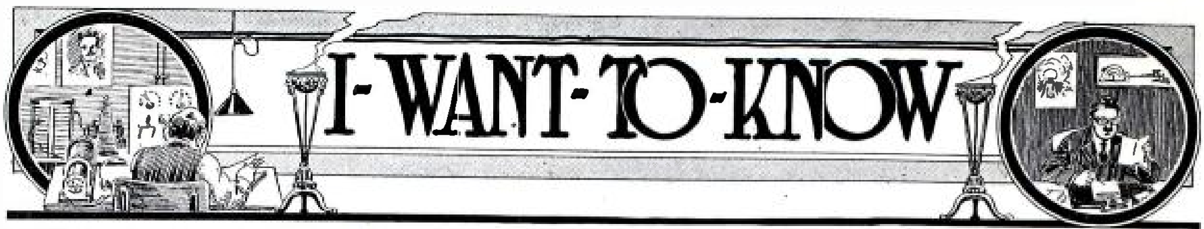
All prizes will be paid upon publication.

By special request the contest closes in New York on November 12th, and the first prize-winning article will appear in the December issue.

This gives would be contestants an additional thirty days. We urge all of you to participate, everyone has a good chance, for only very few entries have been made so far.

Address all manuscripts, photos, etc., to "Editor Radio Prize Contest," care of this publication.

THE PUBLISHERS.



THIS Department is conducted for the benefit of our Radio Experimenter. We shall be glad to answer here questions for the benefit of all, but we can only publish such matter of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent.

2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.

3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.

4. Our Editors will be glad to answer any letter at the rate of 25c for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

You will do the Editors a personal favor if you make your letter as brief as possible.

DEAD ENDS.

(37) D. H. Browne of New York asks:

Q. 1. Herewith is a diagram which I have frequently run across. It appears to me to be a method of eliminating the dead-end losses.

Do you suppose it serves that purpose efficiently, or are you of the opinion that the closed circuits "A" tend to dissipate the energy in the active part of the inductance?

Having seen this diagram in certain hook-ups, which seem to be no longer used, I am of the opinion that it was inefficient. I would thank you to list this in your column.

A. 1. You are absolutely correct. This is a very poor method and should not be employed. That portion of the inductance which is shorted forms a loop or closed aperiodic circuit, which robs energy and dissipates same in the form of heat, hysteresis, etc.

TREE WIRELESS.

(38) Webb R. Charles of Knob Noster, Mo., wants to know:

Q. 1. Can the same instruments that are used on the common aerials be used with a tree aerial?

A. 1. Yes, the same instruments can be used for tree antenna reception, but it will be found necessary to employ an audion with associated circuits of the regenerative type.

Q. 2. What is needed to light a lamp by wireless 200 to 300 feet, and how do you make the connections?

A. 2. You may be able to light a light at this distance if you employ a closed oscillating circuit installed in close proximity to a powerful transmitter; the lamp, such as used in flashlights, is connected in series with the closed circuit. This can be accomplished on a miniature scale by bringing a small loop in series with a lamp near the oscillation transformer of the transmitter. When the inductance is adjusted to resonance the lamp will light.

GALENA DETECTOR.

(39) Charles G. Russ of Albany, N. Y., asks:

Q. 1. Please let me know where I can obtain galena crystals.

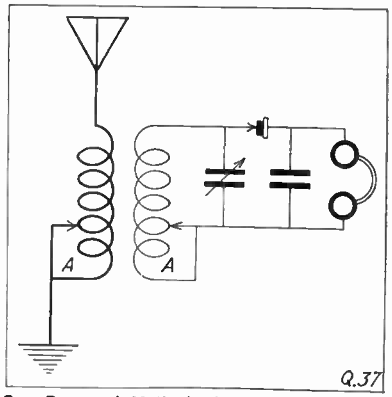
A. 1. You can obtain very sensitive galena crystals from the Electro Importing Co., 233 Fulton Street, at 15 cents an ounce.

Q. 2. Could you give me any information as to how fine a wire is needed in making the galena detector?

A. 2. The best wire to employ as a cat-whisker for your galena detector is an "E" mandolin string.

Q. 3. Where can I obtain a pair of headset phones for a couple of dollars?

A. 3. You can obtain a pair of phones from any of the advertisers in this publication at moderate prices.



One Proposed Method of Cutting Out Dead Ends Which Should Not be Employed Under Any Consideration.

VARIABLE CONDENSER.

(40) Adolph Krause of Detroit, Mich., desires to know:

Q. 1. What metal are the plates of a "variable condenser" made of?

A. 1. Aluminum is generally employed.

Q. 2. Do any companies manufacture them to sell separately? If so, what radio corporation; would you please state the most reliable?

A. 2. No. Do not retail. In very large quantities only.

Q. 3. How can you find out the ohms resistance of any receivers; the spark in inches of any coil?

A. 3. You can take them to a telegraph office and have them measure the direct current resistance by the bridge method. The length of a spark is measured between two needle points for accuracy.

REGENERATIVE TRANSFORMER.

(41) Sol Russo of Brooklyn, N. Y., asks:

Q. 1. The size wire used in a transformer in a regenerative vacuum valve circuit?

A. 1. You can employ No. 28 D. C. C. magnet wire to good advantage in this respect.

Q. 2. The size wire used to make a magnet of the highest lifting power operating on two to four (or six) dry cells?

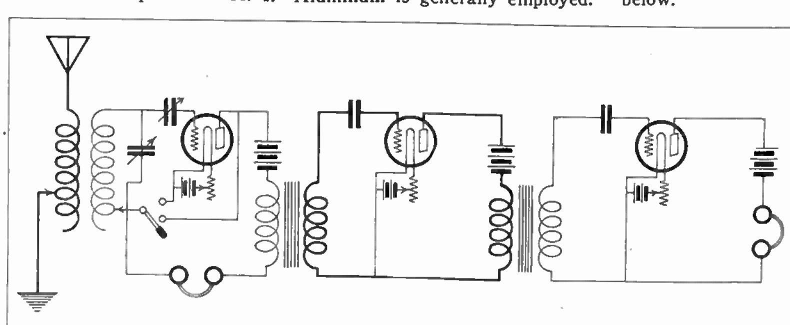
A. 2. Your question is particularly narrow, since you do not state the size core you desire to wind the wire on. The strength of the magnet would depend on the dimensions of the core as well as the size wire. A very strong magnet can be built from the following: Core, ½" diameter x 4" long, composed of a bundle of soft iron wires. Four layers of No. 24 D.C.C. magnet wire is wound on the core, leaving ¼" at each end of core for the core heads.

ULTRA-AUDION.

(42) Dr. G. A. Wehr, Denver, Pa., requests data:

Q. 1. Give me a diagram of the combination audion-ultra-audion two-step amplifier connection.

A. 1. The hook-up requested is given below.



With This Connection You Can Cut Your Audion in "Straight" Ultra Audion and a Two Step Amplifier to Boost the Signals in Either Case. When the Amplifier Is Cut in but One Pair of Phones Are Employed.

Q. 2. Is it possible to receive radiophone messages with a radiotelegraph receiving outfit?

A. 2. Yes.

AMPLIFIER TRANSFORMER.

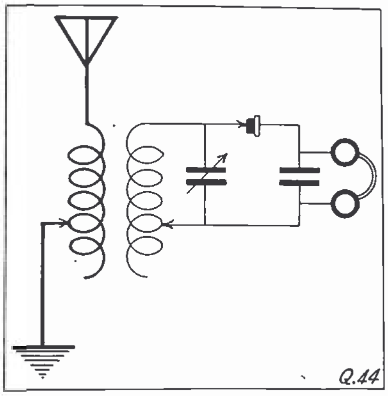
(43) Monroe Dreher, Newark, N. J., desires data:

Q. 1. Please publish in your magazine under "The Oracle" a diagram of a hook-up for a wireless telephone using an audion and other instruments of simple design, with alternating or storage batteries as source of current.

A. 1. If you will refer to the article in this issue by Mr. Benson on an experimenter's panel receiver, you will find a diagram of a circuit which can be employed.

for receiving and transmitting radiotelephone signals. In respect to the operation of audions on alternating current, you are referred to page 26 of the July issue of this publication. Further data can be obtained from an article by Elliott A. White on page 234 of the July issue of the *Electrical Experimenter.*

Q. 2. The construction for an amplifier transformer.



By Inserting the Variable Condenser In Shunt to Your Secondary Inductance Greater Selectivity Will Result.

A. 2. No data is available for print as yet, although we are contemplating furnishing such data in pamphlet form at a near future date.

RECEIVING RANGE.

(44) H. Larsen of Brooklyn, N. Y., asks:

Q. 1. I would like to know if the sketch of the set enclosed is all right?

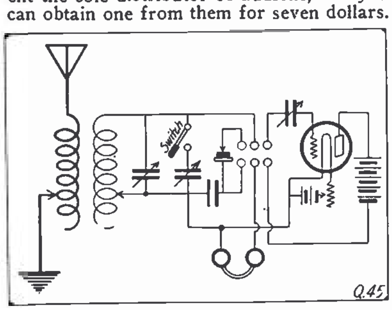
A. 1. The sketch as you furnished is O.K.; you could improve it by inserting a variable condenser of .001 mf. capacity, as shown in the diagram furnished for your benefit. This permits sharper tuning and you will get stations impossible to hear previously due to the flexibility of the circuit.

Q. 2. What would be the range of the set in meters with and without a variometer of the size on the sketch?

A. 2. You could most probably cover a range of 2,500 meters.

Q. 3. Which is the best audion on the market, the audistron, electron audio bulb or the upright audion, one within reach of amateurs who cannot afford a high price, about $5? To be used for all around amateur work.

A. 3. The Marconi Company is at present the sole distributor of audions, and you can obtain one from them for seven dollars.



A Very Valuable Circuit Showing How Two Condensers Can be Employed Shunted to the Secondary Giving a Greater Range of Wavelength.

HOOK-UP.

(45) Wm. L. Shafer of Greenville, Ohio, writes:

Q. 1. Please give the best hook-up for the following instruments: loose coupler, fixed condenser audion, galena detector with switch to use either, two variables with switch to use one at a time or both, phones and a radiotone test buzzer.

A. 1. You will find the connections given herewith to furnish a circuit of extreme value in connection with the apparatus you desire to employ.

HEARS HUMMING NOISE.

(46) R. D. Wahlstrom, Escalon, Cal., writes for data:

Q. 1. When I connect my phones directly between the ground and aerial of my wireless I hear a constant humming. While in the city I supposed this is due to the A.C. wires (lighting), which ran close to my aerial. Now I have put up my outfit in the country, fully 2½ miles from any alternating current (or D.C.) line. Still I hear the humming, and would like you to explain this for me. My aerial runs close to a telephone line.

A. 1. At first it would appear strange that you would hear this humming after changing your location to the place stated, but you answer the question in the last sentence of your communication, and we would advise you to remove your antenna a favorable distance from the telephone line and at right angles thereto.

GREBE RECEIVER.

(47) H. B. Frochlich, St. Louis, Mo., asks the following:

Radio Articles in September Issue Electrical Experimenter

The Fog Warning Radio Telephone

New 1 Kw. Quenched Gap Transmitter, by Lester F. Ryan.

Vacuum Valve Construction, by R. H. Shaw

The Potentiometer; How to Use It, by E. J. Jones

Radio Antenna Construction, by H. Winfield Secor

Eccentric Antenna, by Eugene Dynner

Q. 1. Will you kindly publish in "I Want to Know" a diagram and explanation of the Grebe type regenerator receiver for short wave work. Also give the size and amount of wire required.

A. 1. We have no data on the constructional details, size of wire, etc., of the Grebe receiver, and would advise you to write him direct. His address is Richmond Hill, New York.

ANTENNA CALCULATIONS.

(48) W. C. Richards, Syracuse, N. Y., wants to know:

Q. 1. What is the wave length of an aerial 20 feet high and 30 feet long, consisting of twelve wires?

A. 1. Aproximately 180 meters.

Q. 2. How far can I receive with Radiocite detector, Murdock stopping condenser, 2,000-ohm Brandes phone, 2,500 meter loose coupler and a variometer, the coils of which each have a wave length of 180 meters or 360 for both?

A. 2. You should be able to receive up to 500 miles during the day and probably three times that distance at night.

Q. 3. What stations should I hear and would my range be increased in winter?

A. 3. You would get all the stations within that radius providing their power is sufficient to cover a range which includes your station within its radius.

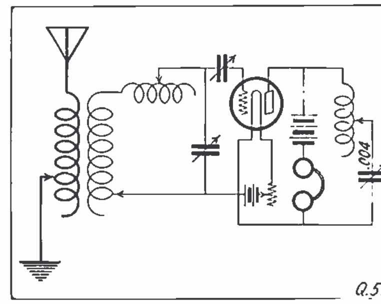
TUNING COIL DATA.

(49) Carl Penther of Oakland, Cal., seeks data:

Q. 1. What would be wave length of coil 27 inches by 4 inches wound full No. 26 B. & S. gauge, S.C.C. taps every 2¼ inches and 4 no "dead-end" switches?

A. 1. Approximately 4,000 meters.

Q. 2. Could same be used for dampt waves?



With This Circuit It Becomes Possible to Receive Damped and Undamped Waves by the Simple Variation of the .004 mf Condenser.

A. 2. Yes, Bolinas, Cal., operates on 4,400 meters.

Q. 3. Would "dead-end" switches be necessary?

A. 3. Yes, they should always be furnished with coils of that length to lessen the "hangover" windings.

INDUCTANCE OF COILS.

(50) Wm. R. Snyder, Philadelphia, Pa., asks:

Q. 1. Would you kindly publish the formula for obtaining the inductance of both single layer and bank windings and naming units each term in the formula represents?

A. 1. Formula for single layer coils:

$L=100.2\ N^2R^2L$ (k

where L=Inductance in cms.

N=turns per inch

R=radius in inches

L=length of winding in inches

K=correction factor.

For double, triple and quadruple bank windings giving within 2, 4, and 8% accuracy, respectively, the following formula will suffice:

$L=100.2\ (AN)^2R^2L$ (k

where L=Inductance in cms.

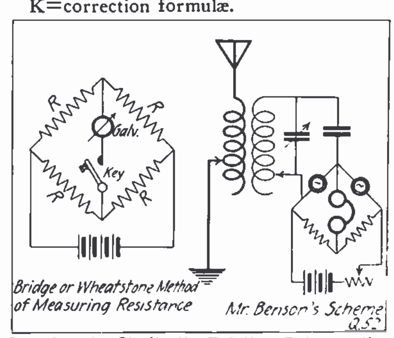
A=number of layers

N=number of turns per inch

R=radius of coil in inches

L=length of winding in inches.

K=correction formulæ.



Showing the Similarity Existing Between the Bridge Circuit for Measuring Resistance and Mr. Benson's Scheme for Recording Wireless Signals.

The correction factor K will be found on page 283, Circular of the Bureau of Standards, No. 74. Space does not permit a reprint.

Q. 2. What relation exists between the Henry and centimeters of inductance?

A. 2. The Henry is the standard of inductance and equals one billion centimeters

—a millihenry equals one million centimeters, therefore it is the one thousandth part of the Henry.

DAMPED AND UNDAMPED HOOKUP.

(51) E. T. Rigg, Baltimore, Md., writes:

Q. 1. What is the design of a transformer to be used between the various steps of a three-step audion amplifier?

Q. 2. Can the same "A"-"B" batteries be used for all three bulbs?

Q. 3. What is a good hook-up for a single audion, so as to receive either damped or undamped waves?

A. 1. We are going to publish a pamphlet shortly giving this data.

A. 2. Yes, if the capacity of the battery is sufficient to warrant it.

A. 3. The hook-up shown will give you exactly what you desire.

BENSON'S BRIDGE CIRCUIT.

(52) Wm. L. Snyder, Curwensville, Pa., wants to know:

Q. 1. I saw in RADIO NEWS an article that told how to use tungsten lamps for detectors by the temperature of filament. I do not know what a bridge circuit is and wish you would tell me, along with details.

A. 1. A bridge circuit is shown below. It is employed in the measurement of resistance. In the circuit shown in our July issue the lamps and units of resistance were of like values, and when such a balance is arrived at no sound would be perceptible in the receivers; however, when the incoming oscillations slightly change the resistance of the lamp it is connected to, the circuit is thrown out of balance and a click is heard in the head set.

WAVE LENGTH OF A COIL.

(53) Wm. Howard Riley, Philadelphia, Pa., asks:

Q. 1. What is the wave length of a double slide tuning coil 4" dia. by 20" of winding of 24 enamel wire?

Q. 2. My station consists of the above coil, a pair of brandes 2,000 ohms receivers, Silicon detector, aerial 50 ft. high, 50 ft. long. Now my question is, can I use a 1 m.f. condenser, as I have one?

Q. 3. Can I use a condenser taken from a ½" Ford coil?

A. 1. The wave length of the coil is 9,000 meters.

A. 2. You cannot make use of a 1 m.f. condenser in connection with the instruments stated. However, a 1 m.f. condenser has been employed in a receiving circuit by shunting same across "B" battery supply of an audion for the passage of the audio frequency currents.

A. 3. This condenser can only be applied to the receiving circuit as described above.

WAVE LENGTH OF ANTENNA.

(54) Claudius Burt, Philadelphia, Pa., wants to know:

Q. 1. What is the natural wave length of an aerial (vertical) which is 1" from the earth at one end (the bottom) and, going straight up, is 30' high at the other and composed of 2 No. 12 B. & S. copper wires placed 3' apart, the lead-in being taken from the top down to a point 5' below?

Q. 2. Data on an amplifying transformer suitable for use with a single step amplifier?

Q. 3. Maximum normal receiving range of 3,000 meter loose coupler 2-43-plate variable condensers audio-tron detector and single-step amplifier and a pair of good 'phones, using above aerial?

A. 1. 125 meters.

A. 2. In the near future we expect to publish a pamphlet on the design and construction of these coils.

A. 3. Approximately 1,000 miles.

HOOK-UP AND GROUND WIRELESS.

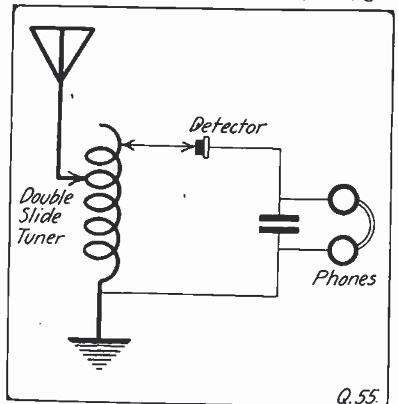
(55) R. E. Priest, New York City, desires to know:

Q. 1. Hook-up for the following: 1 double slide tuning coil, 1 silicon detector, 1 condenser (with three (3) binding posts), pair of electro government 'phones?

Q. 2. Can a gas pipe be used as an antenna with a waterpipe as a ground?

Q. 3. What would be the range of the station described in question one, if used with an antenna 75 ft. high 50 ft. long with two strands?

A. 1. Connections for your instruments are given below.



Hookup for a Double Slidetuning Coil, Silicon Detector, Condenser, and Phones.

A. 2. Yes; on several occasions experimenters have obtained exceptional results with such an arrangement.

A. 3. Approximately 500 miles.

RANGE AND WAVE LENGTH OF SET.

(56) William Pugo, New York, N. Y.:

Q. 1. I am sending with this letter a diagram for the following instruments:

One large loose couple,
Three loading coils,
Three variable condensers,
One phone condenser,
Two galena detectors,
Test buzzer, switches, etc.

Could you suggest an improvement or a better one all together?

Q. 2. What is the wave length of the following:

Loose coupler—(Primary)—4½ inches dia. wound for 6 inches with No. 24 D.S.C. wire. (Secondary)—4 inches dia. wound for 6 inches with No. 28 S.S.C. wire.

Loading coil A—3¼ inches dia. wound for 5 inches with No. 28 S.S.C.

Loading coil B—2 inches in dia. wound for 6 inches with No. 24 D.S.C.

Q. 3. Approximate range of the set?

A. 1. The diagram you furnish is O. K. We cannot offer any improvements on this particular circuit.

A. 2. Loose coupler 2,000 meters; loading coil A, 1,200 meters; loading coil B, 980 meters.

A. 3. Approximately 1,000 miles.

Value of Radio Compass

By L. A. POLLOCK

Perfection of the radio compass and its utilization for giving ships at sea their bearings has already saved the American Government more than $200,000, and, it is predicted by naval officers, will result in a saving during the current year of from $5,000,000 to $10,000,000.

An idea of what expense can be spared Uncle Sam may be gleaned from a computation that a reduction of two hours in the time required to dock a ship of the size of the transport *Leviathan* means $4,000 less for the taxpayers of this country to spend. This figure is not based on an idle guess but has been computed by naval officers as the cost of holding up the former German liner for two hours. It is predicted on the cost of the investment, the yearly depreciation, interest charges, pay of the crew and soldiers, etc.

In a fog a ship like the *Leviathan* no longer finds it necessary to creep about outside New York harbor seeking its bearings. It calls "N A H," the signal for the Naval Communications Office, No. 44 Whitehall street, New York City, and when it receives an acknowledgment, it signals "Q T E," an abbreviated request for radio compass bearings. These same letters have been adopted by the British navy.

Five radio compass stations along the Atlantic coast—Mantoloking, near Barnegat; Sandy Hook, Fire Island, Rockaway Beach and Montauk Point receive the calls and read the bearings of the ship. The readings are relayed to the New York office where they are laid off on the chart and the true position of the vessel is marked by the intersection of the lines of direction recorded by the separate stations.

Of this issue, the third one since "Radio Amateur News" started, 25,000 copies have been printed and circulated. We have added eight more pages, too, this month, to take care of the many new features, as well as advertising.

With your help and support we promise to double the size of the magazine before the first of the year.

Boost R. A. N.!

To the outsider it would seem that this process requires a considerable amount of time, but a ship at sea has received its bearings two minutes after asking for them by radio.

Picture a transport loaded with troops feeling its way slowly toward New York harbor enshrouded in fog. A request to New York brings the desired information regarding its bearings and it proceeds on its way. If its position is again in doubt the information may be had for asking; indeed radio compass bearings may be sent as often as fifteen minutes apart, if necessary.

Moreover, foggy weather is not the only condition under which the system may be put to use for the readings are more accurate than the ordinary methods of reckoning in navigation, it is said, and there is nothing to prevent vessels from availing themselves of the new system at all times. The radio compass is a war invention,[1] having been perfected by the Bureau of Standards for the detection of submarines. As many as thirty ships a day have been apprized of their positions by the New York office, and it is expected that recourse to the device will soon become universal among all craft carrying wireless.

[1] *Dr. F. A. Kolster, Bureau of Standards.*

The Lure of Radio

(Continued from page 124)

The average tramp's Radioman lives on a schedule something as follows:

At eight in the morning he is awakened by a steward, so that he may be down to breakfast at eight-thirty with the captain and the other senior officers. Only the Radioman, Chief Engineer, and the mates enjoy the privilege of being fed with the Captain. On many ships the Chief Engineer sits at the Captain's right and the Radioman at his left. This is particularly the case with the Britishers.

"Sparks"—as the Radioman is invariably called—is one of the most popular fellows at the table. He is generally the youngest present, and there are many efforts to make him the butt of all jokes. If he has a sense of humor—and the Radioman invariably has an exaggerated one—he gets along wonderfully well with everyone. He is generally better educated than the others aboard, and after a short time aboard the men will come to him for advice as to spelling, correct English, etc. And if he excells in these things he will soon be writing letters for all. They will come to him with all their tales of woe so that he may put the proper atmosphere into the letters.

Well, after breakfast the Radioman takes a little stroll about the decks with either the Captain or the Chief. If the Captain happens to be a crab—as is often the case—the Radioman is more apt to stick to the Chief. Chief Engineers are generally a kindly race; they and Radiomen are the good fellows of ships. Both are generally of the widely informed species who know everything under the sun and above it, who talk of psychological influences, anthropological derivatives, and differential calculus, with liberal references to literature and art. This all is easily accounted for, because the two kinds of humans specified have all the time in the world for themselves, and they spend it in ways which make them well read, able to think fast and clearly, and give them a knowledge of subjects more diversified than the average collegian's. And with all his width of knowledge the Radioman is a modest, unassuming young fellow. I have spoken only of the average. There are the exceptional ones.

After taking his morning stroll he enters the radio room and listens in until noon. It is quiet, no one to bother, and attentive listening to signals is a sixth sense. No longer is it necessary to concentrate on the sound in the telephones, as was the case on one's first few trips. Now one may read or write or do anything desired without the necessity of absolutely concentrating on received signals. Yet the moment anything of importance is in the air one becomes alert.

After luncheon he takes a nap. Then at three in the afternoon the steward calls with tea and toast and perhaps a little fruit. Then the morning's period of do-as-you-please is repeated until it is time to have dinner.

After dinner there is generally a pinochle game started in which the Radioman takes part until seven. Then the captain gives him the position report. This is sent out to the nearest land station, and after that one just listens in to the multitudinous things that float in the ether. This is the time that long distance records are broken and record breaking is listened to. N. A. A. time signals and press are copied and then pleasant dreams.

The lure of Radio! It is indeed irresistible. . . .

Some Real Ideas

(Continued from page 118)

to the balanced circuit, as it is an established fact that when such a circuit is equally balanced (A:B :: C:D, etc.) no current will flow thru the galvanometer (headphones in this case). It is hoped that some solution for perfecting such a system is not far off.

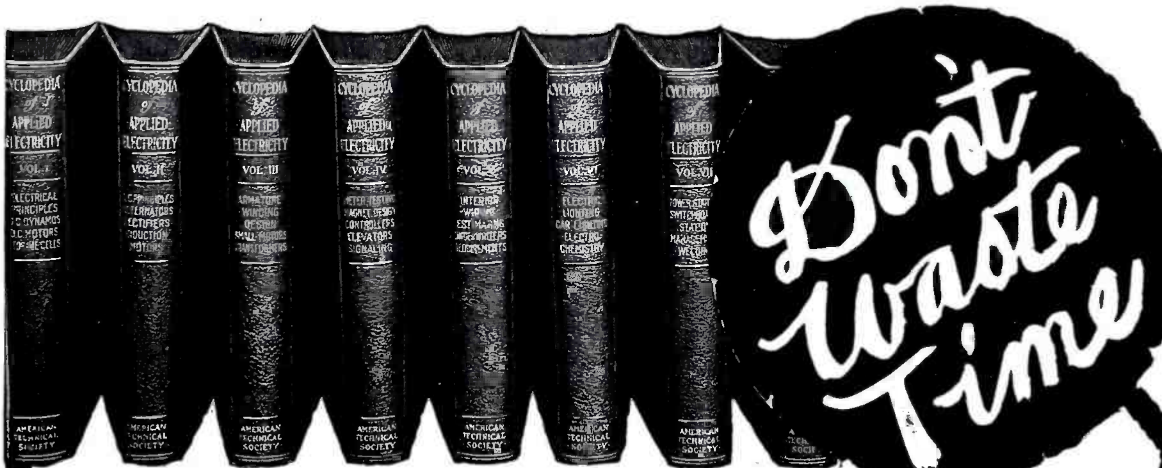
The following circuits (Figure 5) are added in order to suggest a different method to be used in connection with the balanced circuit. It will be seen that here the coil which was to be inductively coupled to the buzzer exciter is now coupled to the antenna circuit and a buzzer excitation coil placed at X in close proximity to one of the balanced units. This will have the effect of producing beats if it is possible to get the circuit balanced and function properly. Besides it seems highly possible with such a circuit to eleminate undesirable signals and static.

Summary: It is rather a hard matter to predict any definite results which may be expected, without carrying out such tests as are necessary to ascertain whether or not said circuit will actuate as is desired. Furthermore, in regards its actions, as stated before, i. e., somewhat similar to the audion bulb, in that it would release a greater amount of current thru the head telephones when changes are set up therein by superimposed radio frequency currents from the antenna circuit, coupled, directly connected, or otherwise, it is to be proven whether the similarity exists, i. e., whether the slight change in the balanced circuit will allow a greater amount of current to flow thru the phones than that which produced the change, or whether it is proportional to the change. In the latter case, it would then seem impossible to use the apparatus to amplify signals, as a too great change in the balanced circuit would be necessary to bring about these results. In regard to the interference question, little can be said at present, but it does seem possible that interference and atmospheric strays could be reduced to a minimum. Owing to the fact that even though the circuit employed to actuate the balanced circuit does intercept the various broad wave transmitters in conjunction with the desired signal, it can be seen that adjustments could be made to that circuit which would still actuate the balanced circuit (after sacrificing some of the desired signal), thereby totally eliminating the undesired ones and some of the bothersome strays in addition. As a whole I am inclined to believe that the circuits described will later on prove of value in conjunction with the receiving apparatus of today, and that interference and strays will be reduced to a minimum, with circuits tending to function along these lines.

Now that I have thrown open the doors to fortune, please do not ask the size of the coils, etc., to be employed with this scheme, as you will remember that the author did not have time to try out the various schemes and therefore knows nothing about the whole outfit except that its a pretty good field to work in—just like going out west in the old days. Gold mines!

BIG STATION FOR BUFFALO.

Plans are being made by the Bureau of Communication in the Navy Department at Washington for construction in Buffalo of one of the largest wireless telegraph and radio telephone stations in the country, according to word received by Lieutenant Commander Charles F. Ulrich, of the naval recruiting station at Buffalo.



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The Latest Design in Antenna Switches

(*Continued from page* 116)

given we will turn to figure 3, where drawings show clearly how this switch can be constructed in a more simple manner and the overall cost of material greatly lowered. The same lettering is maintained to designate the parts so that no confusion will result from different lettering. The

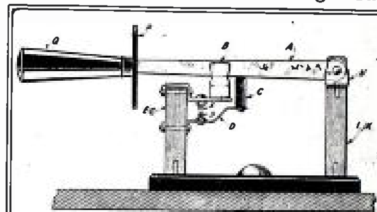
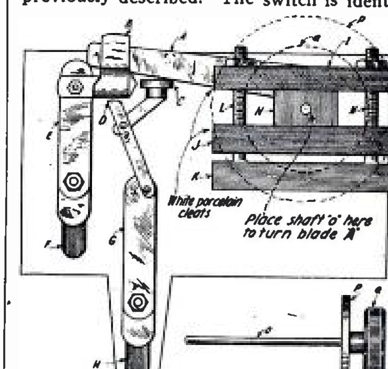


Fig. 3

The Switch Can Also Be Constructed as Shown and the Expenses Reduced Materially.

first accomplishment in respect to economizing is the elimination of the hard rubber base, which in this case is of oak, since the two bakelite posts (EG) and (IJK) form the insulation for the various switch members—EG being substituted for the two cleats and IJK for the three cleats previously described. The switch is identi-



Constructional Details of the Switch Shown in the Photo. Note the Cleats Employed to Support the Shaft of the Knife Blade Switch Portion.

cal in construction with but one exception: the rotary method is dispensed with and the regular knife-blade switch is resorted to. The switch shown in the drawing, figure 3, is in the receiving position, as the two contact points B and D are forced apart, thereby preventing the transmitting inductance from short-circuiting the receiving primary inductance. This undoubtedly is the most efficient and economical antenna switch ever designed.

WIRELESS IN AID OF THE EXPLORERS.

From the heart of the Amazon jungle in South America, Dr. Alexander Hamilton Rice, American explorer and ethnologist, and his wife, will pick from the air up-to-the-minute news of the world, including the scores of the major baseball leagues.

Dr. and Mrs. Rice will carry a wireless on the yacht which will take them 1,000 miles up the Amazon River. When they leave the yacht to penetrate the jungle they will have a new and powerful portable wireless outfit.

BIG MEXICAN RADIO STATION.

The government has completed erection of a wireless station at Tampico, Mexico, which, it is claimed, has a sending radius at night of 2,000 miles.

Guarding the Ether During the War

(*Continued from page* 104)

attention of the authorities, and much valuable information was secured by actually intercepting and often discovering the system of communication the enemy submarines had devised in order to communicate with one another without detection.

One outstanding trick of the German submarine radio operators was to use low wave lengths alternating between 60 and 75 meters. Until this was discovered there was, of course, little chance of nearby vessels intercepting their messages, since the lowest wave lengths used by commercial vessels is about 500 meters. The submarines were usually comparatively near to one another, and therefore could use such low waves with a very small amount of power; in fact, they often used high frequency buzzers similar to those used for testing detectors. German high-power stations, such as Nauen (POZ) and Berlin (LP), knowing quite well that Allied Radio listening-in stations were constantly on watch copying all of their transmission, would camouflage their important transmission by *first sending out press items of the propaganda type on their regular and known wave lengths and simultaneously send their cipher dispatches on the same waves from a nearby antenna,* their receiving operators depending on a system of critical weeding out in order that the press items cause no interference. Another method was for the nearby station to drop down or step up to various prearranged waves and there send dispatches, probably inferring that allied operators in their desire to copy all items of the interesting (?) press would fail to cover other waves. Whatever their motives for these tactics, and if their intent was to decoy listening-in stations, these were crude methods indeed.

A Pocket Size Receiver

(*Continued from page* 121)

to adjust the detector. A small push button to control the buzzer is mounted on the panel.

The panel on which the switches and de-

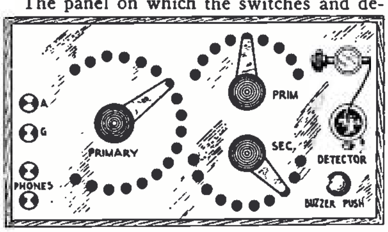


Fig. 2

The Front Panel of the Receiver With All the Variable Units Including a Push Button for the Detector "Test"

tector are mounted is made of Spanish cedar taken from a cigar box and highly finished in mahogany. The panel is mounted so that the switch knobs will not touch the lid when it is fastened.

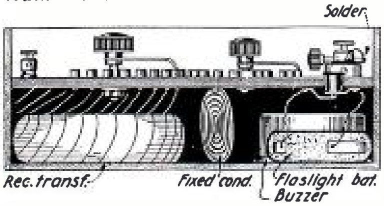


Fig. 3

Side View of Pocket Size Receiver Showing Method of Arranging the Apparatus in a Minimum of Space

LINKS ITALY AND AMERICA.

The announcement that Italy and the United States have recently been connected by wireless telegraphy deserves more notice than it has received. This achievement probably makes a back number of the great wireless station at Nauen, near Berlin, which has been so useful to Germany and which, when the war broke out, claimed to be the most powerful in the world, with an effective range of between 5,000 and 6,000 miles. From the nearest point in Italy to the United States transatlantic station at Arlington, near Washington, the distance is not less than 6,200 miles.

Reviewing American Radio History

(*Continued from page* 103)

to suit himself through a wide range, merely by turning a condenser handle. Then he can amplify this musical note by the third tube and produce a loud, clear tone which can be heard all over the room.

Then by inserting a microphone into the transmitter he can make of it a perfect little wireless telephone generator; by changing the adjustments of the receiving tube he will hear the voice far clearer than over any telephone wire, instead of the musical note which he observed when the transmitter tube was used as a telegraph.

He can, if he desires, arrange the three tubes to oscillate at a low or "audio" frequency and vary the note of each one to suit his taste, so that he can have a little three-note organ producing beautiful sounds, and can very easily change the pitch of these notes, but not the quality, so that he can obtain sounds similar to those of a violin or an oboe or a high piping bird note.

Other Uses

The audion can also be used in place of a microphone to transmit the voice. It has also recently been used in place of a commutator of a motor to control the rotation of the motor armature. Notwithstanding the astonishing developments in so many lines of great utility which the audion has been through, it is safe to say that its future far exceeds its past performance. A boy who now is investigating the laws which govern this device, has the satisfaction of knowing that he is exploring a field of science which is as yet virgin, and that he is himself treading new paths in company with some of the world's most advanced scientists.

A Radio Experimenter's Receiving Cabinet

(*Continued from page* 120)

That shown at B is due to Logwood and uses only the vario-coupler. The primary acting as a tuner, the secondary serving to link the plate circuit with the antenna circuit, forming what is termed a tickler. The oscillations in this circuit can be started and stopt by simply rotating the coil to the proper position.

The circuit at C is one that is very sensitive, giving great amplification of short waves. The tuning is extremely sharp, being done almost entirely with the condensers. This circuit with a telephone transmitter in the ground lead will transmit radiophone messages over two or three miles.

The number of circuits and arrangements possible with the cabinet is practically unlimited. By using the inductances in various arrangements a wide range of wavelengths can easily be obtained.

PLAN BIG RADIO STATION.

Official announcement that Denmark is making plans to open wireless communication between Copenhagen and the United States, was made today by the Danish Legation.

Plans are now being worked out by the Danish Ministry of Traffic for erecting a great transatlantic radio station near Copenhagen which will put Denmark in direct wireless communication with the United States.

Danish newspapers complain that their telegrams for some time have been greatly delayed because of the crowded cables. The Danish papers express the hope that the still important plan for a great transatlantic station will soon be realized.

Junior Radio Course-Lesson 1

(*Continued from page* 130)

of as the medium. In the case of the paddles the water provides the medium. At the present time in actual wireless communication the ether is accepted as providing this medium, and while others contend that the earth serves the same purpose, we will accept the former in preference to the latter due to the fact that it is more generally known and is favored by a great majority of scientists; besides it is not the desire of the author to go into discussion in respect to which is right or wrong. Now that we understand that in order to communicate we must have, first, a means of creating a disturbance in the medium and, second, we must provide a device to record these disturbances, whenever they are of sufficient strength to budge the distance between the two; and when the recording device is sensitive enough to respond to what minute disturbances may happen to be passing; one thing which the author desires to point out in connection with this elementary explanation of the principles of wireless telegraph communication is that while the paddles in the pool of water furnish a very clever and satisfactory method of explaing wave propagation* and reception; one thing of vital importance in connection with what follows, in sequence[1], as the course progresses is that in order that the paddle R may respond to the waves produced by S it is necessary that they both be tuned to resonance[2]—or to the same wave-length, so that the paddle R would not be affected unless the paddle S produced waves of proportions similar to those necessary to cause the former to respond. This can be explained by making reference to a mandolin, as for instance the two E strings; first one is tuned to the note desired to be permanently maintained for actual playing of the instrument; then the second string is adjusted until striking the two at once, with the same pick, but one tone or sound is produced. The two strings are then said to be in resonance in respect to their pitches. In this state, if but one of the two strings were struck, *it would cause the other to vibrate in unison* with it, due to the fact that they have been TUNED to resonance, and this term as applied to wireless telegraphy is of vital importance if the maximum strength of signal is desired from a given transmitter. This process of tuning both S and R to resonance will be taken up in one of the lessons which follow. So we finally realize that we need a disturbing source, a recording source both of which can be adjusted to resonance and a medium upon which the waves may travel.

This medium of which we speak (the ether) is a substance which fills all spaces not already occupied by other substances. It exists everywhere, between planets, suns, in nature, and even in the pores of metals, wood, and other substances. It is comparable to water soaking into a blotter since it occupies every pore in the universe not occupied by another substance.

Questions for Lesson One

Q. 1. Explain fully the production of water waves and their similarity to ether waves employed in wireless communication in respect to forming a medium for carrying the signals.

Q. 2. How is transmission and reception in wireless telegraphy accomplished?

Q. 3. What two distinct installations are required to form a complete wireless system and explain reasons?

Q. 4. What other important consideration is necessary in connection with wireless communication besides the principles demonstrated by the water experiment?

Q. 5. What medium is accepted by the majority of scientists?

*Multiplication of the kind by generation or successive production.
[1]That which follows in order.
[2]The act of resounding.

Grand Opera By Wireless

(*Continued from page* 106)

sees his own figure appearing on the screen he will know exactly how and when to sing into the microphone in front of him.

All of the microphones go to the wireless telephone station located in the radio room above, and there are, of course, sensitive microphones in the studio which pick up the sounds from the orchestra as well. All sounds are then stepped up thru the usual amplifiers and are then led into the high power vacuum pliatrons, *which finally amplifies the original sound several million times.* These impulses are then sent out over the usual aerial located on top of the house and are shot out all over the country instantaneously.

Five hundred to 1,000 miles away—and for that matter all over the country—every moving picture house will have been supplied with the identical film at the stated performance, it having been announced days ahead that the grand opera "Aida" will be given at such and such an hour.

Of course, where the distances are large, the hour of rendering the opera will vary. Thus, for instance, if Caruso were singing in New York and a performance would start at eight o'clock in the evening, New York time, it would start in San Francisco at four o'clock in the evening, *as a matinee,* due to the difference of time. Inasmuch as such performances would probably only be held once a month, people would not mind to inconvenience themselves due to slight difference of time.

Every moving picture house will have its receiving apparatus with its usual amplifiers and anywhere from six to one dozen loud talkers scattered thru the house. Exactly at the stated time the moving picture operator will begin grinding away—the opera has begun. Simultaneously the distant orchestra will begin playing, filling the house with music.

When the actual performance begins, it will be an easy matter for the operator to keep time with the incoming music. All he needs to do is to grind faster or slower, and inasmuch as Caruso with his performers in New York is watching the identical film, the distant operator will have no trouble to have the music keep time with his film. If he finds that he runs ahead for one second, he can readily slow up the next and vice versa. With a little practise it will be easy for the distant operator to time himself perfectly, thus giving the patrons of his house an ideal performance.

From a financial standpoint it would be good business for the opera company, as well as for the moving picture houses, *both of which would thus derive a new income running into the hundreds of thousands without hardly any expense whatsoever.* The grand opera with an outlay of from one thousand to three thousand dollars could buy its high power radio telephone outfit, while every live picture house thruout the country would be able with an expenditure of less than five hundred dollars to buy its necessary radio telephone equipment *and this cost would only be initial,* because nothing except burnt-out vacuum tubes need be replaced and there is practically no cost of up-keep.

The writer confidently expects that this scheme will be in use thruout the country very shortly.

Government Radio Control

(Continued from page 109)

treaty, all restrictions on the use of this art will be removed and many interests will be attracted to this form of investment. It is conceived and shown that ship-to-shore and transocean radiotelegraphy can only be efficiently carried on under a monopolistic control, and this department contends this should be a Government monopoly, and requests congressional authority to assume this ownership and control. At this time this department is confronted with conditions which make it imperative to ask for this monopoly.

Obviously the United States can not own radio stations in other countries. These countries fall into certain groups: (1) Those in which the Government itself maintains a radio monopoly; (2) those in which the Government permits its own nationals, but not foreigners, to own and operate stations; (3) those in which any authorized individual or corporation can erect stations.

Obviously every encouragement should be given American companies to manufacture and sell radio equipment abroad and to own and operate stations abroad. The American Government-owned stations should exchange traffic with such stations and assist them in any legitimate way. Especially should any patents or improvement controlled by the Government be made available to such American companies under proper safeguards and guaranties.

In conclusion this department recommends that Congress immediately enact legislation regarding radio communication along the following lines:

(1) Either by a committee of Congress or by special designated commission authorize a comprehensive study of the problems in connection with radio within the United States. This, however, is not of immediate concern to this department. Of course the department stands ready to give the benefits of its experience and technical knowledge.

(2) Authorization to the President to set aside, by proclamation certain bands of wave lengths for ship-to-shore work, for shore to aircraft, and for transocean services in accordance with international conventions and demonstrated needs from time to time.

(3) Constituting ship-to-shore radio service a Government monopoly under the Navy.

(4) Constituting transocean and international radio service a Government monopoly under the Navy.

(5) Authorization for Navy Department to utilize immediately all Navy radio stations for commercial and press business.

(6) Authorize the Navy and other departments to assist American enterprise in the sale of radio apparatus and the development of American-owned radio stations abroad, and especially to authorize the Secretary of the Navy to authorize the use by American companies under proper conditions of Government-owned patents and improvements, to be paid for either in exchange of patent rights or in other suitable ways.

Sincerely yours,
JOSEPHUS DANIELS.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

Some ships that have not yet been discarded from usage have an unpleasant—to land-lubbers and stewards—propensity to roll badly in smooth seas. One old tanker thought nothing of a half dozen thirty-five-degree rolls in a minute, and with a set tuned as sharply as possible, there was continuous variation in signal strength because of variation of capacity between antenna and sea.

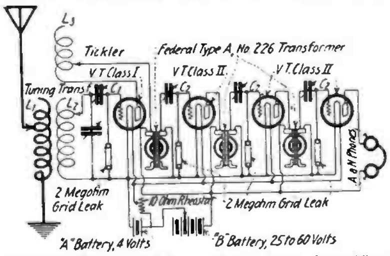
Audio Frequency Amplifying Transformers

(*Continued from page* 115)

It is one of the shell core type with a 1 to 3 ratio of turns. The d.c. resistance of the primary is approximately 2,200 ohms and of the secondary approximately 9,150. The impedance at 500 cycles is the same as that of the internal impedance of the Marconi V.T. The transformer will act equally well with tubes having approximately the same internal impedance. This, as explained above, provides the maximum efficiency of operation. The flux leakage is very low and as a consequence the tendency to oscillate at audio frequencies, due to mutual induction between circuits in a a cascade amplifier, is reduced to a minimum.

REGENERATIVE CIRCUIT WITH THREE-STAGE AMPLIFIER

The circuit shown is suitable for *damped or undamped wave reception at all wave lengths*. In addition to being an extension of the amplifying circuit in Figure 2, it



Circuits Employed in a Three Step Amplifier Employing Three of the Transformers Shown in the Photo.

provides regenerative coupling at the "tickler" transformer L-2 and L-3. Self-amplification is thus obtained from the first valve through the feed back coupling, and the audio frequency component of the plate current in that valve is progressively amplified by the second, third and fourth valves with audio frequency intervalve transformers.

The grid condensers of the amplifying bulbs have capacitance of 0.005 mfd. each. As in the preceding circuits, grid leaks are shunted from the grid to filament of all valves.

This circuit is recommended for long wave reception from high power stations and will permit reception over several thousand miles, using a frame aerial six to eight feet square wound with about forty turns of 3x16x38 Litzendraht wire.

Have you ever listened to Arlington NAA and Key West simultaneously during time signals and note the lag existing between the two dots emitted from both stations? It sounds very much like a locust, due to the slight difference in tone of spark frequencies. It goes Chee-wang-Chee-wang. This lag is due to the ohmic resistance of the line and the drop therein from Washington, to Key West; it being remembered that both keys are supposed to close at the same instant.

"If you're crazy about Wireless you're not crazy at all," is not such a bad slogan for the radio bugs to adopt, when we realize that all people so afflicted are called nuts, bugs, etc. Some yell for the needle, while others make a hurried exit in order that they won't be present when the accident happens; for they sometimes look upon one of these nuts as an accident going somewhere to happen. Presto!—the liniment.

Wireless Telegraphy With the Canadians at the Front

(Continued from page 129)

right angles to the direction of the receiving station, which had lines similarly laid. A three or four valve cascade amplifier picked up the signals.

The loop set system made use of a closed circuit aerial for sending. It was in the shape of a square, about four feet to the side, supported and insulated from the ground by using a hard rubber socket, fitting over the hilt of a bayonet stuck in the ground. A six-volt accumulator supplied the energy for the small spark coil in the instrument. A two-valve detector-amplifier combination constituted the receiving part of the system. Two types of aerial were used, both of which gave good results over distances up to six miles under favorable conditions. One was a bare conductor supported three feet from the soil by shovel handles in the trenches, and the other was a pair of insulated leads of equal length lying on the ground about 15 feet each way.

The continuous wave system was the (now ordinary) vacuum valve sending and receiving set, using two 200-volt dry cell batteries in series for sending.

The spark trench set consisted of a combined transmitter and receiver, as was the

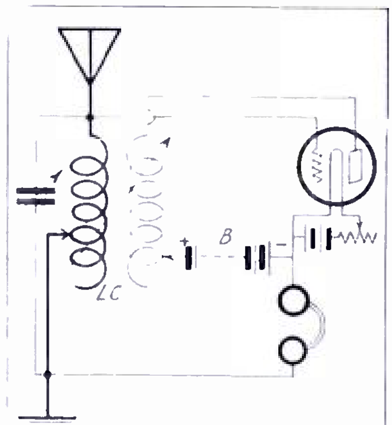


FIG. 2

A New Audion Circuit Also Devised by French Radio Experts Which Was Found to be Best Suited for "Trench" and "Behind the Lines" Communication.

case in the loop set and C.W. systems. The primary source of energy was a ten-volt secondary battery. The closed circuit was inductively coupled to the aerial or radiating circuit. The transmitter consisted of the primary or generating circuit, the closed or oscillating circuit, and the aerial or radiating circuit. The receiver was also of the three-circuit type, using a very rugged carborundum detector and 4,000-ohm phones. *The same aerial tuning inductance switch is common to the sending and receiving circuits, doing away with the necessity of a change-over switch, the change being affected by a short-circuiting device being fitted to the transmitting key.* The aerial was the usual one-wire copper conductor, supported by two 15-foot steel masts. A two-inch coil fitted as standard to these sets made them useful up to distances of eight miles. For distances greater than this there was in use another type of transmitter, using a separate receiver employing valves and a change-over switch. This set used a 28-volt accumulator for the primary energy to the coil, the current being interrupted by a mechanical, motor-operated make and break. The input of the smaller trench set was about 50 watts, and that of the latter about 150 watts.

Whenever it became quiet enough on the front (and especially was this possible during the winter months), nearly every station improvised a crude set for long distance reception. In the devastated areas there were many opportunities for salvaging magnet wire and other useful material for making these sets. Considerable ingenuity was displayed by the operators in assembling these press sets. In the earlier epochs of the war we had to rely entirely on crystal reception, but when, later on, vacuum tubes became more common and consequently easier to obtain, we used them as detectors as well as for amplifiers. Continuous wave receiving sets for wave lengths up to 15,000 meters were made, and in spite of no soldered joints and lack of hard rubber or other good insulated sheeting, marvelous results were achieved. In figure 2 is shown the hook-up of the best working combined C.W. and spark receiver, using only one valve. By putting in an amplifier where the phones are shown, of course far better signals are afforded. The "B" battery is of 60 volts and the filament battery 4-6 volts.

After last August, when the enemy was fairly well on the way to Berlin, the Canadians relied almost entirely on wireless communication, as there were so frequent moves forward, land lines would be useful only for perhaps a day, when the lines would be far behind our advancing troops.

The foregoing tends to show that radio played an important part in the game of war as any other branch of science did, and even when other means of communication failed entirely wireless telegraphy was the only stable means by which this vital necessity could be carried on.

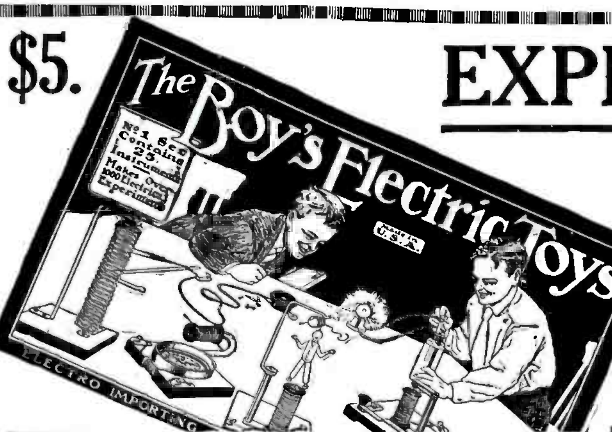
The French power buzzer was probably the best type of apparatus for front line work, owing to the fact that elevated antennæ of any kind were not necessary. This permitted communication to be carried on with ease when other systems employing the overhead antenna were subjected to heavy gun fire and dismantled during the bombardment. The only possible way that the antenna employed in the ground buzzer system could be rendered inoperative was by the explosion of a near-by shell or a direct hit of the wires themselves.

The amplitude of a wireless wave very rapidly gets smaller as the wave gets farther from its starting point, until, if given sufficient room, it finally dies out altogether; in other words, the amplitude decreases as the distance from the starting point increases.

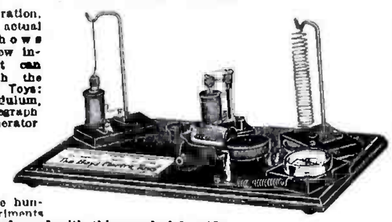
It is interesting to note that while a ship at sea in a strong gale or storm throws water over its masts and the antenna, thereby coating the insulators with a salt water film, no appreciable leak to ground occurs when the transmitter is in operation. It appears that this should cause considerable trouble; however, we hear very little of trouble caused by this source.

When constructing that new detector why not place the cup upside down and have the point come from below, thereby making the mineral dustproof and increase the life of its sensitiveness without necessitating the constant cleaning of the mineral, which is the case with detectors having their minerals placed directly on the base of the detector, consequently the dust settles on the mineral.

$5. EXPERIMENTERS!



A Sample of What You Can Do With This Outfit



This illustration, made from an actual photograph, shows only a very few instruments that can be made with the Boy's Electric Toys: Electric Pendulum, Electric Telegraph Current Generator Electric Dancing Spiral, Galvanometer. Space does not permit us to show the hundreds of experiments **that can be performed with this wonderful outfit.**

No. EX2002

"THE BOY'S ELECTRIC TOYS" contains enough material TO MAKE AND COMPLETE OVER TWENTY-FIVE DIFFERENT ELECTRICAL APPARATUS without any other tools, except a screw-driver furnished with the outfit. The box contains the following complete instruments and apparatus which are already assembled:

Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephone, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat, erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book which we furnish, one hundred experiments that can be made with this outfit are listed, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by means of this outfit, two hands, and a screw-driver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

Among the finished material the following parts are included: Chromic salts for battery, lamp socket, bottle of mercury, core wire (two different lengths), a bottle of iron filings, three spools of wire, carbons, a quantity of machine screws, flexible cord, two wood bases, glass plate, paraffine paper, binding posts, screw-driver, etc., etc. The instruction book is so clear that anyone can make the apparatus without trouble, and besides a section of the instruction book is taken up with the fundamentals of electricity to acquaint the layman with all important facts in electricity in a simple manner.

We guarantee satisfaction.

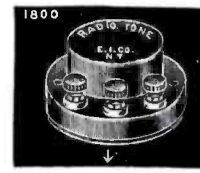
The size over all of the outfit is 14 x 9 x 2¾. Shipping weight, 8 lbs.
No. EX2002 "The Boy's Electric Toys," outfit as described.............. $5.00

IMMEDIATE SHIPMENTS

ELECTRO IMPORTING CO., 231-A Fulton St. NEW YORK

The "Electro" Radiotone

HIGH FREQUENCY SILENT TEST BUZZER



This instrument gives a wonderful high pitched MUSICAL NOTE in the receivers, impossible to obtain with the ordinary test buzzer. The RADIOTONE is built along entirely new lines; it is NOT an ordinary buzzer, reconstructed in some manner. The RADIOTONE has a single fine steel reed vibrating at a remarkably high speed, adjusted to its most efficient frequency at the factory. Hard silver contacts are used to make the instrument last practically forever.

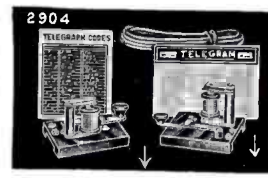
Yes, the RADIOTONE is **SILENT. In fact, it is so silent that you must** place your ear on top of it to hear its beautiful musical note.

You will be astounded at the wonderfully clear, 500 cycle note, sounding sharply in your receivers. **To learn the codes, there is absolutely nothing like it.** With the radiotone, a key and one dry cell and ANY telephone, a fine learner's set is had. Two or more such sets in series will afford no end of pleasure for intercommunication work. **Shipping Weight 1 lb.**

Radiotone as described..............................each **$.90**

IMMEDIATE SHIPMENTS

The "Electro" Telegraph



is not a toy, but a practical, honestly built telegraph outfit, which not only sounds but works like the big commercial instruments. By studying the code for 30 days you can become a first-class telegraph operator. Such operators are in big demand now. Outfit consists of TWO complete telegraph instruments each measuring 3½ x 2½ x 2¼. All metal parts are highly nickel plated, including key lever. Note hard rubber knob. Telegraph Code Chart, telegraph blanks and connecting wire comes with set, but no batteries. Outfit works on 2 dry cells (one cell for each instrument). The "Electro" is the ONLY Outfit that works both ways, each station can call; no switches, no extras. Nothing to get out of order. Guaranteed to please you or money back. **Price Complete as Illustrated (TWO INSTRUMENTS).. $1.25**

Shipping Weight, 2 lbs.

IMMEDIATE SHIPMENTS

The "Electro" Codophone (*Patents Pending*)

$1.50

What this remarkable instrument is and does.

The "Electro" Codophone is positively the only instrument made that will imitate a 500 cycle note exactly as heard in a Wireless receiver. The loud-talking receiver equipped with a horn, talks so loud that **you can hear the sound** all over the room, even if there is a lot of other noise.

THAT'S NOT ALL. By lessening or tightening the receiver cap, a tone from the lowest, softest quality, up to the loudest and highest screaming sound can be had in a few seconds.

FOR INTERCOMMUNICATION. Using two dry cells for each instrument, two Codophones when connected with one wire and return ground, can be used for intercommunication between two houses one-half mile apart.

One outfit alone replaces the old-fashioned learner's telegraph set, consisting of key and sounder.

The "Electro" Codophone is a handsome, well made instrument, fool proof, and built for hard work. Contacts are of hard silver ⅛ inch in diameter, that will outlast the instrument.

There is also a neat code chart and full directions **enabling any intelligent young man or girl to learn the codes within 30 days,** practising one-half hour a day.

Sizes: 6¾ x 3 x 2⅝". Shipping weight, 3 lbs.
The "Electro" Codophone as described, complete.......... **$1.50**

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 20 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 228 Big Pages, 600 illustrations, 500 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 20 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.

ELECTRO IMPORTING COMPANY
231A Fulton St., New York City

I enclose herewith 6 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 20 as described.

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ADDRESS ....

STATE .... R.A.N. 9-19

OPPORTUNITY AD-LETS

Follow these advertisements every month. Reliable advertisers from all over the country offer you their most attractive specials in these columns.

Classified advertising rate two cents a word for each insertion. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. No advertisement for less than 20c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Objectionable or misleading advertisements not accepted. Advertisements for the October issue must reach us not later than September 10.

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Auto Accessories

Double mileage assured! Use self-cured blow-out patches; they weld permanently to shoe, are extra strong, easily applied. The outcome of years practice. Ben's Big Tire Shop, Dept. D, 378-382 Queen's Boulevard, Winfield, Long Island.

Business Opportunities

500% Profit Monograming Autos. "Perfect" transfers. Irvin J. Wolf, Sta. E., Philadelphia.

Stamp names on key checks spare time make as high as $19 a hundred. Send 25c for sample and instructions; returned if required. Elct Keytag Co., Cohoes, N. Y.

Build up an Income in Oil—Others are doing it. Why not you? Today is the opportunity. Join our easy monthly payment plan now—it may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. M, Houston, Texas.

Complete course on compiling and selling names by mail to advertisers. Description free. Globe Publishing Co., 121, Syracuse, N. Y.

$30.00 a week evenings. I made it with a small mail-order business; continued my regular job daytime. Free Booklet tells how; 2 cents postage. Albert W. Scott, Cohoes, N. Y.

$10.00 a Day for Amateur Photographers. Ten cents brings the plan which has been successfully operated. J. W. Bilodeau, Lydonville, Vt., Dept. 99.

Help Wanted

Men Wanted for Detective Work. Write J. Ganor, Former U. S. Government Detective, Danville, Illinois.

Secret Service operatives and Detectives are in demand. Earn big money. Travel everywhere. Fascinating work. Learn this profession by home study. Particulars free. American School of Criminology, Dept. R, Detroit, Mich.

Formulas

Invisible Inks. 30 formulas, 15c. Horton P. Jones, Perry, Ia.

500 Successful money-making formulas and trade secrets. Postpaid 25c. Charles Dynes, Winchester, Ind.

20,000 Recipes and Formulas worth $100.00 to anyone. Price only $1 postpaid. Clifford Camp Co., Claremont, N. H.

For Men

Dredge's Necktie Valet removes wrinkles (without ironing) from neckties. Sample 25c. Get one to-day. Dept. E, 190 Pilgrim Avenue, Highland Park, Mich.

For Advertisers

Jacobus Ads are Business Builders. Booklet free. Jacobus Advertising Service, 1073 Sanford Ave., Irvington, N. J.

For the Hair

Don't Use Soap. Shampoos containing Soap or Alkalies injure the Hair. "Tricon" Herb Shampoo made from Mexican Amole, and other Roots and Barks contains neither. Cleanses the Scalp, removes Dandruff, stimulates Growth, restores Softness and Gloss. 10 cents postpaid. Agents Wanted. W. L. McDaniel, Box 916, El Paso, Tex.

Do You Want Hair? You can have it by using The Ekdee Hair Cerat. 95% of baldness curable. Thin hair made thick. (Not a dye). One month's trial sent postpaid for $2.10. The Ekdee Company, 800 Union Avenue, North Portland, Oregon.

Health

Tobacco or Snuff Habit Cured or no pay; $1 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

Pyorrhea (Rigg's Disease—Bleeding or Swollen Gums). H. E. Kelty, D.D.S., M.D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea. Purifying, healing, preventative. Full month's treatment, $1 postpaid. Or, write for free booklet. Pyorem Mfg. Co., 430 Seventh Street, Brooklyn, N. Y.

Instruction

Gregg Shorthand. Business correspondence and punctuation taught by mail. Low rates. Providence Correspondence School, 44 Franklin St., Providence, R. I.

Stammering

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 121 Potomac Bank Bldg., Washington, D. C.

Scenery for Hire

Collapsible Scenery for All Plays. Amelia Grain, Philadelphia, Penn.

Tricks, Puzzles and Games

Boys—Send 10c for the Greatest Magic Trick Book ever published—Free trick. Lindhorst Magic Shop, St. Louis, Mo.

1,000 Stage Tricks with 500 illustrations. Catalogue 15c; small catalogue free. Hornmann Magic Co., Sta. 6, 304 West 34th St., New York.

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Telegraphy (both Morse and Wireless) and Railway Accounting taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and largest school; Est. 45 years; catalog free. Dodges Institute, 25th St., Valparaiso, Ind.

Wireless

Have your wireless instrument parts made in an up-to-date shop ready to assemble. Send us your sketches or description and get prices, all kinds of machine work done, parts and material supplied. Stevens, 29 N. Seventh St., Philadelphia.

For Sale. Cabinet type receiving set, wireless and telegraph instruments. Write or call mornings. Thos. Shay, 768a Quincy St., Brooklyn, N. Y.

We are selling a first-class Learners Instrument for $1.00 mounted on a polished wood base 5x7 inches, all brass work polished and lacquered. Send stamp for Code and Circular. Every student of telegraphy should own one of these instruments. C. L. Redding & Co., 202 Main St., Everett, Mass.

New Catalog R C 1 now ready! We ask only 2c to defray postage. "Radio"—The Quality Instruments. Radio Construction & Co., 847 Magee St., Phila., Pa.

Amateurs: Special seamless tubing, 3½" diameter by 26" long 25c.; 4" x 26" 35c; 5" x 26", 45c; 5" x 36", 65c; 5½" x 36", 65c; 6" x 26", 50c. Postage 2 pounds extra. Money order only. Send stamps for price-list. Maier & Co., 335 East 93rd St., New York.

Have your own style panel or cabinet made to order at a reasonable price. Panels and cabinets made of black walnut, pine, maple, and bakelite. Special Audion panel including high voltage batteries but minus bulb for $9.00. Satisfaction guaranteed. Henry J. Morton, 55 Concord St., Portland. Me.

Radio Bugs! Listen to Lyons and Rome. Working drawing and hook-up of ultra regenerative undamped or damped long wave set used during war. Astounding results. Set cheaply constructed. Send $1.00. No stamps accepted. Wm. Mayer, 415 Jane St., West Hoboken, N. J.

Mercury-Cup Detectors—Worth $5.50. The most efficient detector in the wireless field to-day. Tested by the Marconi Wireless Telegraph Co. and the United States Government. The many advantages which "The Mercury-Cup Detector" has over other crystal detectors will delight the amateur as well as the professional operator and will be a great improvement to every wireless receiving set. The finest materials and workmanship are employed in the manufacture of "The Mercury-Cup Detector" and it will be sent postpaid to any address for $4.50. (Foreign countries, $5.00.) The H. S. Wireless Co., 164 Ross St., Brooklyn, N. Y.

Aerial Wire—7 strands number 22, pure copper. Highest conductivity and strength. Supply limited at this price. 1c per foot—$9.00 per thousand. L. A. Bates, 8 Moen St., Worcester, Mass.

Wireless Experimenters—Look just received shipment of 5,000—22½ Volts—15 cells United States Army Signal Corps B-Batteries for Vacuum Tubes Type BA-2 at 60c each, shipping weight 1 lb. Also 2,000 lbs. Aerial Wire, composed of copper and iron at 2 lbs. for 70c. Eighty feet to a pound. Shipping weight 2 lbs. Add enough postage for the above and 3c insurance. The H. S. Wireless Co., 164 Ross St., Brooklyn, N. Y.

Exchange

Buy, Sell, Exchange. Wireless and electrical goods. Murdock, Clapp-Eastham, Thordarson, Brandes, etc. Send 10c stamps for our circulars listing new standard apparatus at less than manufacturers prices. We have to exchange: Wireless, Electrical, Optical, Cameras, Printing Presses, Typewriters, Large list free. LaRoy Zehrbach, 5 College Ave., Hiram, Ohio.

Hundred Modern Electric's, Electrician and Mechanic. Also Wireless Age, Electric Experimenter. Ten new, sealed three cell "Ever Ready" "B" batteries. Want head set, transformer, what have you? Wireless, 1794 Filbert, San Francisco, Cal.

Wanted: Wireless instruments, guns, enclose stamp. Lock Box 101, Stockbridge, Mass.

Sell or Exchange—6 inch Spark Coil Powerful Telsa Coil—Long Range Audion Receiving Set and others. List for stamped envelope. Want Weston Meters, camera. Albert Toth, 1628 First Ave., New York City.

Blinker set consisting of light and key. 30 cents postpaid. Robert Martin, Paris, New York.

Wireless instruments for sale: State wants. Please enclose stamp. Natalish, Stockbridge, Mass.

Have Comptometer calculating machine, 22 Winchester repeater $12, Fountain pen (new), Marble Hunting knife (new), Solid gold watch chain (new), V.P. Kodak, Fielder's glove, fine telescope. Want: Good radio apparatus. Lewis Moore, 1719 Sassafras St., Erie, Penna.

For Sale—1,000 Ohm Single Headset, $1.75—2,000 Ohm Double Headset, $4.00—¼ lb. No. 22, 50c.—Buzzer, 50c. Johnson, 4232 Otter St., West Phila., Pa.

"For Sale—Complete set of Hawkin's Electrical Guides, $9. Write quick. Ritchey Hume, University, Mississippi."

One Large Erector Set—Eight Dollars. Good Condition. Chas. Hightshoe, 616 N. Ellsworth, Marshall, Mo.

For Sale: 1 Loose Coupler Navy Type, $5.00. 1 Arnold Type coupler, $10.00. Write S. A. Hendrick, 2210 Aqueduct Ave., Bronx, N. Y.

For Sale: Two Stage amplifier, $30. 1 K.W. rotary quenched spark gap with high voltage transformer, $55. List of other apparatus for stamp. Gebhard, 1820 Calvert St., N.W., Washington, D. C.

For Sale—Two Audio-tron cabinets, each $5.00; Arlington loose coupler, $6.00; AA Crystaloi, $3.00; Crystal detector, 85c; New Oliver typewriter, $50.00; National automatic transmitter, $18.00. Enclose stamp. Harold Davie, Bolivar, New York.

Bargain—Navy Coupler, variable and fixed condensers, DeForest galena and Radison detectors, Loading coil, 2,000 ohm phones, brand new for $33.00. Chas. H. Cross, 1780 West 9th St., Brooklyn, N. Y.

For Sale: ½ K.W. 110 A.C. Transformer Coil with Electrolytic Interrupter, $8.50. J. Bernard Cecil, Anita, Iowa.

Bargain. Murdock, $15.00; Loose Coupler, $10.00; Detectagraph, 5 Ohms Headset, $2.50; High Frequency, $16.00; Transformer primery 14 inches diameter, sacrifice, $7.50; Audion Bulb round, $5.00, etc., etc. All slightly used, guaranteed. What have you to exchange? Cortes, 502 West 141st Street, New York City.

Books

Books Worth While. Circulars for stamp. Joel Tillberg, Proctor, Vermont.

Radio Amateurs—Easy Lessons in Wireless, Vest Pocket size, Gilt edges. Only Fifty cents. Order yours early. Stratton Electric Company, 215 Federal St., Greenfield, Mass.

Nature Laws, every married and engaged person should know, 45c (no stamps). Central Company, 599 Ninth Ave., New York.

Books. Practical Mechanical, Auto, Aviation, Home Study Books. Easy payments. Send dime "to-night" for catalogs. Amsco, Department G., Aurora, Illinois.

Cameras, Supplies—Photo Developing.

Roll Film Developed 6c. Prints 2c up. Send for price-list. The Blad Photo System, Wareham, Mass.

(Continued on page 151)

Construction of an Audion "B" Storage Battery

(*Continued from page* 117)

may be tested by putting a 110-volt lamp across them and it will be lighted brightly. My rectifier and "B" battery together cost me about $5.50 and this is very reasonable, considering that there are no renewals of material, etc., after it is once constructed. If any trouble is experienced in the building or operation of this battery just write me and I will tell you anything that you want to know about it. I had never seen a successful one before, and so I had to work this out by myself.

We have heard many advocates speak at length on the use of variometers for tuning purposes; it is strange, however, to note that the Navy standard receiving apparatus is absolutely void of such apparatus, and likewise practically every commercial station either ashore or aboard ship. There must be some objection to its use or otherwise we would expect to see more of these instruments employed in commercial stations.

Do you remember the old days when NAR was sent in good old plain fashioned Morse and his signals rolled along like the trinkling of lead shot on your roof—those were the days—doesn't it give you the chills down your back to think of it? To-day we have the highly efficient 500-cycle transmitters with their woman-like voices, but practically all the romance is sacrificed in the bargain. Don't you think so?

IF'S.

If magnet chokes coil, will lightning arrester?

If potential is high, will a step down transformer?

If the switch is open, will the spark jump?

If the current lags, will the battery booster?

If the solenoid is a sucker, will the current breaker?

If the commutator sparks, will the fuse blow it out?

If the cable reels, will the copper conductor?

If ohms offer resistance, will the street car controller?

PRECAUTIONS.

Never leave the Ohm sifter uncovered.

Always keep the brushes of a frequency regulator set midway between the pole pieces.

Always put shellac upon your detector point, it makes it about twice as sensitive.

The best receiving results are obtained with the aerial switch open.

Always run your rotary gap backwards, the frequency is doubled.

Strikes us they are peddling booze somewhere. EDITOR.

Contributed by F. V. Bremer.

It is very necessary that every operator endeavor to make his ships call letters as clear as possible, especially during a period when another ship is in distress, so that no unnecessary confusion sets in. Seconds mean lives during these times—and it will be remembered that during the time the S.S. Marowijne was missing the S.S. Creole was mistaken for the Marowijne simply because the operator had a "drag," and instead of signing his call letters "KKR" he made them "KDR." Immediately everyone on the lookout for the KDR broke in and called widly only to receive no response.

What the Entire Amateur Radio-World Has Been Awaiting

A WIRELESS TELEPHONE

that plugs into a lamp socket, at a price you can afford. A genuine DE FOREST UNDAMPED WAVE RADIOPHONE (and telegraph) OPERATING DIRECT FROM YOUR 60 CYCLE 110 VOLT HOUSE CURRENT. NO MOTOR GENERATOR REQUIRED. *JUST PLUG IN AND TALK—SIMPLICITY ITSELF.*

A greater invention than wireless telegraphy. Absolutely silent in operation. Troubleproof, foolproof and *only one adjustment required* after which the instrument "stays right." Couldn't possibly be simpler to operate. Practically simultaneous transmission and reception by means of electrically operated relay transfer switch. Marvellous, snappy clear speech. Voice quality superior to that over a wire. Absolutely stable in operation. Utmost selectivity. No decrement. The panel is divided into three divisions—rectifier, filter and oscillator. The rectifier employs two bulbs thus taking advantage of both halves of the cycle. The filter of inductances and capacities smooths out the ripple, freeing the speech from distortion. The oscillator of four tubes comprises a new circuit of high efficiency both in power output and modulation.

Tested Ranges { Telephone 10 to 20 miles / Telegraph 50 to 75 miles } Depending upon aerial height and terrain.

Our actual experience with this set indicates that these ranges can be greatly exceeded.

PRICE COMPLETE INCLUDING BULBS, $200.00
SPECIAL RATES FOR RADIO CLUBS

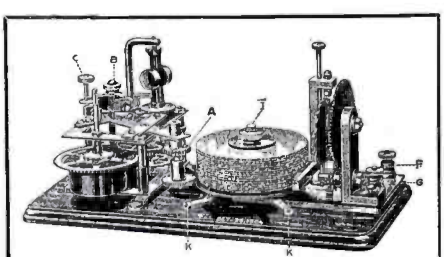
You will eventually use this type of transmitter, now recognized as the most efficient of all low-power systems—so why not now? Order immediately to insure early delivery.

DE FOREST RADIO TELEPHONE & TELEGRAPH COMPANY
1397 SEDGWICK AVENUE, NEW YORK CITY

LEARN THE CODE WITH THE OMNIGRAPH

The Omnigraph Automatic Transmitter

will teach you both the Wireless and the Morse Codes, *at home, in half the usual time,* and at the least possible expense. The *Omnigraph* connected with your Buzzer, or with Buzzer and Head Phones, or with Sounder, will send you unlimited Wireless or Morse Code messages by the hour, and at any speed you desire.



We offer the *Omnigraph* as a positive success and with the strongest of endorsements. It is used by the U. S. Gov't. in testing all applicants applying for a Radio license. It is also in general use by a large number of the leading Universities, Colleges and Telegraph Schools throughout the Country.

If you are a beginner, it will make you an operator in the shortest possible time.

If you are already an operator, the Omnigraph will make you a better one.

Send for free catalog describing 3 different models—$9.00 to $23.00—or order direct through your electrical dealer. We sell the *Omnigraph* with the guarantee that you must be satisfied or your money back for the asking.

THE OMNIGRAPH MFG. CO., 39F Cortlandt St., New York

How did you learn to talk? By listening. JUST LISTEN,—THE OMNIGRAPH WILL DO THE TEACHING