November, 1920 25 Cents

# The WIRELESS AGE



Volume 8 Number 2

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Vol. 8 Contents of **The Wireless Age** for Nov. 1920 No. 2

Edited by J. ANDREW WHITE



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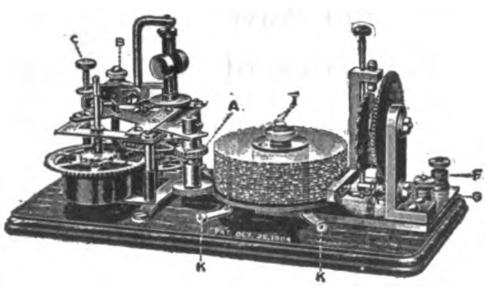

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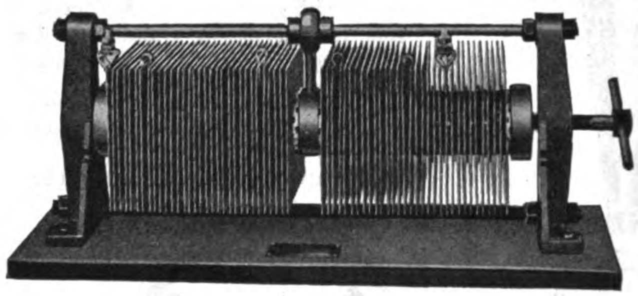

# The Plain Truth About the Amrad Quenched Gap

*Q.—What are the advantages of a good quenched gap?*

*A.*—Briefly, the quenched gap causes the transmitter to radiate maximum energy on a single wave length reducing interference and increasing range. Furthermore, the quenched gap is practically silent in operation even when operating at full power.

*Q.—Does not a quenched gap operate best with 500 cycle current?*

*A.*—No. Frequency does not affect the efficiency of the gap itself. In the case of 200 meter operation 60 cycle current is much more desirable since the slower period permits a saturated condenser charge before each train of oscillation takes place.

*Q.—Is it possible to obtain a good spark note with 60 cycle current?*

*A.*—Yes. A clear, rythmical note of either 60 cycles or 120 cycles frequency may be obtained by adjusting the number of gaps in circuit and the value of resistance in series with the a.c. transformer primary.

*Q.—Why do some Amrad Quenched Gap sets produce a "mushy," uneven note?*

*A.*—Because the operator uses insufficient resistance in the primary power circuit. This causes the spark to "arc" in the gap, producing a "mushy" note. There is an Amrad Resistance made for each size gap and when these resistances are used a clear, firm, spark tone is easily obtained.

*Q.—Will the Amrad Quenched Gap increase my radiation?*

*A.*—Yes, tho in most cases the hot wire ammeter will show a lower reading. Antenna currents are not continuous but intermittent and, when using the Amrad Quenched Gap, comparatively long intervals exist between each antenna oscillation. The hot wire cools during these intervals and consequently the ammeter gives a false reading. Hot wire ammeters should be employed only for indicating resonance. They cannot indicate the actual antenna current.

*Q.—Is the Amrad Quenched Gap liable to wear out or break?*

*A.*—No. The instrument as received will endure long usage if operated according to directions. However, the smallest part is standardized and may be replaced at moderate cost. The gap gaskets, standard thruout all models, should be renewed occasionally to preserve the original efficiency of the instrument.

*Q.—Is any special knowledge required to operate the Amrad Quenched Gap successfully?*

*A.*—No. In fact, knowledge and experience with other types of Gaps have often proven a handicap. Explicit directions contained in Bulletin Q-1 accompany every Amrad Gap. This Bulletin will be sent free to any interested radio man on request, likewise Bulletin Q, which describes each type of Amrad Quenched Gap and Adjustable Resistance.

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With our present factory facilities we have therefore been compelled to hold up putting our proposition and our apparatus in the hands of dealers throughout the country.

As we had promised the Amateur and Experimenter that, at least from one source, he should be able to obtain real apparatus, we have arranged to remedy the above conditions by expanding our present plant and factory facilities to approximately four times their present size.

On October first we take over a factory building at 66-68 & 70 York Street, Jersey City, New Jersey, which is almost as handy as our present location at the lower end of Manhattan, and which will provide four times as much space. Soon thereafter we will be able to take care of the Amateur and Experimenter as well as our ever increasing Governmental and Commercial work.

The above information is given merely by way of explanation as to why it is so hard to buy "Wicony" apparatus at the present time.

WIRELESS IMPROVEMENT COMPANY, Inc.
R. E. Thompson,
Vice President & Gen. Mgr.

Vol. 8 No. 2. NOVEMBER, 1920

THE WIRELESS AGE

# WORLD WIDE WIRELESS

## Radio Steers Ship

TESTS of radio control installation on the old battleship Iowa, just concluded off the Virginia capes, were declared to have fulfilled the highest expectations of naval experts. The 12,000-ton battleship was navigated with precise accuracy solely by means of radio waves, emanating from a control station on the battleship Ohio. The control was found thoroughly efficient up to a maximum distance of ten or twelve miles.

Plans are being made to use the Iowa in target practice for the Atlantic fleet. It will be the first time in naval history that a battleship moving at full speed has been used as a practice target. Guns of all bores and calibres will cut loose on the old sea fighter, which will be given a fair chance, however, of smoke screens and other simulated battle conditions.

## Washington Radio Conference

AMERICAN experts conversant with various phases of the problem of national and international communications have been summoned for consultation with Government officials preliminary to the International Communications Conference at Washington next month. In addition to Admiral Benson, who, as one of the American commissioners to the conference will represent both the Navy and the Shipping Board, Admiral Bullard, Director of Naval Communications, and his aide, Capt. Bryant, have been asked to advise the American commissioners.

E. T. Chamberlain, Commissioner of the Bureau of Navigation, and C. E. Herring, Director of the Bureau of Foreign and Domestic Commerce, have been invited to represent the Department of Commerce. From the War Department, Major Gen. George O. Squier, Chief Signal Officer, who represented the United States at the International Radio Convention in London in 1912, has been delegated to act as an advisor to the American representatives.

## Marconi's Teacher Dies

THE death is announced from Bologna of Prof. Augusto Righo, aged 70. Senator Marconi was his pupil, and it was in his laboratory that Marconi began the study of Hertzian waves.

## Tuckerton Station to Be Enlarged

THE Tuckerton wireless station has been taken over by the Radio Corporation of America, and additions to the plant will be made which, it is said, will make it one of the largest wireless stations in the world.

The radio station recently communicated with the Island of Guam, over a distance of 9,000 miles.

## Canadian Marconi and G. E. Co. Affiliate

THE Marconi Wireless Telegraph Co. of Canada has become affiliated with the Canadian General Electric Co. and the president of the latter, Frederic Nicholls, becomes president, while Sir William Mackenzie and A. E. Dyment, of the Electric board, join the Marconi board. The affiliation improves the position of the Marconi company with respect to a number of the patent rights and manufacturing developments.

Col. Ceasear Bardelloni, who is to attend the interallied conference at Washington in reference to the extension of wireless telegraphy

## Airplane Radio Improved

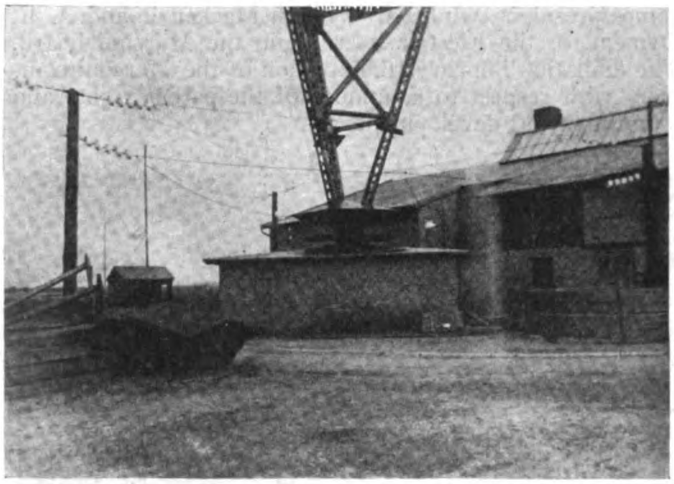
A REPORT has been received from the Commander, Air Detachment, U. S. Atlantic Fleet, that the installation of distant control for ignition systems has practically eliminated all ignition noises, both on the trailing antenna for receiving and on the radio compass coil. This reduction of ignition noises permits intercommunication between planes in flight for distances up to 10 miles, using the skid fin antenna, whereas with the ordinary installation such communication is practically prohibited on skid fin antenna except when planes are flying in comparatively close formation.

### Marconi Pledges Radio Station to Fiume

GUGLIELMO MARCONI, visiting Fiume on his yacht Electra, was met at the landing by Gabriele d'Annunzio, the latter's legionaries, the city authorities and a great throng of cheering citizens, who later massed themselves in front of the Commander's palace and vociferously insisted that the visitor deliver an address.

Senator Marconi complied, and, speaking from the central balcony of the palace, announced his decision of donating to Fiume a powerful radio station capable of transmitting news great distances, so that the world might learn of what was going on in Fiume. The announcement was greeted with a tremendous demonstration.

Gabriele d'Annunzio, Commander at Fiume, has sent a wireless message in which recognition of the "Italian Regency of Quarnero," recently proclaimed by D'Annunzio, is asked from all the nations of the world, says an Exchange Telegraph despatch from Rome.



Foot of the tower of radio station at Eilvese near Hanover, Germany

### Radio Story of the S-5 Rescue

THE rescue of the S-5 takes its place with the immortal stories of the men who go down to sea in ships, the perils that surround them, the epic courage with which they bluff death and beat him.

When the steamer General Goethals sent out the SOS for the submerged and disabled submarine, S-5, the distress signal was picked up by David L. Moore, amateur operator of Farmington, Conn., who communicated it to the Boston Navy Yard. Immediately the word was passed along the coast and shortly thereafter boats from numerous points were hurrying to the rescue.

Such instances as this emphasize the importance of wireless. They are more impressive even than accounts of the wonderful service performed by radio in time of war. The picture of the entrapped sailors aboard the submarine depending on a message flashed without destination, on the chance of its being picked up, appeals to the imagination. So, too, does the result of that flash—the general alarm, the rush to put ship after ship to sea, the turning of dreadnaughts and steamers out of their courses, the exciting dashes toward the scene of the disaster.

Wireless has been responsible for the success of great military maneuvers; its messages have probably turned the tide in numerous battles. But it is when it is brought into play as it was off the Delaware Capes that the human mind best appreciates the miracle wrought when it was invented.

The terse, matter of fact sentences in which a radio dispatch from one of the rescue ships gives the official account of the accident, its cause and the details of the rescue is truly a masterpiece, a classic itself. Here it is:

"S-5 made quick dive for exercise 2 P. M., Wednesday. Large valve in air intake failed to close. Admitted large quantity of water to living spaces.

"Boat went to bottom in 165 feet of water. Got valve closed and expelled all water possible. Whereupon stern lifted barely out of water; bow on bottom, inclined down 60 degrees.

"Water ran into forward compartments. Storage batteries gave off strong chlorine fumes.

"Forward compartments vacated and sealed. Continued all possible efforts to expel water. No success. Chlorine also forced vacating control room, after which the thirty-eight officers and men crowded into two small machinery spaces aft and soon began to suffer from bad air.

"Finding stern just clear of water, Lieutenant Commander Cooke and crew began drilling through with small hand drills.

"Very slow work. Could only work two minutes at a time, bad air.

"At 3 P. M. Thursday, S. S. Alanthus saw submarine, came close, attention attracted by calling and waving through small hole by now through submarine. Made fast and hung to submarine until relieved Friday morning, no tools. Could not enlarge hole, but saved lives whole crew by pumping air in with small water pump.

"S. S. General Goethals next arrived. Her chief engineer clung to submarine stern. Worked small hand drill for eight hours. Splendid work.

"Finally got hole large enough at 3 A. M. Friday and all officers and crew escaped without permanent injury. All suffering from thirty-seven hours' bad air. Some temporarily incapacitated. The captain and some others soon revived and began assisting in salvaging submarine.

"Naval vessels that started from Hampton Roads, Philadelphia, New York and New London began arriving early Friday morning. Ohio now attempting to tow S-5 inshore.

"Consider saving personnel was splendid feat. Slightest mistake after accident on part of officers would have resulted in loss of some on board."

None of the naval vessels for which the Goethals wirelessed reached the scene of the accident until several hours after the men had been rescued. The destroyer Breckinridge came alongside the Goethals, and within an hour or so after that half a dozen destroyers arrived and the battleship Ohio was reported on the way to tow the submarine. The submarine's crew was also transferred to the Ohio.

### Hidden German Radio Sets Discovered

A COMPLETE wireless apparatus which was anchored in twenty fathoms of water off Melleha Bay, with the mast and working parts below the surface to a depth of about eight fathoms, has been discovered by a party of Maltese fishermen. The apparatus, which was subsequently removed by the dockyard authorities for examination, is of German construction and is complete in every detail.

Undoubtedly signaling went on regularly during the war with submarines lying in wait for British vessels, it being quite possible to sink the mast before the operations were detected.

---

A post-war thrill was given the crew and passengers of the Peruvian steamship Eten on her trip from South America when a German wireless set of the telephone type, capable of a radius of one thousand miles, was discovered secreted in a water tank in cabin 28. An investigation is to be made by the Navy Department.

The Eten was, before the war, the German steamship Rahja Kootis and was interned during the period of hostilities in a Peruvian port. Her German crew remained aboard and it is thought the wireless telephone set was installed after the Peruvian Government had disabled her wireless.

### League of Nations Assembly to Use Radio

AN extensive wireless service will be established at Geneva for the first meeting of the Assembly of the League of Nations, which is to be held in November. Three stations during the session will be in daily communication with Paris, Lyons, Prague, Moscow, Budapest, Nauen and Berlin.

### Radio Device Prevents "Listening In"

SUCCESSFUL demonstrations of a new wireless invention which marks a step towards the secrecy of wireless telephone and telegraph messages, have taken place in Great Britain, and Marconi is at present conducting further tests at sea in his yacht Electra with a view to its wider application.

Details of the invention are secret, but it may be stated that an apparatus has been devised which, by what experts call an "electrical method of concentration," propagates the electric wireless wave in a "beam" in any desired direction and in that direction only.

Hitherto the electrical waves sent out from wireless stations have spread out in all directions and all who "listened in" could hear. The new invention will mark the end of the wireless "eavesdropper." When it is perfected a wireless station will be able to send out Morse or spoken messages which will be heard only by those for whom they are intended.

The new apparatus which is being worked at an experimental station in Great Britain with a short wave length, has recently been demonstrated by a number of experts who expressed the greatest interest in the discovery.

It is known that German wireless research has been lately directed to this problem of the "eavesdropper," for the Germans realized that we were able to pick up with our listening sets much valuable information about Zeppelin movements during the war.

### International Radio and Wire Conventions to Be Amalgamated

BY the contemplated proposal of the American Commissioners to the International Communications Conference, which will be held at Washington this month, to amalgamate into a single bureau the international radio and telegraph conventions, the United States may for the first time become a party to an international telegraph agreement.

Presidents Carlton of the Western Union and Merrill of the Postal Telegraph Company have recently presented vigorous objections to the proposed plan. They were understood to take the ground that it would tend to promote government ownership of telegraph lines in the United States, because, it was contended, the telegraph convention would be aimed in the interest of government-owned lines in other countries.

The American commissioners, it is understood, have overcome these objections, arguing that the convention to be adopted would be general in character and aimed merely at the facilitation of international communication.

### Radio Controlled Air Torpedo

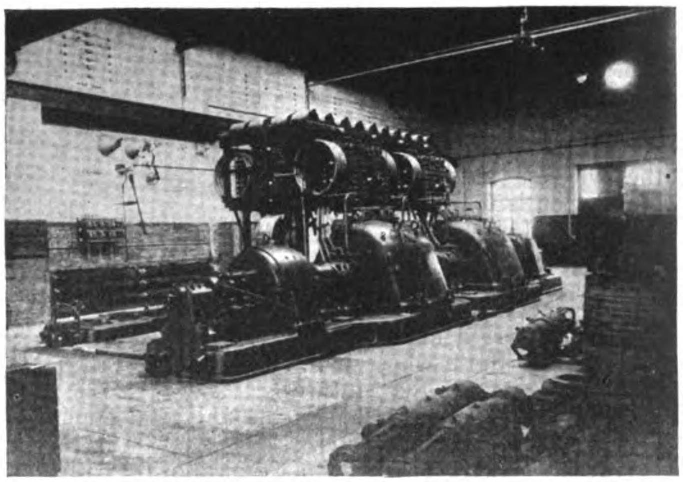
AN aerial torpedo which can be controlled thousands of miles away has been invented by Charles S. Price, a British mechanical engineer.

Carrying no crew, but under absolute control to any distance at which wireless is effective, the torpedo can be used for exploration, observation or carrying mails, it is claimed. It actually has been used by the British War Office during hostilities for bombing purposes.

The machine makes photographs, and the inventor declares he has practically completed an invention by which the efforts of the bombing raid can be recorded at home simultaneously with the raid itself, which may take place thousands of miles away. Mr. Price said:

"The torpedo can travel from 165 to 200 miles an hour, and I can tell at any moment just where it is.

"The Germans called it the devil's airship. A German who was a butler in England in 1915 offered me on behalf of the German Government $5,000,000 for the secret. He was locked up in the Tower of London as a spy."



View of the high-frequency generators at the Eilvese station, Germany

Mr. Price declares he can steer the torpedo to New York or any other part of the world from wireless stations in Great Britain.

### Nauen Station Dedicated

THE completed wireless sending station at Nauen, Germany, was officially dedicated Sept. 29, in the presence of an invited company, including Ellis Loring Dresel, the United States Commissioner to Berlin. Other members of the American Mission also were present, as were representatives of a number of other countries, American and English newspapermen and German officials and scientists.

President Ebert, who spoke at the function, after congratulating the German makers of the plant on their skill and ingenuity, sent broadcast a message opening the new service.

The towers and antennae which serve America, just completed, have a sending radius of 12,000 miles and a capacity of 75 words per minute.

The presence of Mr. Dresel attracted much attention and he was continually being photographed by Germans while he was making his tour of the plant.

Wireless communication between Buenos Aires and Nauen, Germany, was inaugurated with the transmission of a message from Nauen saluting President Irigoyen.

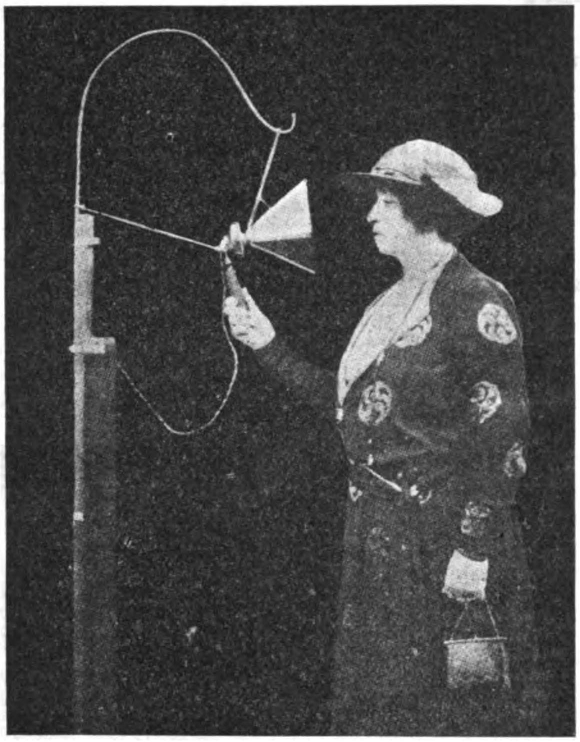
The foregoing message was sent from Nauen direct by the wireless system.

# A Newspaper's Use of the Radio Phone

## Some Epochal Achievement of the Present and a Forecast of the Future

A NEW era in journalism opens with the advent of the wireless equipped reporter. Twenty-one years have gone by since the first radio reportorial feat was accomplished during the international yacht races off Sandy Hook; scarcely as many days have elapsed since the modern method was revealed in reporting the last contests from destroyer, blimp and aeroplane. But still another step is to be recorded. This time it is an achievement belonging to the other side of the Atlantic and behind it is a personality.

Emphasis on the human equation in this instance is in accordance with the best traditions of the art, for the advancement and expansion of the wireless method of communication is largely due to its attraction for men of vision. Radio's chief charm has always lain in its unrealized possibilities, and in no other art or science is there a more certain welcome for those whose habit of looking into the future presages some forward step in the universal application of ether-wave communication.

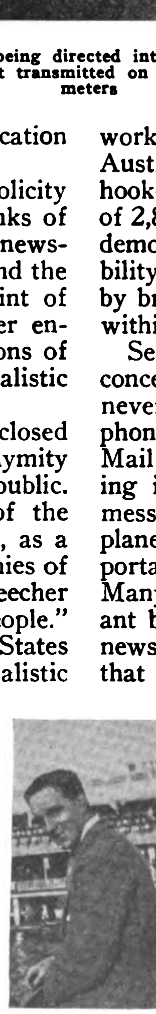


The voice of Melba being directed into a microphone, hooked up with a 15 kw. set transmitted on a wave length of 2,800 meters

Novel, yet characteristic, if not typical of the catholicity of professions and vocations represented in the ranks of wireless enthusiasts is the welcome acquisition of a newsgatherer in the person of Tom Clarke, of London and the world, a newcomer in the field who from his point of vantage as news editor of a great daily newspaper envisioned and put to the test some unique applications of wireless as a means of the extension of journalistic achievement.

Mr. Clarke recently visited America and thus disclosed the man that was hidden behind the cloak of anonymity which shelters the editors of newspapers from the public. His post is the important one of news editor of the London Daily Mail. He functions, one might say, as a Dean of Public Intelligence, guiding the news destinies of one of those daily journals that Henry Ward Beecher liked to call "schoolmasters of the common people." Scattered rumors had trickled into the United States that the London Daily Mail was doing things journalistic in wireless, prior to the advent of Mr. Clarke on these shores, and it was becoming definitely known that Lord Northcliffe, owner of this paper, also The Times, and a string of others, thought enough of radio to have his principal London newspapers equipped with receiving sets of the latest type. Nothing was definitely known, however, of the painstaking "try-out" of wireless in its relation to modern news gathering.

Mr. Clarke made some pertinent observations on this question during a special interview for THE WIRELESS AGE.



Mr. Tom Clarke, news editor of the London Daily Mail

"There are some distinctly new conceptions of wireless," he said, enthusiastically, "but better to gauge the possibilities let me tell you what we have been doing in London.

"First of all, I want no credit for what has been done: I am merely a cog in the wheel that revolves about the very genuine personal interest in wireless taken by Lord Northcliffe, who, you may be interested to know, has a receiving set of his own in his office in The London Times. It is entirely due to him, too, that The Daily Mail was the first British newspaper to install a permanent receiving station in its building.

"Last June, we undertook to awaken the British public to a popular interest in wireless, just as once before The Daily Mail stirred the national imagination to realize the vital importance of flying. The initial step was the broadcasting of a concert by the famous singer, Nellie Melba, her voice being heard not only by the amateurs of Great Britain, but in the wireless stations of Paris, Berlin, the Hague, Madrid and in Sweden. The transmission was effected from the chelmsford works of the Marconi Company, the beautiful voice of the Australian Nightingale being directed into a microphone, hooked up with a 15 kw. set transmitting on a wave length of 2,800 meters. The complete success of this experiment demonstrated to everyone's satisfaction the entire feasibility of the plan of our newspaper to do a public service by bringing the practical utility and economy of wireless within the familiar knowledge of our people."

Several weeks priod to the date of the Melba radio concert a test was made without prior publicity that nevertheless was of great significance. A reporter telephoned by wireless from Chelmsford direct to The Daily Mail office several news messages for publication, ushering in a new era in daily newspaper reporting. One message dealt with the successful conclusion of an aeroplane test at Chelmsford and the other reported an important ruling of the court as to motor car licenses. Many representative journalists, recognizing the important bearing of the experiment on future transmission of news were present in the newspaper office and agreed that the radio speech was clear and infinitely better than news telephoned over the wires by other reporters.

There were other tests, but the one that specially challenged the admiration of Mr. Clarke was made in mid-summer's adverse atmosphere.

"To my mind, as a journalist," he said, "and from a newspaper standpoint, the outstanding dramatic fact in wireless achievement of the present year occurred on July, 23rd, when we summoned one of our reporters to the Daily Mail Office while he was traveling on a suburban train speed ing toward Dover.

"He carried a small portable receiving set, designed by Marconi engineers. The aerial was worn under his waistcoat, the receiving instrument being in a small despatch case.

"The reporter—incidentally he was Harold Pemberton, son of Max Pemberton, the famous author—was merely told to 'lose himself' anywhere he liked. He was instructed to carry the wireless apparatus in case he should be wanted at the office. Having had no previous experience with the modern radiophone he was not a little skeptical, and decided that in any event that on a railroad train, with the conflicting noises of whistling engines and the echoes of tunnels and embankments, it would be impossible to hear over an ordinary telephone with any distinctness.

"He afterwards told me that he was as greatly astonished as his fellow passengers in the small and noisy compartment when the railroad carriage became filled with music. One of the passengers asked pointedly for an explanation; voicing the opinion that Mr. Pemberton was a traveling representative for a new kind of gramaphone, with a sample concealed somewhere in the despatch case. Then, suddenly, the music ceased and a voice said: 'Is Mr. Pemberton there?'

"Instinctively he replied, 'I am here,' forgetting that he had no means of return communication. Then this message came from the news editor, via Chelmsford:

> You are wanted at The Daily Mail Office at once. Have inquired at your house, and they do not know your whereabouts. On receipt of this message please communicate as soon as possible with The Daily Mail office. Good-bye.

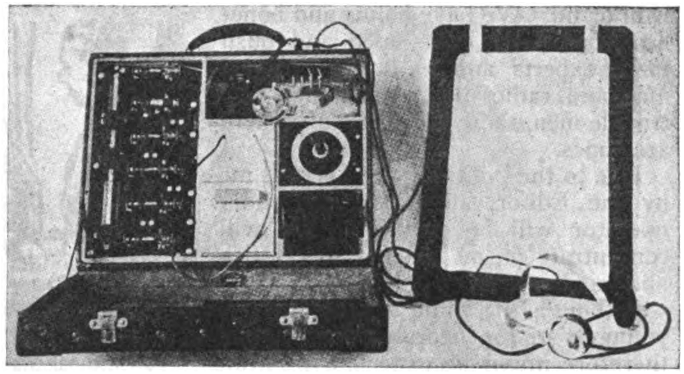
"At that moment the train was traveling at a good speed and was about forty or fifty miles from the transmitting station. At the next stop he left the train, 'phoned through to our office and was instructed to return by the next train, as we had important work for him to do; and in due course he arrived back at Carmelite House."

Mr. Clarke added that this achievement caused good humored consternation among members of the reporting staff of all the London newspapers. Said one journalist to him: "Where is it going to end? It looks as though the day is near at hand when, as you engage a new reporter you will hand him his wireless set, allot him his personal wavelength and have him at your call at all times and places!"

With the incident that occasioned the remark in mind, and knowledge of the recent great improvements made in portable receivers, the journalist's observation seems less a prophecy than a prediction. The type of despatch case set used by Mr. Pemberton is illustrated in the accompanying photograph, examination of which will indicate that this instrument has all the advantages of bigger and less convenient apparatus. The loop aerial measures 13½ x 16½ inches, containing 50 turns of No. 20 wire. The receiver case, measuring 13½ x 17½ x 8 inches, is about half the size of the ordinary suitcase and weighs no more than this style of traveling bag. Six vacuum tubes are in the circuit, the four bottom tubes, shown in the illustration, amplifying in four stages the currents from the transformer. The tube next to the tap acts as a rectifier, and the topmost tube magnifies the rectified signals in the telephone circuit.

The full possibilities of radio communication with this type of equipment are still a long way from realization. As Mr. Clarke observed: "It requires but little imagination to visualize the day when any man will be able to carry a personal transmitting set along with the receiver. And it is but a short technical step to arrange for a bell calling device for such portable apparatus, doing away with the necessity for continuous listening-in." He added also that the police in more than one country had displayed great interest in the portable radiophone tests conducted by the newspaper.

"What the future holds," he continued, "is illustrated in the fact that the lead set by the Daily Mail in developing the application of wireless to daily journalism has been taken up in other quarters. Our Manchester office, as well as our London headquarters, has now been fitted



**The receiver carried by the wireless equipped reporter, contained in a despatch case and hooked up with a frame aerial worn under the waistcoat**

up with receiving equipment and other newspapers have followed suit. A few weeks ago the Press Association, which serves all our English newspapers from its central office in London, conducted for a fortnight highly successful experiments in the distribution of news by wireless, although everything of course is still in the test stage.

"Wireless is still a new idea for the vast majority, and the pain of assimilation of a new idea is proverbial. It is therefore most unfortunate that the technical ahievements in radio are far ahead of the legislation on the subject. We must get the laws—national and international—in step with this revolution in inter-communication.

"In the last few years journalists have specially noted the great part wireless has played in speeding up diplomacy. Formerly it required days to get an exchange of notes when two or more nations were in dispute. Now it seems but a matter of hours—as witness the rapidity of diplomatic exchanges between Moscow and Warsaw, Paris and London. This is a matter of major importance to the world. The quicker you can talk to the man you are quarreling with, the quicker you will come to a peaceful understanding.

"And as a final thought," he concluded, "the indications are that the chief value of wireless to newspapers will be in long-distance foreign work. Sometimes in my day-dreams I see every national newspaper with its own receiving set, picking up from the ether the world's news as it is sent out from the world's capital.

"But, first of all, the problems of administration and control must be worked out. These are beyond my province; but solved or not, in the very near future we shall see great and startling developments in the collection and distribution of news by wireless."

# Seasonable Styles in Operators

**By George F. Patrick**

GENTLEMEN, we have with us the radio operator, a generic term, this, meaning anyone who separates an employer from increment by poking down a brass key all day, without an iota of success in making it stay down.

There are many kinds of operators: the incipient, the coming, the full bloom, the ripe, the limburger, and the common or garden variety known to the trade as the ham or lid. We have bonus and bonehead operators, press men and bush men, experts and ex-bums, railroad men and radio men, traffic men and trouble men, there are chiefs and there are supes.

The average radio man is not an expert; he admits that too, there are other people in the world who have him skinned, but you can be dad-blamed sure that he is the backbone of this radio game

Due to the limited space allowed me by the Editor, all except the radio operator will be excused. We will concentrate on an attempt to classify and catalog him.

Although the radio operator is the youngest of the operator family, and therefore might be expected to be an improvement over the 1890 model, he retains all the family features. In addition, he has developed individual traits that are in turn both disconcerting and maddening. These are due in some measure to the difference in operating on a wire and operating on a ship.

That last paragraph seems somehow to carry the implication that the operator in one class operates while balancing himself on a wire. Although the sigs sound like it in some cases, this is not the thought I intended to express. I had more in mind that there is not so much difference between operating on a wire and maintaining one's balance on some ships we know of. Or, to put it on a basis of universal application, the operator ashore has a trouble gang to maintain the apparatus and lines and keep them in repair; the operator aboard ship must hunt his own trouble and make his own repairs in order to keep going until he arrives in port.

To do this properly, a little knowledge of electricity and the laws governing its use is required. The most expert telegrapher, if his knowledge of electrial apparatus is confined to relays and sounders, would rate a cipher until his ship reached port, should the motor field open. He would not understand the actions of his motor nor where to look for the trouble. Obviously, therefore, it is necessary that the radio operator know more than the characters comprising the code.

Every radio operator realizes this, but for occult reasons there are some who go along blithe and carefree, wholly innocent of elementary knowledge of the workings of various parts of their sets.

I recall one case where an operator, who had been in the game several years, came into port and made requisition for a new motor field rheostat. He claimed that his was burned out and beyond repair, because no matter how he cranked it the speed of the motor did not vary. I wasted no time in argument. Down I went with him to the ship, where in a jiffy I located and removed the ground which had the perfectly good rheostat shunted out of circuit. With any knowledge whatever of motors he would have been able to understand the trouble and not have laid it to the rheostat. Had he been located at an isolated station it would have meant the trouble and the expense of sending him a new rheostat.

Another operator—this one held a special grade license—wrote up a lengthy report of how badly his motor generator was grounded. He stated that it was impossible to work on the motor brushes while the machine was running without standing on a piece of board or something insulated from the steel deck. The lighting system of the ship was the one wire and ground return system. Can you beat it?

Another reported that one end of his motor generator ran very hot and he had been able to run it only a few minutes at a time throughout the entire trip. Had he glanced at the bearing as I did later, he would have seen the chip of wood holding the oil ring from turning.

There was another fellow who found that the circuit breakers kept opening when he tried to start up. So he procured a small line and tied them in, then closed the switch and went looking for the trouble. He was able to find his way back to the switch through the smoke before the circuit opened, but he couldn't camouflage the dripping wires and the scorched paint.

With these few instances we dissolve the picture on this class, commonly known as the Opaque Operator.

We now examine another species; the ones who don't know, and don't want to know.

This type reasons that it is the repair man's job to keep the outfit in shape, not his. A breakdown is welcomed; it means less work for the rest of the trip. It is a fact that the repair man prefers this operator to the one who goes blundering about with a cold chisel and hammer seeking the trouble. But he is persona non grata with the traffic manager, who classifies him as the Irreducible Minimum.

Then there is the opposite type, the pink cheeked, fuzzy faced child, who has scientists, inventors and designers outdistanced. He is running alone and far ahead of the world, so what does it matter to him that his set was designed and put together by highly trained and high salaried men of long experience. They are wrong; he has been tinkering at radio for nearly two years now, and has the dope by the tail with a downhill pull. This kind of operator, if not the most dangerous, is at least the most expensive for the company. The repair man reserves for him a special brand of hate and fear. This young genius is never satisfied with his set: he must rearrange connections, cut, slash, short circuit and shunt, take out, put in, and throw away. He knows more about how to handle storage batteries than the combined authorities of the world and proves it by either ruining or putting in a very precarious condition a fifteen hundred dollar battery . . . a mere trifle. I recall one of these birds who told me that the treatment which the Edison people recommended for their batteries was all wrong; he had handled them long enough to find that out. His association with Edison batteries had been for less than a year's duration at the time. Mr. Hutchinson, of the Edison Company, will probably never know what a wealth of information is lost to him by not having this prodigy in his laboratories.

The outsider cannot appreciate the strange results of giving to a number of operators the same instructions regarding the care of batteries; hardly any two will follow them in the same way. Even where the instructions are attached to the battery in printed form, the interpretation, or at least the execution, varies widely. This may be due to a defective interpretation of perfectly clear English, it may be just carelessness or laziness; it may be a desire to prove that the maker is wrong and does not know his own product; or it may be due to an idea that some one is trying to kid them and to reasoning which runs: "This gink says you must put in enough water to keep the plates covered. I think that's bunk. What difference does it make if a half inch of the solution is gone when there is still a gallon or more left?" For this class of operator, this super-dreadnought, we vote a ticket labeled, The Expert. Now we come to the exasperating class composed of those who neglect to report trouble until a complete breakdown results. They make work for the repair man and expense for the company. A little attention would have saved both had the trouble been reported when it first appeared. The company carries the repair man on the payroll for just that purpose, and it is intended that troubles should not be forgotten but written up in the log at the time when first noticed, the report to be made when the ship gets in. A brief entry may reveal the beginning of a nasty breakdown and a big job later on.

One illustrative case in my experience concerns a man who had just been made first operator on a ship. Severe sparking developed at the commutator; it continued and became worse during the trip in spite of much sandpapering and shifting of the brushes. The matter was not logged or reported, and a transfer of operators took place about sailing day which put another operator on the ship. He, too, fought the commutator during the whole of his trip, with the sparking steadily becoming worse. By the time he returned the commutator was in such condition that there was nothing to do but turn

The pink cheeked, fuzzy-faced child, who has scientists, inventors and designers outdistanced

it down. Upon taking out the armature I discovered one of the brushes broken in two pieces where the brush-holder hid the break. This was the cause of it all. The first operator, fearing to create an unfavorable impression, evidently didn't want to report the trouble and admit he was unable to find it, since it was his first trip as operator in charge. Had he reported the matter we could have smoothed down the commutator without removing it from the machine, but at the end of the second trip it was so badly burned and pitted that it required turning down, thus causing extra work and expense.

In another case the operator failed to report his bridge telephone working poorly. The dry cells for this telephone were located in the wall set on the bridge and had run down; the matter was not reported and later on the cells became leaky. One of them rested on one of the wires leading to the transmitter and this wire corroded off, leaving the insulation intact. Upon discovering that the telephone was not working and after putting in new cells it took considerable time to locate the trouble. Had a report been made when the telephone began to work poorly it would have been a matter of five minutes' work to replace the dry cells with new ones.

There are some who go along blithe and carefree, wholly innocent of elementary knowledge of their apparatus

Numerous receiver troubles go unreported in this way until the receiver almost ceases to function. A poor switch or post contact, a broken or loose wire, may make the signals come and go, and aside from the annoyance on the ship, it causes much calling and repeating by shore stations crowded for time, to say nothing of the interference and delay to others in the vicinity. The member of this "sufficient unto the day is the evil thereof" class is best termed the Good Waiter.

Then there are the Accumulators; those operators who regard time spent in keeping the radio cabin and operating table clean and in order, as time wasted. Always distributed about the room, on the floor, hung on the switchboard, or draped over a chair, are newspapers, magazines, shirts, underclothes, tools, mandolins, guitars, banjos, wire, and assorted sizes and shapes of what-nots, while the table top accumulates dust, pencil shavings, pipes, cigarette ends, burnt matches, and miscellaneous collar buttons, laundry checks, photographs, theatre programs and medicine bottles. It must have been such a cabin scene which inspired the writing of the Battle of the Winds. Nothing changes this habit but a course in matrimony.

And just as there are differences among operators in method of handling and caring for apparatus, so are there many different styles of operating or telegraphing. There is, first, the Beginner, whose familiarity with the code has not progressed beyond bowing acquaintance, and who must pause now and then to count the number of dots and dashes in a character. Scarcity of operating personnel at hand and a big demand is responsible for the fact that they obtain licenses and employment. It is true that everyone must make a beginning, but the logical place is in a class or school; it is pretty tough on the rest of the gang to turn such ones loose and alone on a ship to leave a trail of rage and profanity behind them as they stutter and stumble their uncertain way from port to port. The Boy Scout movement is a good thing, and generally endorsed; but it should not disrupt organized business.

Next we have the operator who likes to hear himself send, sometimes called the Marathoner. He is utterly unable to comprehend the fact that he is expected to come in and state what he has to say concisely and then subside; he makes lengthy calls, goes into windy explanations, gets half way through a sentence then goes back and starts over again. After the burden of his lay has been analyzed his thesis of eighty or one hundred words, you discover perhaps, that he wishes to repeat the message. One word, "repeat," or "again," would have been sufficient, or better still, QTA, three letters. The fact that the whistle blew, the detector knocked out, or he had to stop writing to pursue, capture, and kill a fly which was bothering him, is of no moment to you or the half-dozen others who are standing by, waiting. He is the type who wants to know the identity of everyone he hears and all about him, he is the QRA hound, and ranks low in the animal kingdom, both in the opinion of those whom he QRAs, and those with whom he interferes. If we could have a tape record of the matter sent by one of these sea lawyers on an average trip, it would probably show a total of 30,000 or 40,000 words sent, and actual business handled of about 300 words.

These radiating operators cost the companies money and prestige. Since depreciation of apparatus must be figured out of profits, all useless sending is a drain on the dividends. The steamship companies, who furnish the reason for the existence of ship apparatus departments of radio companies expect prompt and efficient service for their money; any delay, any failure, any mutilation of their business certainly reflects on the radio company. Then, too, down in the engine room is an engineer who must make as good a showing as he can for the precious coal given him; he watches with apprehension the meters on the radio circuit, and he is sure to complain, and probably exaggerate, the cost of the radio to his company. A silent prayer goes up to the air brake, non-skid operator.

We have, too, the Ultra Heavy Sender, the one who makes long dots and short dashes. An ouija board is required when copying this party of the low frequency wrist as he lingers lovingly over his square dots. These are sawmill artists misplaced.

The just-as-bad opposite of this type are the Brownings. They put a bug attachment on the key, move the weight to the extreme limit, and give a correct imitation of a machine gun. But we are not yet ready to work bonus from ship to shore, and there is no necessity for them leaving jobs on fast wires to go to sea for, ahem, one-fourth of shore pay. Perhaps they find consolation in our appreciation of the sacrifice they are making in staying with us and teaching us something about the game.

One more class of fraternity brother deserves mention: The Long Distance Bug, forever working long distances and giving it wide publicity. He is a Big Bertha operator. It is with great difficulty that the members of this clan succeed in handling business a paltry 300 miles; 2,000 miles is a cinch, but offer traffic at 200 miles—the distance is too short; it is very hard to make them hear. These are walkers, who omitted learning to creep.

And last, but far from least, we have the good old Average Radio Man, interested in his work, keeping posted and up to date by reading the various radio publications, striving to get the most out of his set, willing to listen to advice, and to try and keep things tidy and clean. He is loyal to his company, he takes a pride in his set and its performance; he has a head which he uses in the handling of business, and he acknowledges that the only reason he works at radio is to make a living and keep from starving to death. He has no $400 job waiting ashore for him any day he wants to take it; he admits that. He is not an expert; he admits that too; there are other people in the world who have him skinned, but you can be dad-blamed sure that he is the backbone of this radio game, and the thing that holds it together. May his tribe increase!

# Universal, Honeycomb and Lattice Coils

**By O. C. Roos,**
Fellow I. R. E.

(*Continued from October* Wireless Age)

### Synopsis of Fourth Instalment

Formulas; selection of 12 coil-problems for mechanical design and comparison of windings; comparison of "cross-step" and "cross-spiral" design factors.

### General Definitions

$p=P/2$ is the radius of winding pin (see figure 33) (12A)

$$\sin G_u=\frac{W+P}{K};\ \sin G_{um}=\frac{W+P}{K_m} \qquad (13A)$$

### General Relations

$$K=\sqrt{(w+P)^2+l_{asu}}. \qquad (17B)$$

$$K=l_{asu}\csc G_u. \qquad (18B)$$

$$\theta=\sin^{-1}\frac{(P+D)}{K}=\sin^{-1}\frac{(P+D)}{\sqrt{(w+P^2)+l^2_{asu}}}. \qquad (19B)$$

### Resultant Formulas

$$\phi=\theta+G_u. \qquad (20B)$$

L=stretch of wire between "following" pins.

$$=K_m\cos\theta+(P+D)\,\phi_m. \qquad (4C)$$

$F_u$=length of wire in handwound (semi-manual) coil.

$$=30\ my\ L/s. \qquad (5C)$$

M=required distance between adjacent winding pins in outer level of semi-manual wound coils—see figure 33—$l_{avu}$

$$=(P+D)\csc\phi;\ \text{sometimes written } M_e. \qquad (6C)$$

### Special Formula, All Coils

$LL_b$=Approximate length of sinoidal wire in basket-layer (advance travels 360°)

$$=\frac{360\ my}{s\ l_{as}}\int_0^{l_{as}}\sqrt{l^2_{as}+\pi^2 w^2\cos^2\frac{\pi x}{l_{as}}}\,.dx \qquad (7C)$$

$$s=\frac{180m}{ma-1}. \qquad (8C)$$

$$H_q=\frac{360}{s_q N}\ \text{where there are N-wire spirals.} \qquad (9C)$$

$$h_{xN}=h_x/N\ \text{for N-wire step-lattices.} \qquad (10C)$$

$$h_z=h_N/z\ \text{for z-lattice single-wire coils.} \qquad (11C)$$

$$l_{avu}=\frac{(P+D)K^2_e}{(P+W)\sqrt{K^2_e-(P+W)^2}+(P+D)\sqrt{K^2_e-(P+D)^2}} \qquad (12C)$$

Below is a tabulation of given and required Design Factors for 12 coils arranged in sets, with variations in same given factors in every set.

FIRST SET—GIVEN s, t, D, $d_1$, H

| Coil | S | t | D | $d_1$ | H | $k_m$ | $G_m$ | M | w | y | F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I G | 186° | 1″ | .05″ | 4″ | .1″ | | | | | | |
| R | | | | | | 8.25″ | 10.5° | 30 | 1.5″ | 10 | 400 |
| II G | 186° | 1.5″ | .05″ | 4″ | .1″ | | | | | | |
| R | | | | | | 9.08″ | 9.5° | 30 | 1.5″ | 15 | 596 |
| III G | 186° | 1.5″ | .05″ | 60″ | .1″ | | | | | | |
| R | | | | | | 100″ | .83° | 30 | 1.5″ | 15 | 6642 |
| IV G | 186° | 4.5″ | .1″ | 60″ | .3″ | | | | | | |
| R | | | | | | 105″ | 25° | 30 | 4.5″ | 3 | 1490 |

Under every coil, in the factor columns, there are an upper and lower space for entry of data. The upper "G" is for given data, the lower "R" for evaluated data.

When $2s > 360°$, we obtain the value of m by dividing 360° by v instead of 2s by v.

### COIL I

To get $k_m$ we have from equation 1B: $d_m = d_1 + t = 5''$, and from equations 3A and 4A: $x = \frac{180}{v} = \frac{180}{12} = 15$, and from 8B: $w = Hx = 1.5''$.

$y = t/2D = 10$ layers from 11A.

From 11B we get

$k_m = \sqrt{w^2 + 76x10^{-6}\ d^2\ s^2} = 8.25$

$G = 10.5°$

$n = my$ from 9A=300 turns and from 1C

F=414 feet of wire on coil.

From the equation 7A the axial spacing-ratio c, is equal to 2. This is fair, but could be improved by use of a smaller wire since the spacing H is fixed.

The design factor $\frac{d}{w} = 2.67$ which is fair and $\frac{t}{w} = .67$.

### COIL II

We will improve this design by increasing t to 1.5″.

Sin G is about .165 and G is now 9.5° instead of 10.5°. We have n=450 turns.

The length of wire according to formula 2C is not in the ratio of the layers; i. e., 1.5 times 400 turns or 600 turns; as the decrease in sec G from 1.02 to 1.01 brings this to about 99 per cent of that result of 596 feet.

### COIL III

Change $d_1$ to 60 inches. This is an impractical case electrically except for ranges above 20,000 meters, as it contains 450 turns.

The average cross-step $k_m$ is 105 inches and the average swing-angle $G_m$ with same thickness, t=1.5″ as before, is only 50 minutes.

From formula 2-C $F = 3.14\ my\ d_m \sec G_m$ we can neglect the effect of sec $G_m$, as it is practically unity; i. e., the coil winding is almost perfectly efficient in producing inductance. The amount of wire used is about 11.2 times that on coil II, from the ratio of their $d_m$, or 6642 feet approximately with 450 total turns as before.

### COIL IV

We will use insulated flexible wire HD=.3″ and D=.1″. Hence c=3, for this coil. Everything else will be given as in Coil III, except that the number of layers, y, will be cut down so as to make 3y=3 layers of 30 turns each. These layers are to measure a depth t=w=4.5″. One layer is 2D or .6″ deep, hence the ratio r of layer separation, b, to diameter of wire is 5; or between layers is placed a dielectric equal to a thickness of 3 levels or diameters of wire. This makes a strong cross-section, mechanically, compared to a shallow winding.

We have $d_m = 64.5$; n=90; $k_m = 105''$; G=2.5″ approximately. This coil is practical for the very longest waves now coming into use.

It is interesting to consider again the general design formula derived from equation 5B: $2msa - 2s = 360mz$. This is a Diophantine equation and depends on constants "a" and "z" not necessarily given in the problem.

If z=1 we have

$$s = \frac{180m}{ma - 1} \qquad (8C)$$

This shows two things clearly:

1st—That the swing is a function of the turns per "layer," m, except that

2nd—with many turns per layer the swing is independent of this factor; for in this case

$s = \frac{180}{a}$ approximately.

SECOND SET—3 COILS—TABULATED DATA

| Coil | $d_m$ | a | t | m | w | D | s | v | $G_m$ | $h_m$ | n | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V G | 5″ | 2 | 1″ | 10 | 1″ | .05″ | | | | | | |
| R | | | | | | | 94 14/19° | 18 18/19° | 13.5° | .19+″ | 100 | 135′ |
| VI G | 5″ | 3 | 1″ | 10 | 1″ | .05″ | | | | | | |
| R | | | | | | | 62 20/29° | 12 12/29° | 18° | .19—″ | 100 | 139′ |
| VII G | 5″ | 5 | 1″ | 10 | 1″ | .05″ | | | | | | |
| R | | | | | | | 36 36/49° | 7 17/49° | 32° | .17″ | 100 | 153′ |

### COIL V

Assume: w=1″; $d_m = 5''$; t=1″; m=10; D=.05″.

From equation 8C we have $\frac{2s}{m} = 2sa - 360$ or

$$(10a - 1)s = 1800 \qquad (8C)$$

Now, since a must be, under all circumstances, a whole number, we will assume a trial value:

a=2

$\therefore s = 94\frac{14°}{19}$

$2s = p = 189\frac{9°}{19}$

The advance $v = 18\frac{18°}{19}$

By trial v is found to go exactly into the pitch.

We can also conveniently design a pattern for a lattice by assuming the advance as a submultiple of the circumference, as is done in figures 22 and 23, taking care that this submultiple is also a submultiple of the pitch, e. g., taking $\frac{360}{19}$ as the advance we may select a pitch $\frac{360m}{19}$ as a multiple of v. The value of "a" is conditioned by the fact that a multiple of the pitch, such as $\frac{360mz}{19}$ where z is, of course, a whole number must differ from 360 degrees or a multiple there of exactly by v the amount of the angular advance, e. g., when m=4 and z=5.

These exceedingly mixed numbers for s, m and v are very inconvenient to handle but are seemingly inevitable; as "m" and "a" must be a whole number in equation 8-C.

We greatly simplify the arithmetical work if we calculate $G_m$ from $d_m$ by deriving $k_m$ as before from $d_m$. This assumes, as true for all practical purposes when $G < 15°$, that $G_m$ and $k_m$ increase proportionally to $d_m$. This is allowable as $G_m$ here equals 13.5 degrees.

The mean separation of wires, $h_m$, as shown in figure

28C, is given by equation 7B and F, the length of wire by equation 1-C as 142 feet approximately.

In coil VI we will keep m constant, but change s and v. In other words, when s or v are not given, there is another semi-independent factor to be added to the five usually given to determine a coil. It is the factor a, in equation 8C, which factor must be a whole number. Here $s=62\frac{2°}{29}$ and $v=12\frac{12°}{29}$. The separation $h_m$ is smaller theoretically, but not noticeably so practically, compared with coil V. There is about two per cent more wire for same number of turns.

### Coil VII

In equation 8-C, specially applicable when m=10, let a=1. Then s=20, but v is zero.

Trying the value 5 for a, we get $s=36\frac{36°}{49}$; $v=7\frac{17°}{49}$; G=32° and the wire used is about 12 per cent more than in coil VI or 156 feet. This coil is poor, electrically.

### Third Set—Two Coils—Coil VIII

This is to be a Maxwell coil, with design ratios $\frac{t}{w}=1$; $\frac{d}{w}=4$. It is supposed to be used as a small loop and to have insulated flexible wire with large spacing factor, C.

Here $d_i=12''$; t=w=6"; D=.25"; m=10; a=2; hence the swing, advance, etc., as determined from equation 8C, are the same as for coil V.

$$s=94\frac{14°}{19};\ v=18\frac{18°}{19};\ H=\frac{2w}{m}=1.2'';\ c=4.8;\ y=6.$$

Hence b=1" and r=4. This means that the layers are separated by insulation of twice the depth of the external wire diameter. This may be air insulation. There are 60 turns, the mean separation $h_m$ is, HcosG= 1.2cos3.5°=1.2" and $d_m=18''$.

F=300 feet approximately, of wire.

Here there is ample spacing between adjacent wires on any level and between adjacent layers. The wire efficiency is high, the distributed capacity is low and the wire resistance can be made as low as desired in reason, by the large spacing factor c=4.8 used, permitting wide variation in size of wire, whether stranded or solid. It is easy in winding coils, to separate two layers, but not the two levels constituting any given layer.

### Third Set—Three Coils—Tabulated Data

| Coil | di | t | w | D | m | a | s | v | H | G | y | n | dm | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VIII G | 12" | 6" | 6" | .25" | 10 | 2 | | | | | | | | |
| VIII R | | | | | | | 94 14/19° | 18 18/19° | 1.2" | 3.5° | 6 | 60 | 18" | 300 |
| IX G | | | | .25" | 20 | 2 | | | 1." | | | 80 | 60" | |
| IX R | 56" | 4" | 6" | | | | 92 4/13° | 9 3/13° | | .7° | 4 | | | 1276 |

We have in coil VIII two previously untabulated design-ratios. First r=4 which is repeated in Coil IX. Second, C=2.4 which is 4.8 in coil VIII and coil IX. Therefore, H=CD=.6" and b=rD=1".

But $y=\frac{n}{m}=4$; hence t=4" and $d_i=d_m-t=.56''$.

Since $w=\frac{m}{2}H$ we have w=6", $1h_m=.6''$. The swing-angle G increases the wire length about 1% to 1280 feet approximately.

It should be noted that in general we get good values of s and v when $\frac{m}{a} > 10$ in equation 8-C.

### Fourth Set—Multi-Lattice Coil Design—Two Coils

#### Tabulated Data

| Coil | di | D | s | v | m | t | w | y | Hq | H | G | nt | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X G | .72" | .25" | 720° | | | | 30" | 2 | 3.75° | — | | | |
| X R | | | | 0 | — | 4" | | | | | 3.4" | 240 | 4920° |
| XI G | .72 | .1" | 186° | | | | 30" | 2 | | | | | |
| XI R | | | | 2.4° | 30 | 2" | | | — | .4 | 13.5" | 300 | 5950° |

Coil X is 4-wire, uni-lattice spiral-wound and coil XI is 5-wire, bi-lattice step-wound.

Coil X is just four separate coils or lattices started 90° apart. No lattice has any advance as its swing is an exact multiple of 360°.

Coil XI on the other hand has an advance which slips back half its own value at every "turn" in five separate circuits, simultaneously.

In Coil X we find that $H_q$, the smallest axial pitch= $\frac{360}{sN}$ where N is the number of separate spirals—four in this case. This is formula 9C.

From 9B, using $k_q$ for 720° and w=30" we get $k_q$= 243" and G=3.4°.

$n_t$=240 turns total, in all four windings and 4,920 feet of wire are used, allowing .3% increase on account of angle G. The average separation of adjacent wires is 3.65" approximately. The separation of wires belonging to same winding is four times this distance or 14.6". As these windings are put in series their distributed capacity, increases, but the inductance more than compensates for this increase. The ratio c therefore varies between 1.5 and 6 according to the way the four circuits are used. Figure 36 shows the schematic layout of one level, developed on a plane.

To get $k_q$ we use $s_q=720°$ in 15-B. The radial separation b=2" and the ratio $r=\frac{b}{D}=8$. Coil X is adaptable for loop reception work.

In Coil XI there is no problem involved except to start the five windings 2.4° apart and to jump them back every turn 1.2° on the last step. When G < 30° and v < 15° we may ignore the shortening of the last step on every turn if $l_{av}/k$ is less than 5%.

In a multi-lattice, multi-wire coil the axial separation $h_n$ for N wires is $\frac{H}{N}$.

Here $H=\frac{2w}{m}=\frac{60}{30}=2''$.

With five wires, N=5 and $H_N=.4''$.

But $G_m=15.5°$ whose cos=.97.

$\therefore h_m$ for 5 wires is .388".

For a bi-lattice coil $h''=\frac{h_m}{2}=.194''$.

Hence with D=.1"; c=1.9; let r=10, then b=rD=1" and t=by=2". This coil is rather flimsy, and while very efficient electrically, is not structurally sound.

It should be re-designed on the basis of coil IX.

The formulas $h_N=\frac{h_m}{N}$ (10C)

and $h_z=\frac{h_N}{z}$, etc. (11C)

are of importance in allowing for diameter of wire and insulation in multi-wire, multi-lattice coils.

*(To be continued)*

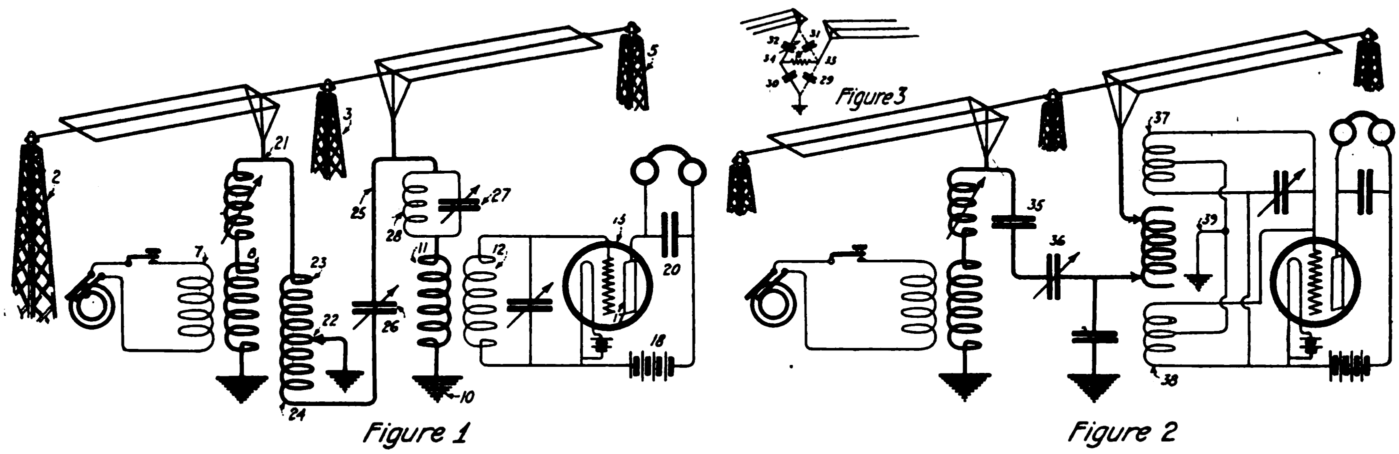
# An Improvement on the Duplex System

ERNST F. W. ALEXANDERSON has developed a means for neutralizing in the receiving apparatus, the effect of waves which are being transmitted from the same station.

Separate antennae are used for transmitting and receiving purposes. Both of these antennae may be suspended from the same towers in whole or in part, or may be located in fairly close proximity to each other upon separate towers. In order to overcome the effect in the receiving apparatus of the waves impressed upon the receiving antennae from the transmitting antenna Mr. Alexanderson derives by direct connection to the transmitting antenna, an electromotive force equal in value and opposite in direction to the potential induced upon the receiving antenna from the transmitting antenna and impresses the desired electromotive force upon the receiving circuit in such a manner as to neutralize in the receiving apparatus the effect of the induced potential.

20 which serves to by-pass the high frequency component of the current flowing in the circuit.

With the system thus far described, when signals are being transmitted, potentials of such magnitude will be induced in the receiving antenna that the received signals will be unintelligible even though the two sets of signals may differ considerably in frequency. To overcome this difficulty a shunt connection to the transmitting antenna is provided from the point 21 to earth at 22 through the inductance 23. The inductance 24 is coupled to inductance 23 in such a way that the potential induced therein is equal and opposite to that induced from transmitting antenna upon the receiving antenna. The potential thus obtained is impressed upon the receiving antenna by means of the connection wire 25, a variable condenser 26 being included in the circuit for tuning it to the frequency of the transmitting current. The two opposing potentials thus neutralize each other and as a result the receiving




**Figures 1, 2, 3—Circuit diagrams of the improved duplex system using Wheatstone bridge principle**

This will best be understood by reference to the following description taken in connection with the accompanying drawing.

Figure 1 indicates a transmitting antenna supported upon towers 2 and 3. A receiving antenna which is insulated from the transmitting antenna is supported upon towers 3 and 5. The receiving antenna may be supported upon the towers 2 and 3, or may be supported independently of either of these towers, but in close enough proximity to the transmitting antenna so that both antennae may be readily connected to the operating station. The transmitting antenna may be supplied with signaling current from a high frequency alternator coupled thereto by means of the coils 7 and 8. The tuning of this antenna may be accomplished by means of the usual variable inductance. The signaling current may be controlled in any desired way for transmitting either telegraphic or telephonic signals. In case it is desired to transmit telegraphic signals, a key may be inserted in series with the alternator and coil 7, as indicated in the drawing. The receiving antenna is connected to earth at 10 through the coil 11 which is coupled to the coil 12 in the receiving circuit of the electron discharge device 13 which may serve as an amplifier and detector for the signals which it is desired to receive. The receiving circuit comprises the cathode of the device, the grid and a variable condenser for tuning the circuit to the frequency of the waves to be received. The detector circuit comprises the cathode, anode 17, a battery 18 for supplying the operating current, and the usual telephone receivers, these receivers being shunted by the condenser

apparatus will not be affected by the waves transmitted from the transmitting antenna. If any difficulty is experienced in adjusting the neutralizing circuit in such a way as to entirely overcome the effect of the transmitted waves a frequency trap consisting of a condenser 27 and inductance 28 may be inserted in the receiving circuit. If this frequency trap is tuned to the frequency of the waves transmitted, it will offer a high impedance to waves of that frequency and a much lower impedance to received waves which differ somewhat in frequency from the waves transmitted.

In figure 2 the neutralization of the induced potentials in the receiving antenna is accomplished by an arrangement of electrostatic condensers. The neutralization effect in this case is to the highest possible degree independent of the frequency and therefore a higher degree of neutralization is possible. The neutralization s also independent of fluctuations in the operation of the transmitting apparatus and the regulation of the system is simple. The operation of this system is based upon the Wheatstone bridge principle and will be best understood by reference to the diagram, figure 3. In this diagram the condenser 29 represents the capacity between the receiving aerial and ground. The corresponding capacity on the other side is the condenser 30 which is termed the "counterpoise" condenser. This is inserted in the ground connection of the receiving antenna as indicated in figure 2. The capacity of the receiving aerial is fixed by the antenna structure and the counterpoise condenser has a fixed capacity which is not changed during the operation of the system. The third arm of the bridge which is termed the "exposure capacity of the receiving aerial" comprises the natural capacity between the transmitting and receiving antennae, and is represented by the condenser 31. This capacity also is determined by the antenna structure and is substantially constant. To balance this exposure capacity a condenser 32 is employed, which is termed the "exposure capacity of the counterpoise." The condenser 32 is variable and by adjusting its capacity it is possible to balance the system in such a way that the points 33 and 34 at the ends of the receiving coil 11 are at equal potentials in so far as the transmitted waves are concerned. In this arrangement the potential across the capacity 31 represents the induced potential on the receiving antenna and the potential across condenser 32 is a potential derived directly from the transmitting antenna which is connected to the receiving coil 11 in such a way as to neutralize therein the effect of the potential across capacity 31. In actual practice it may be convenient to divide condenser 32 into two parts as indicated in figure 2, where 35 is a fixed capacity and 36 is a variable condenser by means of which the operator can easily balance the system.

While the potential due to the signal transmission is equal upon the two terminals of coil 11, it will be apparent from a consideration of figure 3 that both of these terminals have a considerable potential difference above ground. Some care is therefore necessary in designing the transformer of which coil 11 is the primary in order that the electrostatic influence between the primary and secondary winding of the transformer shall be well neutralized and balanced so that this electrostatic influence will not produce currents in the receiving apparatus. This is accomplished by constructing the secondary winding of two carefully balanced coils 37 and 38, connected in multiple, the middle point of the winding of each of these secondary coils being grounded at 39, as indicated.

# Hammond's Selective Transmitter

AN interesting method of transmitting signals so that they affect only the receiving stations they are intended for, is credited to John Hays Hammond, Jr.

Figure 1 shows a transmitting station, in diagrammatic form, with a movable inductance coil in one position. Figure 2 shows the same transmitting station with the inductance coil in another position.

In the figures, A is an antenna in circuit with an inductance coil L and grounded at E. A high-frequency alternating-current generator G is in circuit with an inductance coil L′ and the condenser C is in a shunt circuit. of the spring S, the coil L′ is rotated into its position of minimum mutual inductance with the coil L.

When in operation, the generator G is sending high-frequency alternating currents through the coil L′, but if the key K is open, so that the electro-magnet M is de-energized and the coil L is in its position of minimum effectiveness, as shown in figure 1, coil L′ will have little, if any, effect in inducing oscillations in the coil L and antenna circuit A L E, and there will be little, if any, radiation of electric waves from the antenna A. When, however, the key K is closed, so that electro-magnet M is ener-

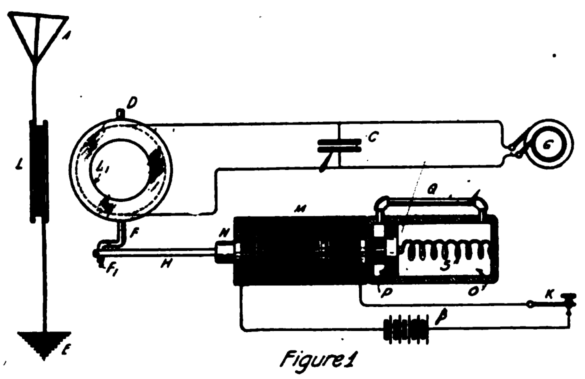



**Figure 1—Diagram of transmitting station with movable inductance coil in minimum position**

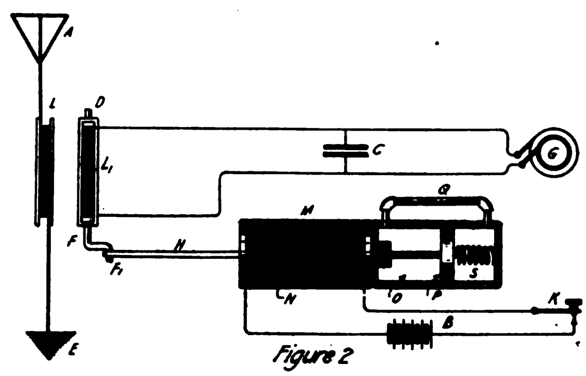



**Figure 2—Transmitting station with inductance coil in a maximum position**

The coil L′ is rotatable on the pivots D and E, so as to vary the mutual inductance between it and the coil L. In figure 1, coil L′ is shown in its position of minimum mutual inductance, and in figure 2 in its position of maximum mutual inductance with coil L. A key K closes and opens a circuit including the battery B and the electro-magnet M. In figure 1 key K is open, and in figure 2 it is closed.

The movable core or plunger N of the electro-magnet M is connected at one end by a rod to the piston P which travels in the cylinder O and is normally held near the left end of the cylinder by the compression spring S. The small pipe Q connects both ends of the cylinder O, and allows the air or other fluid in the cylinder to pass only slowly from one end to the other, so that the piston and the plunger N can travel only slowly in both directions. Attached to the other end of the plunger N is the rod H which is connected to a crank or bent arm F′ on the pivot F in such a way that as the plunger is drawn into the electro-magnet M, the coil L′ is rotated into its position of maximum mutual inductance with the coil L, and when the electro-magnet is de-energized and the plunger N moves away from the electro-magnet under the influence gized, plunger N drawn in, and coil L′ turned into its position of maximum effectiveness, as shown in figure 2, it will induce powerful oscillations in coil L and antenna circuit A L E, and electric waves will be strongly radiated from antenna A.

Owing to the dash-pot arrangement of piston P and cylinder O in connection with plunger N, the latter can move only slowly and the movement of the coil L′ will take place gradually preventing sharp makes and breaks in the trains of electric waves radiated from antenna A.

At a corresponding receiving station, which is not shown in the drawings, the receiving circuits are tuned to the wave length of the transmitting station, but the receiving apparatus will be actuated only when the coil L′ at the transmitting station is at or near its position of maximum mutual inductance with the coil L. When the key K is closed, this position is reached so gradually, in the manner already described, that the transmitted energy will likewise increase gradually and smoothly, so that there will be no sharp breaks or sparks which will affect apparatus at other receiving stations not closely in tune with the Hammond type of transmitting station.

# A New Arc Method for Continuous Waves

A NEW method of signaling with an arc transmitter has been developed by L. F. Fuller, who has brought out several improvements along this line.

One widely used form of signaling with continuous oscillations consists in varying the antenna inductance, either by short-circuiting a portion of the antenna loading coil or by short-circuiting a compensation helix arranged in the antenna circuit. This variation in inductance produces a variation in wave length and to produce a given percentage change in wave length, the antenna inductance must be changed a certain amount. The antenna current through the inductance changed sets up a certain voltage, which, multiplied by the antenna current, gives the kilo-volt-amperes to be handled by the key or relay of other signaling instrument. On account of practical considerations, the kilo-volt-amperes which can be handled by one pair of contacts is limited, and hence it has been necessary to employ a plurality of contacts. With the new Fuller method, the kilo-volt-amperes which can be successfully handled by one pair of contacts is greatly increased and consequently the number of contacts reduced to a minimum. This method also provides a system which makes the load on the key such that it can be successfully handled with air as the contact dielectric, instead of making the contact dielectric suit the load, for example, by immersion in oil to reduce sparking.

Referring to the drawings, figure 1 is a diagrammatic representation of a transmission system; figure 2, the new system when employed in very high powered stations. Figure 3 is a cross section of the lower turn of the inductance and the loop.

The load which can be handled with one pair of contacts is limited mainly by the voltage and not by the current, and by making the amperes high and the voltage low, a much greater load can be successfully handled by one pair of contacts. Heretofore, it has been the practice to employ a relay for opening and closing the short-circuit around the helix in the antenna circuit, and the relay was operated by a key in the local circuit. This necessitated insulating the local circuit from the high potential oscillating circuit, and also permitted the contacts to operate only with the antenna current instead of with a higher current value. Therefore, less kilo-volt-amperes could be handled by one pair of contacts, because the voltage was high, and the voltage across the contacts limits the kilo-volt-amperage to a very great extent. Mr. Fuller's invention is designed to overcome these difficulties, permitting only a low potential in the signaling circuit.

The ordinary and usual continuous oscillation transmission system has an arc 2, supplied with current from the generator 3. One side of the arc is grounded and the other side is connected to the antenna 4, through the variable inductance or loading coil 5. Instead of signaling by short-circuiting a portion of the inductance, 5, a circuit which may consist of one loop 6, is placed in inductive relation with the inductance, preferably in the lower turn. The loop 6 acts as the secondary of a step-down transformer, of which the coil 5 is the primary, and the voltage in the loop is much lower than in the coil. A relay or key, preferably a relay, 7, is arranged in the loop circuit and signaling is accomplished by opening and closing the relay.

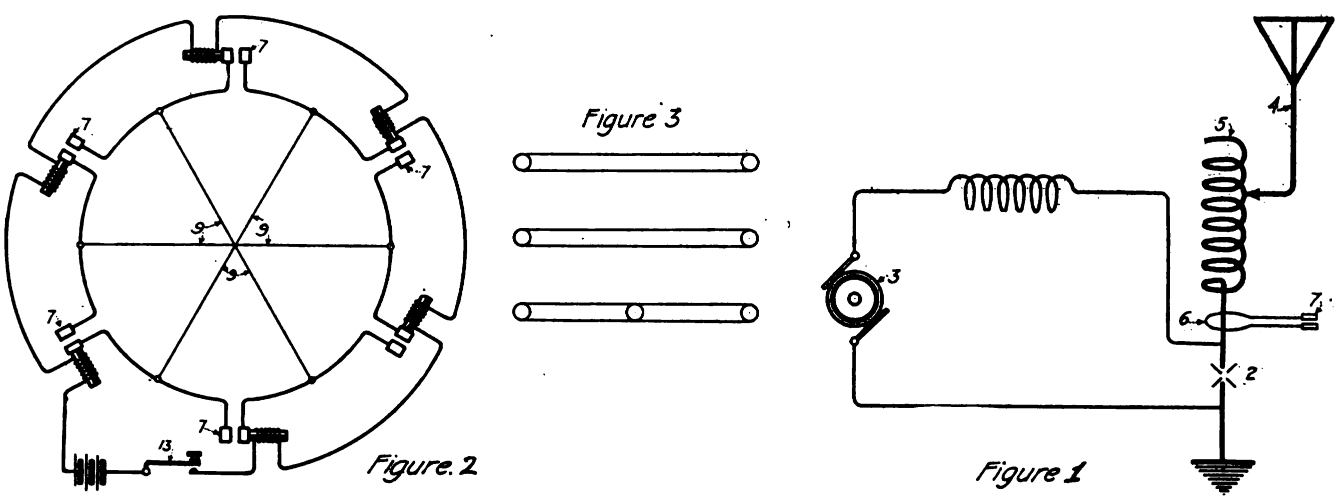



Figure 1—Diagram of transmitting system. Figure 2—System employed in high power stations. Figure 3—Cross section of the inductance and loop

In very high powered stations, where the antenna current may be, for instance, 300 amperes and the loop current 600 amperes, it is impractical to endeavor to control the loop current with one pair of contacts, because the loop-reactive voltage becomes too high, and under such conditions means are provided by Mr. Fuller for employing pairs of contacts so arranged that each pair handles a given load, regardless of whether the contacts are closed simultaneously or in succession. To produce this result, the loop is divided into a number of segments, preferably of equal length, by conductors 9 connected at one end to the loop at equally spaced points and connected together at the other ends. In each segment a relay 7 is inserted, the solenoids of the relays being connected in series in the local circuit, with the key 13. This arrangement equalizes the loads on the pairs of contacts, so that extremely large loads may be handled.

The loop 6 is axially alined with and of the same diameter as the inductance coil 5 and is spaced apart from the lower turn of the coil a sufficient distance to provide for ample insulation of the loop from the coil.

# A Selective Receiving System

DR. ALEXANDERSON is credited with devising a new system for receiving messages from a distant station at the same time that messages are being transmitted from a station near which the receiving apparatus is located.

A coil of wire is employed for receiving the waves coming from a distant station. This coil is located in a vertical plane passing through the distant station. This coil is connected in a circuit which is tuned to the frequency of the waves to be received. Under these conditions although a local station at or near which the receiving coil is located may be transmitting waves of a different frequency, enough energy may be received by the receiving coil to completely drown out the effect of the desired waves. To overcome this difficulty Alexanderson associates with the first coil a second coil which is located at substantially right angles to the first coil and connects this in a circuit which is tuned to the frequency of the waves transmitted from the local station. This coil will absorb energy of the local waves, preventing them from interfering with the reception of the desired waves in the receiving coil. This will best be understood by referring to the accompanying drawing.

The local transmitting station is indicated by the antenna tower 1 and the distant station from which messages are to be received by the antenna tower 2. The receiving coil 3 which comprises a number of turns of wire and of rectangular shape may be located in a plane passing through the distant station 2. This coil is connected in the tuned grid circuit of an electron discharge detector 4 comprising the usual filamentary cathode, anode, and grid inclosed in an exhausted receptacle. The grid circuit is tuned to the frequency of the waves to be received by means of the variable condenser 8.

The coil 3, will of course, be within the field of waves transmitted from station 1 and the energy from these waves received upon the coil may be so great as to entirely prevent the operation of the electron discharge device 4 for receiving the desired waves even though other tuned circuits for selecting the desired waves may be associated with the receiving apparatus. It has been found, however, that this effect may be entirely avoided by the use of a second coil which is so located as to receive energy from the local waves and is associated with the first coil in such a way as to screen it from the effect of the local waves or neutralize the effect of the waves in the receiving coil. The second coil 9 is located at a right angle to the coil 3 and the circuit on which the coil 9 is included, is tuned by means of inductance 10 and capacity 11 to the frequency of the waves transmitted from station 1. This coil will absorb energy from station 1 which comes within the field of coil 3 and prevent the setting up of undesirable currents in the receiving circuits. It thus becomes possible to transmit and receive messages simultaneously at a given point without locating the receiving apparatus at a distance from the transmitting apparatus.

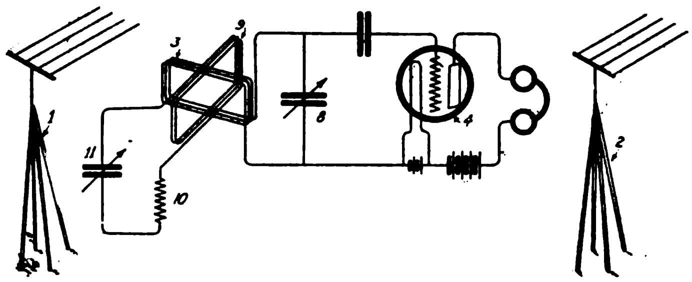


Figure 1—Diagram of the selective receiving system

# Heising's Modulation Method

THE following details are now available of the method employed by Raymond A. Heising for modulating the high frequency power used for wireless telegraphy or telephony:

In view of the extreme sensitivity of a generator electro-motive force to variations in the current of the field windings, it has been suggested that the signaling device be put in the field circuit, the current of which will be modulated in accordance with speech. Although the power used in the field windings is small compared to the output of the generator, it is still true that the power required for the field is excessively large for a telephone transmitter, and the impedance of the field coil is large compared to that of the usual modulator or signaling device, such as a microphone transmitter. It has been found desirable that they should be of about the same magnitude, or that the impedance of the modulator should be greater than that of the field coil. This is necessary in order to obtain efficient or complete modulation. In other words, it is necessary that the modulator shall be capable of absorbing as much power as the field coils. When a microphone is placed directly in the circuit of the field coil, the time constant is not ordinarily thereby reduced to a value which will prevent undue distortion of the modulating currents because of the low resistance of the microphone.

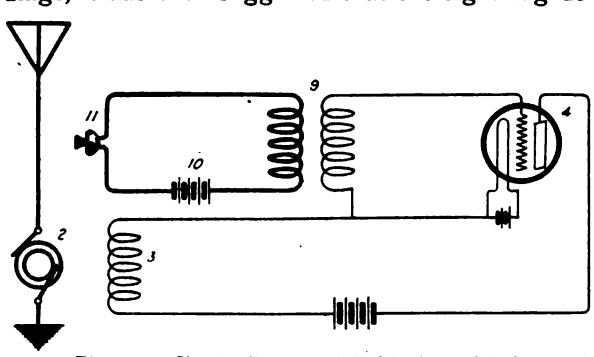


Figure 1—Circuit diagram of Heising's modulation method

According to Mr. Heising, these defects are overcome or greatly reduced by placing the field or energizing winding in circuit with a space discharge device, and properly proportioning its impedance with respect to that of the energizing winding. For maximum efficiency it has been found desirable to make the impedance of the space discharge device of the same order of magnitude as that of the field winding, as already explained. However, it may sometimes be desirable to provide a lower space discharge impedance in case the time constant is, for any reason, to be increased and in case maximum efficiency is not the primary consideration. If desired, the impedance of the space discharge device may be increased to a value greater than that of the field coil for the purpose of reducing the time constant of the field circuit. A space discharge device suitable for this purpose is one having a heated cathode and having the property of amplifying voltage variations impressed upon its input circuit.

Referring to the figure, an elevated antenna is in circuit with the high frequency generator 2 which is connected to the antenna on the one side, and to the earth on the other. Sustained oscillations will thus be radiated from the elevated antenna. The field winding 3 of the generator is connected in series to the output circuit of the thermionic space discharge device 4. This device, as here shown, is substantially the same as the vacuum tube which is now employed as an amplifier. Any known form of discharge device having an element by means of which the impedance of the discharge path may be varied may be employed. The grid circuit includes the secondary of the transformer 9, the primary of which contains the battery 10 and microphone transmitter 11.

The impedance of that part of the tube which is in circuit with the energizing winding of the generator is made of the proper value to give the desired results in accordance with the principles set forth.

The operation of the device is as follows: When speech or other signals are impressed upon the microphone the change of resistance in this circuit produces low frequency oscillations in the input circuit of the amplifier, thereby altering the potential of the grid in accordance with the signals to be transmitted. This alteration of the potential of the grid produces a corresponding change in the impedance of the amplifier, and the field current of the generator is therefore modulated in accordance with the signals impressed on the microphone. This modulated field current will impress corresponding modulations upon the high frequency power radiated from the antenna.

# Transmission of Electrical Energy

A NEW method of transmitting electrical power has been developed by Charles H. Roe, who proposes to transmit alternating current of operation value to a distant receiving station without the aid of wires or conductors. The principle employed is that of resonance in alternating current circuits where currents are propagated entirely by conduction, and it is claimed to be a departure from all methods employing electric, electro-magnetic or electro-static waves and methods in which currents are induced at a distance by electro-magnetic or electro-static fields.

In the drawing, an alternating current circuit in which the increased electromotive force is out of phase with the current is closed by connecting it at two separated points to the earth. This is shown in the diagram by an alternator A in series with condenser C and the terminals of the circuit grounded at two points $G_1$ and $G_2$ distant from each other. The current flowing has a wattless component and spreads out in all directions from the ground terminals $G_1$ and $G_2$ at the transmitting station as indicated by the dotted lines. Two grounded terminals $G_3$ and $G_4$ at a distance receiving station are connected to a receiving device, and lie in the path of some one line of current flow from the transmitting station; an electromotive force, even though very slight, is thus impressed upon the receiving circuit. A reactance introduced into the receiving circuit of said dimensions as to produce conditions of resonance will then cause whatever current that flows as a result of the electromotive force impressed at the ground terminals $G_3$ and $G_4$, to be in phase with the generator electromotive force, that is, of unity power factor, and it may be used to actuate electrical devices. This is represented in the diagram by a variable inductance L adjustable to counterbalance the capacity C at the transmitting station. The load R is shown in series with it, the terminals of the circuit being grounded at $G_3$ and $G_4$ in the same manner as those at the transmitting station.

In the figure there are two components of current flowing through the alternator A. One is almost ninety degrees behind the generated electromotive force, and circulates through the circuit A-C-$G_2$-$G_1$-A, the great angle of phase difference being due to the use of the reactance in series, as at C; this component is termed the wattless component. The other component is nearly in phase with the generated electromotive force and circulates through the circuit A-C-$G_2$-$G_4$-L-R-$G_3$-$G_2$-A. This component is termed the power component, the current and electromotive force being very nearly in phase because the separate tendencies of the two reactances L and C are in opposite directions and operate to neutralize each other. At the transmitting station, the wattless component may be kept very low by using sufficiently high reactance in series as at C; that is, the short circuit current through the ground between $G_1$ and $G_2$ or vice versa may be made very small and since even that is of a low power factor, the loss of power due to this feature may be maintained at a very low figure.

As to the circuit of power component: A non-reactive resistance in a circuit containing capacity and inductance in such proportions that

$$2(\pi) f L = \frac{1}{2(\pi) f C}$$

where $f$ is the frequency of the circuit in cycles, L is the inductance in henries, C is the capacity in farads, will be traversed by a current whose magnitude is determined only by the electromotive force impressed upon the non-reactive resistance and the value of the resistance itself; that is, ohm's law in its simplest form applies. In the circuit A-C-$G_2$-$G_4$-L-R-$G_3$-$G_1$-A, the two reactances L and C, being in series with each other, tend to neutralize each other and we have only the ohmic resistance of the circuit and of the load R to limit the amount of the current flowing. Accordingly, by keeping the ohmic resistance of the entire circuit low enough and so arranging the various parts of the system as to impress the highest possible electromotive force across the terminals of the load R, the power component of the current flowing through R may be many times, even thousands, greater than the wattless component through the ground between $G_1$ and $G_2$. Therefore, the efficiency of transmission will be very high.

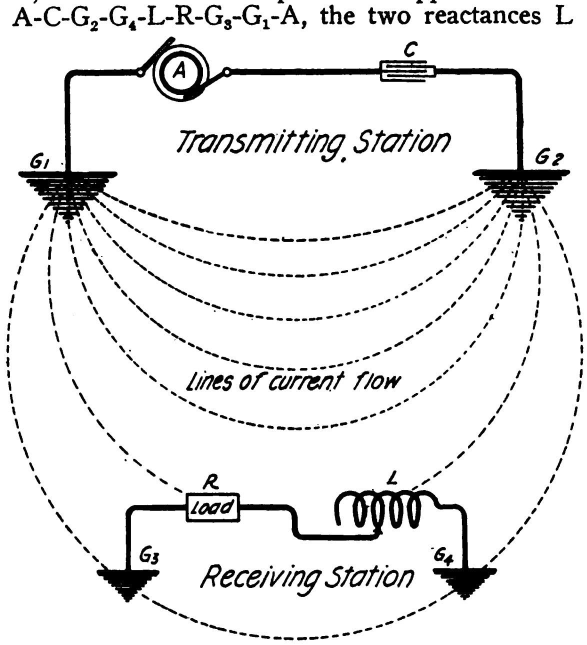


Figure 1—Diagram illustrating the method of transmitting electrical energy

# A New Coil Antenna

A NEW type of coil aerial has been developed by Ernst J. Berg, with the object of providing an inexpensive receiver capable of receiving signals from a desired direction, and excluding other signals and "strays."

As indicated in the drawing the apparatus comprises a coil 1 made up of a large number of turns of insulated wire. Within this coil and at right angles to the plane of the coil are placed a number of sheets of copper 2. These metal sheets are supported in a framework which is mounted upon the rotatable standard 5, having a handle upon its end whereby the entire structure may be rotated in a horizontal plane. The coil is shown as being supported directly by the copper sheets 2, but the turns of this coil may be mounted upon a separate form, the only essential feature of the construction being that it shall be positioned at a right angle to the copper sheets. The terminals 7 and 8 of the coil are connected to the grid and cathode of a vacuum tube. The telephone receiver is included in a circuit which comprises the cathode, anode, and a local battery. The telephone receivers are shunted by a condenser which serves as a by-path for the radio frequency component of the current flowing in the circuit. A variable condenser 16 serves to tune the receiving circuit to the frequency of the waves to be received and a condenser 17 in series with grid may be employed to assist the tube in its action as a detector.

The operation is as follows: If the signal which is to be received comes from a direction in the plane of the coil 1 there will at any given instant be a certain phase difference between the waves cutting the two sides of the coil. Because of this a resultant electromotive force will be set up in the coil, which electromotive force will be applied to the grid of the vacuum tube and will produce an indication in the telephone receiver. If a wave comes from a direction at right angles to the plane of the coil the waves cutting the two sides of the coil will always be in phase and no resultant electromotive force will be set up in the coil. It will be apparent that if the coil is rotated from a position where it is at right angles to the direction of the received waves, toward a position where it is parallel to their direction that an electromotive force will be produced in the coil, which increases in magnitude as the phase difference between the waves cutting the two sides of the coils increases, until the point is reached where this phase difference is greatest, and that this condition will occur when the coil is parallel to the direction of the received waves. Hence by rotating the coil until the point is reached where the received signals are strongest, it will be possible to determine with a considerable degree of accuracy, the direction from which the received signals come.

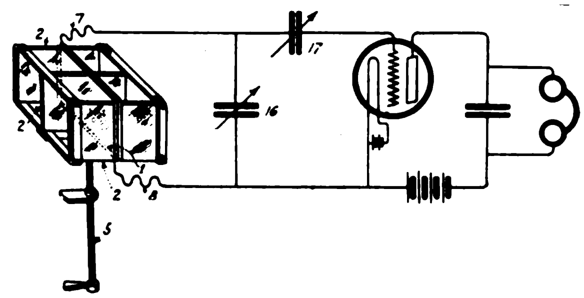


Figure 1—Diagram of apparatus and hookup of the coil antenna

The metal sheets 2 are in effect short circuited coils of low impedance, and in fact, if desired, may be replaced by actual coils of low impedance. Electro-magnetic waves coming from the desired direction will pass through these sheets without producing any currents therein, since they are at right angles to the direction of the waves and hence without any loss of energy. Signals or strays coming from other directions, however, will produce currents in these sheets. They will also, of course, tend to produce currents in coil 1. Because of the comparatively low impedance of coil 1 for any waves except those for which it is tuned, most of the energy of the undesirable waves will be dissipated in the sheets and their effect in the coil 1 will be so small, that it will not interfere with the reception of the desired waves.

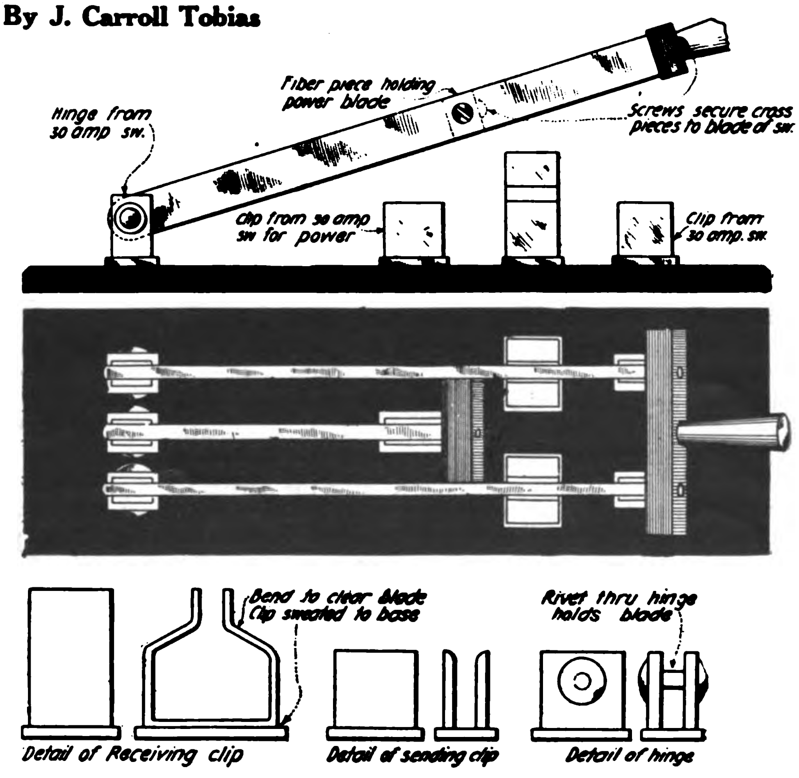
# A Serviceable Antenna Switch

**By J. Carroll Tobias**

THE parts in this antenna switch are all standard except the large clips and base which can be procured cheaply. In the illustration the top section represents a side view, the middle section shows a top view and the bottom section shows details of the receiving and sending c. p and the hinge.

Dimensions are omitted so that the builder can suit his inclinations and adapt the odd material he has on hand in his laboratory in constructing the switch. It must however, be designed so that there will be no sparking between the high tension blades and the power blade. The base in my switch consists of 3/4 inch Bakelite; the blades of 3/4 x 1/4 inch copper bar and the large clips of 3/4 x 1-16 inch copper bar. The throw to change from sending to receiving is 1 1/2 inches.

This design, if constructed carefully, will stand up against hard service and function properly when other switches fail.



# EXPERIMENTERS' WORLD

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

## A Swedish "Cash Register" Receiver

**By Ralph R. Batcher**

CABINET types of receiving sets have so long been accepted as the standard type for both commercial and amateur work in this country, that many radio operators are puzzled when it comes to manipulating equipment built in any other form. In some other countries, however, types are frequently seen that present many interesting ideas in mechanical and electrical features. A set that might be used as an example is the Swedish Telefunken "M-108" receiver, which is built in cash register style.

This seems to be a very efficient receiver in the hands of operators who are thoroughly familiar with it, but I have never made direct comparisons with this and a modern American receiver. Quantitative data on its tuning ability cannot be given.

The photograph shows the receiver as it ordinarily appears. On one side is a crank similar to the crank on a magneto telephone or on a phonograph. On the other side is a lever (not shown) that can be thrown upward engaging with the antenna leads to act as a lightning switch when the set is not in use. The front view presents an appearance somewhat like a cash register. A curved rubber sheet, semi-cylindrical in form, is mounted with its axis horizontal, to enclose the tuning inductances.

Figure 2 shows the circuit found in this set, in simplified form. Figure 3 is the circuit in another set that is more complicated since it is provided with a double tuning circuit.

The most interesting feature of this circuit is the method of varying the inductance of the antenna circuit. It is an inductance coil, or rather, a series of inductance coils wound on five concentric cylinders. The ends of each coil are brought out separately to a special double contact switch (figure 5). When the switch is rotated the first arm makes contact with the switch point, and other studs mounted on an insulated disc engage with two or more of the respective coil terminals after the switch has reached the second position. This switch is shown mounted at the top of the receiver in figure 1. The inductance is thus varied by steps, and the unused coils are not connected in the circuit.

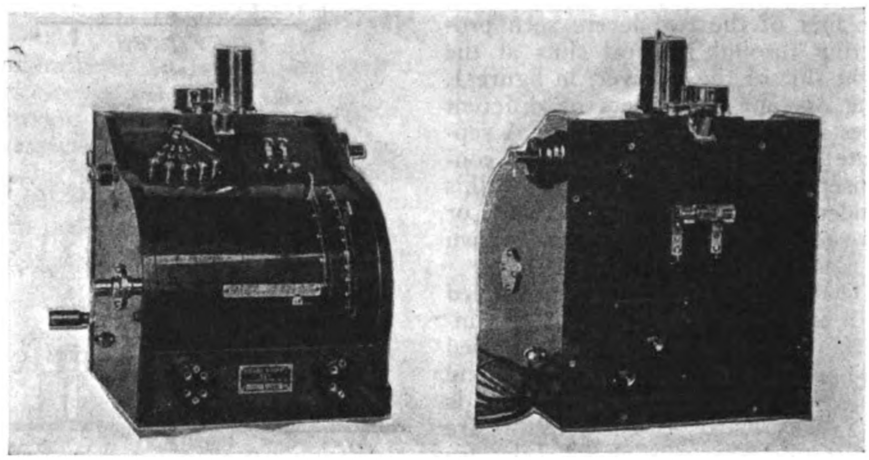
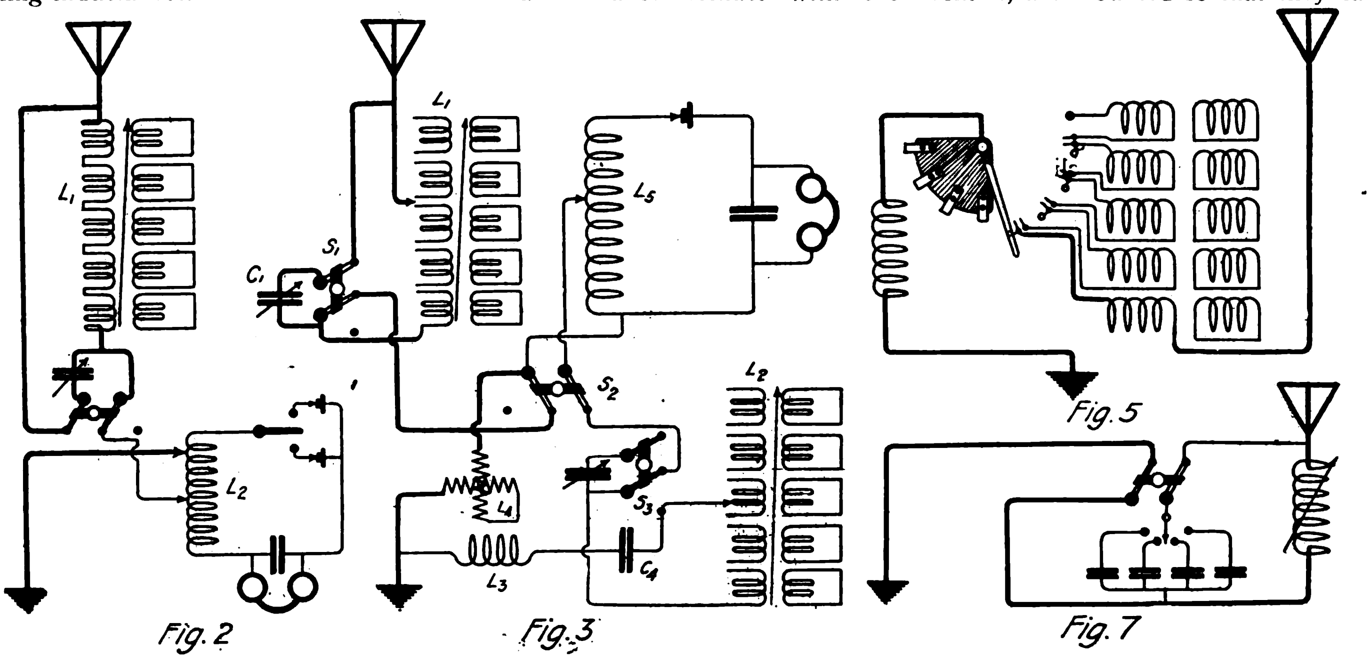


Figure 1—Front and rear view of the cash register receiver

To get finer variations of inductance a unique scheme is used. It will be remembered that this inductance coil is wound on five concentric cylinders. Five other cylinders, also concentric, are mounted so that they can




Circuits of various sets and diagram of special double contact switch interleave the five primary cylinders, after the manner illustrated by a cross sectional sketch, figure 4. Each of these secondaries contains a separate winding which is short circuited on itself, and all are mounted on one disc which rides on a threaded rod through its axis.

Turning the crank, which may be seen at the side in figure 1, causes these secondaries to move backwards or forwards axially, so as to be more or less in the field of the primary coils. A pointer fastened to the movable coils passes through a slot in the front of the case and indicates the amount of coupling on a scale visible to the operator. The principle is shown in the sketch in figure 6.

The tuning condenser in the circuit is varied by steps, by manipulating the first of the two levers seen projecting through vertical slots at the right side of the receiver, in figure 1. One of four condensers of different sizes is thrown in the circuit. A separate switch mounted above the condenser lever can be used to connect this condenser either in series with or across the inductance. This is shown in figure 7.

The receiver is conductively coupled with an aperiodic secondary. The inductance of the coupling coil is varied by operating the second lever, found alongside the condenser lever. It is also varied by steps. The detectors are of the mineral type. Several styles are to be had, each of which will fit in a special connection block mounted on

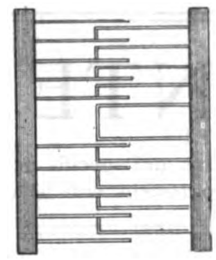


Figure 4

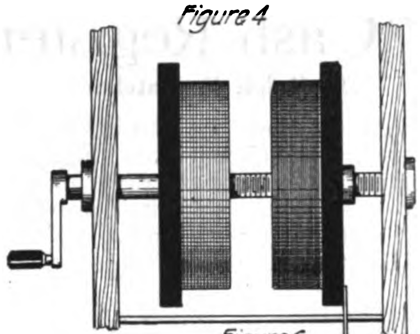


Figure 6

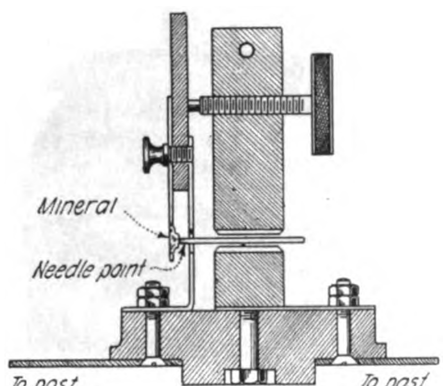



Figure 8

**Primary cylinders, coils and style of detector used**

the receiver. One style is shown in figure 8.

The explanation of the reaction of the short circuited winding upon the primary coils is not difficult to understand. A common illustration of where this effect is noticed is in the case of ordinary power transformers. In these transformers the resistance of the primary circuit is low and they are connected across the mains at all times. The current is kept down by the reactance of the primary winding which is very high at no load. As the load is put on the secondary (which is the same as reducing the resistance across its terminals) the inductance of the primary winding is decreased, and hence the reactance is decreased to permit a larger current to flow in the primary. When the secondary of the transformer is short circuited the reactance of the primary is reduced to a very low value and a very large primary current flows.

The action is the same in this tuner. When the short circuited secondaries are at a distance from the primaries their effect is small and the inductance of the circuit is at a maximum. As they are brought closer, the inductance decreases, and is at a minimum when the two sets of coils are telescoped.

Those who have used both circuits claim that shown in figure 2 to be superior to the simpler one, but it is probable that the additional operations necessary to adjust the set more than offset the tuning advantages.

# Operating Suggestions for the Radio Amateur

**By Ernest G. Underwood**

THE old saying, "advice is cheap", applies to radio as well as to anything else.

When I first noticed the heading for the contest I began to think of all the different kinds of advice about handling traffic, reducing interference and so on that I had ever heard of. I take nearly all the radio magazines published and all of them have their suggestions and advice for the amateur whether he be big or little, old or young.

I have been in the radio game for about nine years and I am just beginning to learn. I am not going to attempt to make this a technical discussion of how traffic should be handled nor am I going to claim that I have an absolute solution to the interference problem. I am just going to present my own ideas in a good friendly sort of a way.

Now for our first problem: The Beginner. I am for the beginner, first, last and always. Why? Because I have not forgotten the time when I was reaching out timidly for a helping hand and found one in a fellow who was somewhat more advanced in the radio game than myself. Now then, whose fault is it anyway when some young fellow in the next block starts his little Ford coil to rumbling and knocks the cans off when you are using 2 or 3 steps of the amplifier to read 9ZN or 7CC? Here is the idea: You have noticed his small and frail antenna proudly holding the wire which radiated the energy of that Ford coil so effectively. You have noticed this antenna several times, but you probably passed it up figuring it was nothing but some poor ham. Now instead of passing these small propects up, go at them this way: Plan on making the young man a visit the next Sunday afternoon. (You nearly always find 'em home Sunday afternoon). Don't think for a moment the young man will not know you if you have had a station up any length of time in the town. Now here is where the personal element plays the big part. You might look over his equipment and if he asks you for suggestions you might make a few. An invitation to visit your station will please him. Before leaving you might tell him how much you would appreciate it if he would not send after 10 P. M. because every time he opened up he just naturally put your place out of business. The personal way of meeting these young fellows and making them feel that you don't wish them out of commission will do more to help the trouble from this source than any other one thing. If you belong to a club you should ask him to come around to the next meeting and become a junior member or a member as the case may be.

Now that we have met the beginner, let's take up the next step in our campaign. The fellows just putting in their first transformer as well as others that may be in the vicinity should be visited and due respects paid to the owners of the stations. A different manner of working this part of our problem presents itself and also introduces the third part of our discussion, "The Radio Club." Now before leaving this fellow we must not forget the invitation to visit out own station and also the fact that Friday night the monthly meeting of the radio club starts at 8 P. M. and that most all of the old timers will be there and we would like to see him among those present. We are sure that if he will come he will like the bunch and will want to join the club right away.

Our third problem, as previously mentioned, is "The Radio Club." I am not going to tell how to organize and run a club as there is plenty of material of that sort much better than I could give. The main thing evident to all is the fact that a club is almost indispensable where the proper reduction of interference is to be secured.

The fourth and last problem of our discussion is traffic. Some clubs and some fellows claim the only way to work this radio game on 200 meters is the cut dried and cured commercial procedure. I am not in favor of this practice only as it relates to recognized relay business. For ordinary work the old simple "chewing the rag" style as was used before the war is the only thing to keep radio on the amateur basis. By "chewing the rag" I don't mean the fellow who sits down to his set and keeps it hot with nonsense. I believe that if a fellow wants to make a date with another fellow to go somewhere or ask some question, the way to do is to ask it, but make it snappy and don't be a "ham." By using the International abbreviations a great deal of time can be saved and the same results obtained as could be obtained by many more minutes of straight talk. Use your head, that's what it's for.

I am not going to tell you how to tune your set, or make a receiver, but I am just trying to give a few ideas I think worth while.

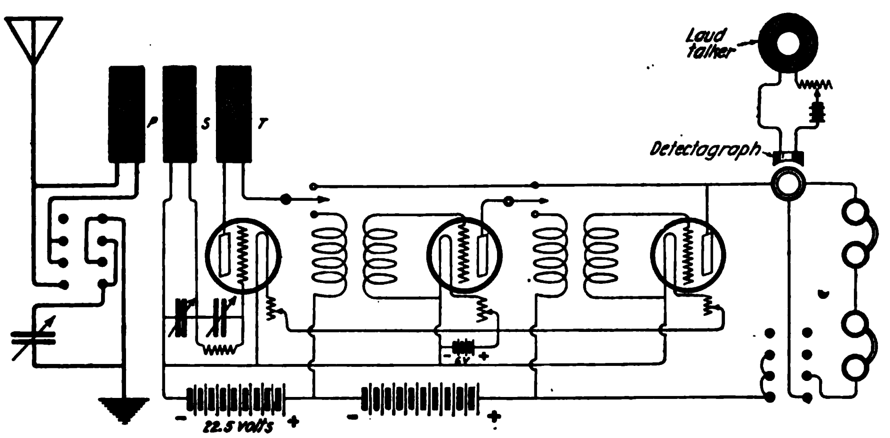
I have made more friends by radio than in any other way. One of my best friends helped me out when I was one of the buzz box bugs.

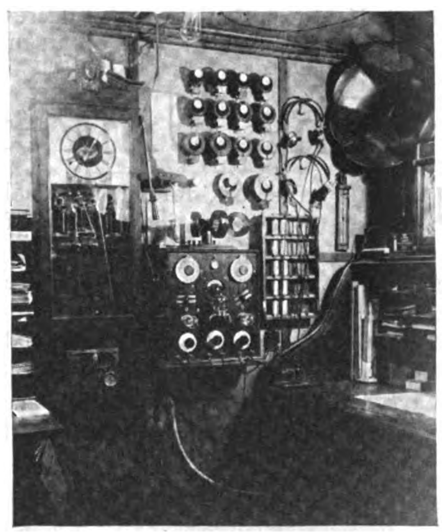
# A Worth-While Receiving Station

E. F. WAITS of Cornith, Miss., has a well arranged station which gives very good results. The aerial consists of four wires of stranded copper, 250 feet long and 140 feet high. A home-built panel with three vacuum tubes is used, together with large size primary and secondary condensers, transformers, etc., also a pair each of honey-comb coils.

In order to obtain results, it was necessary for him to try out every conceivable hook-up; his greatest trouble was in securing proper amplification from the first step-up, or second tube and also in eliminating battery noises in the local circuit. The home made loud speaker, shown in the picture, is very efficient.

There is practically nothing impossible to the receiving powers of this set.



Circuit diagram and photographic view of the receiving set

# Regarding Wavemeters

**By Francis R. Pray**

MANY amateurs are under the impression that a wavemeter is not worth the investment to the average radio man, and that its use entails a knowledge of radio mathematics.

This is far from being the case, and it will be noticed that every amateur station working creditable distances, owns, or has the immediate use of some sort of wavemeter. Any up-to-date experimenter or operator will bear me out in the assertion that this is the most important accessory in the station. Its uses are manifold and clearly detailed in Mauborgne's book on Wavemeters, and, at somewhat more length and involving more mathematics, in Circular 74 of the Bureau of Standards, entitled Radio Instruments and Measurements, both obtainable through the Wireless Press.

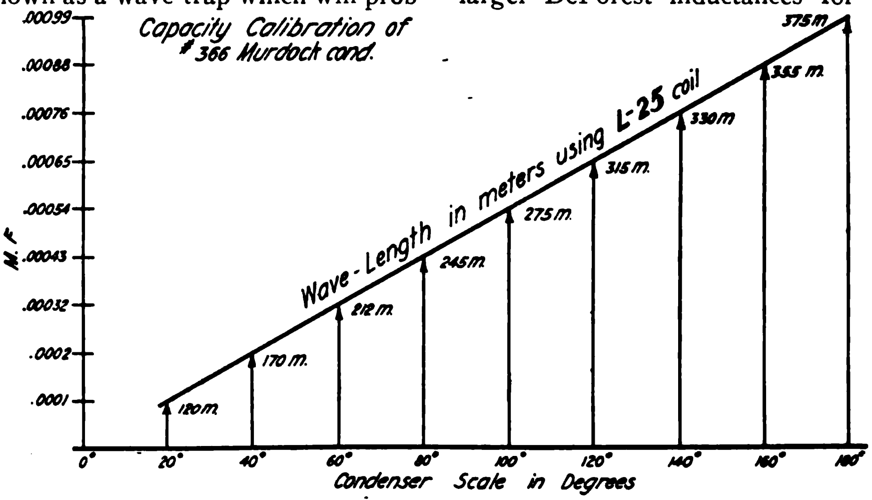
A fairly good direct reading 150-300 meter instrument is now on the market for less than $10.00. It consists of a fixed capacity and a variable inductance of the variometer type. Many amateurs, however, desire to assemble their own in order to secure a more universal wavelength range.

It is simple enough to connect a coil of wire across the binding posts of an extra variable condenser, but the trouble comes in calibrating this unit in meters without the use of a standard. This can now be accomplished in two ways. The most accurate way is to send the condenser with the corresponding inductance coils to the Bureau of Standards, Washington, D. C., who will make a wavelength chart for each coil, charging amateurs but a dollar per coil, plus the transportation charges on the outfit both ways. A quicker and also less accurate way would be to take a standard inductance as sold by the DeForest Company and plot the chart from the formula by using the capacity curve of the condenser scale reading. For all ordinary purposes, this method is quite practicable.

As wire of the desired sizes is now often unobtainable and winding facilities often very limited, I have selected the DeForest honeycomb wound plug inductance for the wavemeter.

The cost is little more than the unwound wire itself and most important is the fact that the inductance in millihenries is given for each size. As many amateurs already own a Murdock 43-plate condenser, I have selected this type as the standard, also perhaps of its low price. The question now arises: "How shall the inductance be fastened onto the condenser without introducing lead wires?" Amateurs around New England will at once suggest the Somerville Radio H-C coil adapter, but for the benefit of Southern and Western radio men, I will say that this is nothing more than a block of bakelite fitted with a socket of standard dimensions to fit the DeForest plug inductance. Projecting brass arms connect with the binding posts of the Murdock condenser. Used in this manner, any size of honeycomb coil can be used and a wavemeter unit will result, covering all the used radio frequencies.

A wavemeter of this type does not necessarily have to be laid away on the shelf after calculating the decrement or wavelength of your outfit, or measuring the inductance or capacity of some part of that new "record breaker" outfit you are making. The unit itself makes a fine sensitizing circuit, or an interference preventer known as a wave-trap which will probably be described soon in these columns—the data having now been released.




Using a DeForest L 25 coil, a No. 366 Murdock condenser, and a Somerville Radio adapter, at a total cost of $7.00, the wavemeter unit had a range of about 120 to 375 meters, as graphed in the following table, which is accurate to within 1%.

Of course, by simply substituting larger DeForest inductances for the L 25, a wavemeter of any range results.

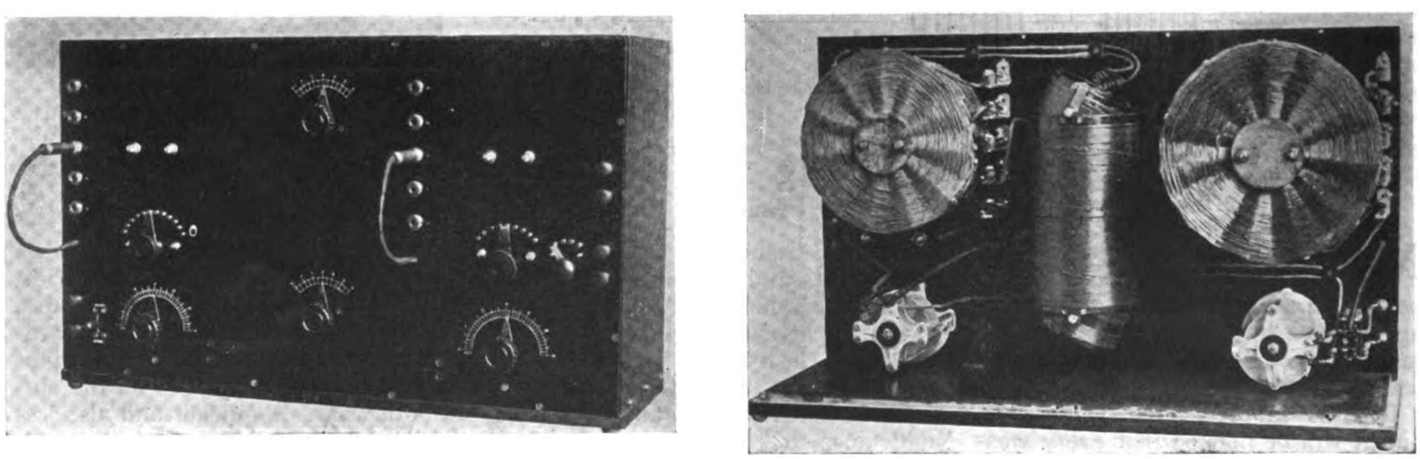
Such a wavemeter is extremely low in cost, may be assembled without tools and may be used in many other ways around the station or laboratory.

# The Universal Wavelength Receiver

RADIO receptors for professional amateur application are of greatest desirability when they are capable of adjustment over the entire band of wave lengths now in use. Plants of the amateur and commercial class are generally below 2,400 meters. Wave lengths greater than this are used for higher powered stations and greater distances. Trans-oceanic stations employ wave lengths up to 20,000 meters.

While short wave receivers may function well on the lower band of wave lengths, loading them for long wave reception causes serious distortion in certain bands of its range. Adjustments are often quite awkward. In order to make tuning more uniform, a short wave receiver is often used; while for the longer wave lengths a larger receiver is effective. Huge inductive couplers or inductances of considerable proportions are found in many stations.

Where such large solenoids are used, interaction of parts results; and where local secondary oscillations are used for undamped reception, these extensively wired units are very susceptible to the movements of anybody within their fields. This may cause local tone disturbances and difficulty in effecting accurate adjustments. Often long insulating rods are attached for adjustment from a distance. Where the inductances possess fields confined to a small volume, the defects do not develop within the receiver. In the instrument to be described, inductances of this concentrated type are used.



Front and rear views of the universal wavelength receiver

Large inductances are necessary for long wave lengths. Ordinarily, intermediate values are obtained by a lead or tap with finer capacitive adjustment. When so used, coils function well near maximum value, but where the unused portion becomes large, certain points in the lower bands will suffer energy loss which is often considerable. To overcome this, coil units are commonly cut in as they are needed. Dead-end switches are sometimes used for this purpose. In the instrument illustrated, the total inductance is normally in circuit. For any adjustment over a certain band, all unused inductance is cut out when any required value is included in the circuit.

Three tuners have been combined within one cabinet. The short wave unit is of 150-900 meter range when used singly. With the intermediate value, the combined range becomes 850-6,000 meters. Combining all units affords a range of 6,000-20,000 meters. Each band functions independently of any possible value above it. It is free of local reaction and dead-end effects.

By reference to the diagram, it is seen that the antenna to secondary coupling is effected through a small primary inductance which is further employed on all waves. On 200 meters this primary is used in conjunction with a small value of the first secondary. For values to 900 meters, further secondary increase is made; and a corresponding increase of the primary capacity or loader. Placing the secondary plug adds the second value of secondary for intermediate waves above 800. For wave lengths above 9,000 meters, additional values may be plugged in on primary and secondary. In designing, the positions of controls for any wavelengths were made alike in both units. This facilitates rapid changes and location of any station.

When adjustments are to be made on short or extremely long waves, a variable condenser may be placed either in series or shunt to the primary system. A key-switch makes this change.

For undamped reception, the autodyne method is used. An inductive feed-back in relation to the secondary system generates local oscillations. Both secondaries are influenced by the tickler. While the first secondary used singly is at a greater distance from the tickler, there is sufficient relation to maintain powerful oscillations to a very high frequncy in the first secondary. The set becomes regenerative for spark reception when the tickler coupling is reduced to a point below that required to maintain oscillations. So for spark reception, the set is regenerative. Both primary and tickler coils are adjusted for absolute zero coupling with a further increase to a small reverse coupling provided in both. An adjustable bridging condenser is provided to by-pass oscillations independently of the oscillator tube arrangement.

Primary panel controls are shown at the left. Aerial-ground posts, series-shunt condenser switch, primary condenser, primary fine adjustment, and plug for loaders are shown. Tickler and coupling control are centrally located. The secondary arrangement is similar with the addition of the four point bridging condenser switch. Self balancing variable condensers of 1,500 mfds. are used in the primary and secondary units. In the antenna circuit, the condenser is placed in series or shunt to the primary by use of a 12 spring key switch.

Adjustment. The secondary is in two sections; the first being tapped for nine values of inductance for low and intermediate waves. The secondaries are two-layer bank-wound, 11 microhenries.

Tickler and coupling coil are supported at the ends of the secondary solenoid. They are carried in brass supports furnished with friction bearings for holding the coils in any position. Formica brackets attach the tube and parts to the panel back.

Five secondary inductances of 5 microhenries each are mounted in the same fashion as the primary loads. The tickler coil is three layer bank-wound with fine copper wire mounted on a radially mounted bakelite tube. A condenser of three values is provided for by-passing local oscillations across phones, B battery and components. Mica sheets separate copper foil plates arranged into values of 2,500. 1,500 and 500 mfds. each. A small 4 point switch selects the required value for any wave length.

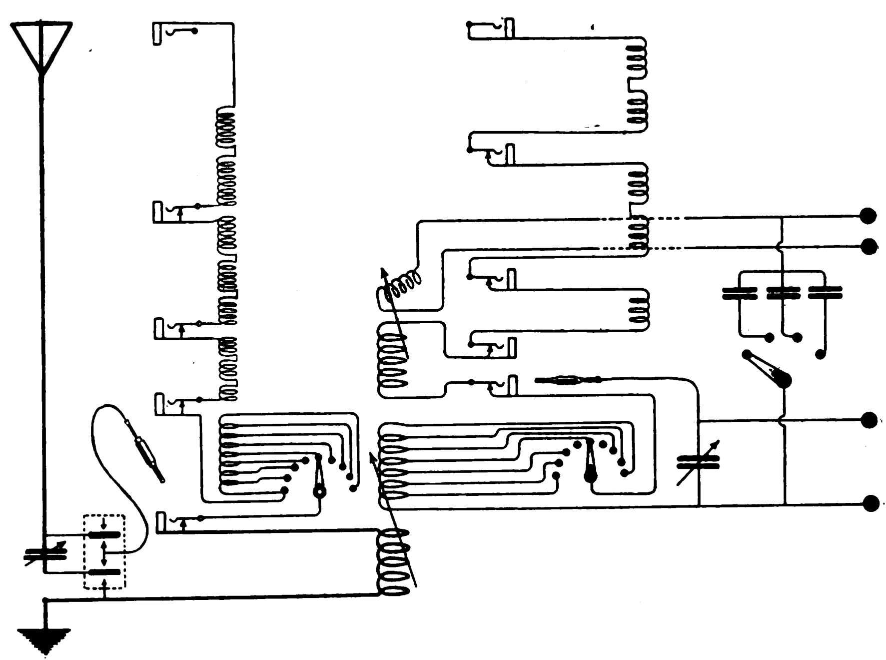


**Figure 3—Circuit diagram of the universal wavelength receiver**

Electro-magnetic coupling between antenna and secondary is obtained through the primary inductance mounted below the first secondary. This coil is two-layer bank-wound upon an axially mounted bakelite tube. Its value is .6 microhenry.

For both loading systems, stagger-wound inductances were constructed. Nine of these flat units are used in the primary, the first five being of smaller radius to give clearance for the jacks. The values of these units are 2 and 3.5 microhenries each. All units are arranged upon rods that clamp them to the back of the panel. The first unit is tapped at eleven points to provide intermediate inductive ad-

All wiring is of rigid copper encased in varnished cotton sleeving. All joints are soldered. Flexible leads connect the movable coils.

(*Continued on page* 38)

# Suggestions on the Distribution of Wave Lengths for Amateurs

**By J. C. Morris, Jr.**

**(FIRST PRIZE, $10.00)**

THE WIRELESS AGE published some suggestions of mine in the June, 1919, issue in regard to the limitations and restrictions to be placed upon amateur stations.

It is in continuation of these ideas that I would like to make the following suggestions:

In my opinion amateur stations

should be divided in two general classes as follows:

1. Local work only;
2. Long distance work.

A further sub-division of the latter class could well be made.

1. Damped or spark stations.
2. Undamped or continuous wave Stations.
   A. Non-modulated or simple type.
   B. Modulated system.
      a. Buzzer modulated.
      b. Radiophone.

Permission must be granted to the undamped wave stations to operate at wave lengths exceeding 200 meters unless new power tubes are placed upon the market having a lower internal capacity than the present tubes.

An ordinary non-modulated undamped wave set has to be heterodyned at the receiving station. When it is considered that a wave length of 200 meters corresponds to a frequency of 1,500,000 cycles per second, the difficulty of heterodyning such a wave will become apparent.

This difficulty is largely overcome by the use of the modulated system. It should be remembered that the radiophone is nothing but a voice modulated system. Another advantage of the modulated system is that any ordinary receiving set—crystal or simple vacuum tube—will suffice. A drawback to the system is that the wave though sharp will still cause interference with damped wave work. It is obvious that the difficulty of making the bulb oscillate at very high frequency still remains.

The advantage of sharp tuning and note control—with non-modulated sets—of the continuous wave systems over the ordinary spark type are too well known to require repetition.

Another point which I would like to bring out is that at present the undamped wave sets are rather expensive and somewhat difficult to operate, so they are operated almost entirely by amateurs of experience and ability.

These facts lead me to make the following suggestions:

1. No restrictions upon and no license required for purely receiving stations.

2. Amateurs doing only local work to be allowed to operate without license, on wave lengths up to 150 meters and to use no power greater than 50 watts.

3. Amateurs who have successfully passed an examination on both code and theory to be permitted to operate stations as follows:

A. Damped wave stations on wave lengths between 150 and 200 meters. Power limited to 1 kw.

B. Modulated wireless stations on wave lengths up to 250 meters.

C. Non-modulated stations from 250 to 275 meters.

Persons desiring to operate a continuous wave set should be required to pass an additional examination upon theory of undamped wave work.

Although at first thought the wave of 275 meters appears to be very close to the commercial wave of 300 meters, the sharpness of tuning permissible with undamped wave sets will permit the two stations to operate at the same time without interference to each other.

After all, however, the only way to do away with unnecessary amateur interference is for the amateurs to each and all learn to apply the Golden Rule: To do unto others as you would they would do unto you.

In my opinion these adjustments would constitute a working system of regulations satisfactory alike to amateur and commercial needs.

# Amateur Wave Lengths

**By George F. Patrick.**

**(SECOND PRIZE, $5.00)**

THE inevitable is about to happen. The laws governing amateur transmission are to be revised, and what is more important, enforced. In spite of all that has been written and said on the subject of interference and proper tuning of transmitters; in spite of the pleas of those farsighted enough to see the rocks ahead; in spite of repeated warnings, the selfishness of many amateur station owners whose mental vision is as limited in scope as their unlawful transmitters, has brought about an agitation for stricter regulation and enforcement. The only ray of comfort in the situation is the fact that many of these radio germs will be forced out of the game by the extra expense involved and the confiscation of offending stations. It is no longer possible to conceal the identity of a station, the radio compass points an unerring finger at the point of transmission and it is to be supposed that the Department of Commerce will make use of this device to locate and convict offenders.

Let us consider what allocation of wave lengths and what amount of power may be alloted for communication at different distances to give a minimum of interference while maintaining satisfactory results. Of course, everyone who has given the matter much thought must realize that the ultimate result of the interference problem will be the abolishment of spark transmitters, and the use of undamped waves exclusively. We are not quite ready for this, however, so the use of damped waves with a minimum of confusion may be considered.

The 1776 style of transmitter, the spark-in-the-antenna, rainbow wave producer, should be abandoned altogether. Considering the mass of information and data at hand both in the current magazines and in book form, the amateur who cannot put together something better than that has not reached the stage where it is safe to let him have a station of any kind. For strictly local work a very short wave of low damping should be used. I would suggest for this, a wave not to exceed 150 meters with a decrement not to exceed .2, the same limit applied to commercial transmitters. Two hundred watts would be sufficient power to allow for this class of work. For longer distance work a wave length not to exceed 250 meters would suffice with the same decrement, and power limited to 1000 watts. Three hundred or 400 meters could be used for undamped transmission without interfering with commercial or government stations on longer wave lengths or amateur stations on shorter wave lengths. The wave length of 300 meters is very seldom used in commercial work and might very well be abandoned. A maximum of 1 kilowatt of power for undamped transmission would not be too much and would give good distances. Undamped transmitters should be required at all stations attempting long distance work, the use of spark transmitters should be confined to the dabblers who work from house to house. Let us make a distinction between experimenters who are in earnest and the irresponsibles who wish only to play.

Due to the great number of stations that are operating, I do not think it wise to specify certain wave lengths for different classes of transmission; but certain limits, low and high, should be designated for each class. This would allow a little latitude in tuning and would cause less interference than if everyone were to be piled in an indiscriminate heap on a certain wave length. I think, too, that the establishment of local schedules would help; that is, to allot certain hours during which local work might be carried on, and other hours when stations fitted only for local work would remain quiet and allow the long distance stations to work.

The establishment of local clubs should be encouraged and their policy should be to co-operate with the Department of Commerce. This co-operation should be an active one and not merely the passing of resolutions. The members should watch for offenders and inform the government radio inspector. To do this properly each club should have several of their members' stations fitted with direction finders, and take bearings on stations found violating the rules; these bearings if plotted on a charted section of any city will enable anyone to go to the exact spot from which any signal is sent. Any club could obtain charts of their city and the surrounding country and keep posted on what each station is doing even though the call letters and sparks were to be disguised. The government is making an effort to help the amateur and common courtesy requires the amateur to co-operate in the movement to make communication by radio as reliable and free from delay as possible.

What are you going to do about it, you earnest experimenters? Are you going to help the government maintain our amateur station service in an orderly well regulated manner, or are you, by a passive attitude, going to help those who with little to lose are fast bringing about the rigid restriction if not the entire abolition of amateur radio transmission? Amateur wireless should be preserved to secure recreation and scientific knowledge.

# Combating Q R M

**By Hugh Richardson**

**(THIRD PRIZE, $3.00)**

WITH the ether so crammed with a mixture of QRM and QRN that it is almost impossible to establish reliable communication any distance, even with the limit of power, it is high time that adequate control of conditions came into effect. A few of the brainy ones have lowered their waves to 185 and are working with comparative ease; but few listen in on such a low wave, so the majority are found anywhere from 200 to 375 meters, in direct violation of the law.

The fact that there is little QRM over 250 meters seems to point the way to successfully combating it on the other wave length ranges, because over 250 hardly anyone uses the same wave, and there is no congestion. The law-abiding citizens who try to get just 200 really cause the trouble.

The answer is: distribute wave lengths with licenses, and require that stations have adequate means of reducing power for short distance.

At any one spot there are seldom

more than five stations interfering seriously. Assign these stations five wave lengths in a band 3 meters apart, and the interference ceases for all.

As practically all bothersome QRM is local, it seems feasible to apply this plan, by having a definite type of license for long distance relay workers and assigning them a band of wave length of say 30 meters, from 200 to 230. The old band below 200 could be split into two bands of 20 meters, 160-180 for low power local work, and 180-200 for inter-city work. As to power, 25-50 watts for local, 200 for inter-city, and 1000 watts for long distance should be assigned to prevent use of the lower waves for long distance. This will largely cut out local interference. As was suggested in the August issue, probably 230-250 will be reserved for undamped, radiophone, and modulated C. W. It would be hardly necessary to assign a definite power limit, in this case as very seldom more than fifty watts is used in such amateur installations.

Each license, when issued, should assign a definite wave length for normal use to its holder, and arbitrary ones a few meters above and below the normal to be used in case of interference on his own wave, provided no one was transmitting on the arbitrary wave already. It would also be a good idea to require all amateurs using more than 500 watts to install a 50-watt transmitter for local work.

Another help would be to have Radio Clubs in various towns form investigating committees authorized by the radio inspector to inspect licensed stations within their jurisdiction and ascertain if these transmit on their allotted wave length, also if they have adequate means of reducing power, and if their decrement is less than .2. All station owners found not complying with the regulations should be punished to the extent of revoking their licenses. High decrement causes a great deal of the QRM and a war against it by the amateurs themselves, authorized by the government, would help conditions greatly.

According to this general plan, the radio inspector of each district, when issuing wave lengths, would divide up the district into several minor divisions and issue the complete band of wave lengths, 2 or 3 meters apart and then repeating with alternates, mapping the stations, and taking care to issue the same wave to no two stations very close to one another. The amateurs themselves and Radio Clubs could be of great help in assisting the inspector in this work. The investigating committees of the clubs could have the distribution of the lower waves, for local work, as the inspector's deputies.

The next radio bill will doubtless

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contain a larger appropriation, as radio has grown in importance in the eyes of legislators, and a much more careful system of "detective" stations should be maintained to investigate wave length and decrement, and enforce the law.

This system may seem inadequate when we think of the thousands of amateurs in the second district alone, but all of them do not work at once, only a very small number, actually, and the system would be a decided improvement over the present chaos.

When certain places in the wave length band become too congested, the wave of some of the stations could be changed permanently to one of the auxiliary waves, upon report by one of the deputy committees.

Whatever happens, it is time for everyone to get together for the big push and drop personal benefits in an operation for the common good, or we may find ourselves with no sets at all, like the unfortunate Frenchmen.

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## Amateur Traffic

**By J. O. Smith**

CONDITIONS improved somewhat during September over those of the summer and amateur relay traffic began to move generally throughout the country. The greatest improvement was noted in the northern sections, where for several nights traffic was handled over regulation winter-night distances.

A few distance stations copied at New York were 1AW, 1CK, 1CM, 1GY, 1XE, 3BZ, 3BH, 3EN, 3JK, 3KM, 3ZA, 4BQ, 5DA, 8BV, 8DR, 8EN, 8EV, 8GW, 8IC, 8NI, 8RQ, 8ACF. The fact that these stations were widely located would seem to indicate that good conditions prevailed over practially the entire eastern half of the country.

During the extremely unfavorable conditions prevailing during September it was interesting to note that the only stations covering good distances were those using C.W. transmitters. These stations successfully worked through static and dead air when spark stations were unable to get through.

Note.—Amateurs undoubtedly have many traffic items of interest in the various sections of the country and communications for these colums will be welcomed.—The Editor.

### Amateur Got S-5 SOS

DAVID L. Moore, the amateur radio operator who picked up the news of the disaster to the submarine S-5 before it came to any navy officials on land, is about 25 years old and is cashier of a brokerage concern in Hartford, Conn. He lives at the home of his father, Jesse Moore, an advertising man, in Farmington, near Hartford, and the "toy" wireless set upon which he received the message telling of the plight of the S-5 is installed in his room there.

This is the way in which young Moore tells how he happened to take up the instrument after supper on the evening of the accident and receive the message which saved thirty men from death by drowning:

"At 8 o'clock my outfit began snapping out an SOS I eagerly listened in and learned it was the operator of the General Goethals talking. The message was that the S-5 had been submerged for thirty-five hours and it was feared the officers and crew were lost.

"Then came a message from the Goethals to all the wireless stations and vessels in the section. It asked that they render all possible assistance. I listened in, hoping that some vessel would reply that she was going to the aid of the submarine. After what seemed ages I heard a vessel reply that she was making all speed to the S-5. I could not make out the vessel's name. From the location given by the Goethals I figured that the S-5 was submerged somewhere off Cape Hatteras.

"I next heard the Goethals asking that a ship fitted with a steel cutting device with which to rip the hull of the submarine be sent at once. After that the air became filled with messages and they were coming too fast for me to make out. It seemed as if the whole Atlantic coast was asking questions. The operator on the Goethals was a wonder at sending out messages."

### Sound-Proof Radio

MEMBERS of the Springfield radio association were startled one evening when they discovered that there was an inventor in their midst. Mr. Creaser, the club instructor, has devised an instrument called the "codafone" or "wonderbox," which opens a new era in code practice. Briefly, it enables a student to practice his code without raising the distant echoes.

Heretofore, the unsympathetic members of the household were forever complaining of the racket which "that there wireless" made and the youthful enthusiast was forced to stop or retire to the barn. The "codafone" is so devised as to be absolutely noiseless except to the person studying.

Mr. Creaser would allow no one to open the "wonder-box." He is reported as saying, "I got it by accident. Anyone can do it. Go to it!" It is hoped, however, that he will soon relent and disclose his secret to the ever-curious public.

### A Message from Montreal

THE Montreal Radio Association, formed about fifteen months ago, found its development during the first year of its existence considerably retarded by the lack of a suitable clubroom, but this disability no longer exists, due to the generosity of James E. Wilder, who has given the club

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the use of two rooms on the tenth floor of the new Wilder Building, together with permission to string aerials on the roof. One has already been strung from a sky sign on a nearby ten-story building, making it 200 feet high at one end and 140 feet at the other, and 250 feet long.

The association is now rapidly developing and at present is working on its station equipment and the possibilities of organizing relay circuits. To the latter end it wishes to get in touch with all amateurs in Eastern Canada. The mail address is, Montreal Radio Association, Wilder Building, Montreal. Secretary L. E. Hunton would like to have other organizations or individual amateurs communicate with him.

# Prize Contest Announcement

The subject for the new prize contest of our year-round series is:

DESIGN AND CONSTRUCTION OF AUDIO FREQUENCY TRANSFORMERS

Closing date, December 1, 1920.

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Prize Winning Articles Will Appear in the February Issue.

*Much experience has undoubtedly been gained by the more advanced amateurs and experimenters along the lines of designing and constructing Audio Frequency Transformers for use in amplifying units. We are especially interested in designs which can be readily put together at a small cost without impairing the efficiency of the finished instrument.*

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

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

## The Universal Wavelength Receiver

(*Continued from page 27*)

The following dimensions apply only to the units. All parts of the receiver are mounted directly upon a formica panel 14 x 24 x 1/4 inches. Complete with the oak cabinet, the weight is 28 pounds.

Cores of the flat coils are sections of a rolling pin and measure 2 1/2 x 3/4 inches each. Eleven wooden "meat skivers" are set radially about the discs. Five are stagger-wound to a depth of 2 inches; the remaining four to 2 3/4 inches. About 3 pounds of 24 SC is required. The secondary coils are similarly wound to a depth of 2 inches. These require about 2 pounds of 26

SC. All coils are double dipped in shellac and baked. Two tie rods pass through the series, binding them to the panel back. No. 28 SC is used for tickler. A bakelite tube 4 x 7½ inches supports the first and second secondaries. These are of 24 S. Silk. Primary and tickler tubes are 3½ inches diameter by 2 inches. Plugs and "normally closed" jacks are used for isolating unused inductance.

In this receiver it was found unnecessary to shield the units in copper boxing. Due to the confined inductances, very little reaction is present. Two stages of amplification are used with this set.

This receiver functions admirably on any possible wave length. The arrangement provides unusually uniform adjustment over the entire range of the tuner. It has proved an excellent instrument as a plain or regenerative receiver of spark signals and as an undamped wave receiver it is very effective.

# Queries Answered

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

A. A. E., North Sydney, N. S.
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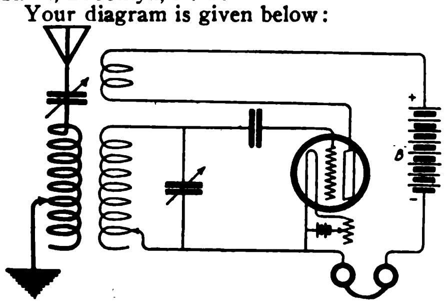
R. L., Brooklyn, N. Y.
Your diagram is given below:



H B., Huntington, N. Y.
Ordinary wet batteries for the plate circuit of vacuum tubes for receiving purposes will give good results.

* * *

J. G., Chicago, Ill.
Additional specifications for the "Laboratory Radiophone" by Mr. Allen H. Wood, Jr., were published in the October issue of THE WIRELESS AGE.

We recommend that you advertise for the second-hand meters you desire; we know of no shop handling this apparatus.

The radiophone in question will give about the same results when Marconi V. T.'s are used.

* * *

N. R. H., Casper, Wyo.
Without more definite details regarding your magnetic device we cannot make any statement about the success of such an apparatus. It seems that you might have considerable trouble with centrifugal forces. We would suggest you send in a sketch of your idea and if possible the purpose for which it is constructed.

* * *

J. C. T., Bethlehem. Pa.
You will be unable to purchase the tubes about which you inquire as it is our understanding they are not on the market for amateur use at the present time.

* * *

C. S. M., Westboro, Miss.
Copies of Philips Code may be obtained from J. H. Bunnell & Co., 17 Park Place, New York.

* * *

J. J. A., Woodbridge, N. J.
You will not have much success using only one vacuum tube as a rectifier in direction finding apparatus. You should use two

or three steps of amplification. The book, "Wireless Experimenters Manual," by E. E. Bucher, in chapter twelve, gives detailed information on this subject. This book is obtainable from the Wireless Press, 326 Broadway, New York, at $2.25 per copy.

* * *

F. R. Y., Delta, Ont.

The 0-1 ammeter will be O. K. for your circuit.

The diagram has been tested out before and seems to give good results.

You may find that no grid leak will be required. However, if the speech is poor, when the first coil alone is used, try various values until best modulation is obtained.

The series condenser is of the right value.

* * *

A. J. B., Brooklyn, N. Y.

You will require a 100 ampere 600 volt switch for this purpose, and if you want an elaborately insulated switch try the American Radio and Research Corporation, 15 Park Row, New York.

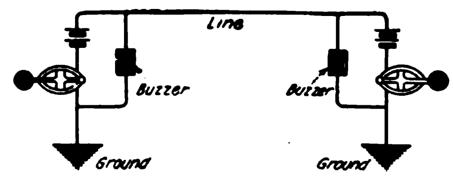
Clapp Eastham Company of Cambridge, Mass., have a good change-over switch on the market.

Rotary gap disc should be eight inches in diameter with ten or twelve studs using a three to four thousand R. P. M. Motor.

* * *

L. E. E., San Jose, Cal.

Following is the wiring diagram you will have to use:




M. M., Toronto, Can.

PTA is a Brazilian Naval Station located in the harbor of Rio de Janiero. It is equipped with a 1 KW. Telefunken set.

PTL, PTN, PTI are in the same vicinity and are similarly equipped.

### The Lyons Station

The popular response to the article published in the September issue, descriptive of the Lyons Station, indicates that many of our readers would like to read this article in the original French, as written by Leon Faljau. It will be found in the May issue of "T. S. F.," a radio communication magazine published in Paris, to which publication THE WIRELESS AGE is indebted for the permission to make the translation.

# Book Reviews

**Experimental Wireless Stations.** By Philip E. Edelman. Cloth binding, 380 pages. Illustrated. Henley. Price, $3.00 net.

Under its familiar title, Mr. Edelman's book for amateurs makes its 1920 appearance in new dress and materially enlarged. Careful attention is given to the basic principles of radio communication, in such form as to be easily comprehended by the younger workers in wireless who seek to graduate from the elementary stages of experimentation. Modern practice is comprehensively reviewed in chapters devoted to continuous wave alternator and arc systems, vacuum tubes as detectors, amplifiers, oscillators and modulators in radio telegraphy and telephony. Both principles and apparatus are described in chapters on tuning and interference prevention and a considerable portion of the volume is devoted to practical instructions for the construction of complete amateur sets and associated apparatus.

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

**Telephony Without Wires.** By Philip R. Coursey. Cloth binding, 396 pages. Illustrated. Wireless Press. Price, $5.00 net.

Speech transmission by the radio method is comprehensively recorded in its various technical aspects in this useful volume for students who aspire to a place in the development of a branch of the art that is engaging the attention of the leading engineers and experimenters in the field. Historical matter introduces the main subject, acquainting the reader with the lines of investigation pursued by early inventors who vainly applied conduction and induction methods to a solution of the problem, some thirty-five years ago. Following a brief treatment of the early attempts at telephony by electro-magnetic waves, the volume takes up the various problems of speech transmission, describes advanced forms of spark and continuous wave production, arc generators and vacuum tubes as producers of oscillations, alternators and the various forms of frequency raisers and gives a broad discussion of the modulation of the transmitted energy. Receiving apparatus and amplifiers are also discussed, together with descriptions of the methods and operation of apparatus and circuits designed for interference prevention. Comparisons are made with wire telephony in the competitive sense, in an interesting chapter which discusses the fields of use for the wireless method of speech transmission.

A notably complete bibliography lends added value to the book, in assisting the reader who wishes to delve deeply into particular phases of the subject

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

**Wireless Transmission of Photographs.** By Marcus J. Martin. Cloth binding, 140 pages. Illustrated. Wireless Press. Price, $2.00 net.

This is a second edition, in which there is some amplification of points insufficiently dealt with in the earlier volume on wireless photography. It deals with a subject that is admittedly in the experimental stage, but presents a careful record of the significant experiments made to date as a means of placing future experimenters on the right track in investigation of a subject that holds enormous potentialities in transmission of news and detection of criminals.

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

**The How and Why of Radio Apparatus.** By Harry Winfield Secor. Cloth binding, 156 pages. 159 illustrations. Experimenter Publishing Co. Price, $1.75 net.

This book successfully carries out its avowed purpose of instructing the novice of average mentality on the basic working principles of general and usual types of apparatus. While the functions of the various pieces of apparatus comprising a complete amateur station are given the briefest kind of treatment, the author has done a distinct service to amateurs in dealing rather fully with the method of calculating and measuring inductance, so that the newcomer will have little difficulty in mastering the mathematical principles that determine wave length and frequency in both the aerial and detector oscillatory circuits.

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

**The Oscillation Valve.** By R. D. Bangay. Cloth binding, 210 pages. Illustrated. Wireless Press. Price, $2.75 net.

The vacuum tube, its importance, limitations and the principles governing its action in radio communication are treated in this volume from the purely logical point of view. The book has a special value for those who are unable to comprehend the highly specialized technical language used by research experts in scientific articles appearing in the periodical press. Commendable simplicity governs the author's explanations of complicated phenomena, making the fundamental principles clear to experimenters whose present knowledge may be inaccurate and hazy.

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

**The Thermionic Valve.** By J. A. Fleming. Cloth binding, 274 pages. Illustrated. Wireless Press. Price, $5.00 net.

This book on the subject of the wonderful device which we, in America, insist upon calling the vacuum tube, has the added interest and prestige of coming from the pen of the man who made the pioneer invention upon which practically all recent advances in radio depend. Prof. Fleming's volume is essentially one for the engineer, presenting a very comprehensive description of the practical appliances which have been developed with the incandescent cathode in a vacuous bulb as their basis of operation. The pure science researches are but briefly treat-

ed and only such early historical matter is included as is necessary to indicate the steps which led up to the practical applications described in the major portion of the text. The vacuum tube is treated in three-electrode form as a generator of oscillations, and as a detector in both radio telegraphy and telephony, up to and including the most recent and improved types and apparatus.

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

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of The Wireless Age, published monthly at New York, N. Y., for October 1st, 1920.

County of New York, }
State of New York, } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. A. White, who, having been duly sworn according to law, deposes and says that he is the Editor of The Wireless Age, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations.

1. That the name and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Wireless Press, Inc., 326 Broadway, New York, N. Y.

Editor, J. Andrew White, 326 Broadway, New York, N. Y.

Managing Editor, None.

Business Manager, J. D. Conmee, 326 Broadway, New York, N. Y.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

Wireless Press, Inc., 326 Broadway, New York, N. Y.

E. J. Nally, (850 shares), 233 Broadway, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

J. ANDREW WHITE,
Editor.

Sworn to and subscribed before me this 29th day of September, 1920.

(Seal.) M. H. PAYNE.
(My commission expires March 30, 1922.)

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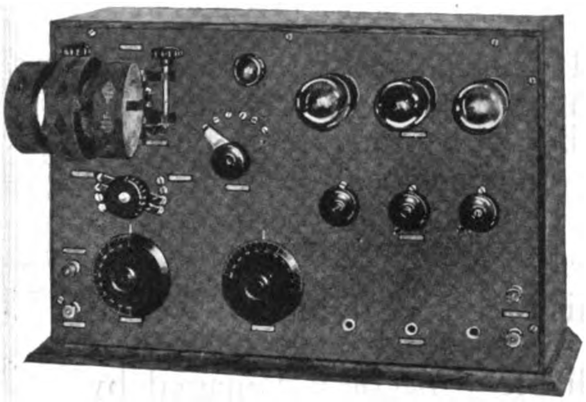

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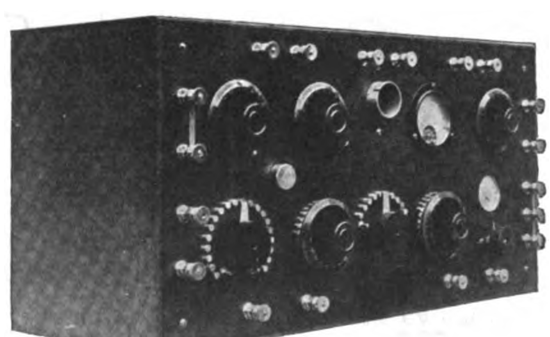

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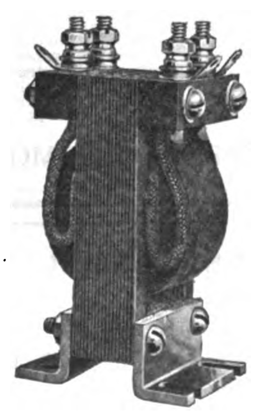

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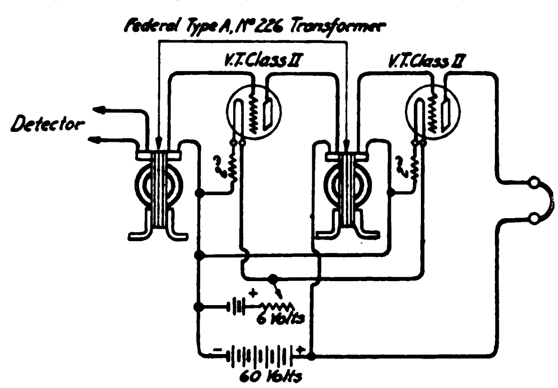


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