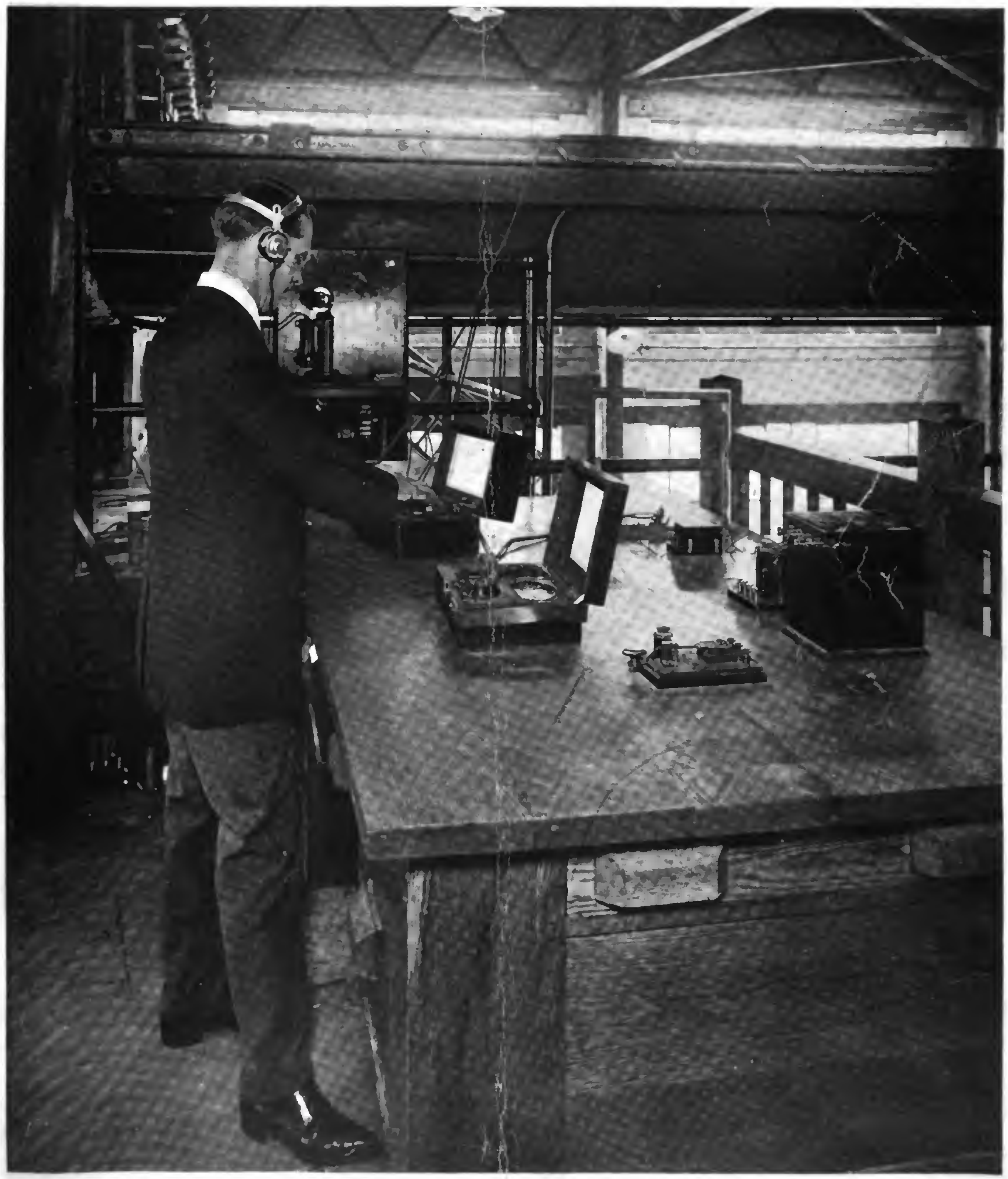
April, 1920 20 Cents

The WIRELESS AGE

Volume 7 Number 7



The Supervisor and His Instruments at a Trans-Atlantic Radio Transmitting Station

The Coil Aerial—Its Use as a Direction Finder

A 25 Mile Radiophone [illegible] Stations of the A.E.F.

HATS OFF TO THE NAVY

INSULATION
"MADE IN AMERICA"

TRADE ELECTROSE MARK
REG. U.S. PAT. OFF. & FOREIGN COUNTRIES
Louis Steinberger's Patents

INSULATION
"MADE IN AMERICA"

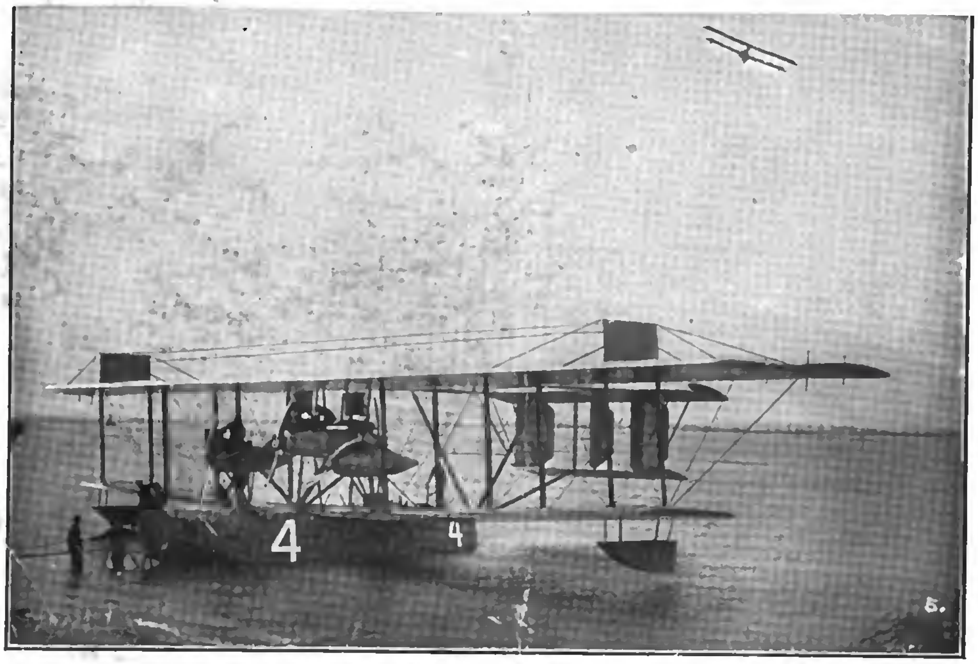
ELECTROSE INSULATORS

FIRST TO CROSS OCEAN IN AIR

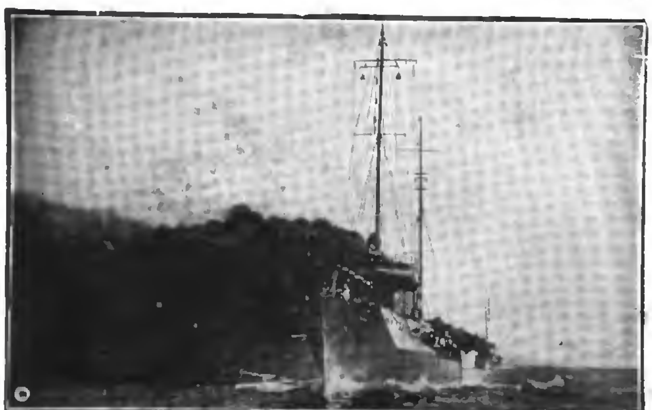
Standard of the World for High Frequency Currents Used by UNITED STATES NAVY and ARMY, and the Wireless Telegraph and Telephone Companies

"By courier, coach and sail-boat, it took days for the news of Waterloo to reach London. During Lieut. Commander Read's flight to Halifax, Assistant Secretary Roosevelt in Washington sent a radio message to NC-4, of whose position in air he had no knowledge. In three minutes he had a reply."

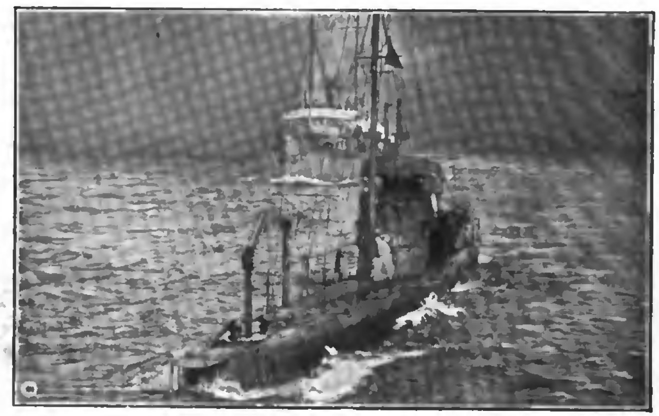
Extract from New York World, June 3, 1919.



NC-4—ELECTROSE Equipped



U. S. S. Cassin and U. S. S. McDougal Working Up a Smoke Screen—ELECTROSE Equipped



U. S. S. G-2—ELECTROSE Equipped.

Medal and Diploma received at World's Columbian Exposition, Chicago, 1893

TRADE ELECTROSE MARK
REG. U.S. PAT. OFF. & FOREIGN COUNTRIES
INSULATION
"MADE IN AMERICA"
LOUIS STEINBERGER'S PATENTS

Medal and Diploma received at World's Fair, St. Louis, 1904

SOLE MANUFACTURERS
ELECTROSE MFG. CO.

66-82 Washington Street
66-76 Front Street

27-37 York Street
1-23 Flint Street

Brooklyn, N. Y., America

Vol. 7 Contents of **The Wireless Age** for April, 1920 No. 7

Edited by J. ANDREW WHITE

Advertisements

Published Monthly at 64 Broad Street, New York

GREAT BRITAIN, 12-13 Henrietta St., London
AUSTRALIA, 97 Clarence St., Sydney, N. S. W.

CHANGE OF ADDRESS—Notify us of any change in your address, giving both the old and new location.

RENEWALS—When subscription expires you will find a renewal blank enclosed. Return with remittance promptly.

Yearly Subscriptions in U. S., $2.00
Outside U. S., $2.48; Single Copies, 20 cents

Entered as second class matter Oct. 9, 1913, Post Office at New York, N. Y., under the Act of March 3, 1879.

Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

Bakelite Micarta

For

Insulating Purposes

The superior qualities of Bakelite Micarta as an insulating material can be judged by its ever-increasing use. This, of itself, is proof that its remarkable qualities have appealed to the designing engineer.

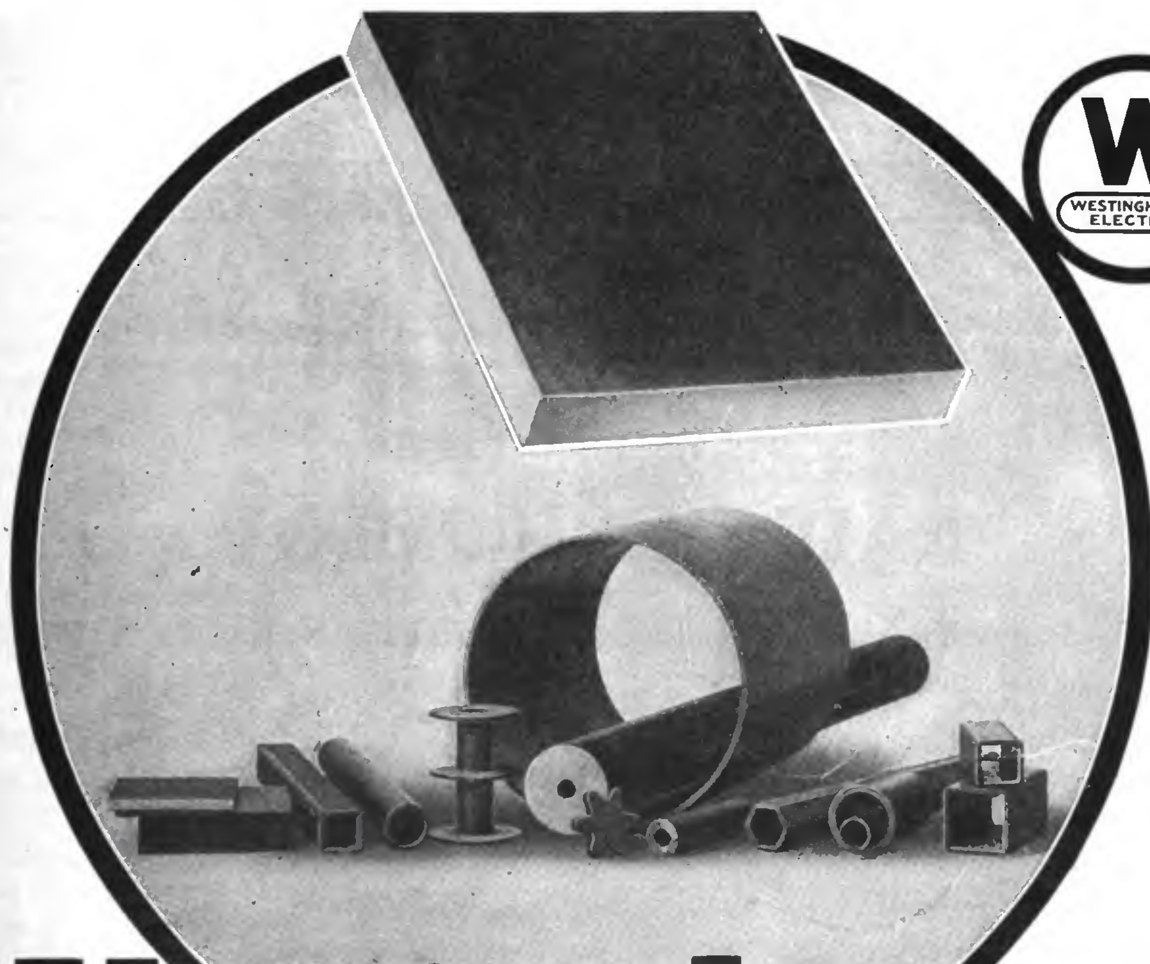
Bakelite Micarta is especially well known for its unusual dielectric and mechanical strength. It is a hard, compact material and will neither shrink, swell nor warp. This material is unaffected by water, oil, and atmospheric changes.

Bakelite Micarta is in many ways superior to hard fibre, rubber, built-up mica and other insulating materials of resinous or fibrous composition. It is furnished in plates, tubes or rods.

This material was primarily created for, and is extensively used in, the manufacture of our own products.

Write for complete descriptive catalogue 5-A

WESTINGHOUSE ELECTRIC & MFG. CO.
East Pittsburgh, Pa.



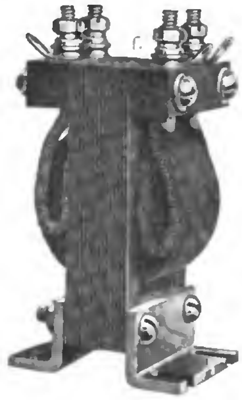
WESTINGHOUSE ELECTRIC

Westinghouse

Federal Radio Accessories and Parts

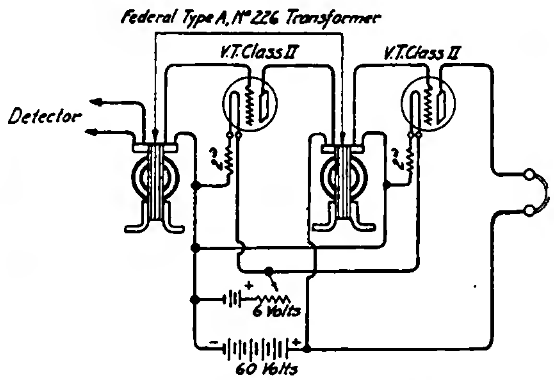
Are Distinguished for Their
Reliability, Quality and Efficiency

WRITE FOR BULLETIN 101 AND 102



No. 226-W Type A

AUDIO FREQUENCY
Transformer
$7.10 each



CIRCUIT WITH TWO STAGE AMPLIFIER

No. 52-W 2200 Ohms

LIBERTY HEAD SET
$12.50 per set

One 226-W Transformer with one Marconi V. T. gives an energy amplification of 400 times. (Audibility amplification of 20 times.)

Two 226-W Transformers with two Marconi V. T.'s give an energy amplification of 160,000 times. (Audibility amplification of 400 times.)

Federal Telegraph and Telephone Co.

Buffalo, New York

Every Month in the Year

brings its need for new

RADIO EQUIPMENT

Whether it is a Transformer, Condenser, Quenched Gap, Radiophone or Vacuum Tube you are assured that we carry it in stock.

And so—the next time you find it necessary to add to your equipment, why not write us for price and description of the particular piece of apparatus you require?

*Bulletin 14 will be sent upon receipt of 10 cents—
amount may be deducted on first dollar order.*

ATLANTIC RADIO CO., Inc.

88 BROAD ST. BOSTON 9, MASS.

THE VACUUM TUBE SITUATION

WHEN the Marconi-Deforest patent arrangement was first entered into, whereby the Moorhead - Deforest - Marconi V. T. was put on the market, the Wireless Improvement Company purchased the first large supply in order to get the pick of the limited quantity originally acquired by the Marconi Company.

We understand the above arrangement has now been terminated and only those who have still a supply of tubes in stock will be able to furnish them for the present.

We have decided to give the amateurs the benefit, for 30 days only, of the large stock we have been carrying for dealers. For the next 30 days, while they last we shall accept orders at list price $7.00 Net, Parcel Post Paid. Check or money order should accompany all orders. These are all picked tubes and are fully guaranteed.

We manufacture a full line of apparatus and accessories, all complying with Navy specifications — which are available to the High grade amateur and experimenter.

DEALERS SHOULD WRITE FOR OUR EXCLUSIVE AGENCY PROPOSITION

WIRELESS IMPROVEMENT COMPANY, Inc.

Radio Engineers, Manufacturers and Distributors,

47 West Street, New York, U. S. A.

If this page is cut out and appended to the same page cut from the editions to follow, a complete file of very interesting information will soon be available. (No. 4)

Vol. 7. No. 7. April, 1920

THE WIRELESS AGE

WORLD WIDE WIRELESS

China Adopts Radiophone Between Cities

CHINA, that land of oriental apathy, which has been asleep for centuries while other nations have moved forward in the march of progress, has beaten the world in the adoption of one modern idea. Guglielmo Marconi calls attention to the fact that China is first among the nations to adopt wireless telephones to carry on communication between cities and rural districts. However, Marconi predicts that wireless phones will within a year supplant the present kind in many lands and that they will be given the widest use in the United States, which, he says, heads the list of nations in wireless inventions.

The wireless telephone has limitless possibilities and should be a great advance step over the present cumbersome system, which requires an enormous amount of work to keep up and at a tremendous expense.

Chinese Government to Establish High Power Stations

IT is reported that the English Marconi Company is making arrangements with the Chinese Government to establish high power stations in Pekin, Urga, Urumohi and Kashgar, which will be able to communicate day and night with the Indian Government station of Simla. There also are to be subsidiary stations in Uliassutai, Kobda, Sianfu and Hami. It seems evident that well informed people feel that these trade routes are of very great importance. If a railway is to be constructed from Kalgan through Urga to connect with the Trans-Siberian. and the old routes to India are to be reopened, the situation in eastern Asia will be materially affected.

Wireless Service for Mexican Border Patrol

IN order to reduce the danger of American Air Service pilots accidentally flying over Mexican territory or becoming lost while on border patrol duty, the commander of the 91st Aero Squadron stationed temporarily at Ream Field, Imperial Beach, Cal., has had every plane of the squadron equipped with a radio set with a wave length of 377 metres, which is the best wave length to dodge interference. All pilots are required to check their position every five minutes.

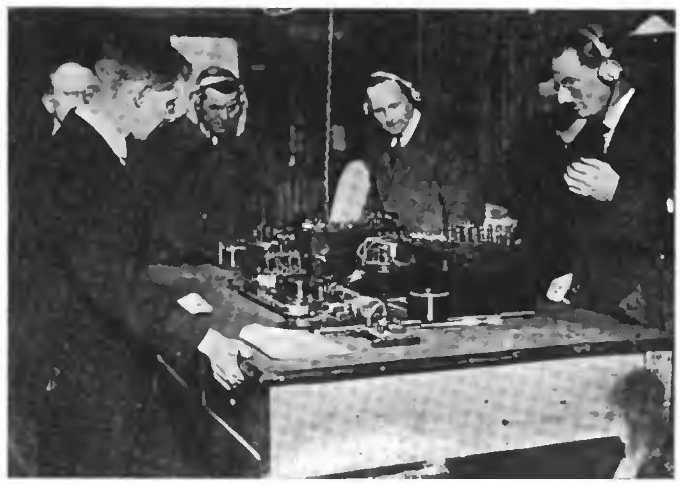
As a further precaution the radio officer of the 91st Squadron has erected at Ream Field a radio compass station by which readings are taken while planes are sending in their position reports. As the course is almost straight east from Ream Field the radio officer can tell almost instantly whether a given plane is holding to its proper air line.

Should a pilot become confused, lose or mistake his position and turn south, the radio compass would immediately show that the plane was over Mexican territory.

1500-Mile Radiophone Message at Sea a Surprise

NEWCOMB CARLTON, President of the Western Union Telegraph Company, returning from a vacation in England on the steamship Baltic, said that on the trip the wireless operator of the vessel afforded him an opportunity to hear a voice over the wireless telephone from a distance of 1,500 miles. There was some slight interference, but Mr. Carlton was greatly impressed by the experience.

Speaking of the wireless, he said it would not supplant the cables, but would be a valuable service to commerce.



(Underwood & Underwood)

Demonstrating the operation of the new wireless bell device with which it is intended to displace the S O S distress signal at sea

England Receives Wireless Offer From Marconi

THE British Government has received an offer from Guglielmo Marconi to link up the entire British Empire in a chain of wireless communication, the system to be turned over to Government ownership, if desired, at the end of thirty years.

Plan to Detect Mysterious Mars Signals

ORGANIZED tests of the mysterious signals supposed to come from some other planet will be made toward the end of April when Mars reaches the nearest point to the earth, Godfrey Isaacs, director of the English Marconi organization, has announced. All Marconi stations will be instructed to watch out for mysterious messages, he said, adding:

"We will try first to discover whether the sounds are picked up in various parts of the world in the same instant, because, if so, the theory that they are definite messages from another planet will be enormously strengthened."

New York Auto Show Has Radio Tractor

THE radio exhibit at the automobile show, New York, staged by the Signal Corps, presented many interesting features, most important of which probably was the army radio tractor, which was used extensively in the recent war. One company in each field battalion is equipped with this tractor.

The special body housing the equipment, is mounted on a two-ton chassis. The tractor is, in itself, a complete radio station of moderate power. The antenna is of the umbrella type, and is carried with the tractor, while the radio generator is operated with the transmission in neutral. While driving the generator, the speed of the engine is governed by a centrifugal governor.

Tractors of similar type were used in the campaign in Mexico, and were also in service with our forces overseas, and are now used extensively by the troops on the border.

Marquette to Have Wireless Station

THE United States Navy Department means to establish a wireless station at Marquette as a part of a general program for giving added protection to Great Lakes navigation.

A representative of the big station at Great Lakes recently visited Marquette and looked over a site on Presque Isle as a possible location for a wireless station. One acre of land on the northeastern corner of the island is owned by the government, and has been retained for lighthouse purposes. The navy man after inspecting the site said it would be the ideal spot for a wireless station.

Navy to Promote Amateur Wireless in California

PROMOTION of amateur radio plants and the study of radio operations has been undertaken on a big scale by the officers of the Twelfth Naval District, San Francisco, Calif.

Lieutenant Commander S. D. McCaughey, district communication superintendent of the Twelfth Naval District, has sent out a circular letter to all radio amateurs outlining plans for the navy co-operation with them. This will include a press service for amateurs and later a special code for reception of code messages to be broadcast for them by the navy.

Advice and assistance in development of their apparatus and ability of reception will be tendered by the navy officials.

All amateur radio stations in the district, embracing California, Utah, Nevada, Colorado, New Mexico and Arizona, are requested to obtain a "data sheet" from the district communication superintendent, U. S. N., Room 418, Sheldon building, San Francisco.

California has been divided into five leading districts, with an additional sixth district taking in all territory not included in the first five. Each of the California districts is formed by a radius of seventy-five miles from the following navy radio stations. Yerba Buena Island, San Francisco Bay; East San Pedro; Point Loma, San Diego; Table Bluff, Eureka, and Point Arguello, near Point Concepcion.

Within each district the amateurs will hold meetings and establish definite rules and regulations for communication among themselves to conform to the regulations relative to wave length restrictions, 200 meters, and power regulations, one-half of one kilowatt.

Competitive drills in communication will be sent out by the navy stations to determine rank among the amateurs.

London Wireless Inventor Hears Concerts in Italy

A LONDON inventor, H. Powell Rees, has invented a wireless-telephone apparatus on which messages from Moscow and concerts in Italy have been heard, although the aerial used is only an 85-foot wire hung outside of his bedroom window, according to a Times copyright cable. The mechanism is contained in a tiny box and the cost of manufacture is said to be small. Messages from American stations are also readable.

New York Central R. R. Radiophone Tests Successful

A WIRELESS telephone conversation was recently carried on for an hour without interruption on the Harlem and Putnam divisions of the New York Central, between Elmsford and Millerton, 78 miles apart. The experiment was made by Maj.-Gen. George O. Squier, signal chief of the United States army. The direction of the waves was guided by the wires strung along the tracks. He was able to speak to and from moving trains and send a number of communications simultaneously.

Moscow Wireless Works Without Stop

THE wireless at Moscow works twenty-four hours a day and grabs practically all the wireless news from America to European countries. Each morning in Moscow bulletins containing this information are printed and distributed in the industries, in the peasant villages and among the soldiers.

Venezuelan Government to Build High Power Station

THE Venezuelan government, up to June 30, will receive bids for the erection of a powerful wireless station to be built near Caracas, which will be of sufficient power to communicate with similar stations in the United States and Europe.

U. S. Forest Service to Use Radiophone

PRELIMINARY tests of the wireless telephone by officers of the Forest Service of the Department of Agriculture, in the vicinity of Portland, Ore., lead to the belief that this invention can be utilized extensively in the national forests, especially in fire-prevention work. The results so far are pronounced satisfactory.

One of the sets in the tests was installed on Mount Hood, Ore., where the problem of providing a satisfactory support for the antennae was a difficult one, since a mast was needed which would be strong enough to resist seventy or eighty mile gales that sweep the mountains. At the same time the mast had to be light enough for the men to be able to raise and lower it before and after sleet storms. A fifty-foot bamboo pole was finally selected as the support.

In the telephone conversation between the sets, some of which were ten miles apart, the voice carried very clearly and was about as loud as over a wire line. Telegraph signals from many stations scattered over the continent were picked up. On Mount Hood they often were so loud as to be audible in any part of the cabin.

Trans-Oceanic Radiophone Service Within Six Months

WIRELESS telephonic communication between England and America has passed beyond the experimental stage.

"Within six months," says Godfrey Isaacs, Managing Director of the English Marconi Company, "we may be speaking to New York, Boston, Chicago and any other towns in the United States more quickly and easily than we are able to communicate with Birmingham or Manchester."

Mr. Isaacs said the cost would only be a few shillings for a three-minute conversation and he added: "In a year or so we hope to establish regular telephonic communication with Australia. We hope to bring every country in the world into telephonic communication with each other—not in an indefinite time, but very soon."

London and Paris Airplane Service Has Radiophone System

ON the regular airplane service now established between London and Paris a system of wireless telephony enables persons on the airships to be in speaking communication with ground stations. The voices are conveyed distinctly and can be identified as readily as if those conversing were face to face. This wireless conversation has been tested over a distance of fifty miles, which is as far as is required in the interval between stations.

Norfolk Police to Use Wireless

REAR ADMIRAL A. C. DILLINGHAM, retired. head of the Norfolk, Va., Police Department, with the title of Director of Public Safety, is working to bring the department up to a state of last-word efficiency through the establishment of an aero squadron and the equipment of the police stations with wireless outfits.

"The wireless," says Admiral Dillingham, "will enable us to get in almost instant touch with the police departments of New York and other great cities when necessity arises."

Saigon, Indo-China, to Have Powerful Station

ADVICES received at the headquarters of the Interchurch World Movement, which is making a religious, economic and social survey of the world, state that the most powerful wireless telegraphic station in the world is being installed at Saigon, Indo-China. This new station will be so powerful that communication may be had with France, Africa, Madagascar, French New Caledonia, Australia, Japan and the United States.

The report explains that the continuous wave system will be used and the electric power will be supplied by two converter groups equipped with internal combustion motors of 2,500 horse power. Aerials will be suspended from a height of 833 feet, nearly 100 feet higher than the Woolworth building, and the network of wires will be spread over nearly 180 acres.

This new station brings the world closer together by many thousands of miles, and it is expected to be of great aid to the Pacific northwest in carrying on transpacific business communications.

Italy and England Connected by Radiophone

WIRELESS telephone communication has been established between England and Rome, the Daily Mail announces.

The distance is more than 2,000 miles.

Denmark and America to Be Connected by Wireless

A DANISH radio commission is proceeding to America on April 8. The commission will negotiate with the American authorities for the linking up of a radio service between the United States and Denmark.

(Underwood & Underwood)

Kansas operator listening to music and conversation from New York transmitted by a radiophone set using a vacuum tube and one-third kw. generator

Bolivia Gets Three New Wireless Stations

THE Ministry of the Government of Bolivia recently accepted a bid made by the Bolivian engineer, Senor Humberto de Asin, to install three wireless stations in the country, to be located at Guayaramerin, Cachuela Esperanza and Trinidad. The Government will contribute the sum of 11,000 bolivianos (boliviano equal to $0.3893 U. S.) for the first, 25,000 bolivianos for the second station, and 75,686 bolivianos for the Trinidad station. These three wireless plants will connect the outlying districts of the republic with the rest of the country.

S. S. Imperator Receives Radio Messages from Scotland Across Atlantic

WITH a new wireless receiving apparatus rigged on her, the liner Imperator arrived from Liverpool recently. All the way across the Atlantic she received radio messages direct from the big station in Aberdeen, Scotland. It was the first time a vessel had been in communication with a single land station on an entire transatlantic trip. The transport George Washington, when she carried President Wilson to France the last time, was in direct communication with this side almost all the way across the Atlantic.

Sir Ernest Glover, Director of the Ship Branch of the British Ministry of Shipping, was a passenger, and was much interested in the wireless feat.

Wireless in the A. E. F.

First Authentic Account of the Organization of the Radio Division of the Signal Corps and an inside View of the Great Obstacles Which Americans Had to Overcome

By Lieut. Col. L. R. Krumm
Officer in Charge of Radio Division, Signal Corps, A. E. F.

and Capt. Willis H. Taylor, Jr.
Co-ordination Officer, Radio Division, Signal Corps, A. E. F.

Part IV—Listening Stations

LISTENING stations were a development of trench warfare, so it naturally followed that the credit for the first utilization of the sensitive low frequency vacuum tube in connection with grounded antenna covering a considerable area was variously claimed by the different armies engaged in the war before our entry. Documents published by the Intelligence Service of the British Army indicated that the German army used their stations against them at the first battle of the Marne. Certain it is, that at the end of the war, the Germans were as well informed regarding listening stations as were the Allies.

This listening station was located in a Vosges mountain sector and was operated jointly by the French and Americans

The information regarding German listening stations published by the British Intelligence Service consisted of captured orders and other data indicating that at the beginning the Germans realized that the effectiveness of listening stations was unlimited, if knowledge of their existence and efficiency could be kept from the enemy. They took extraordinary precautions to keep from their own men—other than those actively engaged in the operation of the stations—knowledge of the existence of these stations. This was the reason why their soldiers, when taken prisoners, could give no hint to the Allies during the usual gruelling cross examination. All the information obtainable indicated that the operators were especially selected and trained for this duty, this personnel being entirely segregated from other troops and special arrangements made for their subsistence and maintenance, making it unnecessary, and in fact, almost impossible, for them to come into contact with the general body of the combat units.

Stories were current of the early days of trench warfare, when in many places the front line trenches were separated by a strip of No Man's Land only fifty yards wide and the necessity for the telephone code was not appreciated, that many an attack came to naught because of information intercepted from telephone lines of both sides by these listening stations. Later, when their use became general in all the armies, the Germans were evidently so impressed by the effectiveness of their own stations that they greatly restricted the use of the telephone in their front lines. The instruments were sealed and their use limited to absolute emergencies; an explanation was required from the breaker of the seal as to the necessity for usage of the telephone.

The interception of T. P. S. messages naturally could not be prevented, and, as with radio, the use of code was compulsory, but even here the Germans attempted to prevent the effective use of our listening stations by employing interfering screens of audio-frequency ground currents, as will be explained later.

Toward the end of the trench warfare operations, listening stations lost a considerable part of their effectiveness because of the general knowledge of their use by all the armies. Possibly the greatest factor in limiting the results obtained by the enemy listening stations in interception of conversations on our lines, however, was the radio section listening stations which acted as monitors of our own circuits. A well insulated and balanced metallic telephone circuit is practically immune against eavesdropping, but such lines were difficult to maintain in quiet sectors and practically impossible in active sectors. Faulty conditions on our own lines were therefore immediately revealed through our listening stations, as well as the transmission of indiscreet messages over leaky or grounded telephone lines. As a result, our telephone circuits were maintained in the best possible condition through the operation of our listening stations against them as well as against those of the enemy. Many an infantry officer reading this article will realize for the first time the source of information upon which was based the reprimand he received for the transmission of an important message in plain English over a telephone.

The use of the listening station was continued in our army up to the last, even in mobile warfare, although conditions were generally unfavorable. The fact that the hastily rearranged and reconstructed telephone lines of the enemy were increasingly defective, compensated somewhat for the difficulties encountered in the operation and maintenance of our stations.

Prior to the development of the listening station, adventurous men in the Allied armies had endeavored to ascertain the enemies' plans by direct tapping of their telephone lines, signalmen crawling across No Man's Land on dark nights to bridge a telephone on the enemies' circuits. But even the advent of the listening station did little to lessen the hazards, and no activity of the Radio Section of the Signal Corps, A. E. F., was more thrilling—and more interesting—than the listening station service.

The radio intercept and radio goniometer service which has been previously described was probably the source of more information, but these stations were usually placed from five to ten kilometers back of the line, in locations of comparative safety. In quiet sectors, and during the first months of our army's operations in France, this class of stations took on to some extent the humdrum character of a commercial receiving station. But the listening stations located in dugouts in or near the front trenches were never without excitement, nor were the personnel assigned to them permitted by the enemy to forget that they were actively participating in a war.

While the function of the stations and the duties of the operators were limited in possibilities, life in a listening station never became monotonous or lost its fascination. Thus the listening service became the goal of every member of the Radio Section who craved action and adventure. However, the qualifications necessary for service in listening stations were more than ordinarily diversified. The first essential was a thorough familiarity with the German language. The operators were given a course of training to familiarize them with the military phrases they might be expected to overhear, but fundamental knowledge of German was a necessity; time did not permit the teaching of the language, and a superficial knowledge was not sufficient. Most of the men selected were of German descent and accustomed to speaking the enemy language previous to entering the army.

Our first effort to obtain suitable men took the form of a request for the Signal Corps in the United States to send over all the German-speaking radio operators available. Inasmuch as the first detachment of 40 German-speaking radio operators, which arrived about the beginning of January, 1918, apparently exhausted the supply, it was decided to make no further efforts in this direction. It was found that the ability to receive and record T. P. S. (ground telegraph) messages was secondary to the necessity of knowing German thoroughly, as T. P. S. code was sent slowly, usually not exceeding the rate of 10 or 12 words a minute. All efforts were, therefore, directed to obtain personnel by selecting men already in the A. E. F. having a knowledge of German and teaching them the T. P. S. code.

Our efforts to obtain such men from the different line organizations in the A. E. F. were productive of many laughable results. Evidently the commanding officers of many units assumed that if a man spoke any foreign language it must be German, and with the numerous nationalities represented in our army the possibilities in selection are evident. Many also reported with only a smattering of German and were promptly returned to their outfits, except for a chosen few whose cooking ability was utilized in place of alleged philological accomplishments.

The selection of German-speaking soldiers also had its less humorous side. When the first detachment of operators arrived from the United States, the men themselves had no definite idea of their prospective duties. An intelligence officer was detailed to ascertain the extent of the linguistic ability of each member, and few made any effort, for they were fearful that signs of ability coupled with German names might be prejudicial to their interests. Only after it was explained that they were intended for a duty of a particularly valuable nature did they loosen up; even then some of them did not disclose their true fluency.

Special commendation is due the men in this service for their great devotion to their duties. Above all, a listening station operator had to be observing, possess imagination and be able to visualize the possibilities within snatches of enemy conversation that came to his ears, and he had to do it quickly if his intuition was to be of any value. We were fortunate in having in our service many men possessing all the qualifications, perhaps the best of whom were those who had been newspaper reporters before the war.

Proper conception of the operation of a listening station requires an understanding of the elementary electrical phenomena which it makes use of, principles which are the same as those used in the T. P. S. (ground telegraphy) operations. Figure 1 shows a T. P. S. buzzer transmitter with its ground connections at the end of wires of approximately 100 meters length. The transmitter is an induction coil taking about 5 amperes at 10 volts in the primary, and generating in the secondary coil a high voltage alternating current of audible frequency. The secondary coil is connected direct to the grounds, the lines of current flow between which are indicated by the dotted lines in figure 1. The equipotential lines (shown in full lines in the figure) are perpendicular to the lines of current flow. If two earth connections are made at points such as 4 and 6, which are not on the same equipotential line, and if the wires leading to the earth connections are connected to a pair of telephone receivers, a current will

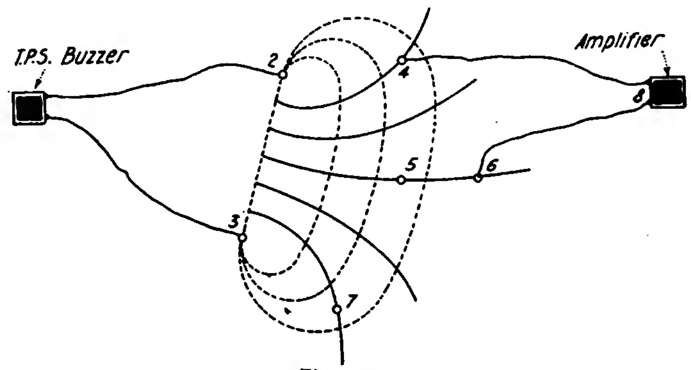


Figure 1

A T. P. S. buzzer transmitter with its ground connections at the end of wires of approximately 100 meters length

pass through the 'phones. If the current is of sufficient strength, the T. P. S. buzzer signals will be heard. If the current is weak—and it usually is—it is necessary to insert an amplifier in the wires leading to the earth connections. It was for this purpose that the vacuum tube amplifier came into use. The amplifier with the two wires and the earth connections—or "earthed antenna," as they are called—make up the essentials of a listening station. If, instead of the two earths 4 and 6, which are situated on two different equipotential lines, two earths, 5 and 6, on the same equipotential line are chosen, no current will flow and, therefore, the buzzer signals will not be heard by the listening station. For similar reasons two earths, such as 4 and 7, which are at a greater difference of potential than the earths 4 and 6, give stronger signals than the earths 4 and 6.

There is also another and lesser effect to be considered, the effect of induction. The circuit 1, 2, 3, is a closed circuit, the earth closing the circuit between 2 and 3. Similarly, 4, 6, 8, is a closed circuit. Therefore, the buzzer loop affects the amplifier loop to some extent by electromagnetic induction. Leaving out of consideration the question of phase difference, the inductive effect adds to the difference of potential effect, discussed in the preceding paragraph. In general, in a system such as shown in Figure 1, the inductive effect is much smaller than the difference of potential effect. Other effects such as the direct inductive and capacity reactions between the earthed antenna of the buzzer circuit and those of the amplifier circuit, etc., may be disregarded, because of their relatively small importance in comparison to the first two effects.

A grounded telephone system used as the source of signals may be considered in exactly the same way as has been done for the T. P. S. buzzer set; there is no difference between the two cases.

An insulated telephone system presents a slightly different case. This system influences the receiving station only by induction. This it does in two ways: first, by direct inductive action on the loop of the receiving station; and second, indirectly, by inducing earth currents which are then picked up by the earths of the receiving station. If the line wires of a well insulated metallic telephone circuit are twisted together, the resultant stray field is feeble, and hence any inductive effect is small. It is practically impossible to overhear signals on such a system.

If the two earthed antenna of the listening station (Figure 1) are entirely insulated from the ground, and if the ends, 4 and 6, are connected by a wire also insulated from the ground, we then have, instead of the earthed antenna, an insulated loop, and the station receives signals by induction only. The insulated loop system was used to some extent by the French.


Listening stations are a development of trench warfare and no activity of the Radio section was more thrilling and more interesting

A listening loop utilizes inductive principles only, and its main advantages over the grounded antenna—in which it is very similar to the radio loop—is its comparative freedom from ground static. Loops were not used extensively by us, because of the difficulties of properly maintaining and repairing them. Loops installed in trenches are too liable to injury, so we placed our reliance in grounded antenna. Several turns in the loop are necessary to obtain satisfactory results and this naturally adds to the maintenance difficulties.

It must be remembered that these listening stations can be used only where conditions are favorable and when the opposing armies are fairly close together, as in trench warfare; and also when the intervening conditions of the terrain are such as will not shunt or side-track the currents which it is desired to intercept. An intervening river or gully or metallic geological formation was found to prevent successful operation in many places.

It was necessary to get the ground plates as close to the enemy as possible, and their installation required the highest type of bravery in the men who accomplished it. The personnel operating listening stations were continuously on duty one week, then off one week, which kept them in the front lines considerably longer than was required of the infantry under ordinary conditions.

The dugouts in which the stations were located were usually a few hundred meters from the front line, and generally in the support or communication trenches; but some times they were concealed under the ruins of a demolished house or structure. One of the first stations established in the Toul Sector, where most of our troops of all services obtained their first taste of real war, was in the village of Marvoisin at the foot of the ever menacing Mt. Sec. The dugout was located under the ruins of an old stone church which had been demolished by shell fire, but it was seen that these ruins formed a fine protection for the station when an enemy shell made a direct hit, but did not penetrate into the dugout proper. The force of the concussion demolished the amplifier and threw the operator on duty off his comfortable seat; it also greatly enhanced his respect for churches.

From the dugouts the leads followed the trenches to their terminating grounds, located at intervals of several hundred meters along the front line trenches and close to the enemy lines as possible. These grounds consisted of copper mesh mats about two by ten feet, buried a few feet under ground. If it was impractical to thus install them, a group of metal stakes were driven down.

Because of the large area covered by the ground antenna these stations were more effective in receiving T. P. S. messages than the regular T. P. S. receiving stations in which grounds were usually separated by approximately 100 meters. Nearby radio stations could also be heard when the French amplifier was used, a combination apparatus providing for the rectification and amplification of radio signals in one position of its control switch, and low frequency amplifications with all three tubes, with the other position. Even when so used, it was found that radio signals could be heard in it. Investigation developed that the first low frequency transformer connected to the ground antenna showed a capacity reactance to radio frequency currents due to its distributed capacity. The inductive effects of this radio frequency current on the remainder of the amplifier wiring evidently resulted in the unintentional detection of radio stations and a demonstration of grounded radio antenna possibilities.

Because it was possible for the listening station to select different grounds, an idea of the approximate direction and distance of a transmitting station might be obtained by an operator of long experience. T. P. S. messages could be heard for as much as 4 kilometers and telephone conversations 2 kilometers. This distance of course depended on the degree of grounding of the telephone lines. The listening station shown in the accompanying photograph does not by any means represent a typical one. It will be observed that it has been located in the same place for a considerable period. This station was located in a Vosges mountain sector on the extreme right of our Toul Sector and was operated jointly by the French and ourselves. The quietness of this sector is attested by the neatness and the apparent comparative comfort.

From the station dugouts the insulated leads radiated to the grounds, which were from 500 to 1500 meters away, and distributed along the front line trenches at intervals of from 200 to 300 meters. They were often carried well over toward the enemies' trenches, for the effectiveness of the station was dependent on the distance to the source of the intercepted current, as will be appreciated from the foregoing explanation. Grounds were also installed in our own area back of the station for use when it was used as a monitor for our lines. Because of the proximity of listening stations in this work it was much easier to overhear the communication within our lines, and by the same token this drowned out much of the German communication we were trying to copy. Listening stations have more interference to contend with than a radio station, because the element of tuning is not available and because of so-called "earth static."

The principles used in listening stations are well known and have long been utilized, but only with the development of the super-sensitive vacuum tube amplifier did their possibilities become valuable for war purposes. The type 3 ter French amplifier first utilized has already been described. Later the type SCR-72 amplifier was received from the United States, and was found to be a trifle more efficient for voice and audible frequency currents. The circuit for this amplifier is the usual audio frequency amplifier utilizing two tubes as against three in the French amplifier, but it was only intended for low frequency amplification and no provision was made for rectifying radio frequency currents as in the French instrument.

Many times it seemed that the Germans were providing an electrical screen for their communication, for their motor noises came in so loud in some cases that we believed they had intentionally carried over wires from their machine and grounded them near or in our lines so as to drown out the signals from their T. P. S. stations further back. However, it was noticed that if these motor noises stopped there was an immediate increase in the T. P. S. activities so that if it was a purposely provided screen it would have also been effective in interfering with their own ground telegraphy. No doubt it was effective in protecting their defective telephone lines.

That the operators determined the efficiency of our listening service, however, is a fact that must not be lost sight of. This service could not be organized as scientifically as the radio intercept stations, in which gonio stations could locate the radio stations intercepted and wave lengths could be measured and other characteristics of the stations recorded. The listening station operator had only his ear to aid him in determining the probable distance and location of the station he overheard. T. P. S., like radio, has characteristic notes and the operator's "fist" also betrays itself, but neither of these are as pronounced as in wireless.

The listener had therefore to depend on his judgment to determine what any unusual occurrence or activity might foretell, in addition to what might be revealed by the decoding of the message he recorded. He soon learned that unusual T. P. S. activities by the enemy forecasted a military offensive or some unusual operation. For weeks his efforts might be unproductive, but his vigilance could not be relaxed. A probable change in an enemy station could be noted by a change in its note or in its intensity. A sudden change in the T. P. S. communications indicated a difference in the troops opposite or a rearrangement of their lines. The first information regarding the relief of enemy battalions opposite was usually obtained through our listening station operators noting the change in their T. P. S.; in nearly every case the operator's deduction would be later verified by a prisoner.

By diagramming the T. P. S. stations of the enemy according to loudness and the stations with which they worked, operators could quite accurately place the large and small units, their observation posts and posts of command. Just previous to the St. Mihiel operations, the operators quite accurately reported the withdrawal to the rear of the enemy T. P. S., which indicated the removal of troops from the front lines, or at least a rearrangement of the forces.

The listeners were repeatedly commended by the General Staff for their intelligent deductions, especially with regard to telephone interceptions. In this work—which could not be recorded literally—the operator had to act as an intelligence officer. One man deduced the arrival of a new division opposite him by the increased politeness used in telephone communication, and he proved to be right in his surmise. As the Germans also used code words for all places and military phrases in their telephone conversation, only the slightest clues were available for making deductions. Through hearing a certain time spoken repeatedly by the enemy and its anxious reception at the other end of the lines, the 42nd Division was warned of attacks on Ferme-le-Chamois, Village Negre and La Chapellette, and being forewarned they effectively repulsed the offensive.

The most hazardous part of the operation of the listening station was in the maintenance and installation of the ground lines. The entire effectiveness of the station obviously depended on the maintenance of the lines in good condition; they were continually broken by artillery fire and the necessity for repairs was always immediate.

It was at these lines that the fibre of the station personnel showed at its best. Usually wearing their gas masks, the men stuck to the task, in most cases under shell fire, until they had established their circuits. In one instance

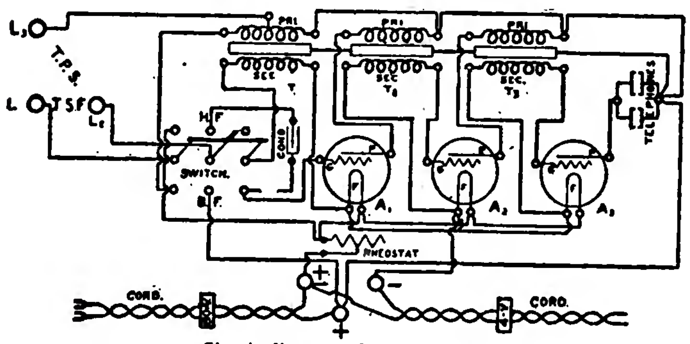
Facsimile of German poster distributed amongst the German Intelligence Service for the purpose of retaining secrecy

all three operators of the station were wounded during an attack on our position. The majority of casualties in the Radio Section occurred in this service, and there is not one case of a man shirking his duty. If a station was not getting satisfactory results it was usually the operators who suggested the advisability of carrying the grounds over nearer the German lines, then they would volunteer to install it themselves.

These night excursions to bury ground mats in the enemy area showed our men's intense interest and devotion to their work. At these times they were usually accompanied by a covering patrol and it took many hours of slow arduous crawling through barbed wire entanglements and across No Man's Land to carry the wire to the desired location. Then followed the stealthy burying of the mat to accomplish the desired end. Star shells threatened to reveal their presence every few minutes and they could advance only during the intervening periods. Returning, they might be taken for an enemy raiding party by some nervous doughboy and be received accordingly. This actually occurred more than once.

The Seicheprey fight was waged all around one of the listening stations and for a time it was behind the German front. Fortunately, in the night and the confusion its existence was not realized by them and when American counter-attack recovered the ground the operators were still on the job.

Another factor that increased the effectiveness of listening stations was the possibility of connecting on to old and grounded lines running over into enemy territory. In the continual surging back and forth of their fronts both armies necessarily abandoned lines in areas which later came under enemy control. The trenches were a mass of old and abandoned wires of both sides and these were usually the bane of the telephone men of our Signal Corps in taking over sectors from the French. Their greatest ambition seemed to be to tear them all out and start over with new and better circuits, thus in many cases they destroyed a source of information for us. In one case the allied armies were notified of a commercial underground cable, installed before the war, but lying behind both lines; this cable possibly would have been a fertile source of information to the army that could connect to it without the other's knowledge. Some of these old circuits that extended far back into our lines were certainly the source of information to the enemy, as there were reported many incidents, such as the shelling of expected relief troops or truck trains in the night, which could only have been ascertained by intercepting telephone conversations, possibly only a few minutes before the expected arrival. A typical instance was that of a Brigade headquarters which received its supply trucks every night at a regular hour, and as regularly the road was shelled. It was assumed the Germans had in some manner ascertained this hour and it was decided to change it. Arrangements were made over the line and, sure enough, the time of shelling changed also. Inasmuch as the headquarters was too far back for an ordinary listening station to be effective, it is probable that the Germans had connected to an old line running back over the intervening five or six kilometers.



Circuit diagram of 3-ter amplifier

One of the most daring feats in the listening service was that performed by Private 1st Class George Stroh, who volunteered to accompany a raid on the German position at Marcheville, and install a ground connection for his station inside the enemy line. He went along with the attacking party carrying his wire ground stakes and tools, and when the infantry had attained its objective he coolly proceeded to hammer in his stakes and lay his wire as he returned to his listening station in Soule.

Sergeant Carleton R. McQuown, while installing a ground at night near the enemy lines, discovered a machine gun nest, and the following night an American raiding party acting on his information succeeded in destroying it and capturing twenty-eight prisoners.

Incidents like these, indicating the bravery and resourcefulness of the listening station operators, were so numerous that only a few can be mentioned. It has repeatedly been said that the glamor has gone from war, but the experiences of these men, who in the new warfare combine somewhat the duties of both the scout and the spy give this assumption the lie. Among the men cited for their work by the General Staff were Corporal (later Lieutenant) Frank B. Fairbanks, Sergeant Braun, Corporals Floyd F. Felmick, L. V. Garner and H. T. Schoefer, and Privates 1st Class L. V. Pease, D. O. Butterfield, W. R. Hogel and Geo. J. Baum.

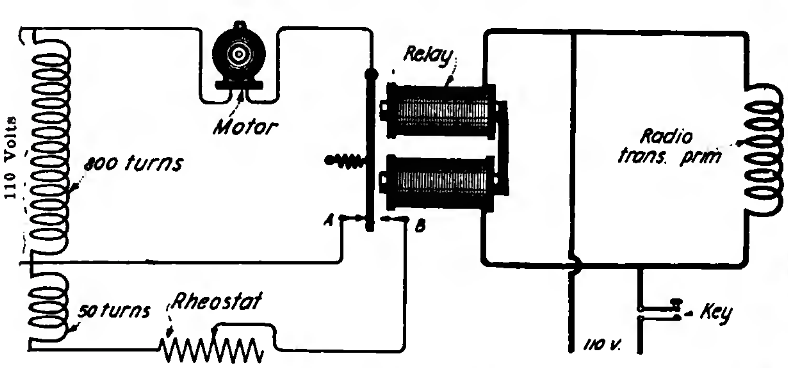
If anyone could be expected to be "fed up" on war, listening station operators certainly qualified. These men, in many cases for nearly half their term of service in France, had for their quarters dugouts the size of a packing case, with smelly pools rising in the bottom and rats and smaller but no less active intruders as constant companions. Under these conditions they worked, ate and slept—certainly they can claim to have done their bit for their country.

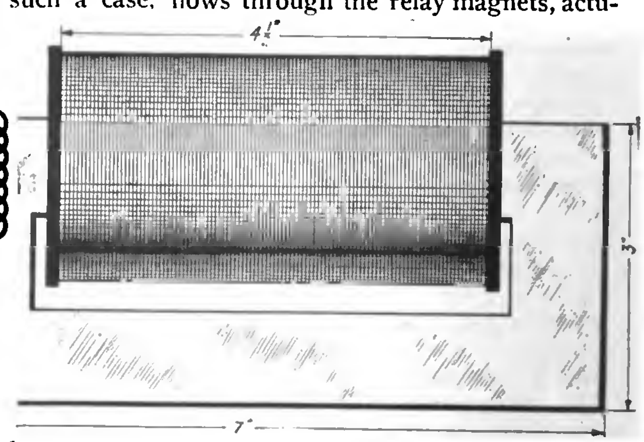
Constant-Speed Regulator for Series Motors

By L. A. Bartholomew

IN many amateur stations where a series motor is used for the rotary spark gap, in connection with a transformer of considerable input, the voltage drop when the key is depressed is sufficient to slow down the motor somewhat resulting in a disagreeable "whine" in the spark note. Sometimes this can be remedied by increasing the size of the wiring in the station, but more often it is due to insufficient capacity of the power company's feeders which is beyond the control of the consumer.

A method which has been found to give excellent results in such a case, and which may be of value to other amateurs troubled in the same way, is to insert a small auto-transformer in the motor leads with a double contact relay connected to the key. Figure 1 shows the circuit for such a device. When the key is open, the regular line voltage flows into the motor through the contacts A. As soon as the key is pressed, however, current also flows through the relay magnets, actuating armature and closing contacts B, which connects the motor across the entire winding of the auto-transformer, and the increase in voltage will compensate for the drop due to the





Circuit diagram and dimensions of coil

(Continued on page 22)

25-Mile Radiophone Transmitter Using Marconi V.T.'s for 200-Meter Amateur Work

By Chas. R. Leutz

A GREAT many amateurs would undoubtedly like to construct a short range 200-meter radiophone transmitter, using the Marconi V.T. tubes that are available, so I am undertaking to describe in detail the plans of a set which has shown its ability to work twenty-five miles in the day time with normal conditions prevailing.

Only four V.T.'s were required for the transmitter. The antennae used at both transmitting and receiving ends consisted of four wires, spaced three feet, each 100 feet long, T-type, with an effective height of 100 feet. Capacity was approximately .0008 microfarad and the fundamental wave length about 125 to 150 meters.

A Paragon short wave regenerative receiver was used at the receiving end with marked success. Two steps of transformer coupled amplification (audio frequency) were tried, and from the resulting increase in signal audibility, it is estimated that a range of 50 miles could be covered under favorable conditions.

Any V.T. acting as an amplifier or "repeater" will generate oscillations if coupling is provided to transfer energy from the output circuit back to the input circuit. The period of the oscillations may reach either audio or radio frequencies, which will depend upon the natural periods of the wing and grid circuits. For practical purposes and for adjustment to any desired wave length, only one circuit should control; as the wing circuit contains the most energy, it is the most suitable controller.

A schematic diagram showing the wiring of the circuit used is given in figure 1. It may be stated in this connection that the circuit used is not the most reliable and steadiest known, but this oscillating circuit does give a much better output with a given number of tubes than with more stable circuits where output has to be sacrificed to gain reliability. However, with intelligent operation, perfectly satisfactory results can be obtained.

The construction of the individual component parts of the complete transmitter will first be taken up separately and, as a suggestion, a drawing of the complete transmitter shown.

Figure 2 gives a cross-sectional view and an end view of the microphone transformer. As the schematic diagram indicates, a telephone microphone, a four-volt dry battery and the primary of the microphone transformer are in series. Speech directed into the microphone results in electromagnetic transformations in the transformer in accordance with the pitch and volume of the speech, and, subsequently, potentials are developed across the secondary of the microphone transformer, these potentials varying in accordance with the pitch and volume of the speech. This potential is thrown on the grids of the modulating V.T. tubes and modulates the oscillating current in accordance with the speech directed into the telephone microphone. Any ordinary telephone transmitter may be used, but a little experimenting will prove that some are far superior to others.

The construction is clearly shown in the drawing. The core consists of a bundle of soft Norway iron wire, No. 22 B&S gauge, ¼″ diameter, 4″ long. Two end pieces of dilecto 1½″ square and ¼″ thick are placed on each end of the core. Two layers of .010″ Manila paper are shellacked to the core for insulation and it is then ready for winding. The primary winding consists of 230 turns of

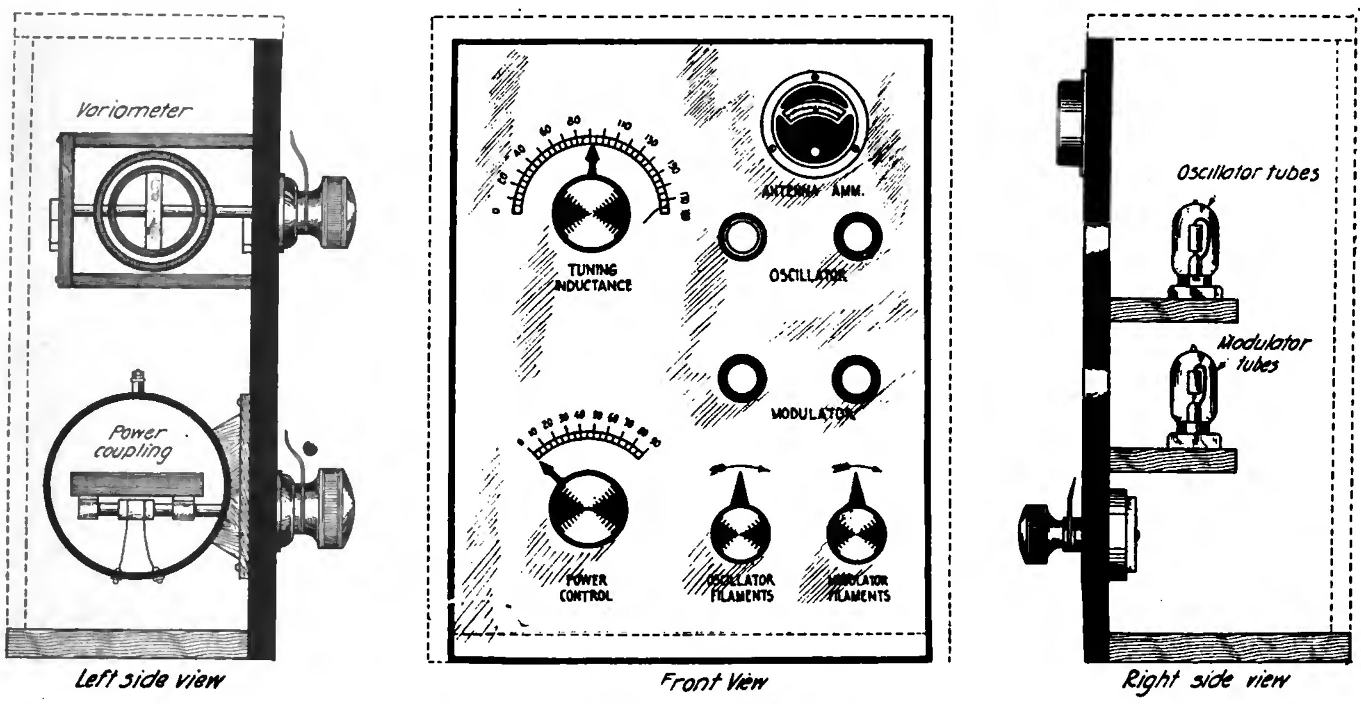


Figure 10—Panel assembly of the various instruments

No. 26 B&S double cotton covered wire, one layer of .010" paper between layers of wire. Over the primary winding, two layers of .010" Manila paper are wound and shellacked for primary-secondary insulation. The sec-

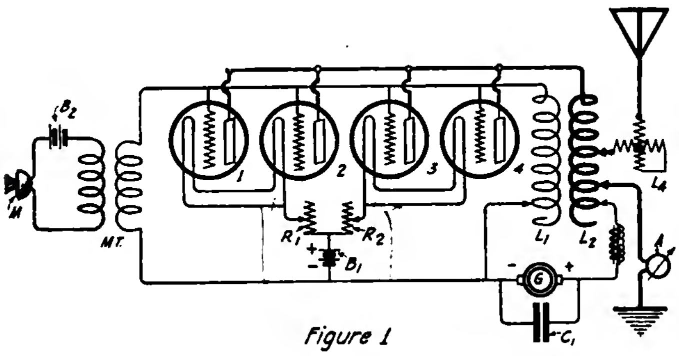


Figure 1—Schematic wiring diagram of the circuit used

ondary winding can then be placed on, consisting of 6,520 turns of No. 36 B&S enameled copper wire. A piece of Empire paper .001" should be placed between layers of the secondary winding. The start and finish of the windings should preferably be heavy flexible wire, such as lamp cord, which will allow external connections to be made safely.

Figure 3 shows, cross-sectionally, the constructional details of the audio frequency choke, shown in the schematic wiring diagram. This coil is placed in one leg of the generator line lead to prevent radio frequency oscillations from passing into the generator, or direct current supply.

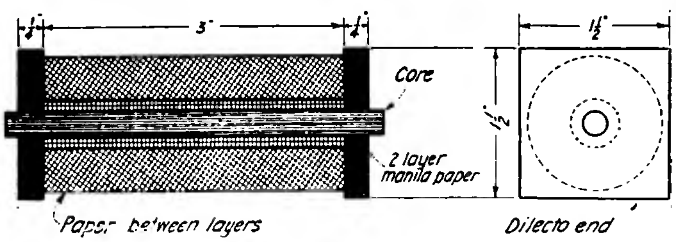


Figure 2—Cross-section and end view of the microphone transformer

The constructional details are very simple. Seventy leaves of .014 silicon steel, 6" long by 1" wide, are packed together and taped evenly with friction tape, making a core one inch square. Five layers of .010" manila paper are then shellacked on and the form is ready for winding. A total of 3,600 turns of No. 36 B&S copper enameled wire are wound on in layers, one layer of .001" Empire paper being wound between layers of wire. The winding space should only occupy 5" so that there will be space left on the core to place end pieces for support of the core by clamps, when assembling into the complete set. The start and finish of the winding should be a 6" piece of lamp cord, so as to provide substantial external connec-

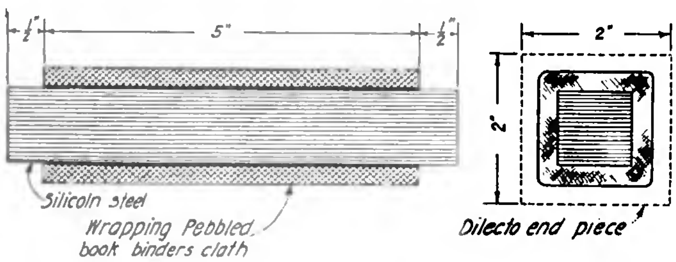


Figure 3—Constructional details of the audio frequency choke

tions. For the sake of appearance all coils may be covered with one layer of pebbled book binders' cloth.

Referring to figure 4, the method of mounting the Marconi V.T. tubes is shown clearly. The upper shelf holds the two oscillating tubes and the lower shelf holds the two modulating tubes. The tubes are mounted vertically, so that the filaments will not sag when they are heated and thus touch the grid. Observation holes may be cut into the windows so that the brilliancy of the filaments may be noted.

Figure 5 gives the assembly sketch of the filament rheostats, two of which are required. One controls the two oscillating tubes, and the other controls the two modulating tubes. A strip of fish paper, or other flexible heat resisting insulation, ½" wide by .040" thick, and 3" long, is wound with No. 24 Advance resistance wire, 26 turns

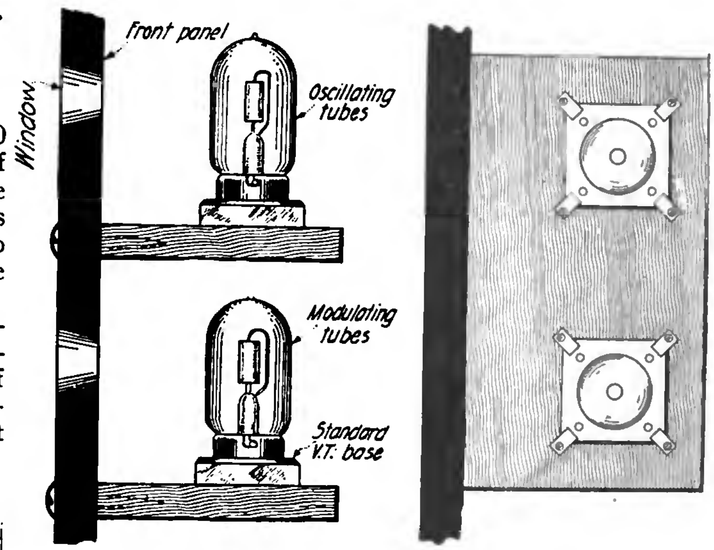


Figure 4—Method of mounting the Marconi V. T.'s

to the inch. The last few turns at each end are soldered together to prevent the winding from getting loose. After this strip is wound, it is forced into the circular slot in the dilecto base, as shown in the drawing. An adjustable contact with suitable bearings is shown so that the resist-

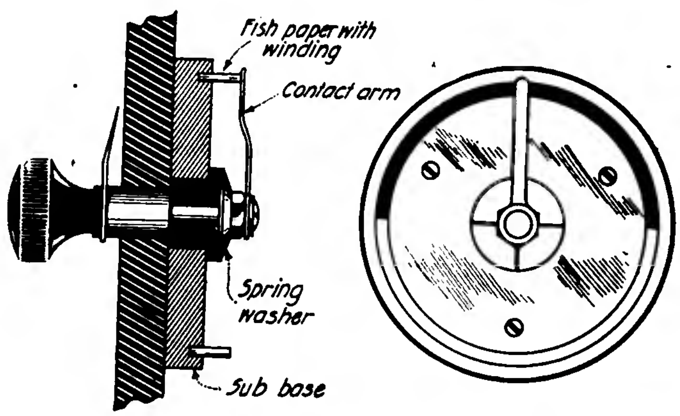


Figure 5—Assembly of the filament rheostats

ance may be varied in accordance with the value desired.

In the circuit diagram, it will be noted that a condenser is shown in shunt to the high potential generator. This should have a minimum capacity of 0.10 microfarad and should have enough dielectric strength to stand the full generator potential continuously.

A suitable 400-volt direct current generator may now be purchased on the market, or a lower voltage generator rewound and driven at a higher speed to give the necessary 400 volts. The generator should be one able to deliver about 125 milliamperes.

A description of the most important parts of the transmitter, the inductive coupler and the antenna tuning variometer, follows: For best efficiency the coils should have low distributed capacity and subsequently low high frequency resistance. For 200 meter transmission, investigations prove that solid wire will have the same or lower high frequency resistance than coils wound with Litzendraht, sometimes called high frequency cable. However, if longer wave lengths are to be used, say about 400 meters, high frequency cable may be used to advantage.

The wing inductance is wound on the stationary tube, figure 7, which is cardboard or dilecto, thickness 1/8", outside diameter 5½", and 2½" long. Upon this tube, 40 turns of 3/16 No. 38 Litzendraht, or No. 22 D.C.C. copper wire are wound. Taps are taken every three turns and brought up through the terminal block shown, so that substantial external connections may be soldered to the taps. Litzendraht may be successfully tinned by first dipping the wire in soldering acid and then heating to a cherry red, then wiping with cotton waste. Bare copper should then be dipped in a half-and-half solution of alcohol and rosin and dipped into a tin bath. After winding, all coils should be given a coat of Sterling or Ajax varnish and left to dry in an oven at about 200° F.

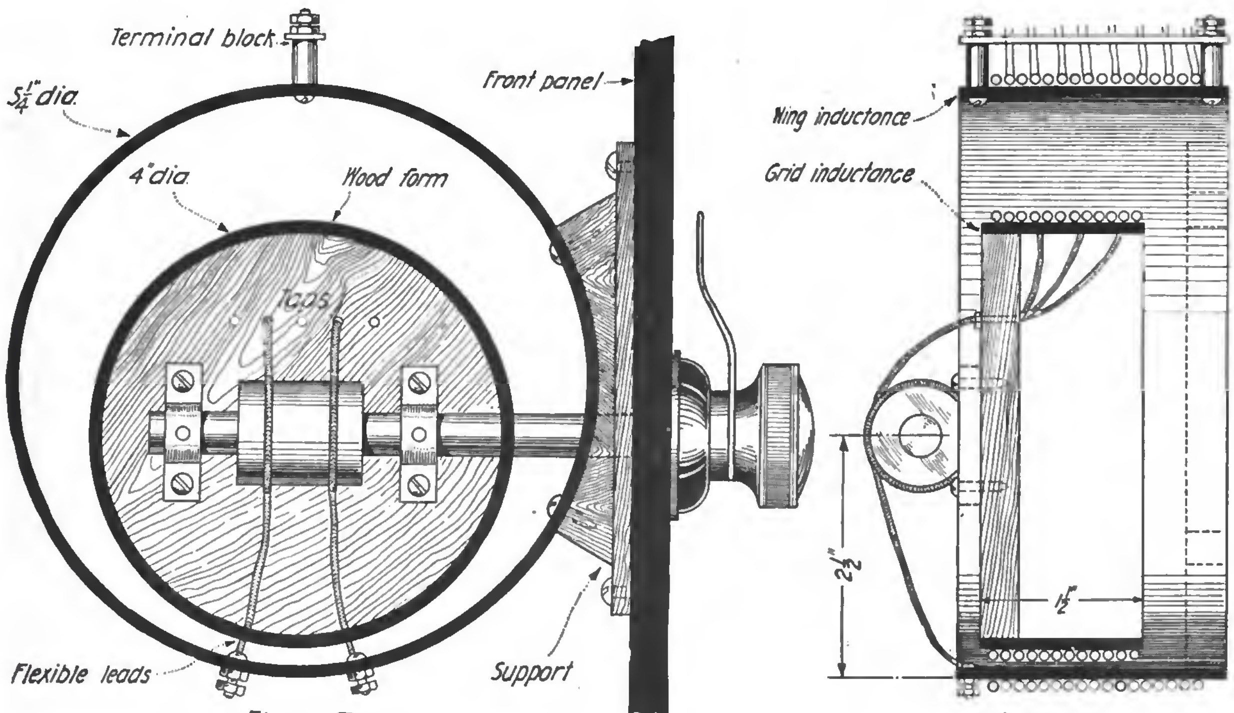


Figure 7 Figure 6

Figure 6—Front sectional view and Figure 7, side view of the construction of the coupling device

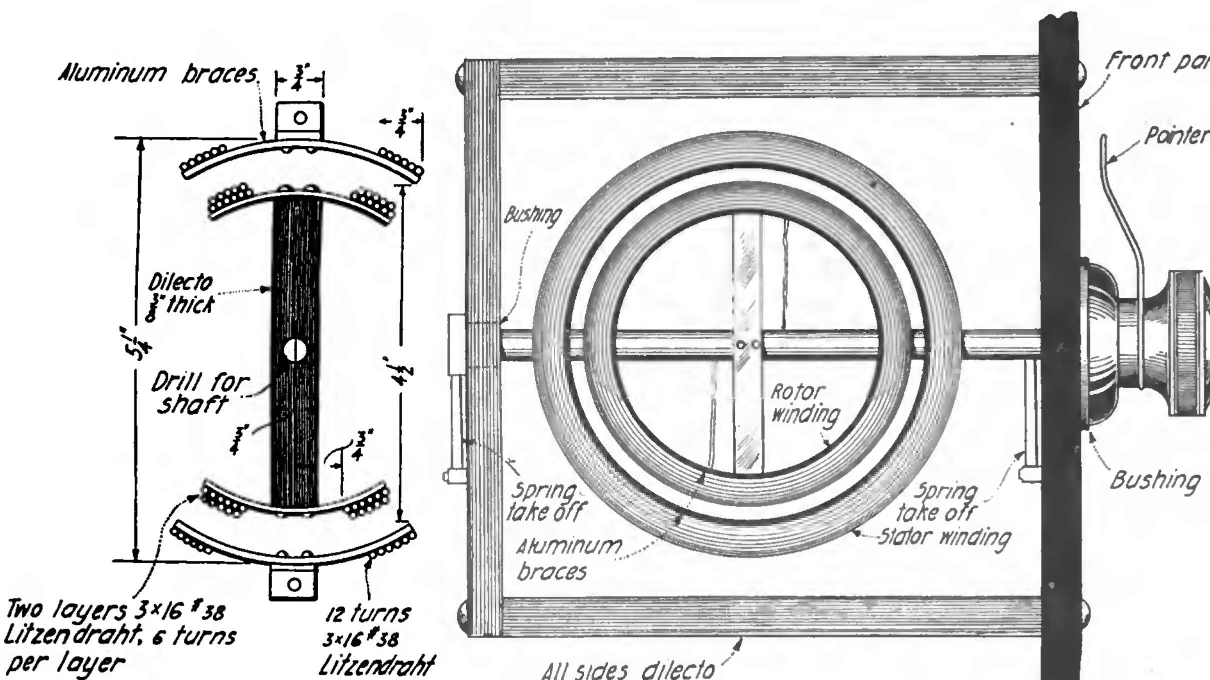


Figure 8 Figure 9

End and side views of the antenna tuning variometer

The grid or movable inductance is wound on a tube 4″ outside diameter, ⅛″ thick and 1½″ long. This is wound with thirty turns of the same size wire as on the stationary coil. Taps are taken out every three turns and brought to brass studs, so that the two flexible leads may be connected to any of the taps as required in operation.

The constructional details of this coupling device are clearly shown in figures 6 and 7.

The antenna tuning variometer is shown in figure 8 and figure 9. Sufficient dimensions are given to allow the constructor to make wooden winding forms to wind the stator and rotor coils. The same form will do for both halves of the stator coil, and then the form may be turned down to wind the rotor coils on. Either 3-16-38 Litzendraht or No. 20 D.C.C. copper wire may be used, preferably the latter, as the coil will hold its shape better. After winding, the coils should be dipped in hard beeswax and left to dry before taking from the form.

Small aluminum brackets are made to hold the coils in their proper places and to the frames. The two rotor coils are connected together so as to produce a continuous winding in the same direction. Leads are brought to the shaft, which is split and insulated in the center. Flexible springs from which connections are taken are soldered on the shaft ends. The stator coils are also wound so that the coil is in one continuous direction. These two coils are in series and maximum inductance is obtained when the two coils add in the same direction and minimum inductance when they oppose.

Figure 10 shows a possible assembly arrangement, but this may be altered to suit the individual taste. Connections should be made with heavy wire and all joints soldered, using the alcohol and rosin flux.

The operation of the transmitter is very simple. Starting with tight coupling on the power control, connect the high potential direct current and heat the filament to normal temperature. Oscillations will be indicated by radiation, noted from the aerial ammeter. The four taps of the wing inductance and the two taps of the grid inductance will now have to be adjusted until maximum radiation is obtained, consistent with the wave length desired, final tuning being accomplished with the antenna tuning variometer. Definite connections cannot be stated for the taps as the inductance of the connecting leads of the various sets built will vary too widely, but the right selection of taps is not difficult.

The microphone battery circuit is closed after maximum radiation is obtained and the set is then ready for transmission. Good modulation will be indicated by a slight decrease in antenna current while speaking into the microphone.

The Coil Aerial

Its Use as a Direction Finder

By Leon T. Wilson

DESPITE some limitations, the coil aerial has jumped into a position of considerable importance in the last few years, and a large amount of research work has been expended in an effort to find out just what is its peculiar field. For the benefit of those who desire to take up this very interesting field of experimentation and research a description of the construction and use of the aerial as a direction finder will be sketched. There is still a great deal to be done in investigating this peculiar type of aerial, and the opportunities for the amateur to be of real constructive assistance to the art are manifold.

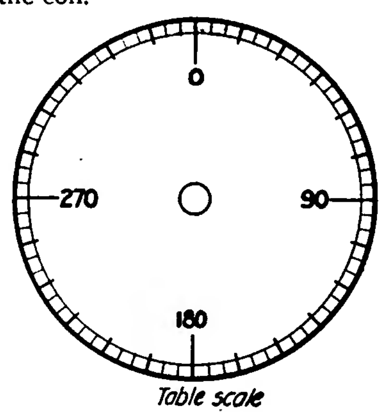
Limitations: There are only two disadvantages of the coil aerial which demand serious consideration.

First: It is not suitable for long wave work, either in transmission or reception unless unusual facilities are available for the erection of a very large coil. In commercial work, of course, this limitation is almost fatal, as it bars the coil aerial from use on wave lengths over 300 meters. For the amateur this does not mean much, as he is restricted to transmit on wave lengths of 200 meters or less.

Second: The general bulkiness and unhandiness of this type of construction, especially in the larger sizes, makes it difficult to construct a rigid and durable frame with the facilities at hand for the average amateur. Do not think that this is an objection of any moment in making a direction finder, though, for as we shall see in the details of construction, the square coil is only about 4 feet on a side. Such a small dimension as this is perfectly easy to handle and pivot. It is only when the coil grows to 20 or 30 feet on a side, as it must be to compete with the results of a flat top antenna, 40 or 50 feet high, that we get into difficulties.

Advantages—First: A coil aerial, can, in general, be made to have less resistance than an average flat top antenna. The tuning is therefore sharper, with resulting clarity and ease of reception, due to the decrease of interference.

Second: Besides the effect of lessened resistance on interference, there is the unmistakable effect of the directional qualities of the loop on clearness of reception. This is due to the fact that when the coil aerial is set for the best reception of any particular station, all other stations, with the exception of possibly one or two, come in at an angle to the coil, and their strength is consequently decreased. The intensity of signals decreases the nearer the line of direction is to a right angle with the plane of the coil.



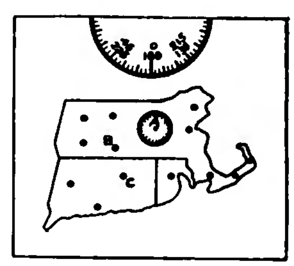


Figure 2—Compass card. Figure 3—Plotting board

Third: The coil aerial generally gives a smaller stray to signal ratio. That is, the intensity of the "static" coming in is smaller in comparison with the intensity of the signals, than is the case of a flat top antenna.

Fourth: A coil aerial has the peculiar properties of being able to indicate the *line of direction* of any transmitting station. Basically, this is due to the fact that any solenoid made up of a few turns of wire on a frame that is considerably larger in the dimensions of its cross section than it is in length, gives a minimum signal when its plane is at right angles to the line of the incoming wave. An approaching wave front strikes both sides of the coil at the same time, if the coil is facing the wave, and the currents set up in opposite sides of the coil neutralize each other. If the coil is swung into any other position the wave front does not impinge on the two sides of the coil simultaneously, and consequently some part of the current is left unbalanced. This unbalanced portion produces the signal. This effect is the same from whichever side the wave comes, hence the coil will indicate the *line of direction* only.

Since the line of direction only is given, it is necessary to have at least two stations take and compare observations, if actual locations are to be determined. The point of intersection of the lines of direction is the location of the transmitting station. In general, a well constructed aerial will give directions accurate to two degrees. Best results can be obtained with reports from more than two stations, as the additional reports serve as a check on the others. The use of the minimum signal point gives much sharper definition of direction than the maximum. It is evident that the nearer the reporting stations are to 90 degrees with each other, the more accurate can the intersections be plotted.

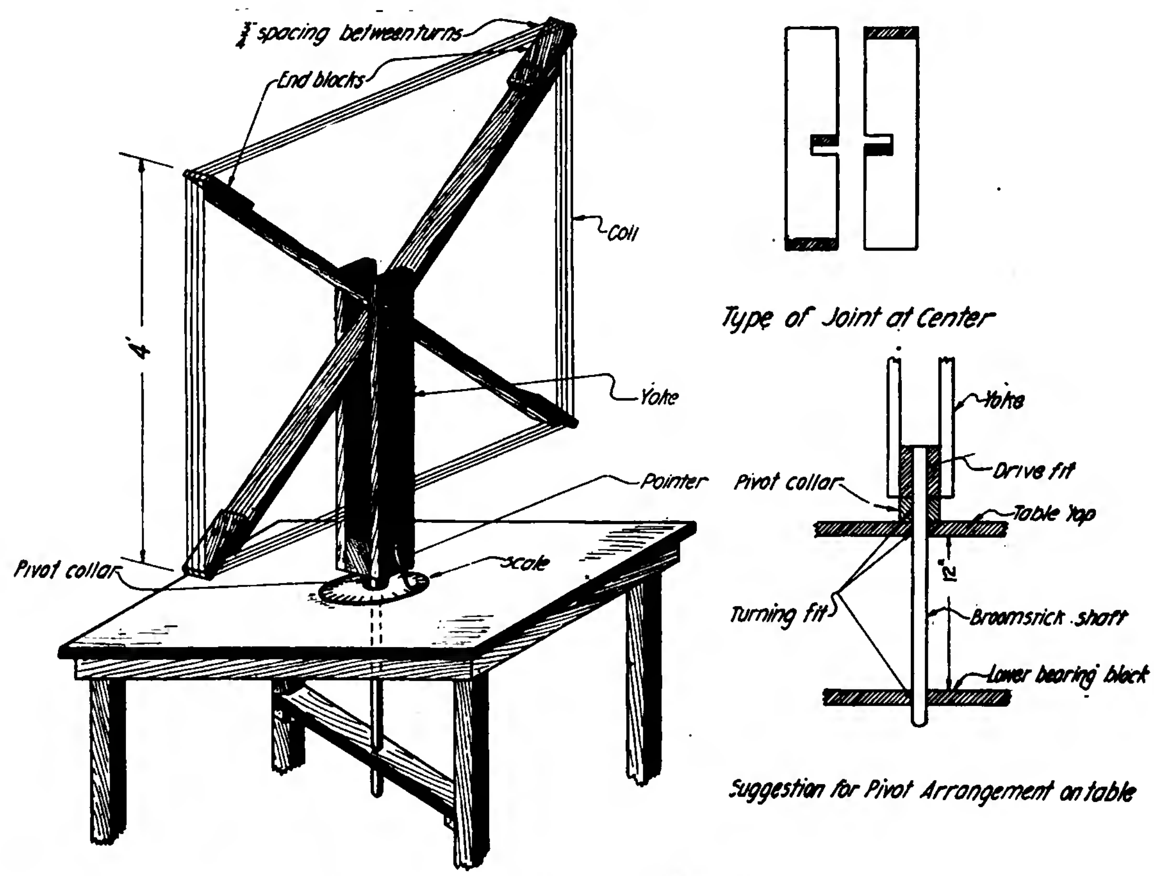


Figure 1—Detailed constructional view of the coil aerial

CONSTRUCTION SUGGESTION—A size convenient for indoor operation, on 200 meters, is a square loop, 4 feet on a side. The frame may be made up of cheap wood, varnished or shellacked. Four turns of No. 18 D.C.C. copper wire will be sufficient. Space the wires ¾" apart in the form of a helix. This means that they must be laid on the edge of the frame. For experimental work with the aerial, the frame shown in figure 1 is easily constructed, and has the advantage of the corner blocks being easily removable for a change in spacing or number of turns used. Leads may be tapped out where convenient.

Mount the frame in a yoke, and arrange the yoke on a tripod or a table, so that it may be rotated about a vertical axis. Make a pointer to fix to the yoke, so that it will rotate with the coil and indicate the direction in which the axis of the coil is pointing with reference to the scale. To the tripod or table attach a compass card, or circle divided into 360°. This card should be at lease 6" in radius, 12" in diameter, with every five or ten degree mark distinctively drawn and numbered, as in figure 2.

Place the scale so that the zero point is to the north, as determined with a pocket compass. This is one point that must not be overlooked, as otherwise two or more observers will have no common zero from which to report their lines of direction. Be sure, then, that the scale reads zero when the face of the coil is due north. For permanency make the card of a thin piece of wood, or mount the drawing on a heavy back of similar nature. If a table is used, simply fasten it to the table top.

When the amateur is satisfied with his execution of these details the coil may be connected into circuit, and the desk instruments tuned.

PLOTTING BOARD—To use the coil aerial as a direction finder we must have a map and a simple form of an alidade, for plotting reports.

Secure a cheap drawing board, or mount a map of the territory you wish to cover on a table top. If a drawing board is used, paste it on with the edges of the map and board parallel. Now, using compass and protractor, lay off a semicircle of 6" radius and divide it into degrees, having the center of the semicircle at the center of the top edge of the board, see figure 3. Number every 5-degree mark so that it reads for both ends of the diameter of which it is one end. The drawing makes that clear. About the location of your home-station circumscribe a complete circle of 2" radius and divide that into degrees, every 5th degree as before, only numbered consecutively. Zero is always to the north, or top of the map.

To each of a half a dozen or more push pins attach a heavy thread with a small weight at the end. These are to insert at the locations of the home station and other reporting stations. The threads indicate the lines of direction, and their intersection point locates the unknown sending station.

The alidade is an instrument by which the angle of direction can be laid off from any point on the map. It consists of a cheap T-square, or if one is not handy, of two pieces of thin wood joined together as shown in figure 4. The blade is about 30" long—or 6" longer than the width of your map board, of 1/8" x 2½" stock. The head is about 8" long, of 3/8" x 2½" stock. They are joined with a screw and thumb nut, so that the blade may be turned to make any desired angle with the head. If a T-square is purchased, remove the small screws which hold the blade solidly to the head, and substitute the screw and thumb nut mentioned.

This completes the construction of the accessories for direction finding.

To locate the direction of a station, ascertain the direction from the home station by reading the angle of the incoming wave on the scale of the coil. Transfer this angle to the map by inserting one push pin at the home station and laying out the thread over one of the two possible angles. That is, a station may be either 90°, or 270°—as you only know the line of direction. In most cases you can guess correctly which one, but positive check will come with the report from the station co-operating in finding the direction. When his report comes in turn the blade of the alidade to the proper angle on the large semicircular scale. Then slide the head of the alidade along until the blade edge crosses the location of the reporting station. The intersection of this line with the line from the home station locates the transmitting station. If reports from other stations are to be obtained, insert a push pin at each station, laying out the line of direction with the thread as in the first instance. The more reports you have, the more accurately can you allocate the sending station, a result most desirable when attempting to spot a station that is jamming the ether with an obnoxious variety of wave lengths.

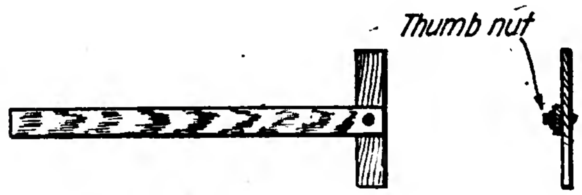


Figure 4—Method of constructing the alidade

Some Precautions—In operating such a coil aerial as a direction finder some precautions are necessary. In order that a sharp setting may be obtained the grounding of any part of the receiving apparatus should be avoided.

If operated indoors the coil should be at least the length of one side of the coil away from the sides of the room to avoid undue absorption in the walls. Likewise the coil should be well away from masses of metal such as steam radiators, pipes and the like.

If operated out-of-doors, unshielded, the coil *and receiving apparatus* should be several feet off the ground, preferably as much as 7 feet.

If it is desired to operate the set closer to the ground a grounded horizontal shield placed above the loop may be used to advantage. This shield may be built of parallel wires arranged in a harp-like fashion. The wires should be long enough to extend about 6" beyond each end and wide enough to extend 6" beyond each side of the loop. A ¾" spacing of these wires will do nicely. The shield should have its wires parallel to the top wires of the coil. They should be joined at their centers and grounded. In general such a shield will sharpen the minimum setting considerably and will also serve to decrease the ratio of strays to signals.

If the signal received on a coil aerial is weak, the minimum setting of the loop may be very broad. That is, there may be a zero signal over several degrees. In such event, the direction of the sending station may be approximated by taking the mid-point of the section of the scale over which a minimum signal occurs.

Although the direction of the incoming signal is of course perpendicular to the plane of the coil when it is set on a minimum, this is not always the true direction of the sending station, especially if the wave has passed over land for a considerable distance. This is because the waves do not necessarily radiate in straight lines. They tend to follow good ground paths such as are offered by rivers. Where a wave passes entirely over water the propagation is practically a straight line. A number of reports will get around this difficulty in most cases.

In this article only the simplest form of construction has been outlined. As in everything else pertaining to radio work, care and accuracy in detailing the various parts are sure to bring their reward in increased and more dependable results. Research and experimentation in this field will be not only fruitful but interesting, and the amateur is urged to investigate the possibilities of the device to the limit of his abilities.

Uni-Control Receiver Without a Coupled-Tuned Circuit

In an invention of Roy E. Thompson, he claims to have discovered that, in the use of two circuits in a radio receiving set, closely coupled together, a transfer of energy from the first to the second and its utilization in useful work in the second can be effected equally well at any period of the first circuit and wholly independent of the period of the second circuit, provided the second circuit be properly constructed.

Heretofore at radio receiving stations it has been customary to employ two circuits supplying the detector and telephone, these two circuits being termed the antenna circuit and the secondary circuit, and heretofore the most efficient use of the received energy has been obtained when both circuits were made resonant, and both adjusted to have the same, or substantially the same, time-period. The utility of this two-tuned-circuit arrangement was due to the fact that the secondary circuit not only received energy from the antenna, but being a resonant circuit, it permitted that energy to accumulate to the maximum and thereby efficiently operate the indicating apparatus, such as a detector and telephone, or in some cases, a telephone alone. This secondary circuit, also having the same time-period as its primary circuit, thereby permitted the two circuits to resonate harmoniously with consequent beneficial results.

This coupled-tuned circuit receiving apparatus (known as the Marconi type) proved so exceedingly useful in radio work that for many years it was not deemed possible to devise practical apparatus which was not of this type.

However, notwithstanding that this type was standard practice for many years, the art recognized that it possessed certain serious disadvantages. Attempts were made to improve the type so as to eliminate these disadvantages, but the latter proved to be inherent in the type.

The chief disadvantages were two: First, the inconvenience and delay involved in making fine adjustments in order to operate at best efficiency; and second, the inefficiency of operation due to coupling difficulties incidental to the transfer of energy from the antenna to the secondary circuit.

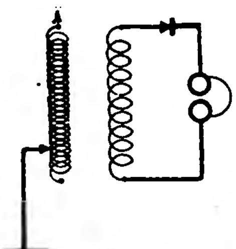


Figure 1

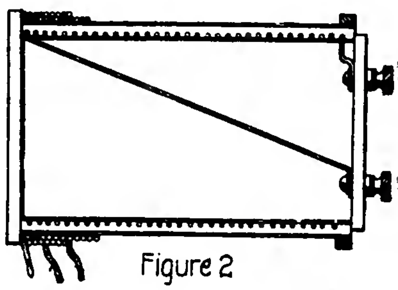


Figure 2

Figure 1—Location of the detector near an end of the secondary coil
Figure 2—Coil of the utilization circuit

The first disadvantage in the coupled-tuned circuit type was involved in the manipulative adjustments executed by the receiving operator. Each of the two circuits contained at least one frequency-determining element, such as a variable coil or a condenser, and generally both of such elements, and such elements in both circuits, were required to be accurately adjusted, in order to obtain the efficiency of the type, each time that a message at a different wave length came in from a distant transmitter. In fact, the highest efficiency of which this type was capable could not be obtained unless the operator first by trial adjustments put the two circuits into the same tune. This usually involved, first, an adjustment of the antenna circuit; then an adjustment of the secondary circuit; then a re-adjustment of the antenna circuit; then a re-adjustment of the secondary circuit, etc., sometimes including an adjustment of two or more elements in each circuit, so that, at best, it took a substantial length of time to put the apparatus into best condition. All this was a very serious disadvantage in practice, on account of the great importance of quick service. But this disadvantage was borne with, because it was inseparable from the efficiency of this type.

Thompson claims that in his arrangement there is equal efficiency with the coupled-tuned-circuit type without the necessity for any adjustments of a secondary circuit.

The second disadvantage in the coupled-tuned-circuit type involved difficulties in the coupling between the two resonant circuits. If this coupling was too close some of the energy accumulating and persistently oscillating in the secondary, was transferred back to the antenna, and re-radiated and wasted, instead of going forward to do useful work on the indicating apparatus—for the very fact that harmonious persistent oscillation of the two circuits facilitated the transfer of energy from primary to secondary, likewise facilitated the re-transfer of energy back from secondary to primary. On the other hand, if the coupling were then loosened in order to prevent such re-transfer, then that resulted in a decrease of the efficiency of energy-transfer from the antenna to the secondary. In practice a compromise was made by having the coupling neither very close nor very loose, *i.e.*, not so close as to cause a re-transfer of considerable energy back to the antenna, and not so loose as to prevent the transfer of a substantial amount of energy from antenna to secondary. This, however, did not remove, but merely alleviated, the difficulty, and there yet remained a substantial loss of efficiency because the compromise coupling was not close enough to transfer to the secondary all the energy supplied to the receiving antenna.

In the scheme here shown, there are no coupling difficulties because the accumulative action of the circuit supplied from the antenna is eliminated entirely, so that instead of a re-transfer of energy back to the antenna, the entire energy, transferred to the utilization circuit, is instantly consumed therein, and doing useful work in operating the detector.

In the best form of the coupled-tuned-circuit type, the secondary circuit included the secondary coil of an oscillation transformer, and a condenser, in series with each other; the condenser was in shunt or parallel between the detector and the secondary coil, the coil and condenser constituting a resonant cumulative circuit, this condenser being preferably variable to adjust the period of the secondary to that of the antenna; or else the inductance in the secondary was variable; or both the condenser and inductance in the secondary were variable, in order to obtain the best tuning.

In other forms of this coupled-tuned-circuit type, in order to reduce the manipulative operations of the receiving operator, the condenser has been omitted, and then the secondary coil was the only adjustable element in the secondary circuit. Of course, in all cases, the antenna is adjusted to be put in tune with the received waves.

In yet other forms of this type, no adjustment has been provided for the secondary circuit, but it has been given a fixed period approximating the range of commercial frequencies received on the antenna (no variability being provided for any reactance in the secondary circuit), the idea having been to eliminate all the troublesome secondary adjustments, but yet to retain the advantage of having the secondary more or less closely or broadly tuned to the antenna. This form has been termed the non-adjustable or "untuned" form, although the fact is that the secondary did have a "tune," as various investigators have shown. The difficulty with such attempted simplified form, however, was that the efficiency was reduced in proportion as the fixed period of the secondary was different from that of received signals to which the antenna was tuned. That is, although such a modified receiving set of the coupled-tuned-circuit type might be very efficient when the incoming waves at a period which happened to be the same or

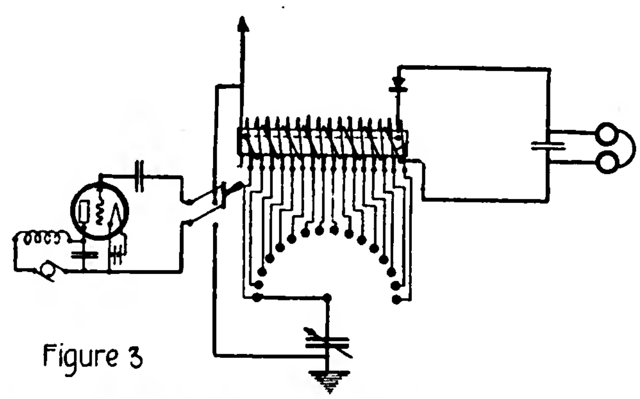


Figure 3

Figure 3—Showing arrangement whereby a vacuum tube produces oscillations to produce beats with an incoming signal

nearly the same as the fixed period of the secondary, yet the efficiency for receiving wave lengths higher or lower than the period of the secondary, was proportionately less, and the efficiency fell off rapidly for increases of difference in periods of secondary and received waves.

Thompson states that the inefficiency of the non-adjustable (so called "untuned") secondaries was due to the presence of distributive capacity yet existing in the circuit, even in cases where no condenser (lump capacity) was used in shunt to the detector and coil; that this distributive capacity was acting to make the circuit cumulative to a certain degree so that when it was attempted to simplify the operation by omitting an adjustable condenser paralleling the detector (in addition to the omission of adjustable inductances) such omission alone did not make the secondary circuit a non-resonant circuit, but simply deprived it of the mechanical advantage of being adjusted to have identically the period as that to which the antenna was adjusted. It possessed the disadvantages of a condition of resonance in the secondary without the ability to take advantage thereof. It, therefore, was nothing else than an inferior form of the coupled-tuned-circuit type, notwithstanding that this modification has been termed an "untuned secondary" type by many writers, simply because no adjustable condenser for exact tuning was provided in the secondary. The secondary was in fact tuned, although not to the exactitude required for the highest efficiency of the type.

In the practice of making secondary circuits without a condenser in parallel to the detector and secondary coil, it has been assumed, apparently, that the omission of this condenser removed from the circuit all capacity which was acting to make it a tuned cumulative circuit. The fact apparently has been overlooked that the circuit always possessed substantial capacity other than that of the omitted condenser—especially that capacity which is resident in the secondary coil.

It is Thompson's claim that the reason why the so-called "untuned," i.e., non-adjustable secondary,did not respond efficiently to the various wave lengths, was the existence of such distributed capacity. This distributed capacity of the coil provided it with ability to accumulate enough energy to be effective in re-acting on the driving circuit to such a degree as to make necessary the adjustment to the same period in order to eliminate such re-action effect.

It has been demonstrated that if the secondary circuit be constructed to have so little capacity (in parallel to the detector and secondary coil) as to be substantially non-effective in making the secondary a tuned circuit, then it is possible to operate a receiving station at maximum efficiency for all possible period of transmitted waves, without any reactance adjustments of the secondary whatsoever.

Under practical conditions, and with such minimum capacity in the secondary as the fundamental condition for substantial aperiodicity of the secondary, it is claimed that the same efficiency of reception at all present commercial wave lengths is obtained without any adjustment whatsoever of the secondary circuit. The coupling between the antenna and the utilization circuit should be sufficiently close to cause an instantaneous and complete transfer of energy from the antenna, and thereby cause the creation of maximum potential in the utilization circuit, without any necessity for (or any actual) substantial accumulation of energy, as in the coupled-tuned-circuit type; yet without any substantial loss of energy, and without any substantial re-transfer of energy back from the detector circuit to the antenna. This instantaneous maximum potential is created across the detector, and the resulting effect is passed directly, via the detector, to the telephone. Under these circumstances, the utilization circuit being actually aperiodic, and no energy being accumulated therein, there is none of the coupling troubles which existed in the couple-tuned-circuit type, for there is no re-transfer of energy back from the utilization circuit to the antenna, all the energy which was instantaneously transferred from antenna to utilization circuit being instantly employed in causing the indication of the signal. In all cases the non-adjustable utilization circuit has the same efficiency irrespective of the frequency of the transmitted waves. All this is particularly true when the natural period of the aperiodic non-accumulative utilization circuit is far below 300 meters—the shortest commercially used wave length—and when the antenna is adjusted above 300 meters.

In brief, the construction is such that substantially all of the energy received on the antenna is instantly passed on to its place of utilization without any interval of accumulation in the utilization circuit.

In putting his discovery into practice, Thompson reduces, so far as possible, the distributed capacity of the coil itself, and by so locating the detector in the circuit that any capacity which may exist in the circuit connections acts as in series with the detector and not in parallel thereto; that is, the detector is located as near as possible to an end of the secondary coil, as is illustrated in figure 1. In figure 2 is shown a coil of the utilization circuit especially adapted for an antenna coil of a given range of wave lengths; i.e., in this example 100 to 3,600 meters. For a receiver, the antenna and primary of which is to have a range of 100 to 3,600 when connected to an average ship's antenna, the following dimensions are suitable in connection with this scheme.

Around the primary core (see figure 2) of suitable insulating material, 4" in diameter and 7" long, is wound a primary coil consisting of 280 turns of wire, having a diameter over the insulation of approximately .05". This primary is "banked" in two layers. Suitable taps may be taken off as desired for purposes of adjustment of the wave length of the antenna circuit. Provided with means for sliding all the way inside of the primary core is the secondary cylinder, which is 3½" diameter and 7" long. Around this cylinder is wound a single layer secondary coil, consisting of 70 turns, having a diameter outside of insulation of .05", each turn being separated from each adjacent turn by a distance equal to the thickness of the wire. The extreme ends of the winding are connected to binding posts which in turn are connected to the detector and telephone (figure 1). The novel feature of figure 2 is, according to Thompson, that a high inductance is had here without the capacity normally corresponding thereto.

In figure 3, an arrangement is shown whereby a vacuum tube may be connected for the production of oscillations which are to produce beats with any incoming signal. Here the antenna circuit controls the frequency of the oscillations of the vacuum tube and also, as before, the frequency to which the antenna circuit is tuned.

Many efforts have been made during the past few years to simplify the operation of a receiving device. The foregoing is a very good example of the trend that these efforts have taken. A solution such as this, however, would not seem to be the final solution.

Constant Speed Regulator for Series Motor

(Continued from page 14)

wireless transformer, providing the auto-transformer is correctly designed. A ten-ohm rheostat is also included in the circuit to the motor for close regulation of the compensating voltage in each case.

The auto-transformer, for the usual type of high-speed series motor using about 50 watts, consists of a laminated iron core one inch square in cross-section and three by seven inches outside dimensions, as shown in figure 2. On one leg of this core are wound 800 turns of No. 22 D.C.C. wire, a tap brought off, and an additional 50 turns on top of this. In some cases, with larger motors or where the voltage drop is already excessive it may be necessary to use more than 50 additional turns, but these can readily be added after the device is completed. The line voltage is connected to the 800 turns and the motor is normally connected to these also giving it the regular line voltage, but when the key is pressed the compensating winding is connected in circuit.

The double contact relay can be made from any available parts the experimenter may possess. The magnets should be of about 200 ohms resistance and have laminated cores if possible. The contacts need not be very large as only one-half ampere of current is carried by them.

The whole device is so simple and inexpensive that it is recommended to any amateur who desires a constant, readable, spark note.

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

An Original Aerial Switch

By Thos. W. Benson

FIRST PRIZE, $10.00

THE writer has had occasion to handle many types of aerial switches, from the ceiling type operated with cords to the foot operated switch, and few, indeed, are really satisfactory. The usual D. P. D. T. switch operating through an arc of about 60°, in common use, makes a fine appearance but it is unhandy to throw upward, requiring some effort when the clips are tight.

To overcome these defects the switch described was designed and worked splendidly. There are several advantages, the most important being that either a downward or upward thrust of the hand will throw the switch either way. The switch, when mounted over the key is remarkably easy to throw. When reaching for the key, the hand naturally throws the switch with the minimum effort.

It includes a device for closing the primary circuit and starting the rotary gap. Other attachments are not advised as they lead to induction currents in the receiving set. A convenient place to mount the thermo-ammeter is over the switch. A special arrangement of contacts allows this meter to be up in the circuit when desired. This eliminates an extra switch used for short circuiting the meter. The circuit used is rather novel, the problem of insultation is solved by receiving through the secondary of the oscillation transformer. Though not exactly new, the method is not used as extensively as it deserves to be.

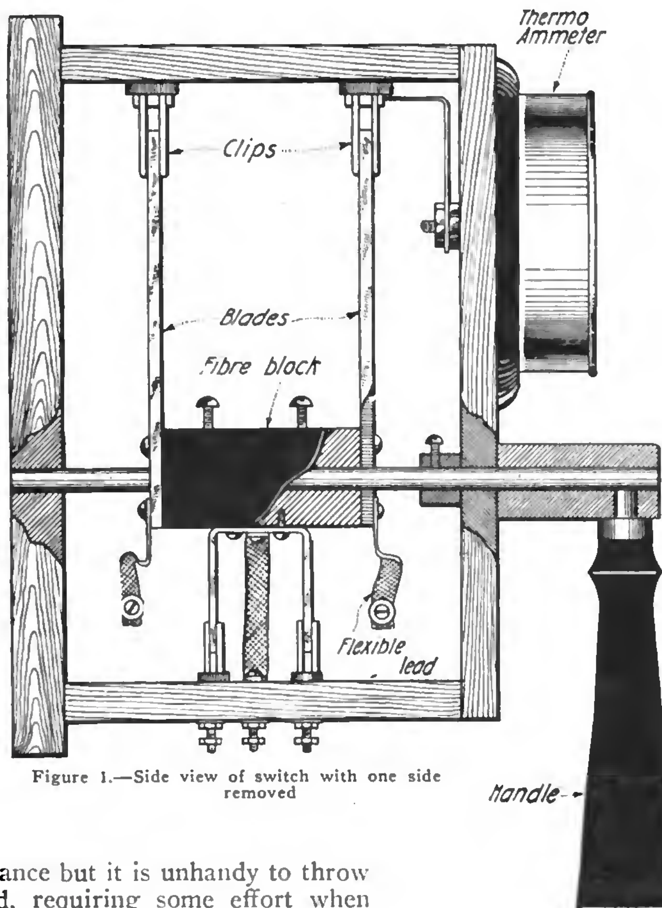


Figure 1.—Side view of switch with one side removed

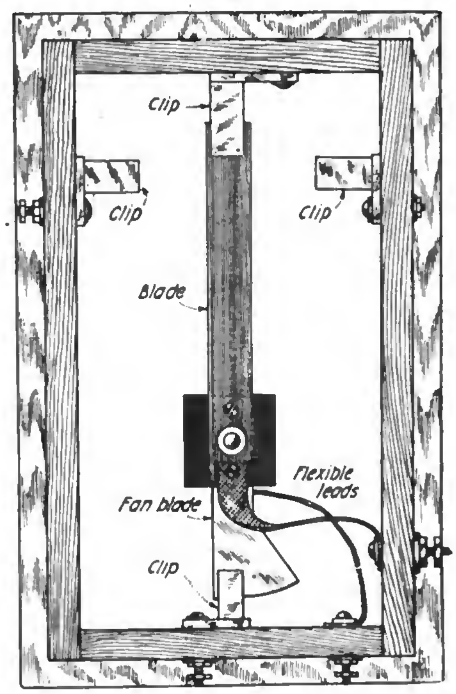


Figure 2.—Sectional end view of switch showing arrangement of clips

The constructional details of the switch are given in the attached illustrations and due to its simplicity requires little, if any, explanation. The dimensions will vary slightly with the apparatus available, hence only general data is of any practical value.

The switch blades are made from copper strips 4" long ⅛ x ½". These are held 2" apart by a block of bakelite or fibre. A hole drilled through the fibre passes a brass rod to actuate the switch. A hole larger than the rod drilled in the copper blades prevents them making contact with the brass rod. The insulating block is fastened to the rod by two machine screws running through the block.

Two copper Ls attached to the lower side of the block, act as blades for controlling the primary supply current and the rotary gap motor. Connections are made to all the blades by heavy stranded wire, No. 14 serving for the smaller blades, a braided ribbon for the aerial circuit blades. These are clamped under the screws and soldered securely in place. Three binding posts on the bottom of the box allow of connections to the small clips. A heavy pair on the lower right hand side is for connection in the aerial circuit.

The arrangement of the clips is shown in Fig. 2. The box is 4" wide; two switch clips being mounted on both sides of the box 2" apart to receive the blades, the clips on the right being short circuited by a copper strip, those on the left having binding posts on the outside for connecting to the receiving set. Midway on the top of the box, and arranged so as to make contact with the blades, are mounted two other clips. These are shaped so the blades will enter easily from either side. Heavy leads are run from these posts to the thermo-ammeter on the front panel.

The actuating handle may take different forms depending on the desire of the builder. A small hand wheel may be used or either of the ideas shown. In one form a round block of fibre is drilled to pass the rod and tapped to take a switch handle projecting downward. The thread in the switch handle clamps again a flat side field on the brass rods. or two switch handles may be threaded into the fibre cylinder projecting on either side.

The switch is mounted on the wall or back of the operating table, six inches above the top. With the single form of handle a sweep of the hand will throw the switch. The double handle requires downward pressure on the proper side to operate the switch. By setting the blades in the centre a reading can be taken on the ammeter, the width of the primary and gap circuit blades permitting the circuit to remain closed.

The wiring diagram in figure 3 shows how the circuits are controlled. The switch acts to open the aerial circuit and connects in the receiving set thus receiving through the secondary of the O. T. Leakage of the sending current is impossible. The switch is connected in the ground lead of the set so the lead can be run directly to the O. T. simplifying the wiring. The thermo-ammeter is connected in the ground lead, the proper place for this instrument.

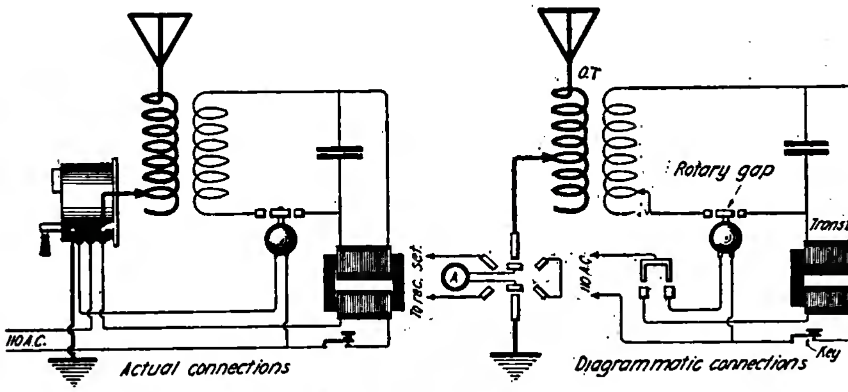


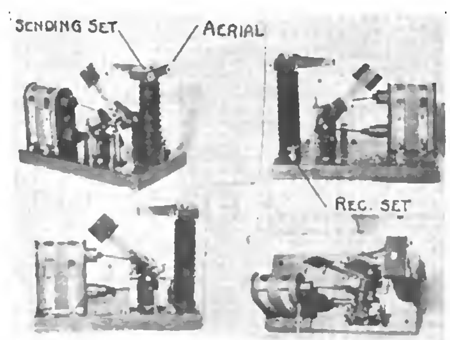
Figure 3.—Wiring diagrams showing how the circuits are controlled

A Remote Control Antenna Switch

By Omer E. Cote

SECOND PRIZE, $5.00

A GREAT many amateurs will find it possible to increase the efficiency of their transmitters considerably if they locate the transmitting apparatus at a point which is remote from their receiving apparatus. The amateur is not always able to choose the location for his apparatus, and is usually allotted a room somewhere in the garret. Those who have had experience with the transmitter located in the garret have learned that they do not function as well in such a location as they would near the ground. The design of a remote control antenna switch which may suggest possibilities in this direction, is therefore offered. This switch, as constructed, is suitable for powers to ½ KW. For higher power a longer strip on the switch blade will be required. The switch, as designed, merely changes the aerial connections from "receive" to "send" and vice versa, the ground connection being on both transmitter and receiver at all times. It is necessary, however, to disconnect the ground from the receiving set when transmitting. This may be accomplished by having a small porcelain base single pole switch near the receiving apparatus which is to be open when the transmitter is in operation. This method simplifies the construction of the antenna switch itself, although the ingenious amateur will be able to so al-



Various views of the switch

ter the design as to meet any of his requirements.

Figure 1 shows the base which may be made of mahogany or any wood. Bakelite or hard rubber is not necessary, since all the high voltage terminals as well as the receiver terminals may be mounted individually on hard rubber or bakelite. This method will save considerable expense. Dimensions are clearly shown on the base drawing. Standard binding posts may be substituted for the three No. 8 machine screws which are called for in connection with this base. Machine screws will serve every purpose, however, since, once the connections are made, they are never changed.

Figure 3 shows the standards for the shafts. These may be made of iron or cold rolled steel. Two are required. A coat of dull black enamel will furnish a neat appearance. Figure 2 is the magnet rotator arm. The hub may be made of either cold rolled steel or of brass and is fastened to the long fibre piece with two No. 4-36

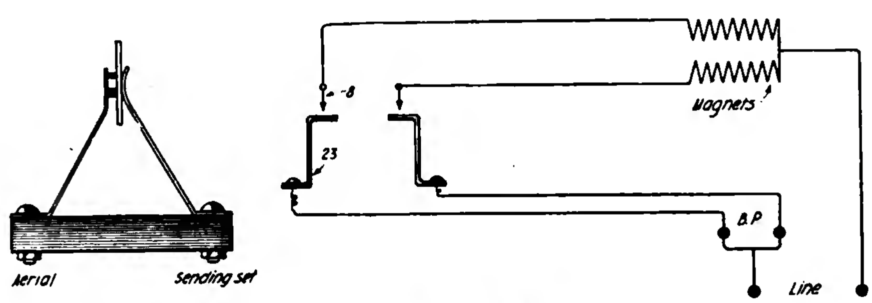
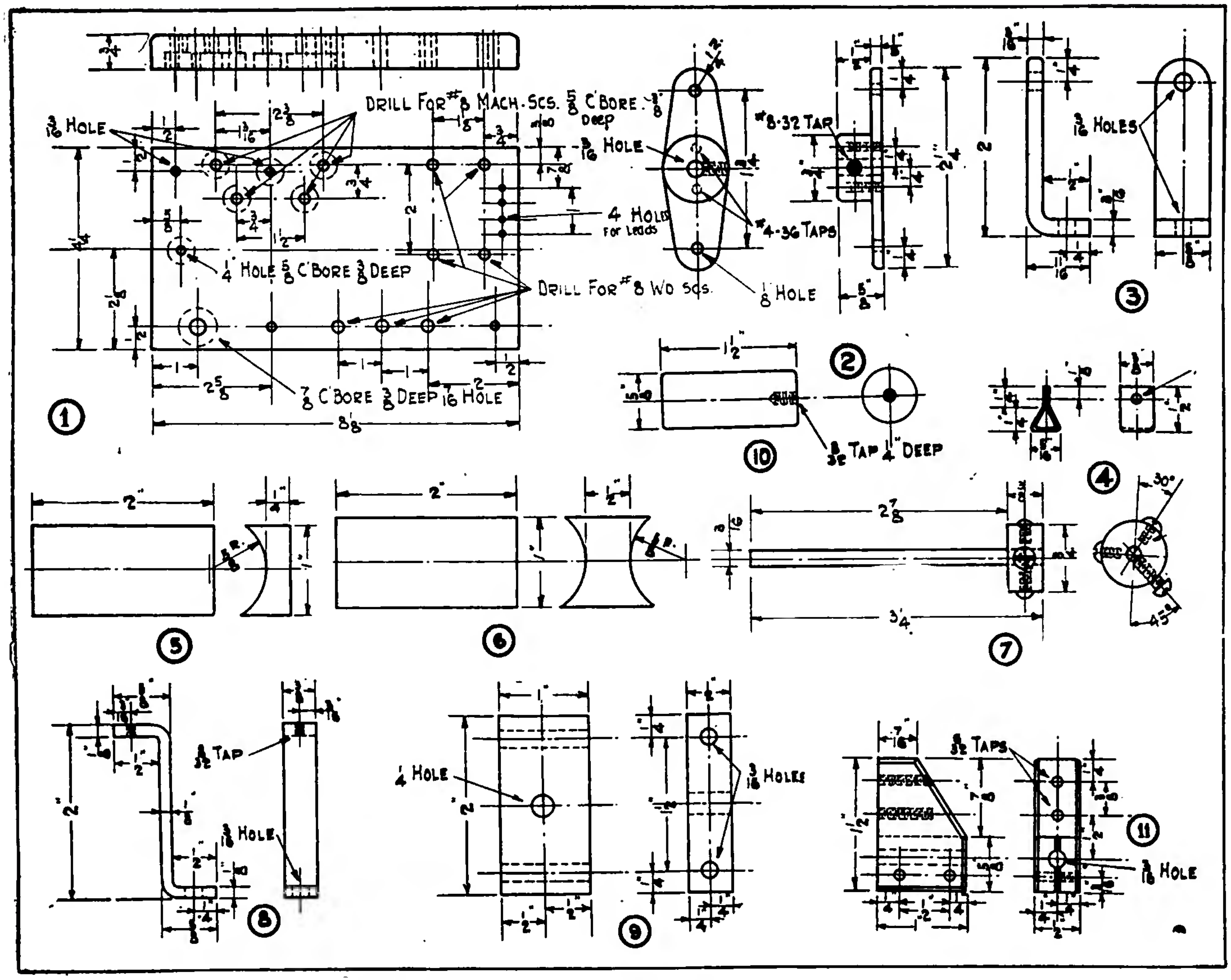


Figure 25.—Circuit diagram showing connections



Figures 1 to 11.—Constructional details of various parts

round head machine screws. An 8-32 machine screw in the hub itself is used for a set screw in holding the arm to the shaft. One arm is required.

The shaft shown, figure 7, is either brass or cold rolled steel and at one end is fastened the magnet current breaking attachment. The cam is made of hard rubber or bakelite and the two 4-36 screws are ¼ inch long, as they should not touch the rod. The other screw can be a 6-32 machine screw to hold the cam to the rod. It is important that the point of this set screw fit on a flat spot on the shaft to keep it located at all time; otherwise the shifting of the magnet would soon twist the cam out of alignment.

Figure 4 is the clip fastened by a machine screw to the magnet core, figure 10. The ⅛-inch hole is for the connector arms, figure 15. The arms are made of iron wire to the sizes shown. Figures 5 and 6 are made of wood and are the support for the magnets. Figure 5 goes on the base, then the first magnet, then figure 6, then the second magnet.

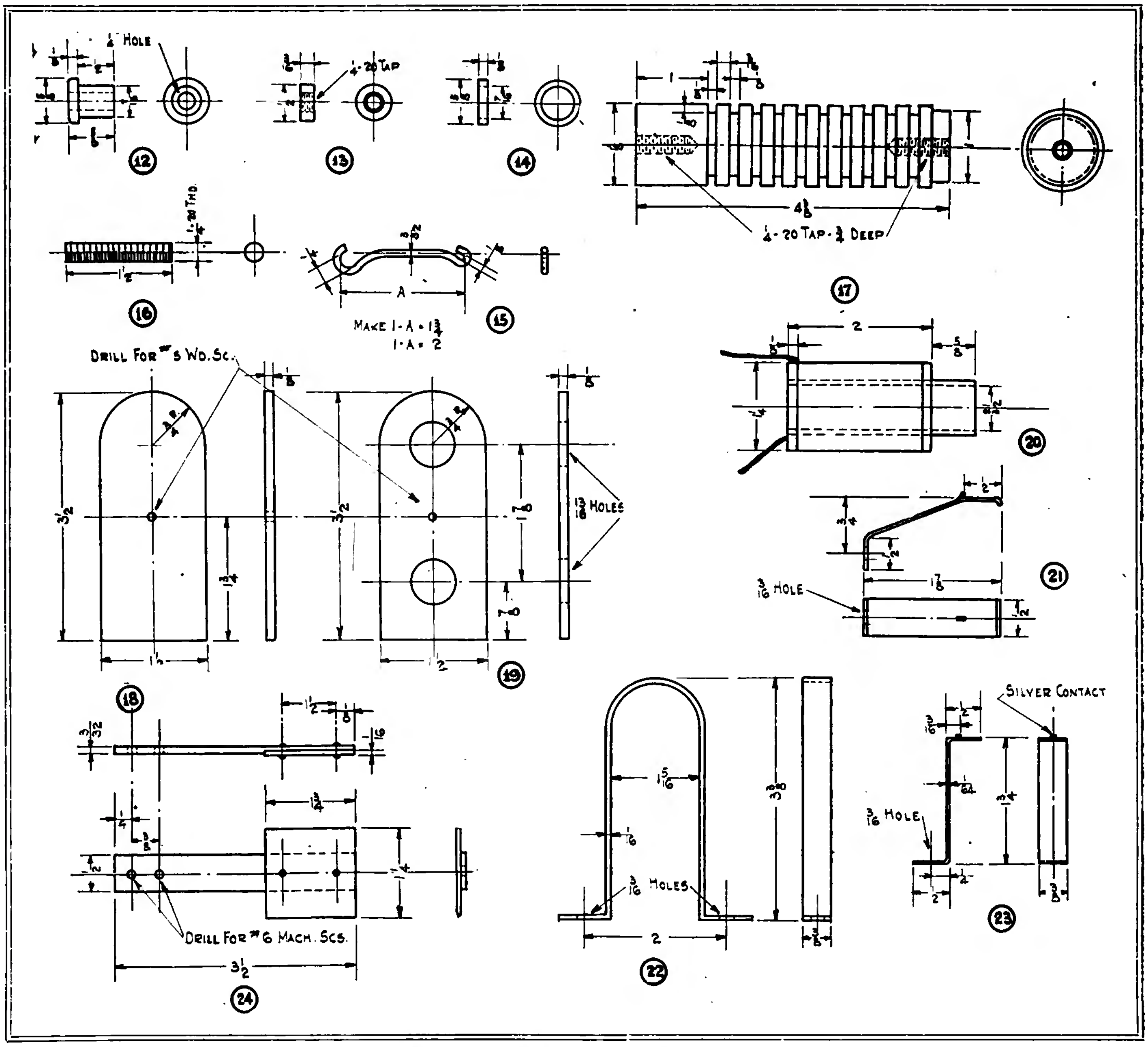
The magnets are shown in figure 20. The solenoid is a piece of brass tubing which is covered with varnished linen before winding the wire. The magnets are wound each with 1500 turns of No. 27 enamel wire which gives a resistance of about 20 ohms. The ends are of fibre.

These magnets are fastened in place in the following manner. The blocks 5 and 6, having been placed between the magnets, a piece of fibre about 1/32 inch thick and cut 2⅛ inch wide, is put around the magnets before putting on the straps, figure 22.

If it happens that these straps do not hold the magnets good, the latter are wound with a few wraps of tape to increase their size; it is important that they be fastened very tight so that they will not move when working. The magnets being 2 inches long and the fibre covering 2⅛ inches, leaves at the outer end a space of ⅛ inch for bringing the leads down and through the base. At both ends are the parts 18 and 19, which are made of fibre and held in place by wood screws fastened into part 6.

Figure 11 is made of bakelite and holds the knife blade. As can be seen in the photos, this blade is entirely insulated from the shaft. A connecting wire made of many strands of fine wire, to be flexible, is fastened to the knife blade at one end and the other end is fastened to the insulated terminal on the base.

This terminal is shown in figures 12, 13, 14 and 16. Figures 12 and 14 are made of hard rubber or bakelite, while 13 and 16 are made of brass. A knurled nut is used to connect the lead wire. Figure 17 is the insulating support and is made of either hard rubber or bakelite, while part 9, which is fastened on top with a ½-20 round head brass machine screw, is also made of the same material. The 3/16-inch holes in part 9 are for 10-32 round head machine screws., 1¼ inches long, which hold the springs, part 21, in place. Part 17 is fastened to the base with a ½-20 machine screw.



Figures 12 to 24.—Additional constructional detail

Part 21, two of which are required, is made of spring brass or copper.

Figure 8 is a brass standard which holds the contact screw. Two of these standards are required. The contact screws are 8-32 round head brass machine ½ inch long with a silver or platinum contact at the end. Two check nuts are also used with these screws.

Figure 23 is the spring standard, two of which are required, and is actuated by the cam at end of shaft.

The switch blade, figure 24, is made of copper and the insulating strip at the end is of bakelite held by two brass pins.

Figure 25 shows the connections.

1 KW. Antenna Switch

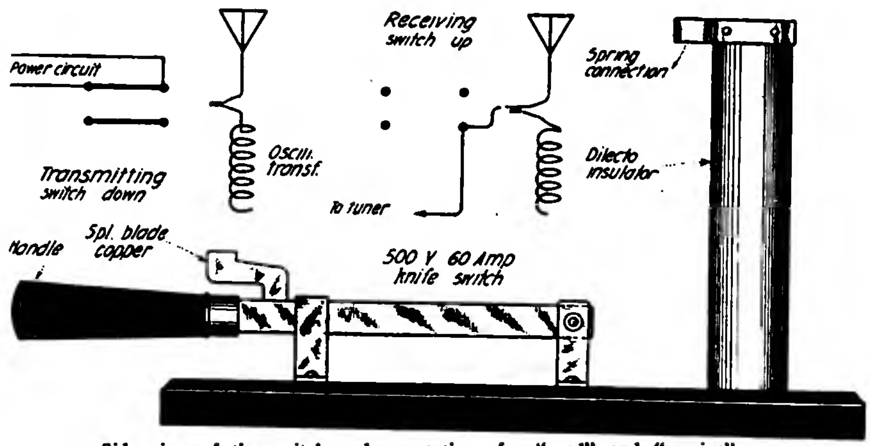
By M. P. Koopman

THIRD PRIZE, $3.00

The design of the following described switch has been worked out with the idea of reducing the machine work to a minimum, as most amateurs have not the facilities of good tools.

The sketch shows the connections for the "send" position and "receive" position and side view of the switch. The main part of the switch can be bought new or secured second hand and is a 500-volt 60-ampere knife switch with high jaws, front connected. This switch is then mounted on a slate base of suitable size. Also on the same base a dilecto rod insulator is mounted as shown. In a 1-kw. set the rod should be about 8 inches high, and for a ½-kw. set about 5½ inches high.

At the top of this rod insulator, two contact springs are placed, and so adjusted that they touch each other with good contact at all times that the special blade contact is not between them. One of these contacts is connected to the antenna and the other to the transmitting loading inductance or oscillation transformer. When the switch is down, the special blade is not between



Side view of the switch and connections for "send" and "receive"

these two contacts and direct connection from the antenna to transmitter is made. At the same time, the auxiliary contacts on the knife switch may be used to start the rotary gap and close the primary of the transformer circuit.

It is noticed on the drawing that the special blade on the switch is insulated on one side. Then when the switch is up, the transmitter is insulated from the antenna, and connection from the antenna is made through the special blade down through the switch blade to the switch hinge on one side.

Such a switch is very simple, very easily constructed and will give excellent operation.

70-Foot Mast for Umbrella Antenna

By M. P. Koopman

FIRST PRIZE, $10.00

THE mast and antenna described was erected some time ago (before the war) for 200-meter transmission, and it gives very good results. Many people claim that the umbrella type antenna is the best for transmitting, especially on low wave lengths.

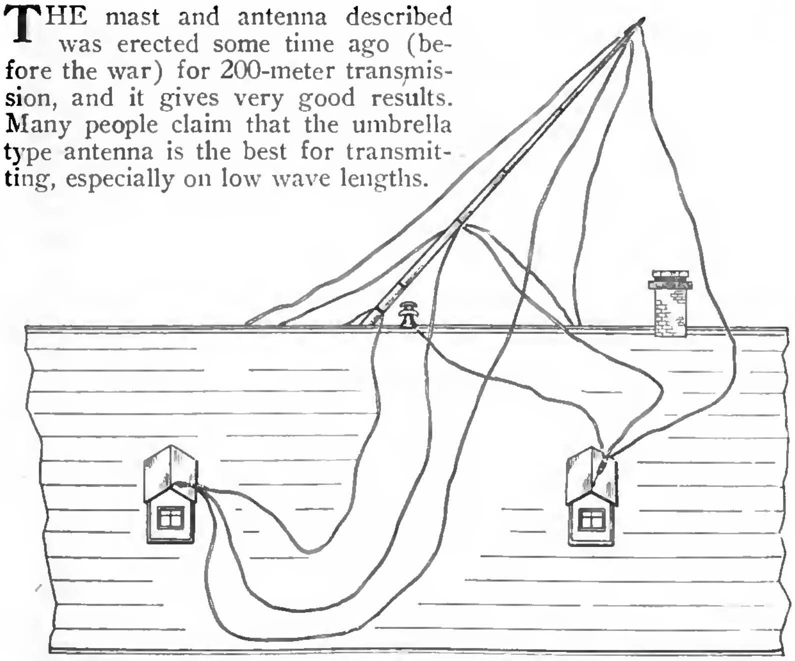


Figure 2.—Showing method of erecting the mast.

Inasmuch as the amateur has to pay quite a little money for his mast and then an additional sum for the antenna, by incorporating the antenna and mast together, this total is reduced considerably. Furthermore, this type, besides being efficient for transmitting, occupies very little space and may be erected on one's premises where the amateur is confined to his own residence.

The material necessary is itemized as follows: Eight 10-foot lengths of conductor pipe 3 inches diameter, No. 26 standard gauge, extra heavy galvanized; one petticoat insulator, porcelain, glazed, should be rated for at least 80,000 volts for wooden roofs and 120,000 volts for tin roofs; four large strain insulators, voltage will depend upon the power and wave-length that the set is to be worked at; four heavy screw eyes for anchors, screw should be about ⅞-inch thick and 3 inches to 4 inches long; antenna wire, seven strands of No. 22 B. & S. gauge silicon bronze, preferably tinned. Quantity can be figured out for the particular installation. Muriatic acid for soldering, solder (half tin, half

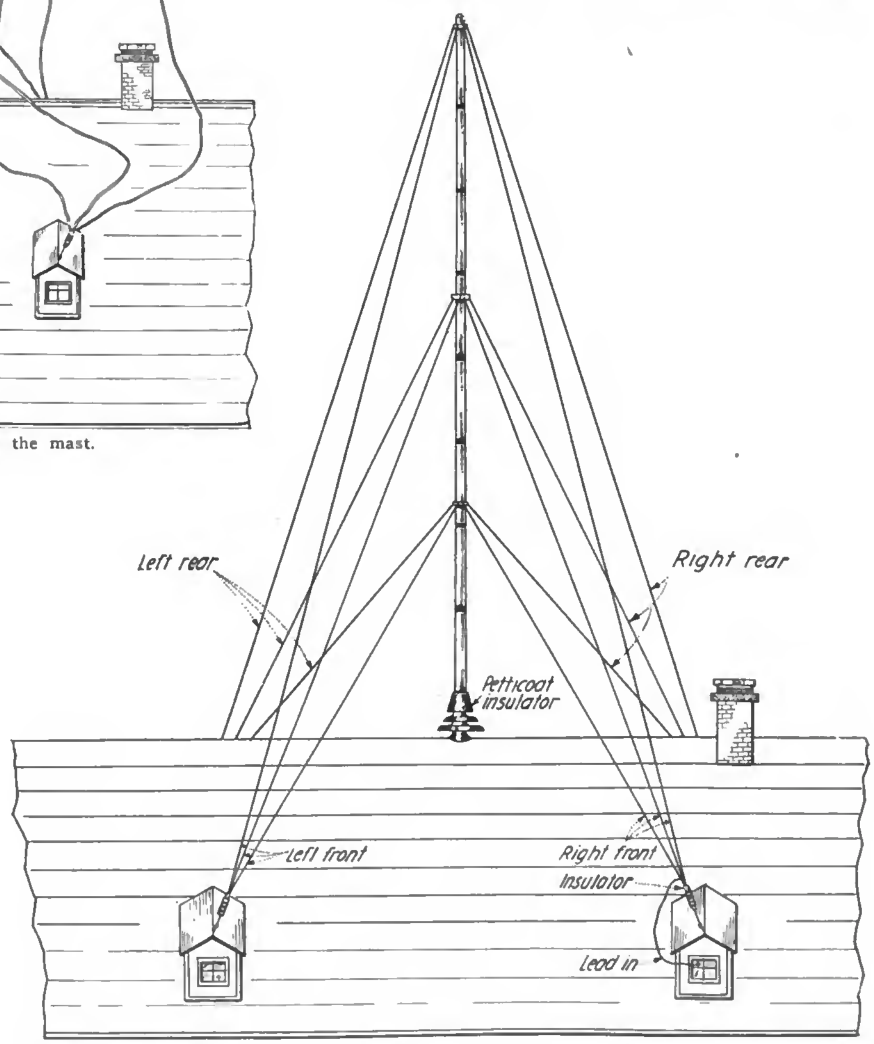


Figure 1.—Showing mast in position and location of the guy wires and lead-in wire

lead), cotton waste and rubber tape, little shellac or varnish, some asphaltum.

The third sketch shows the details of the petticoat insulator. This should be installed first, in the center of the four anchor posts that will be selected. As shown, the pin that screws into the insulator, is one that has a large wood screw at the other end. This wood screw is screwed deep into the ridge pole. It will be found that the ridge pole is a heavy beam and a hole will have to be drilled for the wood screw. Before screwing it in, the hole should be filled with asphaltum and later asphaltum spread all around the hole to prevent the roof from leaking. The four anchor wood eye screws are then screwed in their respective places in a like manner. It must be ascertained that the anchor wood eye screws are fastened into beams and not into the roof, which is only ½-inch stock.

Conductor pipe comes small at one end and large at the other and in 10-foot lengths. There are eight sections in all. While on the ground, these sections should be placed inside each other for 18 inches, making a total length of about 70 feet. It will be found that they will have to be forced in order to go in that 18-inch and that they will not go in much further without undue effort. Now that the sections are fitted together, these joints should be very thoroughly soldered, using a gasoline blow torch, muriatic acid diluted with water for soldering flux, and good solder. It may be advisable to tin the joints before forcing them together and then heating with the blow torch, making the soldering operation easier. At the top section,

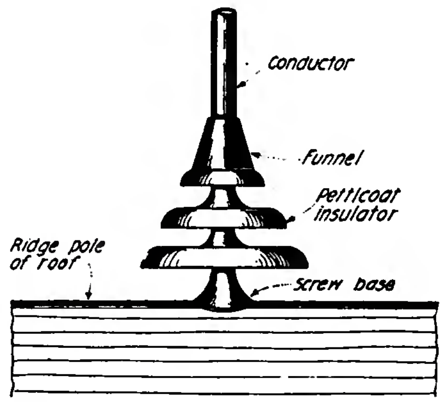


Figure 3.—Details of the petticoat insulator installed in the center of the anchor posts

the end is hammered over to prevent water running down the inside. This should also be soldered to make it water proof.

At the end of the bottom section, an ordinary 8-inch heavy gauge gasoline funnel is inverted. This gives a means of evenly distributing the weight of the mast on the petticoat insulator. This funnel need not be soldered to the bottom section as it will center itself.

The antenna wires should be cut about 10 feet longer than the exact size required in order to have a working margin. The lower antenna wires are placed 25 feet up the mast, the center wires 50 feet up the mast, and the upper wires at the top. At that place where the wires are fastened to the mast, they should be wrapped around very securely and soldered carefully. After feeling that they have been soldered properly they should be covered with asphaltum as far as they are soldered and all over the mast where there is soldering. This will prevent corrosion, at a later part of the season.

After the wires are cut to size and soldered to the masts, they should be so placed that they will not cross when the mast is lifted up alongside the house. Figure 2 shows the first erection operation. Most houses are from 30 to 40 feet high, and when the mast is hoisted along side the house, it will stick about thirty feet above the roof. The best way to raise the mast is to fasten long ropes to the end of each set of three wires and have a man hold each set. A block and tackle can then raise the bottom of the mast to the top of the roof and be placed on the petticoat insulator, while the four men steady the mast by holding the guy wires. Afterwards, one set of wires can be fastened to its anchor screw eye and the others following.

The whole outfit does not weigh more than sixty to one hundred pounds and no difficulty will be experienced in raising if there are five men available. Larger masts of the same type could be built, but the natural wavelength would be too great for 200 meter transmission without a series condenser which is not desirable.

100-Foot Radio Mast

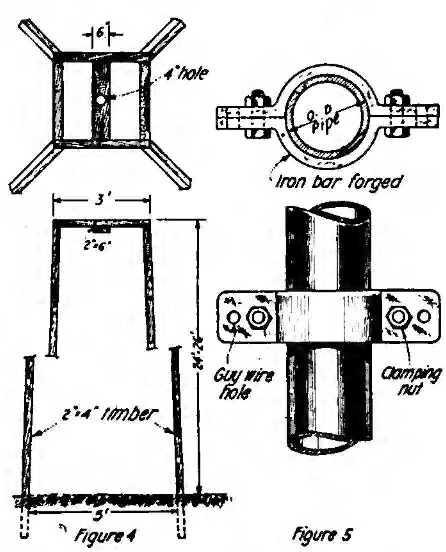
By L. D. Dillenback

SECOND PRIZE, $5.00

A YEAR before the war, an excellent mast was put up in New England by a few amateurs, 100 feet high, made of second hand iron pipe and second hand guy wire that was purchased very reasonably. Of course, prices have gone up about 200 per cent in iron pipe and wire, but even now a good mast could be put up reasonably.

This particular mast, figure 1, was used to support one end of an aerial, the other end being supported by a 130-foot pine tree which was located about 100 feet away. The antenna was strung between these two points, made T type and the fundamental was about 170 meters.

The technical data at the end of this article show the hardware that will be necessary, with the exception of the pivot, guy clamps and anchors, or "deadmen" as they are called in telegraph practice. When purchasing the pipe, new or second hand, look for the manufacturer's mark. The year is also



Figures 4 and 5.—Frame for concrete foundation and details of guy clamps, respectively

there and either a B or an L after the year it is manufactured in. B means butt welded and L means lap welded. Lap weld should be secured if possible as this will not buckle so easy and is much stronger. Furthermore, galvanized pipe should be secured. After buying second hand pipe, test the pieces by dipping them into a saturated solution of sulphate of copper and watch for defects in galvanizing, or spots where the galvanizing is disappearing. Black spots show where the galvanizing is weak or incomplete. In case the defects show up, it will be best to paint the pipe with black asphaltum or a graphite paint which will last some years.

The guy wire should also be bought galvanized or it will not last any length of time at all. In case it is bought second hand, it should be tested by stretching out and inspecting closely. Both new and second hand wire should be greased thoroughly with a good graphite grease before being erected. Care should be taken at all times to see that no kinks are made in the wire, for when these are pulled taut the wire will break easily.

The first operation is to carefully select the location of the mast, or the masts if there are two. The position of the pivot should be marked with a stake, and the position of the anchors should be laid out and marked with stakes. The pivot is then set in concrete, figure 2, and allowed to stand at least a week. During that time the anchors can be put down, figure 3, guy wires cut to length and other material all put in accessible places. A light frame of wood timbers, 2 x 4 inches, should then be erected at the pivot foundation, about 24 to 26 feet high, figure 4.

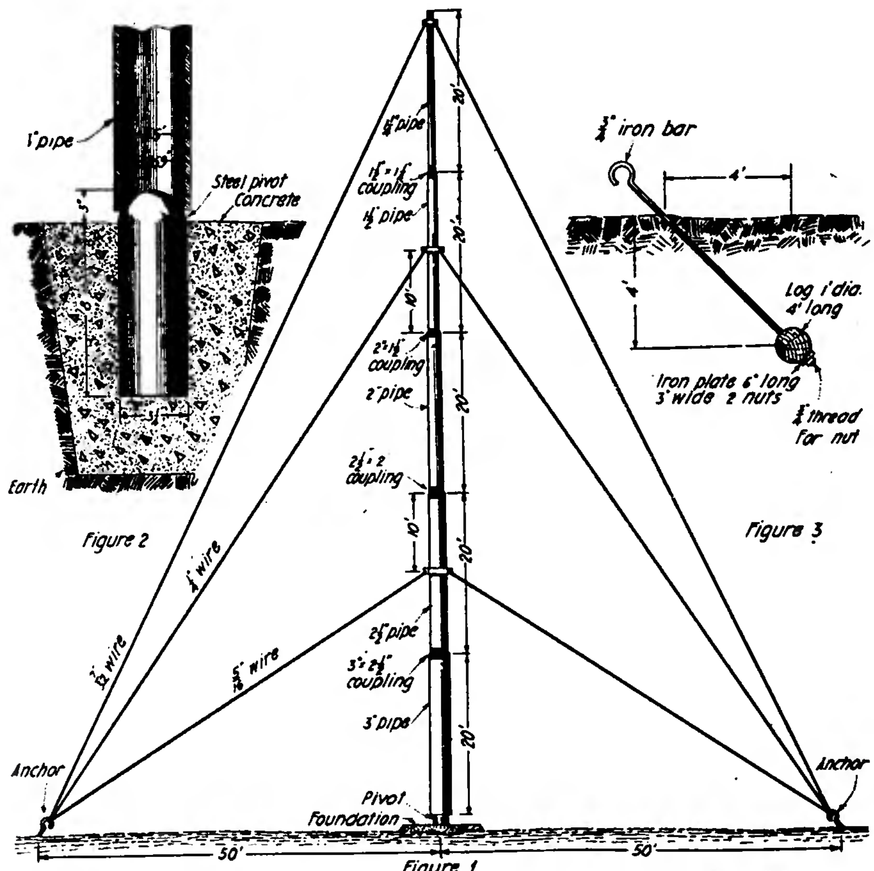
After the concrete around the pivot is dry and hard and the deadmen are laid and all the wires cut to size, etc., erection may start. It is suggested that six men be available and that they start in the morning. Then, in case things go slowly for some unforeseen reason, the work may be completed in a day and will not have to be left unfinished during the night with chances of a storm coming up to wreck the mast.

The 1¼-inch pipe is first lifted through the hole in frame and the upper guy wires fastened to the guy clamp, figure 5, for that pipe. The 1½-inch pipe is then joined to the first section by the reducing coupling. The 1½-inch section is then lifted ten feet, its guy clamp and the middle guy wires attached. That section is then lifted ten more feet and the 2-inch pipe coupled on with the reduction coupling. During this time, one man at each of the four anchors is paying out the guy wires. It may now be necessary to put a block and tackle on the pipe to hoist it, as the total weight without guy wires is about 450 pounds. The two-inch pipe is raised and coupled to the 2½-inch pipe and that raised ten feet more and its guy clamp and the lower guys fastened on. The 2½-inch pipe is then raised ten feet and coupled to the last section, the three-inch pipe. The three-inch pipe is then settled on the pivot and full attention given to the guys.

If the guys are kept steady when the sections are raised, it will be found that no trouble will be experienced. However, jerks or unsteadiness increases the possibility of trouble. In those spots where the guy clamps are fastened to the pipes, the pipe should be knurled with a center punch and hammer, to prevent slipping when strains are placed on them.

The guys should then be taken up temporarily by hand by each man. Later, one man should go some distance away and signal each man at the different anchors to take his guy in or out the proper amount to get the mast exactly perpendicular. Then two or three men should go around each anchor and draw the guys as tight as possible.

Of course, before the mast is put up, a tackle and rope should be fastened on the first 1¼-inch section to hoist the antenna on. After the antenna is raised, further adjustments on the guys will be necessary to compensate for certain unusual strains that may be encountered according to the height of the other supporting end of the antenna.



Figures 1, 2, 3.—Mast erected, concrete for pivot and anchor fastening, respectively

Exclusive of the labor, this mast could be put up for about $75 to $100 and would not have to be overhauled for at least three years, so it would cost about $30 a year.

HARDWARE REQUIRED—TECHNICAL DATA

Wrought Iron Pipe, Galvanized, Standard Lap Weld

Length	Size	List Price per Foot	O. Dia.	I. Dia.	Lbs. per Ft.	Wght. 20 ft., Approx.
20	1¼	.23	1.660	1.363	2.272	44
20	1½	.275	1.900	1.604	2.717	54
20	2	.37	2.375	2.060	3.652	72
20	2½	.585	2.875	2.460	5.793	114
20	3	.76½	3.500	3.059	7.575	150

Total weight of pipe (lbs. approx.)....450

REDUCING COUPLINGS:

Size	Approx. Length	Approx. Weight
3 -2½	3"	3 lbs.
2½-2	3"	2.2 "
2 -1½	2½"	1.3 "
1½-1¼	2¼"	.8 "

1-1¼" End Cap.

Upper Wires: Four 115 ft. long; each 7 strand; 7/32" dia. total: .095 lbs. per ft., 1,800 lbs. breaking strength.

Middle Wires: Four 86 ft. long: each 7 strand; ¼" dia. total; .012 lbs. per ft., 2,300 breaking strength.

Lower Wires: Four 59 ft. long; each 7 strand; 5/16" dia. total; .210 lbs. per ft., 3,800 breaking strength.

See details of pivot, guy clamps, and anchor for other material required.

An Easily Constructed Mast

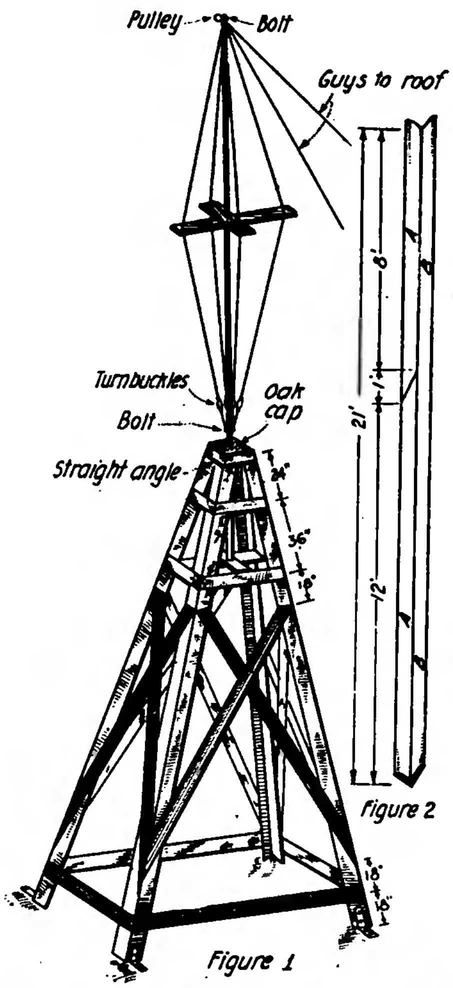
By Frank H. Mulcahy

THIRD PRIZE, $3.00

THE following is the description of the mast which I use at my station, formerly 2AIL, now 2NG, located at Park Avenue and 169th Street, New York City.

The material required for this type of mast consists of three bundles of furring strips, one twenty-foot length of ¾-inch galvanized iron pipe, four iron straps 2 feet x 1½ inches x ¼ inch each, four 4-inch straight angles, six dozen 2½-inch round head bolts, twelve dozen washers, one dozen 2-inch wood screws, two pounds of 2-inch nails, a galvanized iron pulley, four turn buckles (small), and about 200 feet of steel guy-wire. When I built the tower the material cost me about eight dollars.

To begin with, the corner members are formed as shown in figure 2. Two furring strips are prepared as A, and two as B. These are nailed to form an "L", placing a small section at each end so as to bring the joint at different places in the member. Two corner members are laid on the ground, touching at one end and eight feet apart at the other. Eighteen inches from the open end a piece of furring is bolted to each corner member, and a few inches from the top a four-inch straight angle of iron is fastened. Two feet and five feet respectively from the top two more pieces of furring are bolted. Then six and one-half feet from the top and three feet from the bottom two pieces of furring are bolted forming an X. This complete operation is repeated and a second side is formed. Then placing these sides so they meet at the top and are eight feet apart at the base, the remaining sides are bolted to correspond to the two already formed. A 4-inch x 4-inch x 1-inch oak cap is nailed on the top and a hole drilled to fit the outside diameter of the pipe. Connecting the mid-points of the opposite cross-bars that are five feet from the top, a strong cross is nailed, at the intersection of which a hole is drilled part way in the upper piece to form a socket for the pipe to rest in. A washer is placed under the head and nut of each bolt.



Figures 1, 2.—Constructional view of mast and details of corner members

A hole is drilled in the pipe two inches from one end and six feet from the other end. A bolt is placed through each hole as a fastening for the ends of the guy-wires. Two three-foot pieces of strong wood are nailed to form a cross as indicated in figure 1, a hole drilled at the intersection for the pipe and a small hole at each end for the guy-wires. The guy-wires are made tight to the bolts and through the holes in the cross by turn-buckles placed in each guy near the bottom. To the top of the mast a galvanized iron pulley is fastened and from the same point guy-wires go down to the roof to compensate for the pull of the aerial wires.

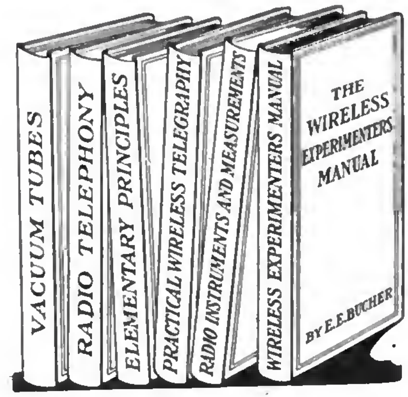
Four iron straps, 2 feet x 1½ inches x ¼ inch are bent to the angle which the foot of the tower makes with the roof, and three bolts fasten one leg of the angle to the tower and three 2-inch wood screws fasten the other leg to the roof. Roof cement packed around this strap will prevent rain from leaking through.

The tower can be built on the ground, disassembled and reassembled on the roof. As my roof space did not

Which Way?

Franklin Studied Electricity via The Kite String

but there is a better way open to YOU



Study Wireless Right

If You Expect To Succeed

Don't Grope--KNOW—Then Go Ahead Fast

With the right books at your elbow for constant and ready reference you can progress *ten times as fast* in wireless, as by picking up snatches of knowledge here and there. Accurate knowledge is what you most need.

Those Books Are LABORATORY TESTED—They Contain FACTS

Mr. Bucher's New Book Ready To Ship

THE WIRELESS EXPERIMENTERS' MANUAL — By Elmer E. Bucher

The only book published that comprehensively covers the theory and design of amateur wireless transmitters and receivers. Construction of transformers, high voltage condensers, spark gaps, aerials, masts, receiving sets for long and short wave length reception are described in great detail.

Construction and operation of a 50-mile buzzer transmitter, regenerative receivers, cascade amplifiers, preferred circuits for long and short wave receivers—all these are covered.

Direction finders, underground aerials and the use of Weagant's static eliminator for amateurs are the subjects of special chapters.

The amateur is told how to measure the inductance, capacitance and resistance of his aerial, how to check up the efficiency of his station. Construction of quench-gap transmitters, methods of measuring the internal impedance and amplification of constant of vacuum tubes are explained.

All in all it is the most complete textbook on the broad subject of amateur wireless telegraphy yet published. Cloth bound. About 300 pages. Fully illustrated. Price.......... $2.25

VACUUM TUBES IN WIRELESS COMMUNICATION By Elmer E. Bucher

The only text book on the market devoted solely to the various applications of the Oscillation Valve.

An elementary text book for students, operators, experimenters and engineers. Navy wireless men find this book especially helpful.

Tells in understandable language the fundamental operating principle of the vacuum tube.

Shows over 100 different circuits for the practical use of the Vacuum Tube as a Detector, Radio or Audio Frequency Amplifier, Regenerative Receiver, Beat Receiver and Generator of Radio Frequency Currents.

More than 100 diagrams reveal, step by step, in simple and direct form, the uses of the vacuum tube.

Cloth. Size 6x9 inches. 184 pages, 130 diagrams and illustrations. Price.......... $2.25

RADIO TELEPHONY By Alfred N. Goldsmith, Ph. D.

It is the only book treating the subject of Radio Telephony in all its aspects.

This complete text on radio telephony is intended for radio engineers, operators and experimenters, also radio electricians in the Navy, men in the Signal Corps and especially men in the Aviation Service who handle radio equipments. Students and others who desire to be clearly informed concerning this newest and most interesting branch of electric communication need this book.

It is written in clear style, and presupposes very little knowledge of radio. Fully illustrated with wiring diagrams and previously unpublished photographs of "wireless telephone' apparatus.

There are over 400 separate topics listed in a carefully prepared index.

Size 6x9 inches. 256 pages, 226 illustrations. Full cloth, stamped in gold. Price.......... $2.50

RADIO INSTRUMENTS AND MEASUREMENTS

Here is a book that should be in the hands of every wireless worker. It answers the questions you want to ask and will add materially to the efficiency of your wireless work.

Under the general heads that follow it treats simply and concisely of all phases of the subjects indicated. These are some of the subjects: Fundamentals of electromagnetism. Principles of alternating currents, Radio circuits, Damping, Wave meters, Condensers, Coils, Current measurements, Instruments and methods of radio measurements, Resistance measurement, Sources of high frequency current, Calculation of capacity and inductance, Design of inductance coils, High frequency resistance. Miscellaneous formulas and data. **Cloth bound. 332 pages. Fully illustrated. Price.......... $1.75**

PRACTICAL WIRELESS TELEGRAPHY By Elmer E. Bucher

More than 60,000 copies of this book have been sold to date. It is used in practically every school, college, and library in this country.

PRACTICAL WIRELESS TELEGRAPHY is the recognized standard wireless text book. It furnishes much information of utmost value in regard to the very latest styles of wireless sets now in use.

It is the first wireless text book to treat each topic separately and completely, furnishing a progressive study from first principles to expert practice. Starting with elementary data, it progresses, chapter by chapter, over the entire field of wireless—fundamentals, construction and practical operation.

Size 6x9 inches, 352 pages, 340 illustrations, handsomely bound in full cloth. Price.......... $2.25

ELEMENTARY PRINCIPLES OF WIRELESS TELEGRAPHY By R. D. Bangay

Part I

This book has been used very largely for the training of Telegraphists to take sole charge of complete Wireless Telegraph Installations. All parts of the transmitting and receiving apparatus are described in a way to give the student a sound working knowledge of the apparatus entrusted to his care.

Cloth, 212 pages, 132 illustrations. Price.......... $1.75

Part II

This second volume deals particularly with the component parts of a Transmitter. Each part is explained separately and fully.

242 pages. 302 illustrations. Full cloth. Price.......... $1.75 Both Books for $3.25

MAGNETISM AND ELECTRICITY FOR HOME STUDY By H. E. Penrose

Every person interested in electricity can obtain a thorough grasp of the elementary principles of this science without previous acquaintance with the subject, through the study of this book.

During the war, Mr. Penrose instructed hundreds of men in the Royal Flying Corps, the Royal Navy, Transport Service and Mercantile Marine in England and this experience made possible a book of unusual value.

224 illustrations. 515 pages. Full cloth. Postpaid. Price.......... $1.75

WIRELESS PRESS, Inc. ROOM 22, 64 BROAD ST. NEW YORK

A 4-20

OPPORTUNITY COUPON—Mail Today

Wireless Press, Inc.,
Room 22, 64 Broad Street, New York.

Enclosed please find $............ for which send me the books checked below.

	Title	Author	Price
	Wireless Experimenters' Manual	Bucher	$2.25
	Vacuum Tnbes	Bncher	$2.25
	Radio Telephony	Goldsmith	$2.50
	Radio Instruments and Measurements		$1.75
	Practical Wireless Telegraphy	Bucher	$2.25
	Elementary Principles: Parts 1 and 2	Bangay	$3.25
	Magnetism and Electricity for Home Study	Penrose	$1.75
	*The Wireless Age (one year)	With Book Order	$1.50
	*The Wireless Age (two years)	With Book Order	$3.00
	*The Wireless Age (one year)	Without Books	$2.00

Name ....

Street ....

City .... **State** ....

***Include 50 cents additional for postage outside of U. S.**

permit the placing of the mast in the tower before standing it upright it was necessary to bolt the tower in place first, leaving the mast rest on the roof in the center of the tower with the top end passing through the hole in the top of the tower. Before placing the mast in the tower the guy-wires are loosened and the cross pushed to the top of the mast. Two men now climb up the tower, which is strong enough to support them, and raise the mast until it rests in the socket on the cross-arm five feet below the top of the tower. While raising the mast the cross should be brought down from the top of the mast until it is seven feet from the top and then left there. After the mast is set in place the guy-wires are again fastened and the construction of the tower is completed. A coat of light gray paint gives a steel-like effect.

This tower has supported one end of a four-wire 150-foot span, without giving way under the severe storms to which it has been subjected.

X-Ray Tube Holder and Shield

HARRY F. WAITE has devised a novel combination X-Ray tube holder and shield shown in the accompanying figures.

at the same time acts as a shield enabling the rays of the tube to be projected only through the end of the shield, and thus protecting at the same

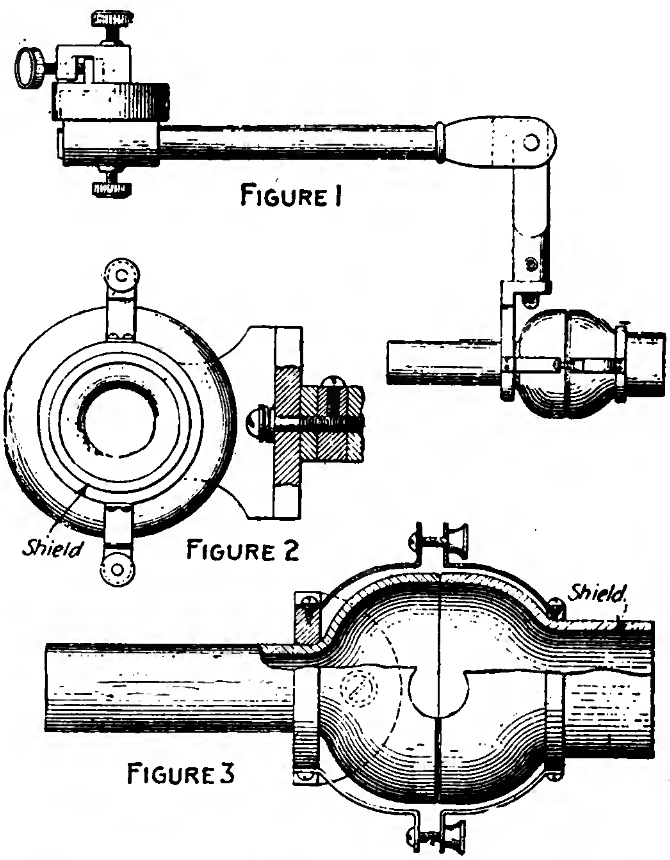


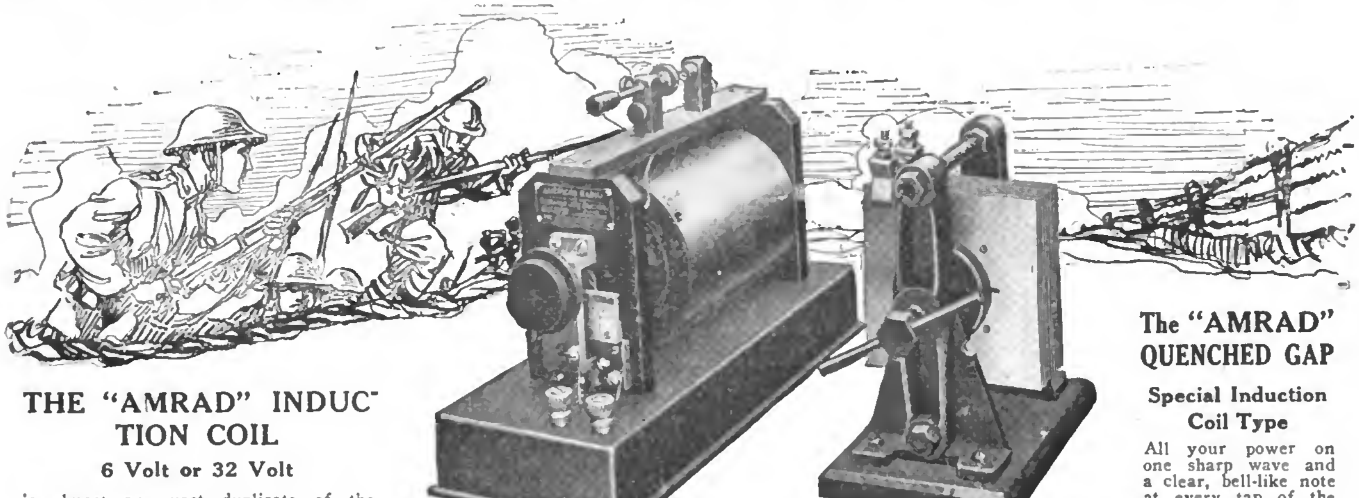
Figure 1.—Side view. Figure 2.—End view. Figure 3.—Top view.

The purpose of this device is to provide an X-ray tube holder which is adjustable to all positions and which time the patient and the operator from ill effects resulting from undue exposure to the rays.

Explanation—January "Age" Article

WITH reference to the article by Chas. R. Leutz in the January issue, covering the construction of a VT detector and 4-stage resistance coupled amplifier, the circuit diagram shown in Fig. 8 should be altered to include a connection joining the terminal marked "wing" to the positive terminal of the common B battery.

With reference to figures 11 and 12, it is understood, of course, that in order to get proper action when the circuits shown in above figures are connected to the amplifier, it will be necessary to provide some means of coupling the detector circuit to the amplifier. This may be effected most easily, perhaps, by connecting a pair of telephones, or, a single telephone piece across the grid-filament terminals of the amplifier.



The Monthly Service Bulletin of the

National Amateur Wireless Association

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

Getting Results

By P. F. Geagan

WHENEVER and wherever radio operators, amateur or professional, congregate, the conversation will nearly always swing around to a discussion of the merits of different appliances. Apparatus, circuits, antennae, etc., are discussed pro and con, and each one of the participants holds decided convictions as to what is good, fair, and bad, among them. Of course, each boasts the particular arrangement which has given in actual use the best satisfaction to him, and invariably condemns whatever has failed in his case to deliver the goods.

There is always an arrangement of circuits which one enthusiast boasts to the skies, giving instances of long distance work, unbelievably loud signals, or great selectivity of tuning. His claims are ridiculed by another for the reason that he has given it a thorough trial himself, and being unable to get anything out of it, returned to his own pet hook-up, the only one in captivity, all others being base imitations. A third member of the group pities both of them, since he knows from actual experience that neither one of the layouts they are arguing over can compete with his lashup, which, take it from him, is the only one extant that will . . . . etc., etc., etc. And so on to the end of the meeting.

The reason for the widely different results obtained from any method of connection among a number of experimenters, is carelessness or a lack of knowledge. Obviously, what works well at one station should work well at another, under the same conditions. But it is not generally understood that, "under the same conditions," covers a multitude of sins of commission and omission. Utter disregard of a few thousand ohms resistance, more or less, due to square knot splices, dirty corroded contacts, and wires hanging perilously by one strand (the other seventy-nine having parted company with a disreputable binding

post) is the probable cause for the government inspector who views the quivering remains wondering whether it is an exhibition of lightning arresters or a miniature reproduction of No Man's Land.

Experimenters who spend a number of perfectly good and healthy dollars in the purchase of Litz wire in order to reduce the high frequency resistance of their circuits, connect it carelessly and loosely to what should be termed a "subterranean binding post"—that is, one which requires extensive excavation of dust and disturbing the clutter of cigarette ashes and the other things around it in order to correctly place an inoffensive and long suffering wire. Then the wire is carefully draped around the table in imitation of the course of the Mississippi River, the remainder which the small fifteen foot table will not accommodate being looped up on a gas jet. The experimenter then pounces upon the helpless apparatus which has endured much, and proceeds to prove that Litz wire is a snare and a delusion. He spent his good money for it and imagines that he has given it a fair trial. Results? Nothing from nothing equals their numerical value. And so, when later on, he meets with station owners or operators who extol Litz wire, he opens wide his face and shames the hyena with his mirth. You've met the type!

The number of weird schemes and queries submitted to the editorial staffs of the magazines devoted to radio, indicate how far in advance of the scientists are some of our amateur station owners. At the moment I have in mind—with apologies to Wool Soap Eddie—one who sent in a letter with a sketch of a row of trees standing beside a house with a wire running from tree to tree and into the house. The height of the trees, the distance apart, the height and length of the wires, were all carefully set forth, even the information that the trees were descendants of the maple family, was included. It was requested that the wave length of this multiple tree antenna be furnished.

As the writer neglected to supply information as to the number of pickets in the fence surrounding the house, the editors were unable to answer the question.

Much of the hit or miss trust to luck method of assembling and handling the transmitter also naturally results in as many different degrees of failure. Transformers are often connected to a condenser capacity of a greater value than they are able to supply. Loose connections, carelessly arranged power circuits, and indifferent antenna and ground connections, all contribute to negative results.

If a few simple rules are followed

increased efficiency will be produced in many cases. First comes cleanliness. All apparatus and the operating table should be cleaned often. Do not allow dust to accumulate, or the binding posts or switch contacts to become corroded or dirty. Run all leads as directly as possible and do not allow loose ends to wander at will about the table. It is preferable also to solder a terminal on each wire. Arrange the circuits as far as possible so that the coupling between circuits is confined to the coils designed for this purpose. Very often poor results are obtained as a result of a system of wiring which resembles the freight yards of a railroad terminal. Especially in circuits designed for undamped reception, cleanliness and arrangement of wires plays an important role. A little resistance may make the whole difference between success and failure. Make soldered connection wherever possible. See that all binding posts are kept clean and tight. Keep switches clean and making good contact, and a great many troubles will disappear.

For reception of undamped waves, the condenser values should be relatively small compared with those which would ordinarily be used for spark reception. If an amplifier be used, reversing input leads or tickler leads may make all the difference between success and failure. Correct polarity of both batteries is necessary also, as well as the proper amount of voltage. Less precaution is necessary when using the crystal detector, but when it is considered how small is the amount of energy being handled, it should be realized that too much precaution cannot be taken.

On the transmitter, use leads of sufficient circular mil area to prevent a high impedance and consequent low power factor. It does not avail much to have 1,000 apparent watts flowing and only 0.3 kw. in the transformer. If the transformer is rated at 7,000 volts, do not use a spark gap of such a length that the condenser voltage must rise to 15,000 volts to break it down. If the outfit boasts a motor generator, see that the bearings get clean lubricating oil. It may not seem necessary for two surfaces rubbing against each other at a high speed to have any lubrication, but years ago somebody established the custom of looking at motor generator bearings once in a while to see that they were getting oil. We might as well cater to custom as long as it saves the delay and expense incident to getting new bearings.

The best commutator advice ever printed for the inexperienced is "let it alone." If the temptation to fix it becomes too great to be overcome, however, take the precaution to throw overboard all the cold chisels, files,

Prize Contest Announcement

Articles submitted to be printed in July issue on the subject.

"A Sensitive and Compact Portable Receiver."

Closing date, May 10, 1920.

Summer, with its vacations and days when one loves to be out of doors, is on its way, and many will begin to plan the construction of apparatus which is sufficiently portable to permit its inclusion in the camp kit, or the holiday trunk. There have been a great many developments since the last holiday season when Government regulations permitted the use of radio apparatus, as a result of which portable devices now in existence will have become, perhaps, more or less obsolete. The portable receiver should, if possible, include a vacuum tube detector. The great objection to the use of this detector in a portable receiver lies, of course, in the necessity for a heavy battery for filament current supply.

In the case of the outfit being taken on a cross-country hike, dry batteries or a low ampere-hour capacity storage cell may be substituted. In the case of the camp outfit where no supply current is available, the crystal detector has to be depended upon, but in the case of one who goes to the sea-shore or to some summer resort, it should either be possible to rent a storage battery from some handy garage or to devise a means whereby the detector tube may be supplied from the lamp socket in one's room.

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

hammers, and sledges at hand before attacking it. Give the unfortunate repair man a chance.

Much may be said about storage batteries and their care, but the main points are: keep the battery clean; watch for acid creeping and corrosion; keep the plates covered with solution. Many operators have discovered that it is easier and quicker to bring the solution up to the proper specific gravity by adding acid than by charging. This is a tremendously clever idea and a great saver of time, but such is the perversity of storage batteries that they persistently refuse to accept this innovation. Wise men prefer the old established methods and keep off this method of raising the "speegee." Do not discharge beyond the point given by the maker, and do not allow the battery to stand idle when low. Place it on charge as soon as possible. Contrary to opinion in some quarters, 100 A.H. stamped on a cell does not mean that it may be left on short circuit for one hundred actual hours!

Too much antenna insulation is a valuable fault in any installation. Too, no one has ever yet succeeded in making the ground lead too short. Keep the antenna resistance as low as possible. A circuit as stiff as a bar of iron will have difficulty in oscillating even though its intentions are the best in the world.

In the oscillating circuit use strip or tubing if procurable, and, as in the case of the receiver, try and arrange so that all the coupling takes place in the oscillation transformer.

While it is possible that the people who put up the money for wireless equipment may go to the trouble and expense of installing some appliance that they do not intend shall be used by the operator, still in the main, this is not the case, and such scintillating schemes as tying or jamming in a circuit breaker so that it cannot open, or replacing a fuse with an enormous piece of wire, will never set the world of science afire. Innovations of this character, too, are not overwhelmingly popular with the people who have to effect the repairs to the outfit as a result of such blacksmith methods of handling.

While meters will read higher without their shunts and resistances, it is customary to allow these to remain connected to their respective meters, if only because of the mental attitude of the makers that these are essential if the meters are to function properly.

Due to the slow rate of progress made by our inventors and manufacturers, the elastic telephone cord has not yet arrived, and it is better to remove the head set when wandering from room to room. Such cords as we are offered have a disagreeable habit of breaking when we attempt to stretch them more than a yard, and this causes the receiver to function poorly, due, of course, to the unmentionable detector.

Try to confine sparking to the spark gap. Several sparks operating simultaneously at different parts of the wiring or switchboard are unnecessary. The one furnished with the set is sufficient.

Before proceeding to disembowel your receiver, have a clear idea of what you propose to prove. It does not pay to cut, slash, and short circuit indiscriminately and then be able to re-assemble after the new hook-up has proved a failure. In case this happens, and you give the repair man a chance, admit at once that you have perpetrated improvements. The inside of the box may contain connections fearful and wonderful to behold, but unless he has reason to suspect it has undergone something of an ordeal, he will probably spend considerable time looking elsewhere for the trouble.

A motor generator or transformer name plate marked 1, does not imply that this is the minimum power at which it may be worked; when increasing power, it is better not to wait until the apparatus bursts into flames before deciding that perhaps the allowable increase in temperature is being exceeded. Horsepower is horsepower, much the same as "pigs is pigs," but if your motor, marked for instance, 3 HP, shows a tendency to slow down when you attempt to pile on the load, do not decide at once that the particular three horses that the manufacturer of your motor had in mind must have been emaciated, underfed, and on the point of death.

Of course all this has been written many times before. The only reason we keep on writing the same stuff is that we live in hopes that some of those who know better will come to think there is something to it.

Albany Radio Club

THE meeting night of the Albany Radio Club has been changed to Monday evenings, instead of every second Tuesday, and hereafter the weekly sessions will be held in the Y. M. C. A. building, Albany New York.

This club has installed a modern receiving set and a number of distant stations have been heard. Temporarily, a six-inch coil is to be used for transmitting, but it is expected that this will be replaced by a transformer in the near future. Other equipment includes a number of buzzer sets which have been installed to help the younger members to master the code.

E. C. Tasolett, president of this club, has a private radiophone set and is giving concerts every Saturday evening which are enjoyed by amateurs within a radius of fifteen to twenty miles.

The members of the Albany Radio Club would like to hear from amateur organizations and a wide-open invitation to this end is extended by Herbert Ammenheuser, corresponding secretary.

Clean English in Wireless

HAS it ever occurred to those operators of radio telephone stations in the vicinity of metropolitan centers and elsewhere that what is being said by them is being heard by hundreds and perhaps thousands of ears?

Has it ever occurred to those experimenting with radiophones that they may be "getting out" when they think they are *not* being heard?

In asking these questions, we have in mind a radiophone conversation carried on between two amateur stations in the vicinity of New York City on a recent date, when the ether was thoroughly contaminated with foul and profane language.

This wireless game is a great game, and those of us who are interested in it should do all we can to foster interest on the part of others. We can think of nothing which will so quickly kill the game as thoughtlessness in the respect just mentioned. In the old days when all amateur radio was strictly telegraph, we presume that those who were unable to express themselves in *clean* English gave little thought as to *what* they might say, since there was always a feeling that only the initiated few would be able to understand them, but with amateur phones coming into general use, unless we are mistaken, the entire family "sits in" for the evening concert. After reading the above may we suggest the use of a little imagination?

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.

H. A. T., Brooklyn, N. Y.:

In reply to your several queries; prior to the assignment of WSE to the Sea Gate Station, their call was "SE." Sea Gate abandoned the magnetic detector in 1912. This station rated 3½KW, and used a non-synchronous spark gap.

The call for the Manhattan Beach Station was "DF" (Dreamland, Coney Island). There is no data available as to the date on which the Manhattan Beach Station was opened. A straight gap was used.

The United Wireless Co. was absorbed by the Marconi Company in 1912.

The range of the station at 42 Broadway, New York, "NY," which was shut down in August of 1912, was about 300 to 400 miles day time. It was very common, however, for "NY" to work distances of several thousand miles.

The station at Bush Terminal, Brooklyn, "WCG" has always been owned by the National Electric Signaling Co., now the International Radio Co.

We are uncertain as to when the Cape Hatteras station, "HA," opened up, but it was probably in the fall or winter of 1907. This station was closed April 7, 1917.

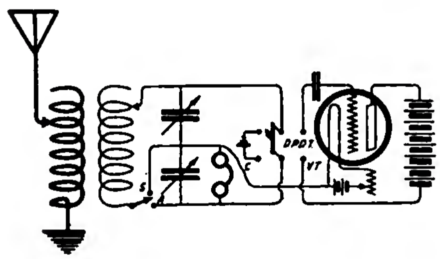
We are unable to say definitely as to when the first time signals were sent out by radio. The regular transmission of time signals in the U. S. commenced, however, directly after the completion of the Arlington station in the late fall of 1912.

At the time when Jack Binns sent out the first "SOS" from the S. S. Republic there were about 400 vessels which carried radio.

The Marconi Service News has been changed to "World Wide Wireless," and we suggest that you communicate with the Radio Corp. of America, Woolworth Bldg., N. Y.

M. K., Oakland, Calif.:

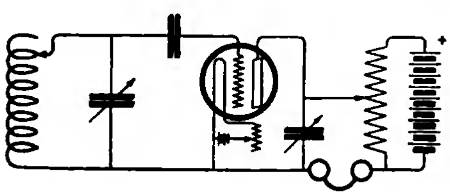
With reference to the circuit diagram on page 34 of the September issue, the reception of arc signals and of spark signals at their natural tone is effected by adjustment of the switch marked "tickler" and the bridging condenser. It is only possible conveniently to switch from spark connection to continuous wave connection when a circuit is used wherein the "back coupling" is capacitive. Such a circuit is shown below, wherein a switch has been incorporated for change from crystal to audion detector.



The 110 volt house lighting current may be used to light the filament of the audion and to supply the plate battery. This scheme cannot be made to operate quietly without considerable difficulty, the 60 cycle hum being heard in the telephones continually. It is needless to point out that this may become quite troublesome in cases where extremely weak signals are to be received.

Iron core amplifier transformers have proven to be the most satisfactory. We hope to be able to publish in the near future an article on how to construct them. The construction of an efficient amplifier transformer is not a very easy problem for the amateur inasmuch as the windings consist of many thousands of turns of No. 44 wire.

It is suggested that you use a switch for the regulation of your B battery in preference to a potentiometer. The battery will last longer since there is a continuous leak through the potentiometer when connected to the battery. A diagram showing connection for potentiometer is given below.



We regret that we have no data available concerning the construction of De Forest Company's radiophone outfit.

* * *

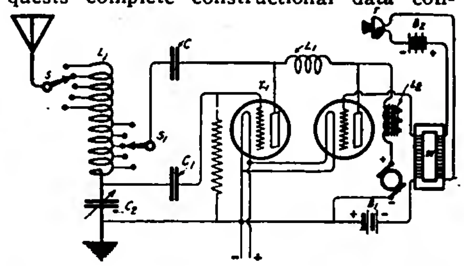
A. E. H., Toronto, Canada:

Asks for information concerning the schedule and wavelengths of radio telephone stations. Perhaps some of the readers of the WIRELESS AGE will be glad to submit any information concerning the wavelength and schedules of radio telephone stations within their receiving range.

There are several amateurs within the vicinity of New York City who are operating radio telephone outfits on wavelengths between 200 and 400 meters. Several of these have been able to communicate with points as far west as Ohio, and if you have an outfit which is particularly efficient on short wavelengths, you should be able to pick these up. In addition to this, the Western Electric Co. has been carrying on experiments with radiophone outfits at wavelengths in the vicinity of 1500 meters. As far as we know, none of the stations mentioned have regular schedules, and in fact, we know of no other stations which do have, inasmuch as all of the work is purely experimental.

H. R. W., Lansing, Mich.:

Encloses a circuit diagram of the "SCR 67" which is reproduced herewith, and requests complete constructional data con-

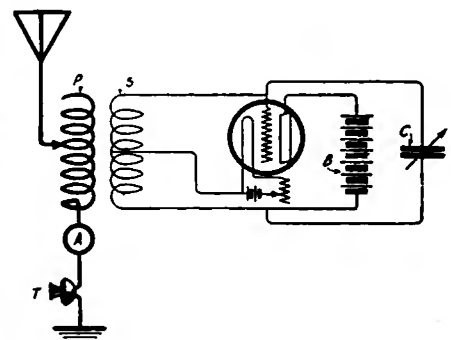


cerning the radio frequency inductance L, its taps, etc.; the condensers and the radio frequency choke coils L_1 and L_2, as well as the voltage of the generator used in connection with this outfit. Perhaps some of the readers of the WIRELESS AGE will be able to supply this information.

* * *

C. R. L., Winnetka, Ill.:

A diagram suitable for use in connection with the laboratory radiophone described by J. Pignone in the November issue, is printed herewith.



The wavelength range will be over about 200 to 400 meters, and the transmitting range with such a set, using a Marconi vacuum tube and, say, 350 volts on the plate circuit, should be in the neighborhood of 6 to 30 miles depending on the type of receiver used.

* * *

A. V. M., Penn Yan, N. Y.

There is considerable difference between a radio telegraph and radio telephone transmitter as the average amateur thinks of them. For radio telegraphic purposes the alternating current supply which is available in every town of any size may be passed through a transformer, the voltage thus being raised to 15 or 20 times its original value and then utilized to charge a high tension condenser which upon discharging across a suitable spark gap, sets up high frequency oscillations in the discharge circuit. The discharge circuit is so associated with the antenna circuit that oscillations are induced into and radiated by the antenna. With a spark transmitter these oscillations are radiated in groups at group-frequencies depending upon the frequency at which the condenser becomes completely charged and discharged; or, if a rotary spark gap or discharger is used, the frequency of the groups of oscillations will depend upon the number of times the rotating electrodes pass the fixed electrodes. Present day radiophone practice on the other hand, requires a generator capable of supplying oscillations continuously, that is, oscillations which are not radiated in groups. This is accomplished now-a-days by the use of electron discharge devices such as the three element vacuum tube. For the theory and operation of the three element tube, you are referred to "Practical Wireless Telegraphy" by E. E. Bucher, Wireless Press, Inc., N. Y. C.

While there is considerable difference between a radio telegraph and radio telephone transmitter, the same receiver may be used for both.

We regret that we are unable to tell you where you may purchase a steel mast. You need not necessarily use steel, neither is it necessary to use more than one, although the mean height of the antenna will be considerably increased if it is supported by two masts, and you understand, of course, that the higher the antenna the greater the strength of the received signal and the greater the range of the transmitting station. It is possible to construct your own mast from gas pipe or to build yourself a wooden lattice mast. Suggestions along this line are being printed in current issues of this magazine. If you are desirous of doing transmitting at amateur wavelengths, we suggest that you make your masts about 70 ft. high, set them about 125 ft. apart, and take your lead-in from the middle of the horizontal wires. If you wish to use only one mast, we suggest that this be made as nearly 100 ft. as possible, the wires being brought down from the top of the mast to the station so as to form an angle of about 45 degrees with the mast. In the case of the two masts, it makes no particular difference whether they are in an east to west, or north to south line.

* * *

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 April 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 E. J. Nally, who, having been duly sworn according to law, deposes and says that he is the President of the Wireless Press, Inc., Publisher 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, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher, Wireless Press, Inc., 68 Broad St., New York, N. Y.
Editor, J. Andrew White, 68 Broad St., New York, N. Y.
Managing Editor, none.
Business Manager, J. D. Conmee, 68 Broad St., 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., 68 Broad St., New York City, N. Y.
E. J. Nally (850 shares), 233 Broadway, New York City, 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.

E. J. NALLY,
President.

Sworn to and subscribed before me this 19th day of March, 1920.
(Seal.) M. H. PAYNE.
(My commission expires March 30, 1920.)

A WARNING

Fleming Pat. No. 803,684
De Forest Pat. Nos. 841,387-879,532

to Manufacturers
Importers
Dealers
Jobbers
Agents
Amateurs
Purchasers
Users of

Vacuum Tubes

The Marconi V.T. Patent is Basic

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

It is a basic patent and controls broadly all vacuum tubes used as detectors, amplifiers or oscillions in radio work.

No one is authorized to make, sell, import or use such tubes for radio purposes, other than the owners of the patent and licensees thereunder. Any others making, selling, importing or using them alone or in combination with other devices, infringe upon the Fleming patent and are liable to a suit for injunction, damages and profits. And they will be prosecuted.

THE AUDIOTRON AND THE LIBERTY VALVE ARE NOT LICENSED UNDER THE FLEMING PATENT

The price of the genuine Marconi V. T. delivered is $7.00 each. The standardized socket is $1.50 additional. The standard resistance, complete, costs $1.00 and is made in the following sizes: ½ megohm, 1 megohm, 2 megohms, 4 megohms, 6 megohms.

Do not take chances by making, importing, selling, purchasing or using vacuum tubes for radio purposes not licensed under the Fleming patent. By selling, purchasing or using licensed tubes for radio purposes you secure protection under the Fleming patent and avoid the risk of litigation for infringement thereof.

This warning is given so that the trade and public may know the facts and be governed accordingly.

Send all remittances with order to COMMERCIAL DEPARTMENT

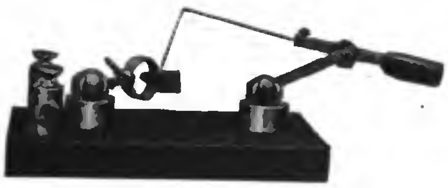
RADIO CORPORATION OF AMERICA
MARCONI WIRELESS TELEGRAPH CO. OF AMERICA

233 Broadway Woolworth Building New York

Sole Distributors for De Forest Radio Telephone & Telegraph Co.

Retail Office and Exhibition Rooms, 25 Elm St., New York

Schofield Bldg., Cleveland, Ohio
American Bldg., Baltimore, Md.
Insurance Exch. Bldg., San Francisco, Cal.
136 Federal St., Boston, Mass.
301 Commercial Bank Annex, New Orleans, La.
109 South 2nd St., Philadelphia, Pa.



The Jones Patented Crystal Detector

presents six different surfaces of the Crystal to the action of the needle, without changing its position. It keeps you on the LIVE SPOT at all times and thereby gives you the loudest and clearest signals.

Four Dollars net, Postpaid.

Send for new Illustrated descriptive Bulletin describing these and other High Grade Radio Apparatus.

OUR LATEST CABINET VACUUM TUBE RECEIVING SET

Employing the New MARCONI VACUUM TUBE

Reception range from 200 to 8000 metres.

Can be used for either DAMPED or UNDAMPED waves, without the addition of any other coils or apparatus.

Model "D" $60.00
Model "E" 85.00

Interior view from the Rear, showing Loose Coupler, its action, and Wiring Diagram of the Vacuum Tube Circuit. Also showing how the entire Apparatus is built within the metal frame, to permit its removal from the cabinet for examination or additions.

We reproduce the set in its entirety that you may see and understand its construction, instead of enclosing it in a Cabinet and **allowing you to guess. It is now used in Schools** of Radio instruction where Technical and satisfactory results are necessary.

THE JONES RADIO COMPANY, 384 Monroe Street, Brooklyn, N. Y.

ARLINGTON TESTED CRYSTALS

Why buy minerals on a gamble? Be SURE when you put a crystal in your detector that it is EXQUISITELY SENSITIVE. Buy Arlington individually tested Minerals, Galena or Silicon, post paid on receipt of price.

35¢

THE NEWMAN-STERN CO.
Dept. W. A. Cleveland, O.

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 10th St., Valparaiso, Indiana

---

Radio Handbook & Catalogue

Contains much valuable radio information, tables and data. Describes a remarkable line of wireless instruments including "Red Head" 'Phones, Arlington Tested Minerals, DeForest, Murdock and Signal Apparatus. Write for this book today

The Newman-Stern Co.
Dept. W.A. Cleveland, O.

Red Head Radio Phone

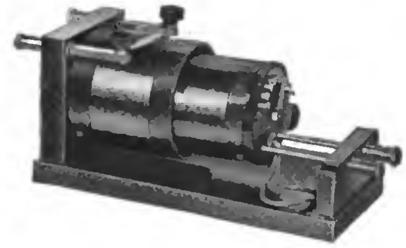
$7.00

The accepted standard in wireless receivers. If they are not BETTER than anything you've ever seen return them for full cash refund. Our Radio Handy Book and Catalogue, free on request, describes them, and many other instruments.

The Newman-Stern Co.
Dept. W.A. Cleveland, O.

NEW SHORT WAVE COUPLER No. 747

Comes up to the CHAMBERS' usual High Standard. Especially adapted to long distance Amateur work. Tunes to 800 meters. Does away with the dead-end effect so common when large couplers are used for short wave reception.



Mahogany finished woodwork. Brass metal parts. Has new slider feature. Secondary has six taps. Wound with Red Enameled Wire, or, secondary with Green Silk if so ordered. Measurements over all, length 12 inches, width 4½ inches, height 5 inches.

PRICE - - $10.00

F. B. CHAMBERS & CO.,
2046 ARCH STREET - - PHILA., PA.

RADIO APPARATUS

Distributors of all prominent makes. Largest and best stock of any house in New England

DE FOREST HONEY-COMB COIL INDUCTANCES

Cat. No.	Solid wire. Appx. wave length range with .001 MF. Variable condenser	Price on plug mounted	Litz wire Cat. No.	Price on plug mounted	Cat. No.	Solid wire. Appx. wave length range with .001 MF. Variable condenser	Price on plug mounted	Litz wire Cat. No.	Price on plug mounted
L-25	170-375	$1.40	LL25	$1.40	L-300	1340-4800	$2.10	LL300	$2.66
L-35	200-515	1.45	LL35	1.45	L-400	1860-6300	2.25	LL400	3.10
L-50	240-730	1.52	LL50	1.64	L-500	2340-8500	2.40	LL500	3.35
L-75	330-1030	1.60	LL75	1.70	L-600	2940-12000	2.65	LL600	3.00
L-100	450-1460	1.70	LL100	1.76	L-750	3100-15000	2.80	LL750	3.20
L-150	660-2200	1.80	LL150	2.16	L-1000	5700-19000	3.00	LL1000	3.75
L-200	860-2850	1.90	LL200	2.28	L-1250	5900-21000	3.35	LL1250	4.16
L-250	1120-4000	2.00	LL250	2.50	L-1500	7200-25000	3.60	LL1500	4.68

Cat. No. LC-100—Inductance coil mounting with gears but without base to hold three coils. Primary, secondary and tickler $9.00
Cat. No. LC-101—Same as above, but mounted on oak base 12.00
Cat. No. ULC-100—Same as No. LC-100, but mounted on Unit panel 10.00

All coils and mountings postpaid to any part of the U. S.
All orders shipped the same day. Give us a trial!! Send 6 cents in stamps for new catalog just out!!!

F. D. PITTS CO., Inc. (*Dept. B*) 12 Park Square, Boston, Mass.

BAKELITE - DILECTO

Manufacturers!

Wireless apparatus for commercial, experimental and amateur use has recently moved a considerable number of notches ahead.

Yesterday's Construction Don't Go Today

Handsome appearance must be combined with efficient working. The true enthusiast looks for both in the apparatus he buys nowadays.

This is particularly true of the insulation used. And the engineers and amateurs of widest experience have learned that when genuine

BAKELITE - DILECTO

is used, SATISFACTION is **SURE**

Combine the popularity of this wonderful insulation with the best work you can do. Tell your customers that you use the genuine **BAKELITE-DILECTO**—and watch your sales grow.

BAKELITE-DILECTO WILL CUT YOUR MANUFACTURING COSTS—

because it comes in sheets, rods and tubes. This means the minimum of fitting work. It is waterproof, permanent and strong.

We also manufacture Vulcanized Fibre and Conite for special insulating purposes

Write us about your requirements. Our engineers will gladly show you how our products will solve your insulating problems.

THE CONTINENTAL FIBRE CO.

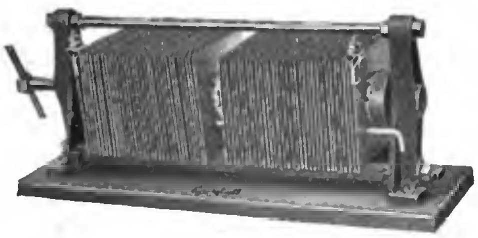
NEWARK, DELAWARE

233 Broadway, New York City
525 Market St., San Francisco, Cal.
Cor. King and Yonge Sts., Toronto, Ontario, Canada.

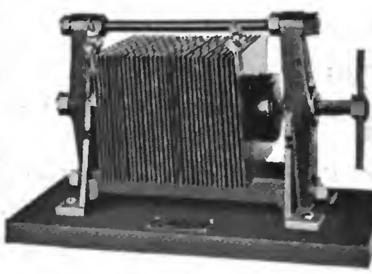
332 S. Michigan Ave., Chicago, Ill.
411 S. Main St., Los Angeles, Cal.
301 Fifth Ave., Pittsburgh, Pa.

At Last! Immediate Deliveries on All

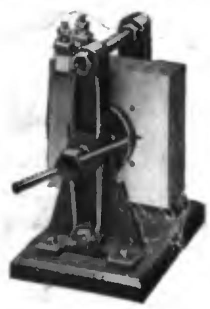
AMRAD QUENCHED GAPS



TYPE G-1—This gap is built to control the energy necessary to do real long distance work. 1,000 miles and over. It has 32 sparking chambers. Designed for use with transformers delivering 20,000 volts up. Maximum power 1,000 watts. Price, $26.50.



TYPE G-2 — Our first gap. Out only four months. It is now in operation in every U. S. A. radio district and in Canada. No inducements offered to introduce this gap; evsry ussr a voluntary purchaser. Enthusiastic reports on file in our offics. Intended for moderately long distance work, 600-900 miles. It has 16 sparking chambers and is designsd for uss with transformers delivering over 10,000 volts. Maximum power 500 watts. Price, $17.50



TYPE G-3—Especially designed for use with the Amrad 100 watt induction coil, but is suitable also for use with ordinary spark coils or small transformsrs delivering over 7,500 volts. This gap will increase ths range of any induction coil set nnd at the same time will permit ths operator to comply with the Federal law regulating decrement. It offsrs ths only practical solution to ths QRM problem in congested districts. Seven sparking chambere. Maximum cspacity 250 watts. **Price, $12.50**

Adjustable Resistances: To operate quenched gaps efficiently on 60 cycles a. c. an adjustable resistance must be used. We furnish three types of adjustable resistances. Prices and description of complete mounted units and parts contained in Bulletin Q.

Why You Should Use The Amrad Quenched Gap

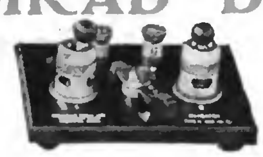
1. Correctly operated, it will radiate more *effective* energy on a given power input than any other type gap. This absolutely assures consistent long distance work.
2. On the above adjustment your decrement will drop below the maximum .2 set by law. You will therefore not illegally interfere with other stations.
3. The Amrad Quenched Gap is silent. No longer need your radio station be a nuisance to your family or neighbors.
4. It puts you and your station on a high-class "commercial" plane. The quenched gap is the most modern gap and its successful operation reflects no mean degree of skill and care on your part.
5. It is reliable. When using the Amrad Quenched Gap there is no danger of your station suddenly being put out of commission by a kick-back burning out motor windings.
6. It is economical. It reduces electric current bills. No moving parts to wear out, break or get out of balance. With careful use the quenched gap gaskets need be renewed only occasionally and then at a trifling cost.
7. It is efficient on 60-cycle supply circuits. Two spark frequencies may be obtained, either 120 or 240 sparks per second. When adjustments are correctly set, both notes are clear, snappy and wonderfully uniform. The gap is equally efficient when used with induction coils.
8. It increases speed of handling traffic. No waiting for motors to come up to speed or slow down. Quick back-and-forth communication over the longest distances.
9. The Amrad Quenched is the *standardized quality* Gap. All plates in the various types are identical and interchangeable. Each gap plate is tested to meet a high standard of accuracy. The entire instrument is essentially a "commercial" product especially designed for private use.

Full descriptions of and specific operating instructions for the Amrad Quenched Gaps, all types, together with description of adjustable resistances, contained in Bulletin Q.

Coil and Gap Combination: The Type G-3 Gap and our 100 watt Amrad Induction Coil, 6 or 32-volt type, will be sold for a limited time at the special price of $33.50. See page 33. Described in Bulletin P.

AMRAD DETECTOR STANDS

DUPLEX



$4.50

SINGLE

$2.50

TESTED AND APPROVED BY NAVY DEPARTMENT

Without question the leading instrument of its kind. Duplex type equipped with eelector switch having open circuit point. Moulded base ½ inch thick. Size 4" x 3". All metal parts nickel-plated, satin finish. Crystal mountings enclosed and dust proof. Ball and socket adjustment made by tip of forefinger. All points of the crystal accessible. Adjustmsnt remarkably proof against shock. Postage, 10c, both types.

Single type is the most compact and ruggsd Detsctor Stand built. Moulded base 2¼" x 1⅞". Equal in all other respects to our Duplex type. Substantial binding posts with non-rsmovable tops. Tension of Whisker instantly adjustable. In appearance and design it harmonizes with the finest panel construction. Especially suitable for portable sets where weight and space are factors. Bulletin T describes both types.

Upon reqnest we will enter on our monthly mailing list for one year the names of all active radio amateurs. To these we will send our catalog, now in preparation, and all onr latest bulletins as rapidly as printed for insertion therein. An extensive line of Amrad apparatus is under development. If there is no radio dealer in your town, ask for our list of Amrad retailers who stock our goods.

AMERICAN RADIO AND RESEARCH CORPORATION

19 Park Row
New York

Address all Communications to New York Office

Factory and Laboratory
Medford Hillside, Mass.