

April, 1920

GENERAL LIBRARY
Engineering Library
APR 16 1920
UNIV. OF MICH.

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 Stations of the A.E.F.

www.americanradiohistory.com

HATS OFF TO THE NAVY

INSULATION
"MADE IN AMERICA"



INSULATION
"MADE IN AMERICA"

Louis Steinberger's Patents

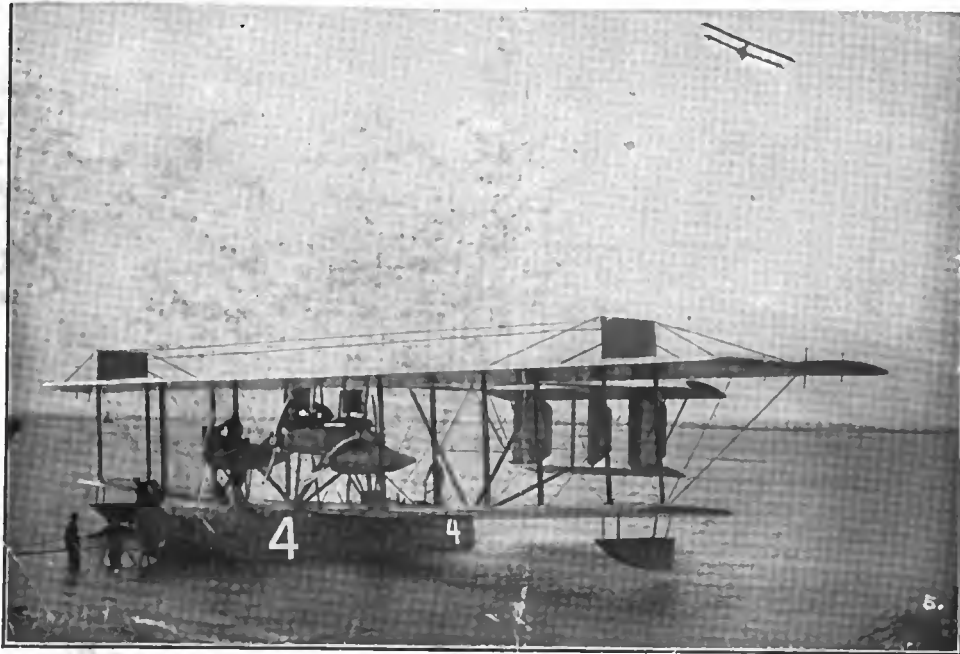
ELECTROSE INSULATORS

FIRST TO CROSS OCEAN IN AIR

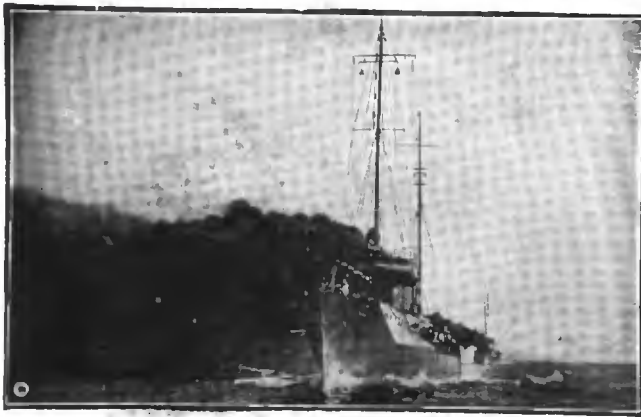
Standard of the World for High Frequency Currents Used by UNITED STATES NAVY and ARMY, and the Wireless Telegraph and Telephone Companies

"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."

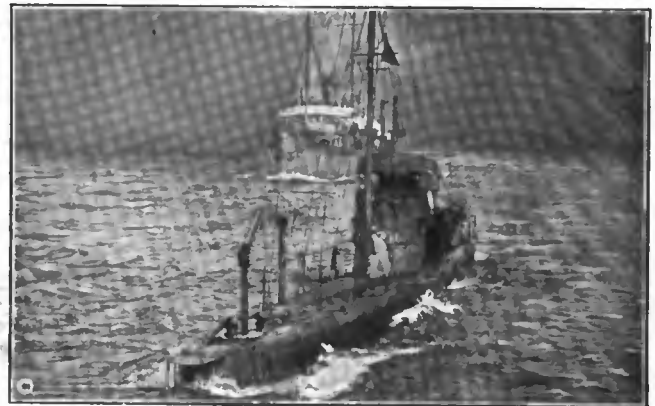
Extract from New York World, June 3, 1919.



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



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



INSULATION

"MADE IN AMERICA"

LOUIS STEINBERGER'S PATENTS

SOLE MANUFACTURERS

66-82 Washington Street

27-37 York Street

66-76 Front Street

1-23 Flint Street

ELECTROSE MFG. CO.

Brooklyn, N. Y., America

Radio Frequency Ammeters

for determining

Antenna Currents



Model 400

Self-contained. Front-Connected
Radio Frequency Ammeter

Weston

Model 400

Thermo Ammeter

(Not a Hot-Wire Instrument)

is a Switchboard Type Instrument
7¼ inches in diameter.

Guaranteed accuracy of 1%. Equally accurate on currents of any audio or radio frequency.

Unaffected by changes in temperature. Extremely low power consumption. Can be used where bad wave form or frequency precludes the use of other forms of instruments.

Write for information

Weston Electrical Instrument Company, 27 Weston Ave., Newark, N.J.

New York
Chicago
Philadelphia
Boston

Cleveland
Detroit
St. Louis
San Francisco

Denver
Cincinnati
Pittsburgh
Richmond

Buffalo
Minneapolis
New Orleans
Jacksonville

Rochester
Seattle
Toronto
Montreal

Halifax
Winnipeg
Vancouver
Calgary, Alta.

And in Principal Cities Throughout the World

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

Edited by J. ANDREW WHITE

FEATURE ARTICLES

Wireless in the A. E. F.	10
25-Mile Radiophone Transmitter Using Marconi V. T.'s for 200-Meter Amateur Work. By Charles R. Leutz.	15
The Coll Aerial. By Leon T. Wilson.	18
WORLD WIDE WIRELESS	7
RADIO SCIENCE	
Uni-Control Receiver	22

EXPERIMENTERS' WORLD

Constant-Speed Regulator for Series Motors. By L. A. Bartholomew	14
An Original Aerial Switch, First Prize Article	23
A Remote Control Antenna Switch, Second Prize Article	24
1 kw. Antenna Switch, Third Prize Article	26

70-Foot Mast for Umbrella Antenna, First Prize Article	27
100-Foot Radio Mast, Second Prize Article	23
An Easily Constructed Mast, Third Prize Article	30
X-Ray Tube Holder and Shield.	32
Explanation—January "Age" Article.	33
N. A. W. A. BULLETIN	34
QUERIES ANSWERED	43

Advertisements

AUTOMATIC TRANSMITTERS	Page
Omnigraph Mfg. Co.	2
BLUE PRINT PAPER	
New York Blue Print Paper Co.	34
BOOKS	
Audel & Co., Theo.	41
Radio Review, The.	38
Wireless Press, Inc.	31, 37
Experimental Science Pub. Co.	41
CANOES	
Old Town Canoe Co.	32
ELECTRICAL EQUIPMENT	
American Electro Technical Appliance Co.	41
American Radio and Research Corporation	33, Fourth Cover
Atlantic Radio Co., The.	4
Bates, Lee A.	39
Brandes, C.	39
Bunnell & Co., J. H.	48
Burgess Battery Co.	32
Chambers & Co., F. B.	47

Clapp-Eastham Co.	42
Cole & Morgan, Inc.	41
Continental Fibre Co., The.	Third Cover
Corwin & Co., A. H.	44
Daynor Radio Electric Co.	38
Duck Co., The William B.	38
Electric Storage Battery Co., The.	48
Electroac Mfg. Co.	Second Cover
Federal Telegraph & Telephone Co.	4
Firth & Company, Inc., John.	35
General Radio Company.	45
Grebe & Co., A. H.	43
Hovey, A. T.	45
Inland Specialty Co.	39
International Radio Telegraph Co.	39
Johnston, Chas. H.	44
Jones Radio Co., The.	47
Manhattan Electrical Supply Co.	40
Mignon Mfg. Corp.	43
Mutual Purchasers Association	36
National Radio Supply Co.	40
Newman-Stern Co., The.	47
Oliver & Co., James O.	44
Pacnet Electric Co.	45
Pitts Co., F. D.	47

Precision Equipment Co.	34
Radio Corporation of America.	46
Radio Distributing Co.	5
Radio Electric Co., The.	43
Stromberg-Carlson Telephone Mfg Co.	36
Toledo Radio Specialties Co.	32
Tresco	42
Vandercook, J. Donald.	40
Westinghouse Electric & Mfg. Co.	3
Wireless Improvement Co.	6
ELECTRICAL INDICATING INSTRUMENTS	
Weston Electric Instrument Co.	1
INSTRUCTION	
Dodge's Institute	47
Eastern Radio Institute	43
Marconi Institute	35
Service Radio School	42
Y. M. C. A. Radio School.	30
MOTORS	
Crocker-Wheeler Co.	37
SMALL ADS OF BIG INTEREST	29

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.

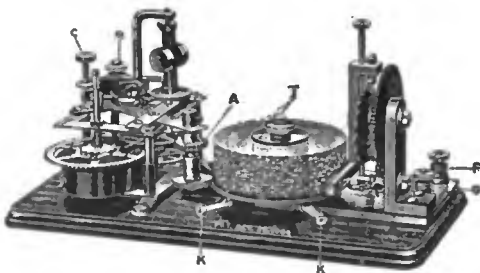
Yearly Subscriptions in U. S., \$2.00
Outside U. S., \$2.48; Single Copies, 20 cents

Entered as second class matter Oct. 9, 1913. Post Office at New York, N. Y., under the Act of March 3, 1879. Copyright, 1920, Wireless Press, Inc. Edward J. Nally, Pres. Lee Lemon, Vice-Pres. David Sarnoff, Secy. George S. De Sousa, Treas. J. D. Conmee, Business Mgr.

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.

Learn The Code With The OMNIGRAPH

The Omnigraph Automatic Transmitter will teach you the Code—at home—in the shortest possible time and at the least possible expense. Connected with Buzzer or Buzzer and Phone, the Omnigraph will send you unlimited Continental messages, by the hour, at any speed you desire. It will bring an expert Operator—right into your home—and will quickly qualify you to pass the examination for a first grade license.



THE OMNIGRAPH MFG. CO.
Cortlandt Street, New York.

Gentlemen:—I wish briefly to commend your very excellent Automatic Transmitter. Recently I was successful in obtaining a first-class Commercial Radio License and I believe that the Omnigraph was my principal aid.

I took a four weeks course at a Resident Radio School in Theory only. I relied on the Omnigraph to get my Code to the proper speed, and the Omnigraph did it.

I was one of two in a class of eighteen to obtain a first-class License. The stumbling block for the others was CODE. And I know that a short time receiving Omnigraph messages daily would have enabled them to pass the examination as easily as I did.

I believe the Omnigraph to be the easiest, quickest and cheapest method to learn the International Morse Code.

Cordially yours,
(Signed) GEO. E. SELLERS.

4341 Richardson Ave.,
New York City.
Jan. 21, 1920.

The Omnigraph is used by several departments of the U. S. Government and by a large number of the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada.

The Omnigraph is also used by the Bureau of Navigation in testing applicants applying for a Radio License. Thousands have learned both the Morse and Wireless Codes with the Omnigraph.

Send for free catalog describing three models—\$12 to \$28. Do it to-day. The Omnigraph is sold under the strongest of guarantees—if not as represented, your money back for the asking.

THE OMNIGRAPH MFG. CO., 39C Cortlandt St., N. Y.

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,

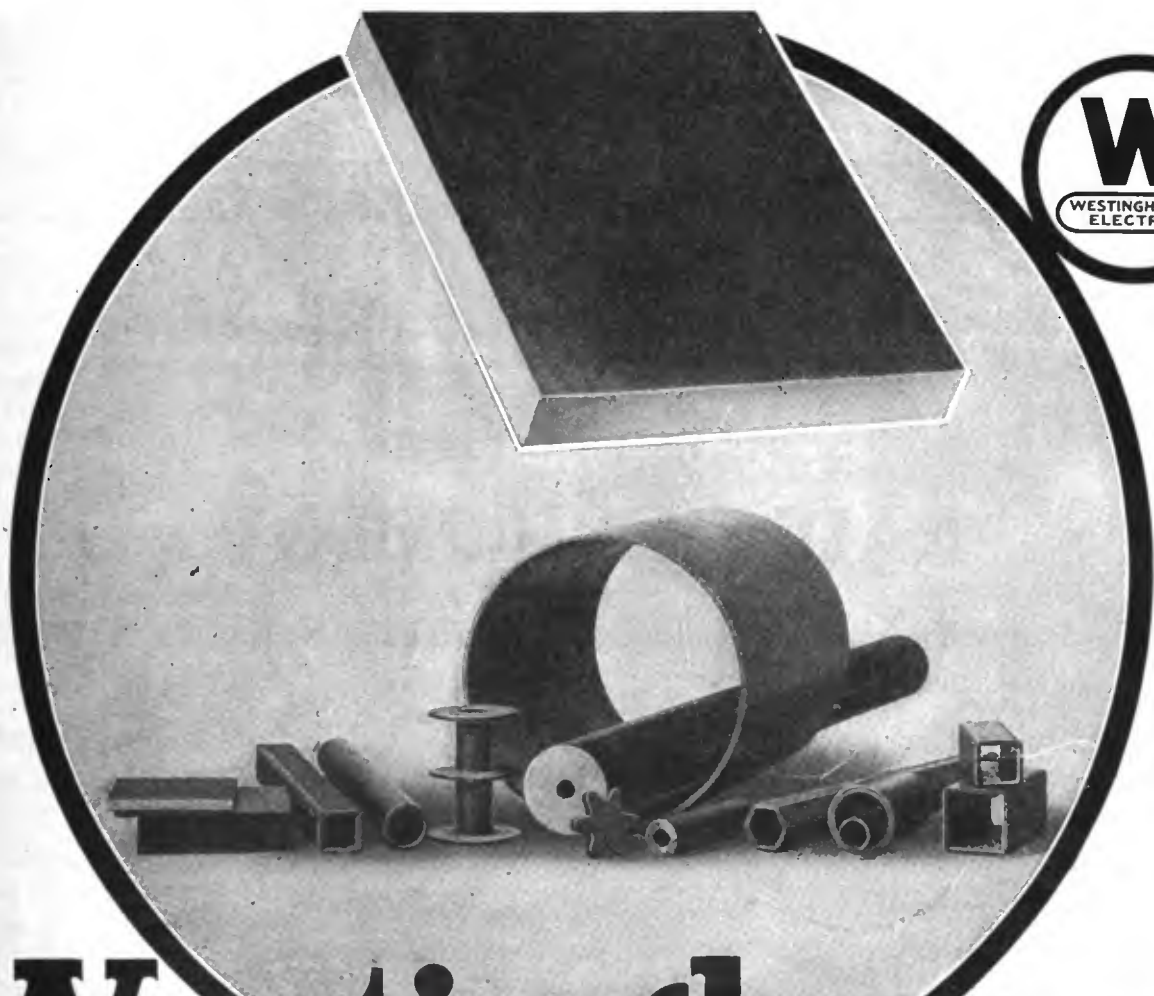
swell nor warp. This material is unaffected by water, oil, and atmospheric changes.

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.

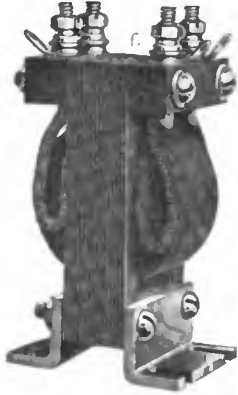
Write for complete descriptive catalogue 5-A

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



Westinghouse

Federal Radio Accessories and Parts

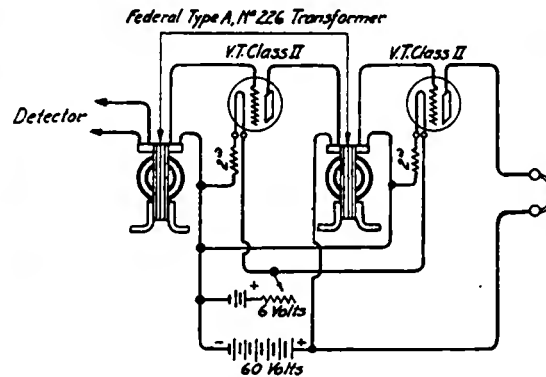


No. 226-W Type A

AUDIO FREQUENCY
Transformer
\$7.10 each

Are Distinguished for Their
Reliability, Quality and Efficiency

WRITE FOR BULLETIN 101 AND 102



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.

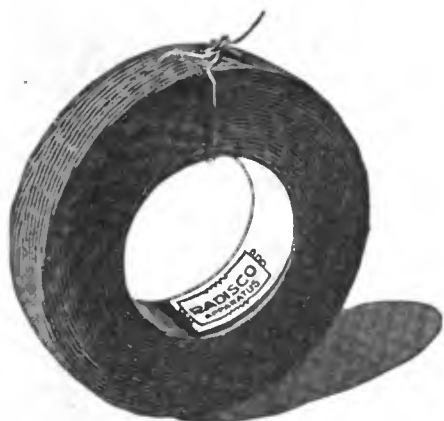
And so—the next time you find it necessary to add to your equipment, why not write us for price and description of the particular piece of apparatus you require?

*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.



Two Famous RADISCO SPECIALTIES

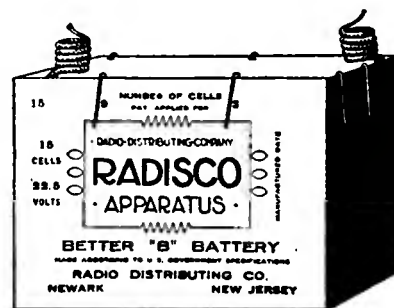
RADISCO COILS

conceded by several well known Radio Men to be far superior to any similar type of Inductances. Made in seventeen sizes, tapped and plain. Wave length range from 200 to 20,000 meters, priced from 60c. to \$4.85. Plentiful supply in stock at all Radisco Agencies.

RADISCO BETTER "B" BATTERY

is made according to Government specifications in two (2) sizes— $3\frac{3}{4} \times 2 \times 2\frac{1}{4}$ " and $6\frac{1}{2} \times 4 \times 3$ ". A first-class 15 cell, 5 group battery, VARIABLE VOLTAGE (Pat. applied for) is a special feature of this battery which enables you to provide critical voltage regulation for your vacuum tube by means of a switch connection with cells, taps of which have been taken off. Very economical and convenient. If one cell goes bad just test each group of 3 cells and short circuit the bad one. Price, small size, \$1.40. Large size, \$2.40, at any agency, or if ordered by mail include postage for 2 pounds on small size and 5 pounds on large size.

RADISCO AGENTS carry only apparatus of proven merit. Look for the Radisco trade mark on all parts you buy and be sure of getting efficient apparatus.



Below are listed a few of the reliable firms who carry the RADISCO COILS, Better "B" Batteries and are our Agents for all other standard apparatus of merit.

COMMUNICATE YOUR WANTS TO THEM.

ALBANY, N. Y.

E. L. Long,
21 Magnolia Terrace

ATLANTIC CITY, N. J.

Independent Radio Supply Co.
118 So. New Jersey Ave.

BALTIMORE, MD.

Radio Engineering Co.,
827 Madison Ave.

BEINVILLE, QUEBEC, CAN.

Canadian Radio Mfg. Co.

BOSTON, MASS.

Atlantic Radio Co.,
34 Batterymarch St.

BROOKLYN, N. Y.

Kelly & Phillips Electric Co.,
312 Flatbush Ave.

BRONX, NEW YORK CITY.

Amateur Wireless Equipment
Co.,
1390 Prospect Ave.

CHICAGO, ILL.

Chicago Radio Laboratories,
1316 Carmen Ave.

EUREKA, PEORIA, ILLINOIS

Klaus Radio Apparatus

HAMPTON, N. H.

DeLancey Felch & Co.,

LOS ANGELES, CALIF.

The Wireless Shop,
511 W. Washington St.

McKEESPORT, PA.

K. & L. Electric Co.,
427 Olive Street

NEW ORLEANS, LA.

L. A. Rose,
4323 Magnolia Street.

NEWARK, N. J.

A. H. Corwin & Co.,
4 West Park Street.

NEWCASTLE, PA.

Pennsylvania Wireless Mfg. Co.,
507 Florence Ave. "8HA"

PHILADELPHIA, PA.

Philadelphia School of Wireless
Telegraphy,
Broad and Cherry Streets.

PROVIDENCE, R. I.

Rhode Island Elec. Equip. Co.,
45 Washington Street.

PITTSBURG, PA.

Radio Electric Co.,
4521 Forbes St.

SCRANTON, PA.

Shotton Radio Mfg. Co.,
P. O. Box 3
Branch 8 Kingsbury St.,
Jamestown, N. Y.

SPRINGFIELD, MASS.

Electric Service Co.,
585 Armory Street.

TORONTO, ONT., CAN.

The Vimy Supply Co.,
585 College Street.

WASHINGTON, D. C.

National Radio Supply Co.,
1405 U Street, N. W.

WICHITA, KAN.

The Cosradio Co.,
1725 Fairmount Ave.

If none of the above agencies are in your vicinity, communicate with

RADIO DISTRIBUTING COMPANY : : Newark, New Jersey

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)

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 Peking, 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.

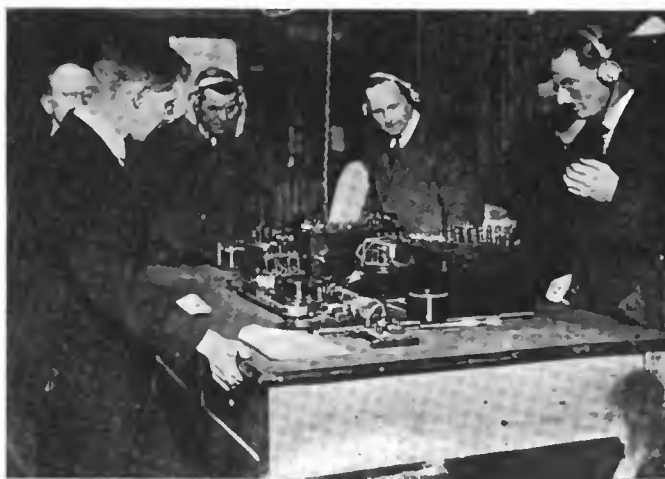
As a further precaution the radio officer of the 91st Squadron has erected at Ream Field a radio compass station by which readings are taken while planes are sending in their position reports. As the course is almost straight east from Ream Field the radio officer can tell almost instantly whether a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

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 Inter-church 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, Cachueta 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. Emperor Receives Radio Messages from Scotland Across Atlantic

WITH a new wireless receiving apparatus rigged on her, the liner Emperor 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.

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 grueling 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.



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

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

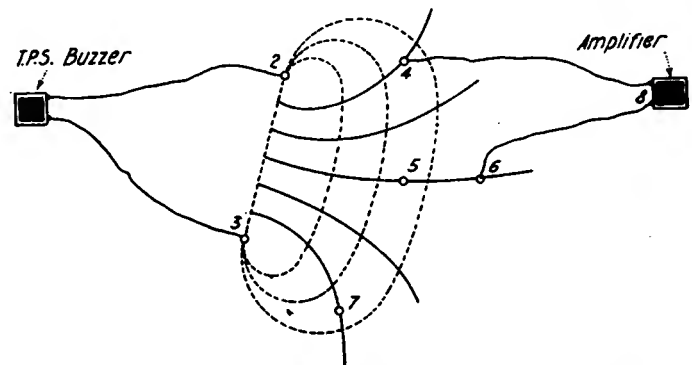


Figure 1

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 an-



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

tenna, an insulated loop, and the station receives signals by induction only. The insulated loop system was used to some extent by the French.

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 Cha-

pellette, 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

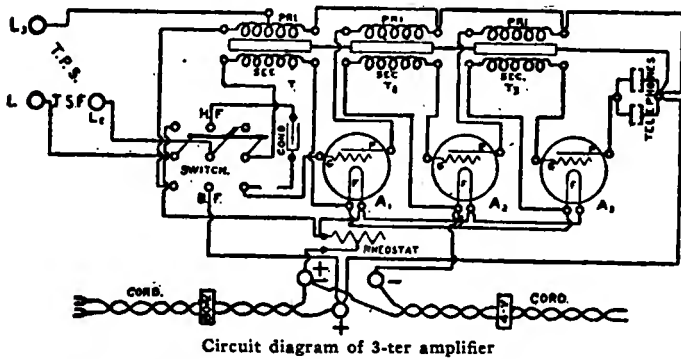
all three operators of the station were wounded during an attack on our position. The majority of casualties in the Radio Section occurred in this service, and there is not one case of a man shirking his duty. If a station was not getting satisfactory results it was usually the operators who suggested 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 ex-

istence 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 de-



Circuit diagram of 3-tube amplifier

stroyed 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.

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

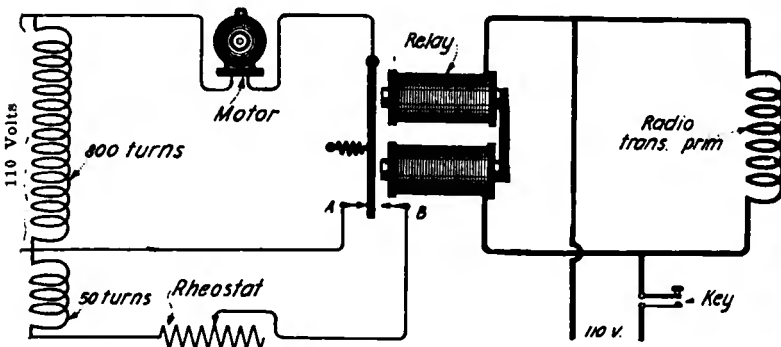
By L. A. Bartholomew

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

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.

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, actu-



Circuit diagram and dimensions of coil

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 ca-

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 de-

ating 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

(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

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

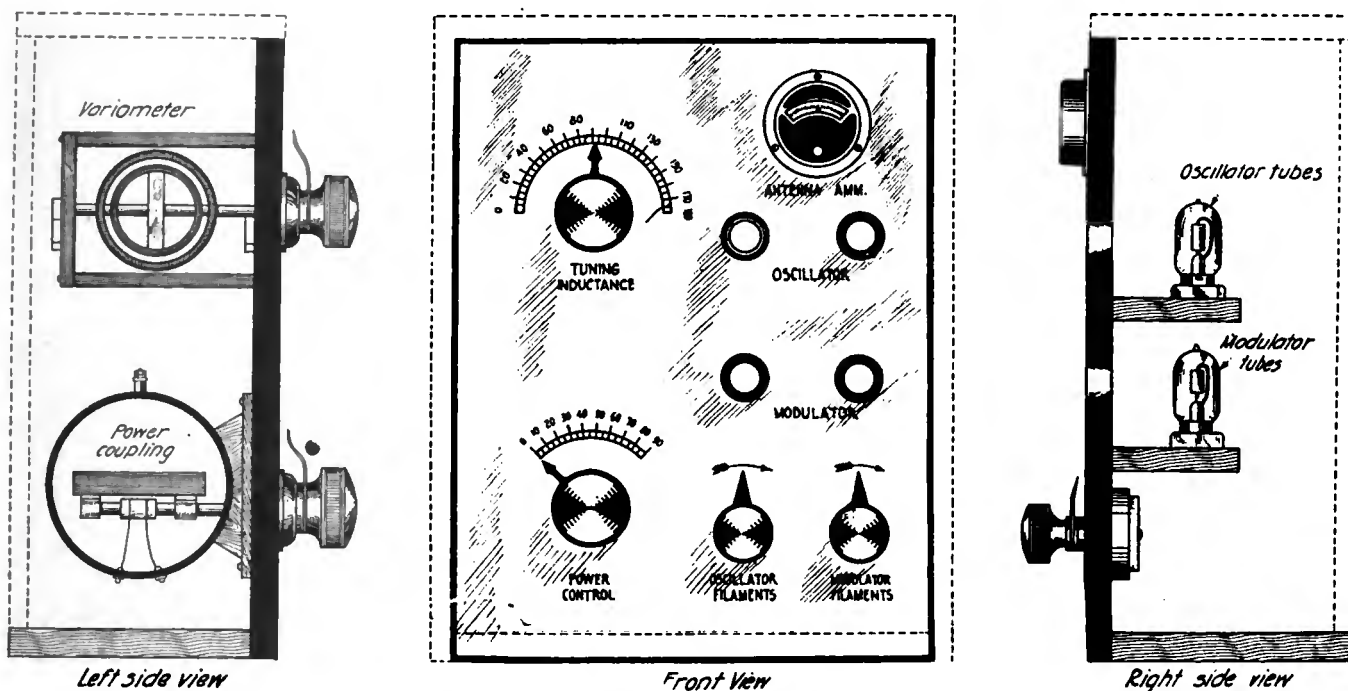


Figure 10—Panel assembly of the various instruments

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

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, 1/4" diameter, 4" long. Two end pieces of dilecto 1 1/2" square and 1/4" 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

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-

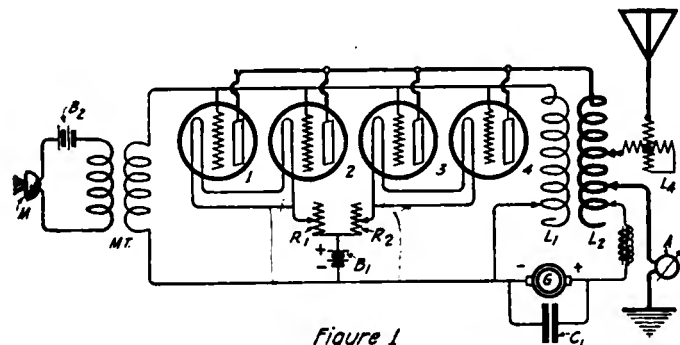


Figure 1—Schematic wiring diagram of the circuit used

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.

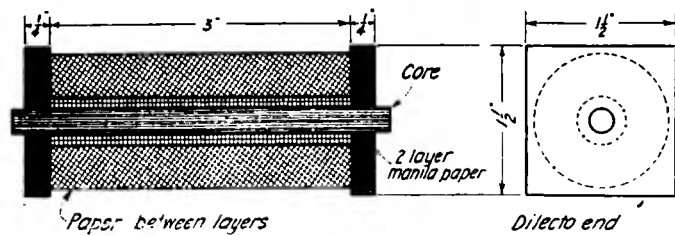


Figure 2—Cross-section and end view of the microphone transformer

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-

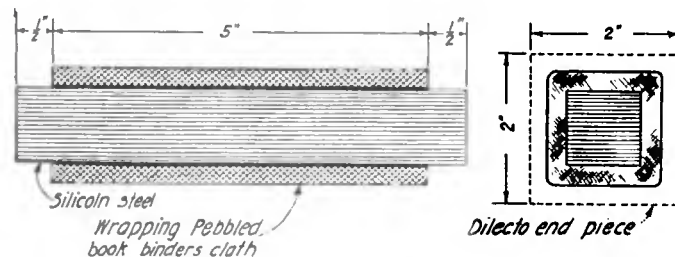


Figure 3—Constructional details of the audio frequency choke

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, 1/2" wide by .040" thick, and 3" long, is wound with No. 24 Advance resistance wire, 26 turns

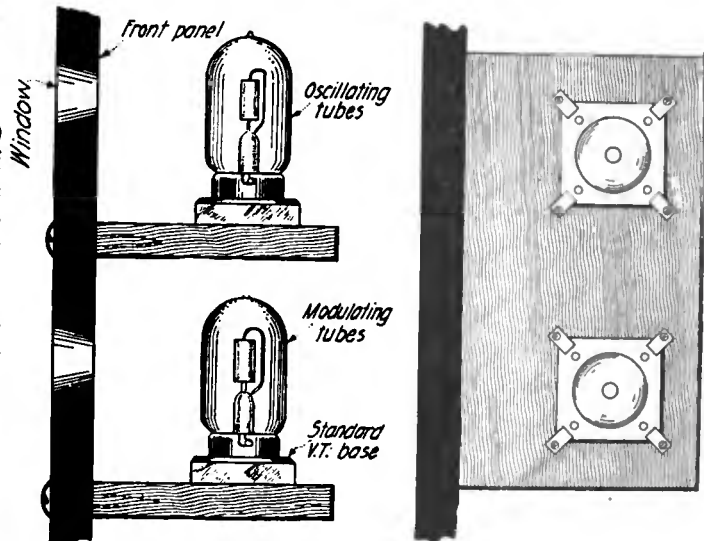


Figure 4—Method of mounting the Marconi V. T.'s

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-

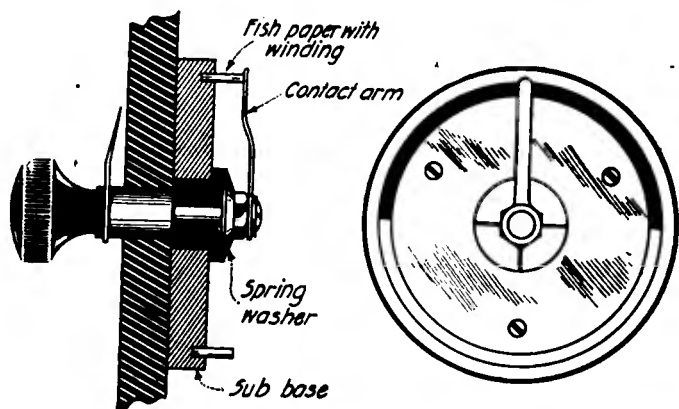


Figure 5—Assembly of the filament rheostats

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

side diameter $5\frac{1}{2}$ " and $2\frac{1}{2}$ " long. Upon this tube, 40 turns of $\frac{3}{16}$ No. 38 Litzendraht, or No. 22 D.C.C. copper wire are wound. Taps are taken every three turns and

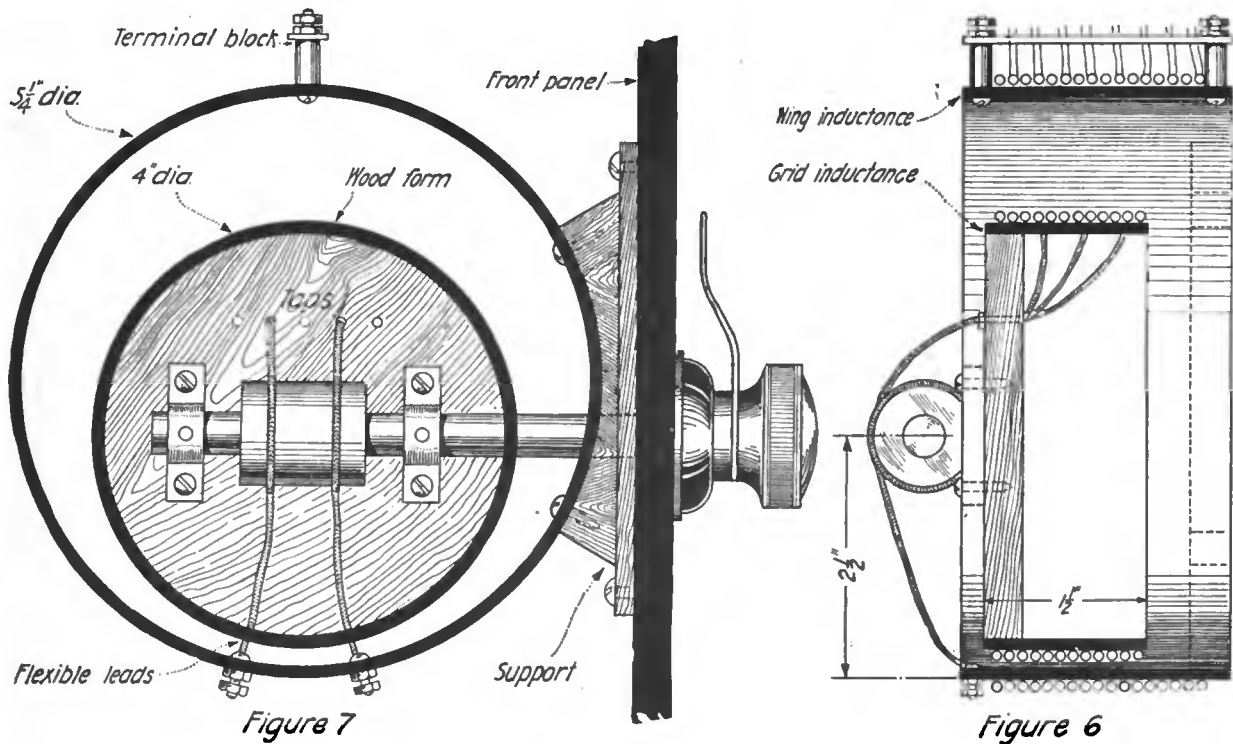
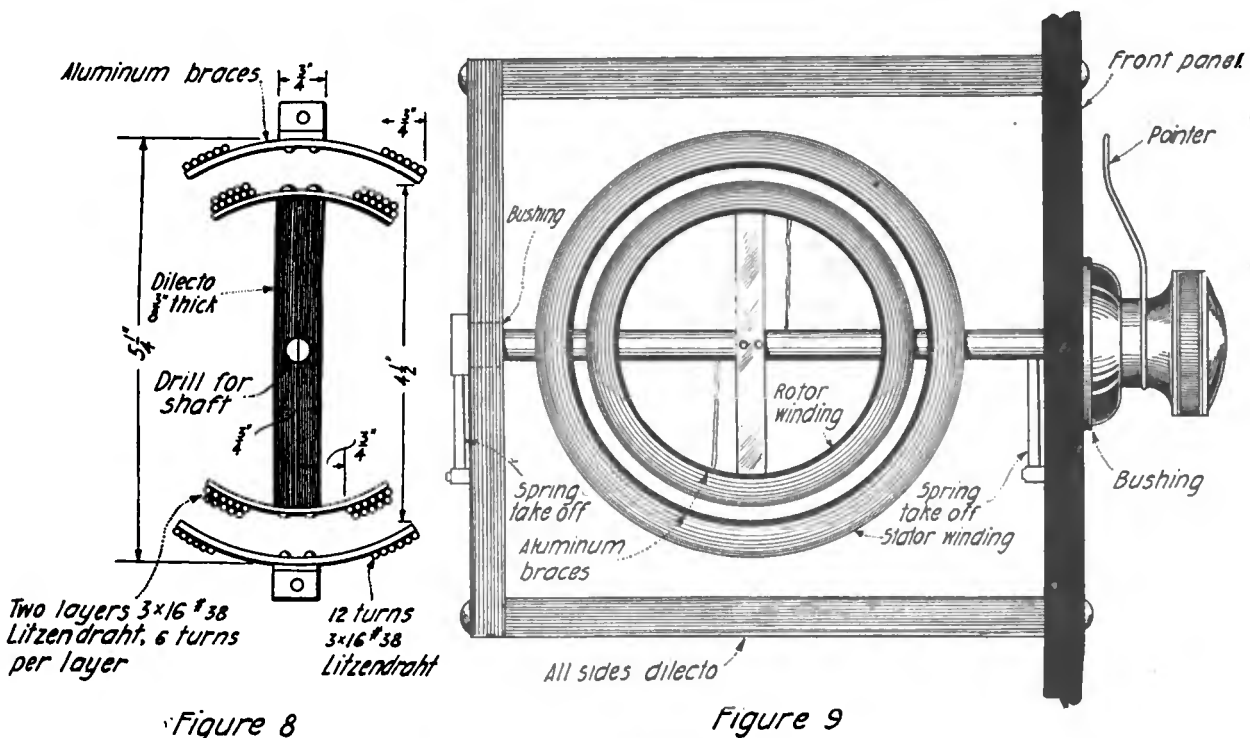


Figure 6—Front sectional view and Figure 7, side view of the construction of the coupling device

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,

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



End and side views of the antenna tuning variometer

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 $\frac{1}{8}$ ", out-

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.

The grid or movable inductance is wound on a tube 4" outside diameter, $\frac{1}{8}$ " thick and $1\frac{1}{2}$ " 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 Litzen-draht 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 direc-

tional 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.

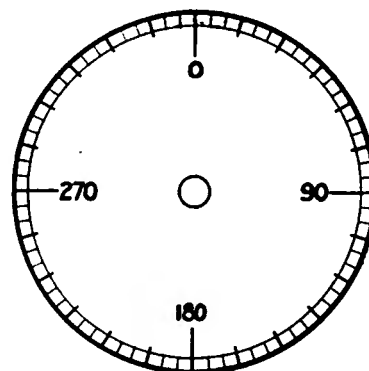


Table scale

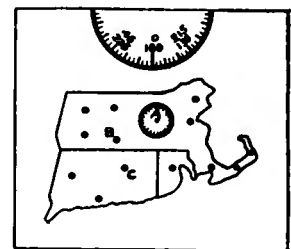


Figure 2—Compass card. Figure 3—Plotting board

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

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

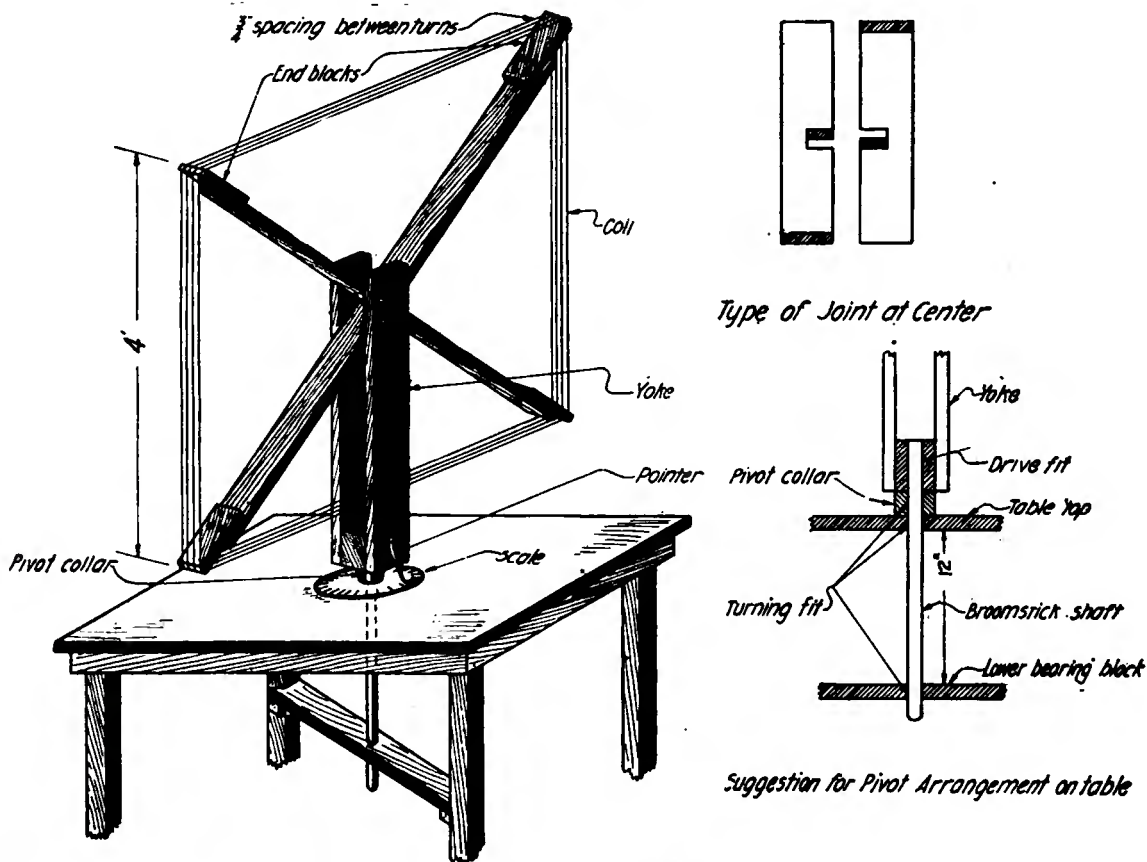


Figure 1—Detailed constructional view of the coil aerial

evident that the nearer the reporting stations are to 90 degrees with each other, the more accurate can the intersections be plotted.

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 $\frac{3}{4}$ " 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 least 6" in radius, 12" in diameter, with every five or ten degree mark distinctively drawn and numbered, as in figure 2.

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 $\frac{1}{8}$ " x $2\frac{1}{2}$ " stock. The head is about 8" long, of $\frac{3}{8}$ " x $2\frac{1}{2}$ " 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 ali-



Figure 4—Method of constructing the alidade

dade 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.

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 $\frac{3}{4}$ " 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.

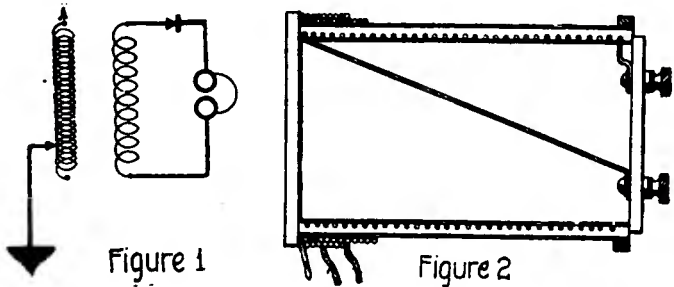


Figure 1—Location of the detector near an end of the secondary coil
 Figure 2—Coil of the utilization circuit

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 sup-

plied 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

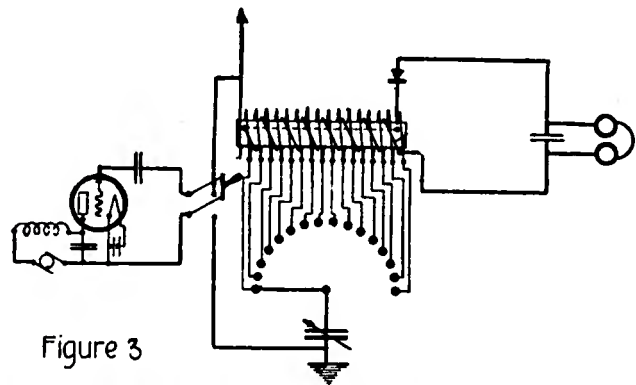


Figure 3—Showing arrangement whereby a vacuum tube produces oscillations to produce beats with an incoming signal

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 out-

side 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

ient 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 insulation is solved by re-

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

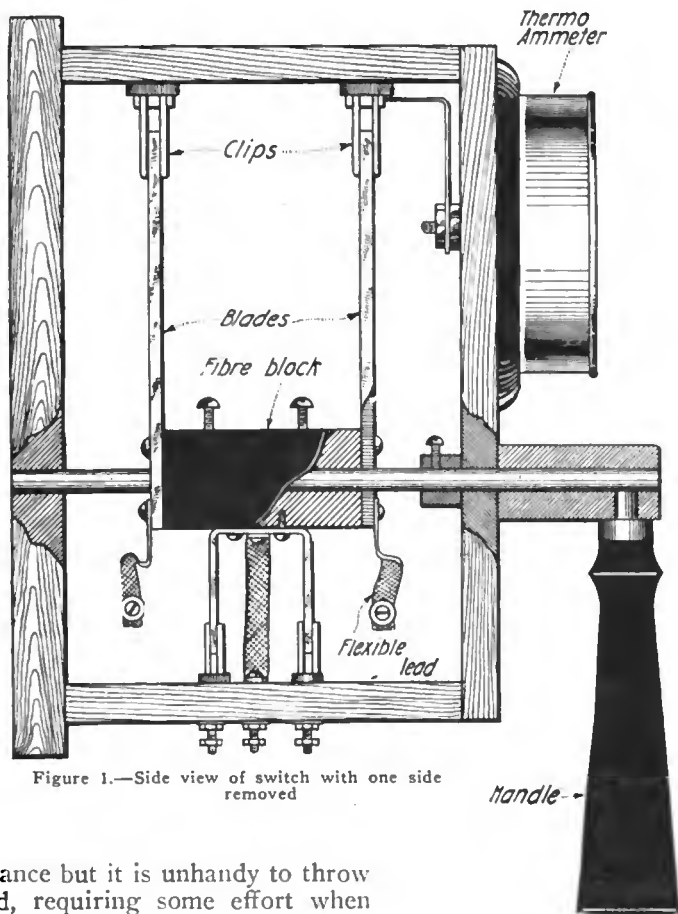


Figure 1.—Side view of switch with one side removed

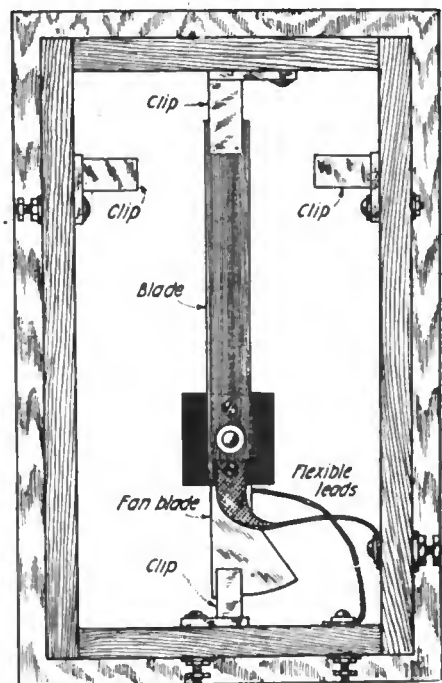


Figure 2.—Sectional end view of switch showing arrangement of clips

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 conven-

ceiving through the secondary of the oscillation transformer. Though not exactly new, the method is not used as extensively as it deserves to be.

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 $\frac{1}{8}$ x $\frac{1}{2}$ ". These are held 2" apart by a block of bakelite or fibre. A hole drilled through the fibre passes a brass rod

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 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

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.

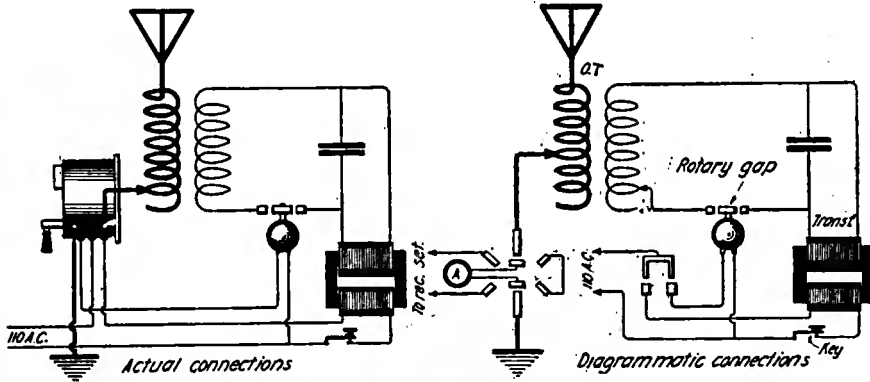


Figure 3.—Wiring diagrams showing how the circuits are controlled

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.

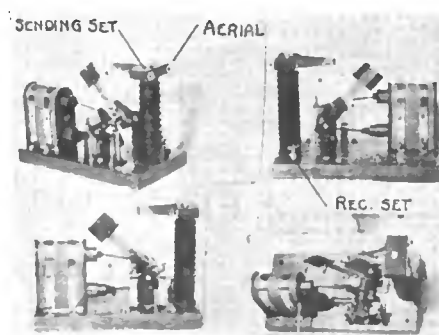
shown. In one form a round block of fibre is drilled to pass the rod and tapped to take a switch handle projecting downward. The thread in the switch handle clamps again a flat side field on the brass rods, or two switch handles may be threaded into

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 1/2 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.

nals 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

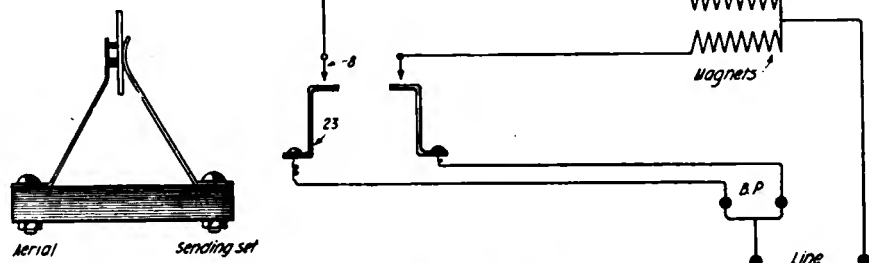
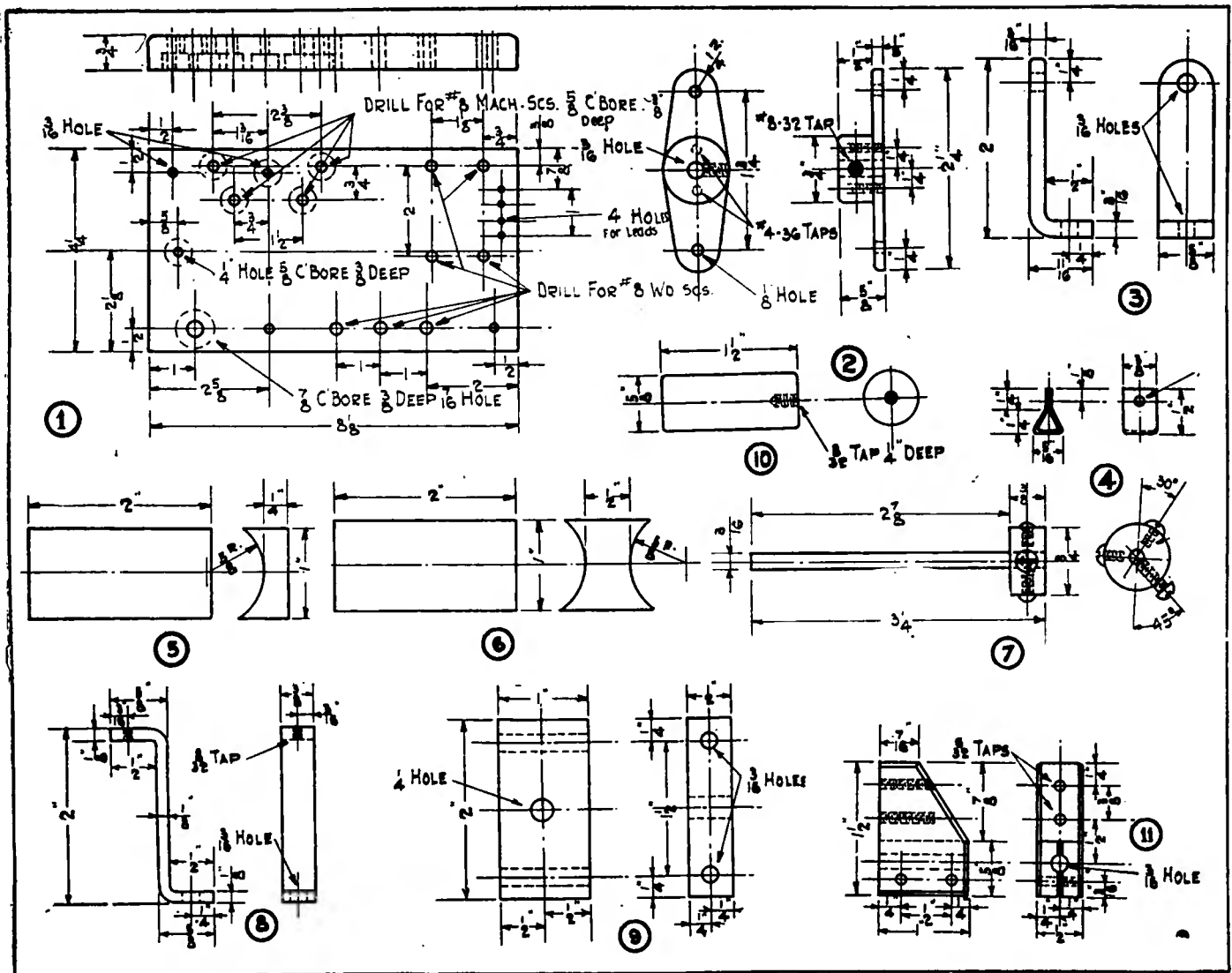


Figure 25.—Circuit diagram showing connections

Bakelite or hard rubber is not necessary, since all the high voltage termi-

steel or of brass and is fastened to the long fibre piece with two No. 4-36



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 1/4 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 1/8-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.

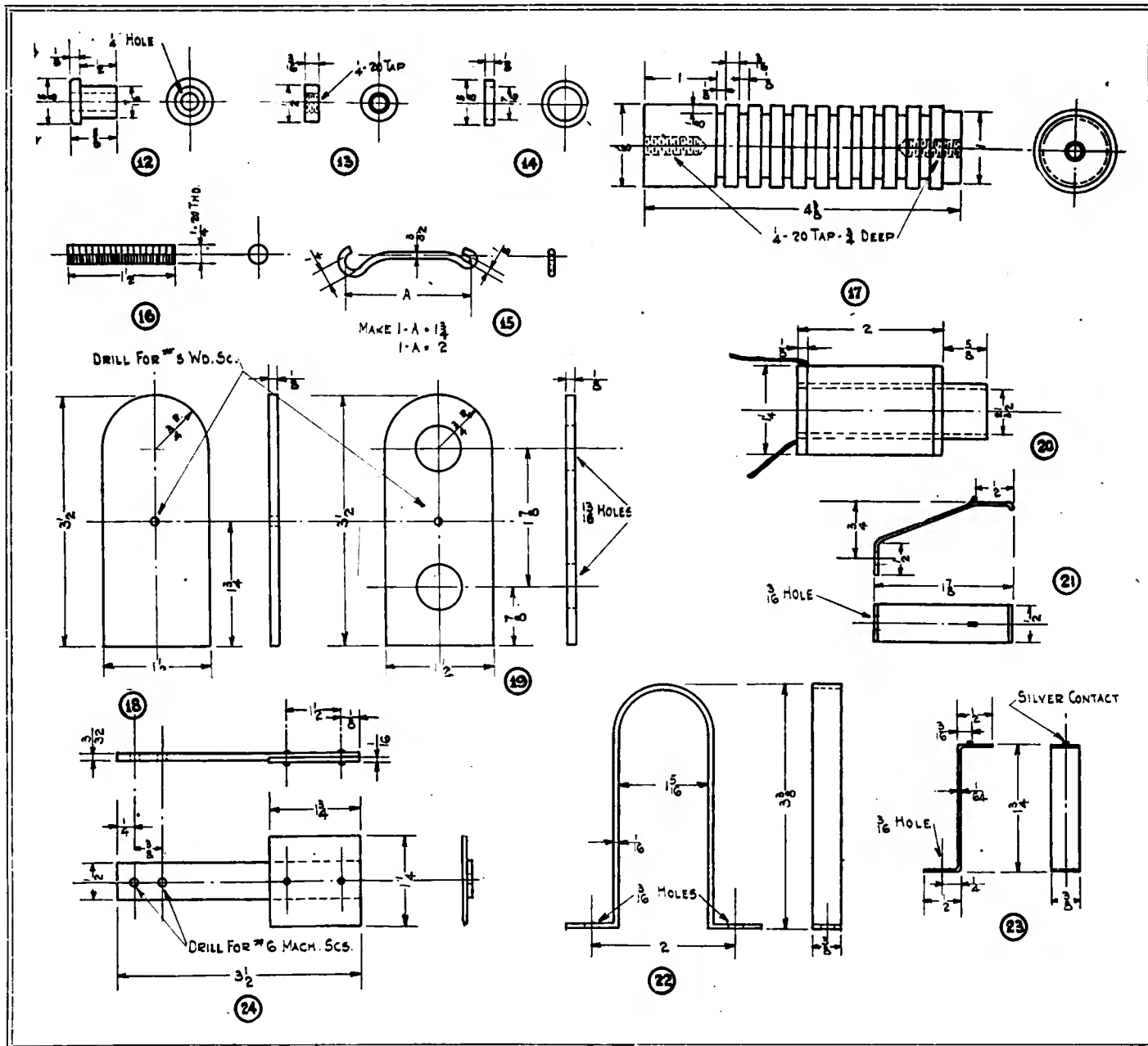
These magnets are fastened in place in the following manner. The blocks 5 and 6, having been placed between the magnets, a piece of fibre about 1/32 inch thick and cut 2 1/8 inch wide, is put around the magnets before putting on the straps, figure 22.

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 2 1/8 inches, leaves at the outer end a space of 1/8 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 1/2-20 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, 1 1/4 inches long, which hold the springs, part 21, in place. Part 17 is fastened to the base with a 1/2-20 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 1/2 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

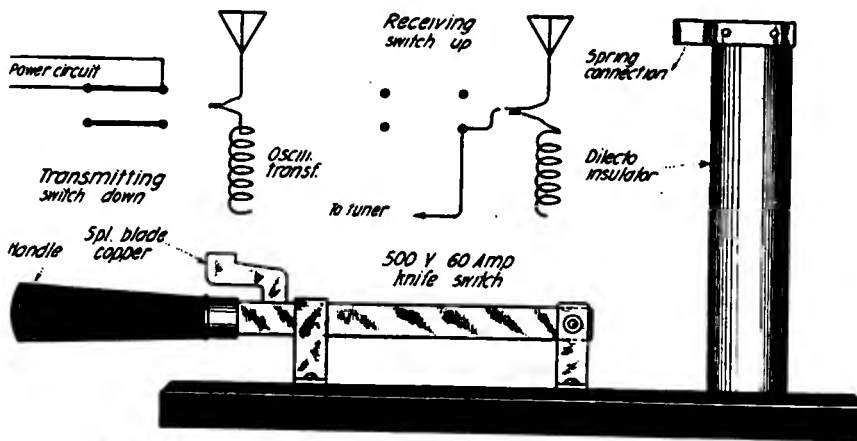
THIRD PRIZE, \$3.00

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 1/2-kw. set about 5 1/2 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.

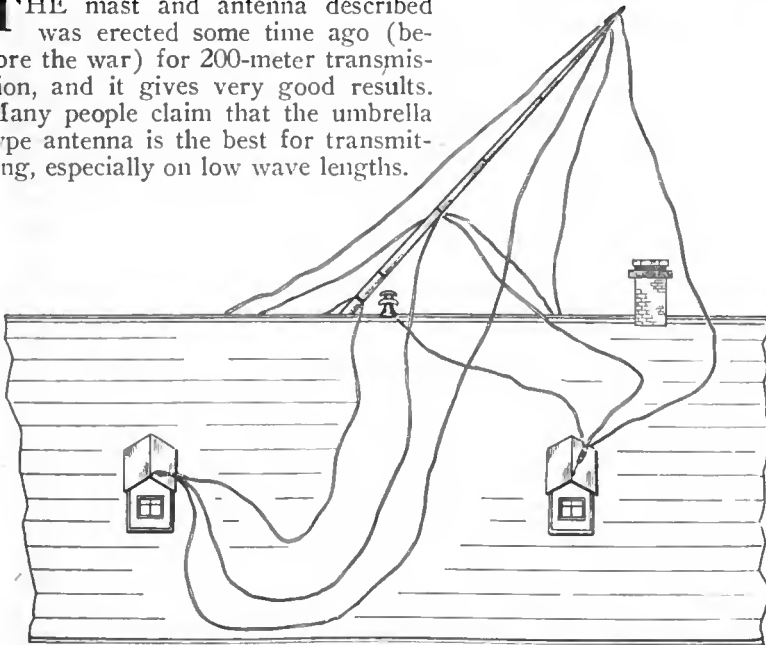


Figure 2.—Showing method of erecting the mast.

heavy screw eyes for anchors, screw should be about 7/8-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

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

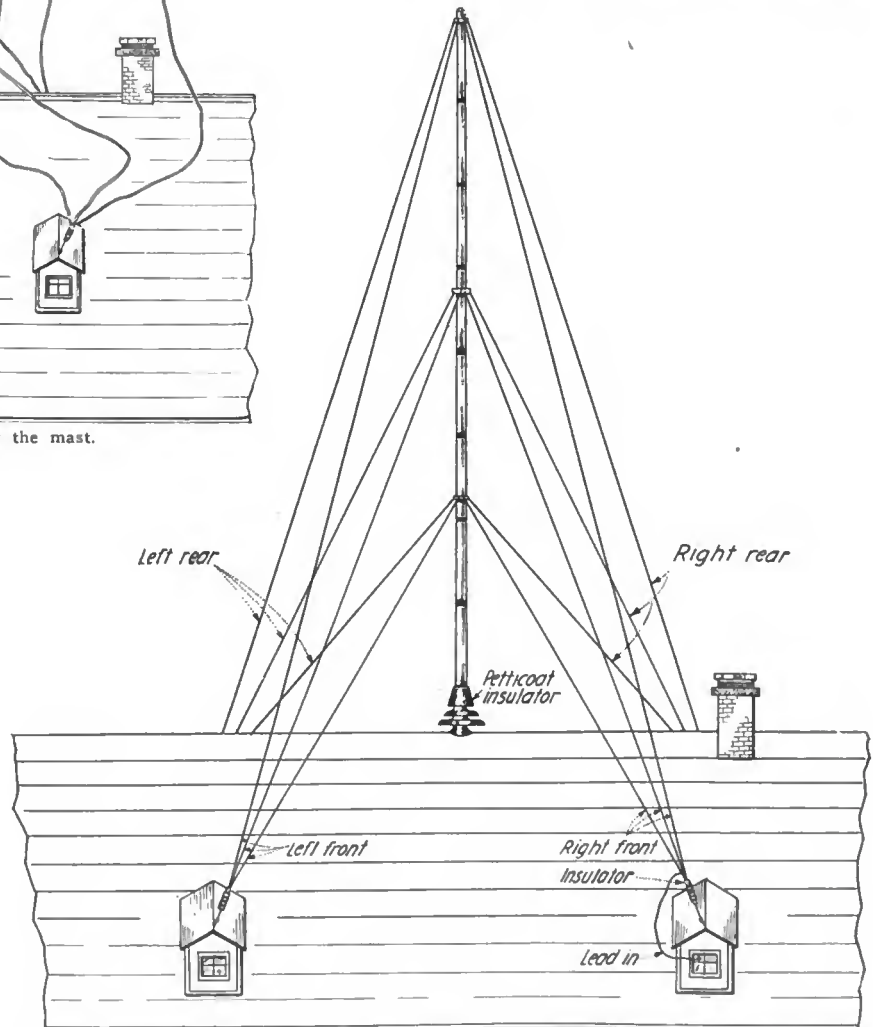


Figure 1.—Showing mast in position and location of the guy wires and lead-in wire

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 1/2-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 ad-

visable to tin the joints before forcing them together and then heating with the blow torch, making the soldering operation easier. At the top section,

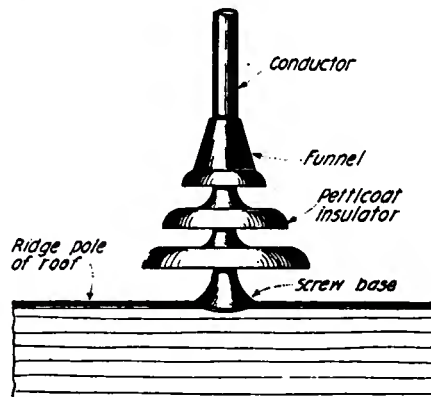


Figure 3.—Details of the petticoat insulator installed in the center of the anchor posts

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 cen-

ter 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

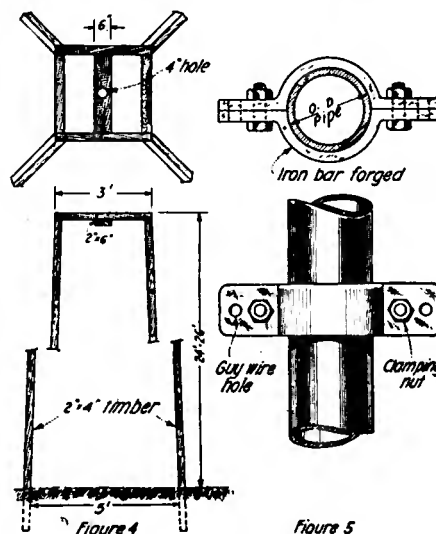
By L. D. Dillenback

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

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

there and either a B or an L after the year it is manufactured in. B means

that no kinks are made in the wire, for when these are pulled taut the wire will break easily.

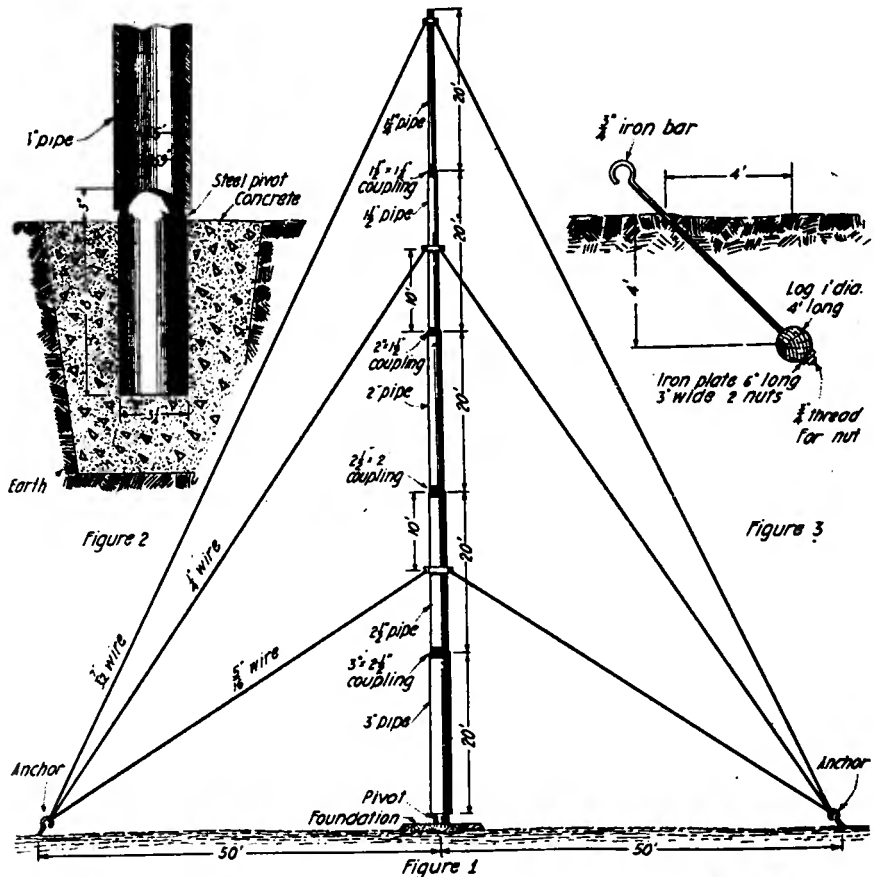
The first operation is to carefully select the location of the mast, or the masts if there are two. The position of the pivot should be marked with a stake, and the position of the anchors should be laid out and marked with stakes. The pivot is then set in concrete, figure 2, and allowed to stand at 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 1 1/4-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 1 1/2-inch pipe is then joined to the first section by the reducing coupling. The 1 1/2-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 2 1/2-inch pipe and that raised ten feet more and its guy clamp and the lower guys fastened on. The 2 1/2-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 ham-

Of course, before the mast is put up, a tackle and rope should be fastened on the first 1 1/4-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



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

mer, 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 the other supporting end of the antenna.

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	1 1/4	.23	1.660	1.363	2.272	44
20	1 1/2	.275	1.900	1.604	2.717	54
20	2	.37	2.375	2.060	3.652	72
20	2 1/2	.585	2.875	2.460	5.793	114
20	3	.76 1/2	3.500	3.059	7.575	150

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

REDUCING COUPLINGS:

Size	Approx. Length	Approx. Weight
3 - 2 1/2	3"	3 lbs.
2 1/2 - 2	3"	2.2 "
2 - 1 1/2	2 1/2"	1.3 "
1 1/2 - 1 1/4	2 1/2"	.8 "

1-1/4" 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; 1/4" 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.

Small Ads of Big Interest

A Meeting Place for Buyers and Sellers

Space in this department costs only 25c a line. Minimum space 8 lines. Payable in advance.

"Silverplate" Without Electricity

Modern, efficient radio apparatus is silverplated, giving higher conductivity to high frequency currents, and giving a finer and more substantial appearance. "SILVERPLATE" needs only to be rubbed or brushed on any metal, and will produce a fine permanent silver plating. One bottle will plate a whole set. 35c prepaid.

ROBERTS LABORATORY,

11718 Detroit Ave., Cleveland, Ohio.

Wireless supplies especially for the amateur. Magnet wire, brass and zinc rod. Inductance tubes. Standard wireless knob and lever 35c. Switch points and screws 25c dozen. One place switch point with screw stud and nut 40c dozen. NOVOTON RADIO SHOP, 20 West 5th St., Charlotte, N. C.

If you have anything to sell or if you want to buy something use these columns to get results.

An Easily Constructed Mast

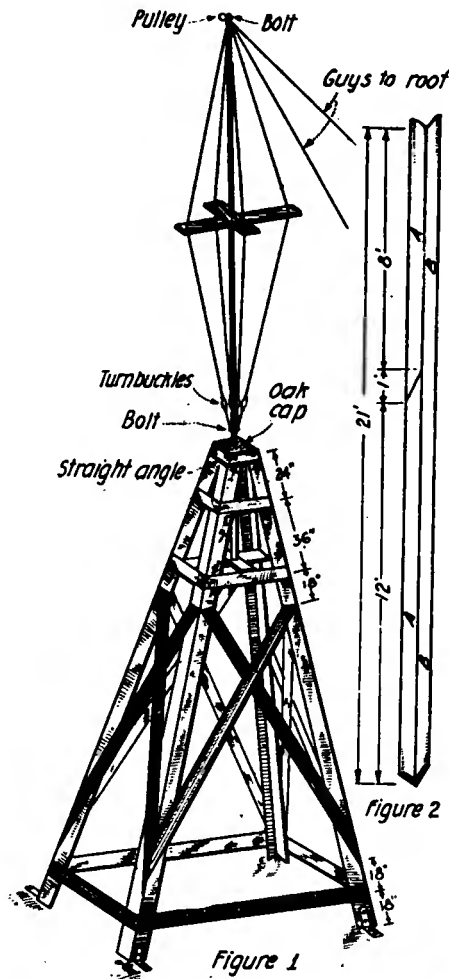
By Frank H. Mulcahy

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 3/4-inch galvanized iron pipe, four iron straps 2 feet x 1 1/2 inches x 1/4 inch each, four 4-inch straight angles, six dozen 2 1/2-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



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

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.

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 1 1/2 inches x 1/4 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

RADIO OPERATORS

\$125.00 Per Month Upward
Plus All Expenses

Call or write for Illustrated Booklet giving full information regarding Special Privileges included in tuition fee.

INDIVIDUAL INSTRUCTION
MODERN EQUIPMENT
SPECIAL SHORT COURSE
DORMITORY
SWIMMING POOL

"BEST RADIO SCHOOL IN THE EAST"

Y. M. C. A. RADIO SCHOOL

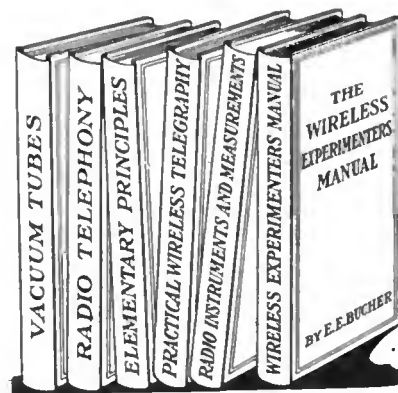
149 East 86th Street, New York, N. Y.



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

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. **\$2.25** Cloth bound. About 300 pages. Fully Illustrated. Price.....

By Elmer E. Bucher

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 **\$2.25** illustrations. Price.....

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, **\$2.50** stamped in gold. Price.....

By Alfred N. Goldsmith, Ph. D.

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**

By Elmer E. Bucher

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

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. **\$1.75** Both Books for **\$3.25** Price.....

By R. D. Bangay

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. **\$1.75** 224 illustrations, 515 pages. Full cloth. Postpaid. Price.....

By H. E. Penrose

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 Tubes	Bucher	\$2.25
Radio Telephony	Goldsmith	\$2.50
Radio Instruments and Measurements		\$1.75
Practical Wireless Telegraphy	Bucher	\$2.25
Elementary Principles: Parts I 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.

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

BURGESS "B" BATTERIES

SEVERAL SIZES FOR SPECIAL WORK



SEND FOR CATALOGUE
BURGESS BATTERY COMPANY
HARRIS TRUST BLDG. - CHICAGO, ILL.

Switch Points FREE!

For five cents, to cover cost of packing and mailing, we will send one nickeled switch point and nut free. If requested this amount credited on first order for two dozen at regular price of

35c per dozen
(Postage extra, 1 1/2c per dozen)

These points are some type as used on first-class commercial apparatus, measuring approximately as follows—
Head 3/4" x 3/8". Shank No. 6 x 3/4" screw.

Toledo Radio Specialties Co.
Box 343 St. Clair St. P. O. Toledo, Ohio

"Old Town Canoes"

An "Old Town Canoe" will jump at the thrust, or glide at the dip of a paddle. Floats light as a fleck of foam, but every "Old Town" has the built-in strength and sturdiness to withstand many years of rugged service. For the youngsters, buy the "Sponson Model" the canoe that's safer than a row boat. Write for catalog. 3000 canoes in stock. \$67 up from dealer or factory.

OLD TOWN CANOE COMPANY
924 Fourth Street
Old Town, Maine, U. S. A.



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

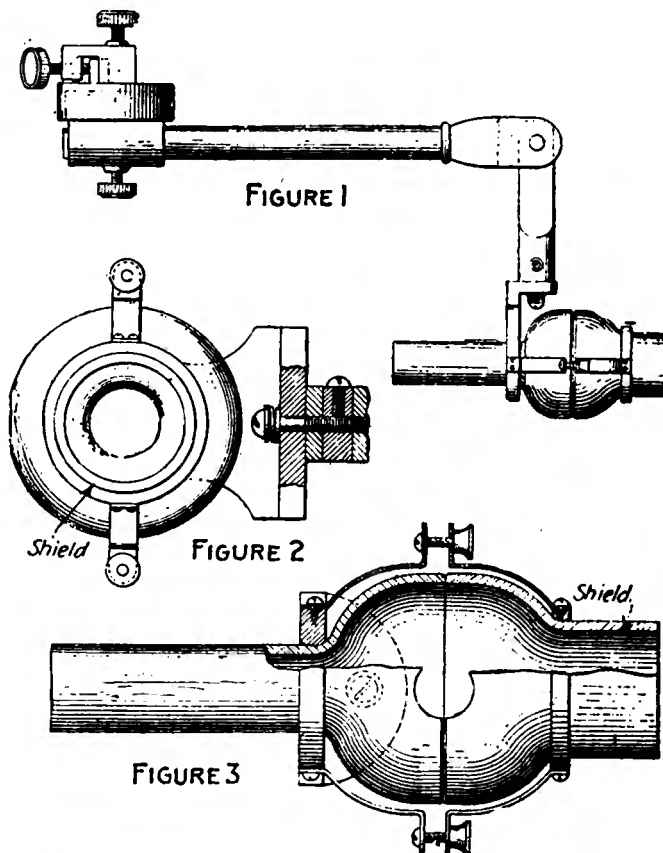


Figure 1.—Side view. Figure 2.—End view. Figure 3.—Top view.

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.

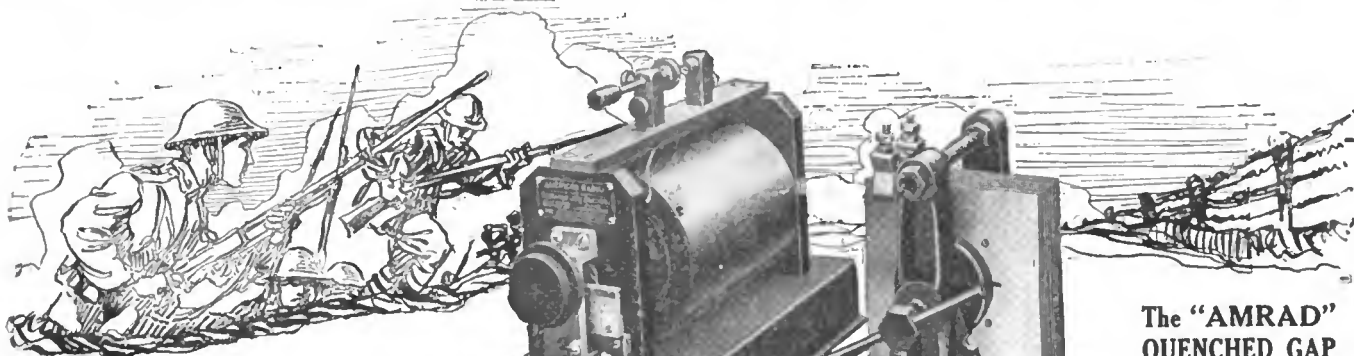
it is understood, of course, that in order to get proper action when the circuits shown in above figures are connected to the amplifier, it will be necessary to provide some means of coupling the detector circuit to the amplifier. This may be effected most easily, perhaps, by connecting a pair of telephones,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

With reference to figures 11 and 12,

AMATEURS ATTENTION!

Send over **25 Miles on D.C.**

Here at last is real "commercial type" radio apparatus designed for low power direct current. New transmitting records are in store for you. Take advantage of this special introductory offer and save \$7.50.

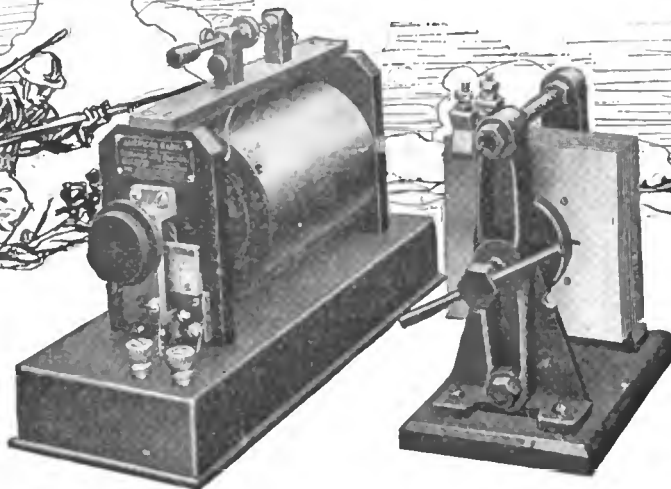


THE "AMRAD" INDUCTION COIL

6 Volt or 32 Volt

is almost an exact duplicate of the U. S. Signal Corps coil used in trench service during the war. It has bakelite insulation throughout. Its secondary, wound in 29 sections, produces 50,000 volts. Rated at 100 Watts this coil has an output about 100 per cent. greater than the average 2 inch coil. The vibrator is rugged, steady and non-sticking and designed to give a spark frequency equivalent to 100 cycles which means maximum transmitting range on short wave lengths. The 32 volt coil is intended especially for use on farm lighting circuits. When ordered separately this type is \$1 extra. To get maximum results with the 6 volt coil a heavy 6 volt storage battery is the best and most economical source of current.

Price, 6-volt type..... **\$28.50**



The "AMRAD" QUENCHED GAP

Special Induction Coil Type

All your power on one sharp wave and a clear, bell-like note at every tap of the key will make other amateurs in your state sit up and take notice. The Amrad

Quenched Gap carefully operated, yields the secret of long range transmitting on low power. This special gap is identical in design to the heavy 1/2 k.w. and 1 k.w. Amrad Quenched Gaps now being installed in long distance amateur stations. Not only will this special quenched gap make your transmitter as efficient, for its power, as the more costly equipment, but you will be able to send more messages without interfering with other stations. For the first time in the history of amateur radio every induction coil transmitter can now be tuned to comply with Government decrement regulations. The Amrad Quenched Gap is the secret.

Price, Induction Coil Type..... **\$12.50**

Special Introductory Offer

If you have had limited power at your disposal and inefficient apparatus or if you are waiting to be introduced to the fascination of sending radio messages over into the next county or state here is your chance to get the two most important pieces of transmitting apparatus at an actual saving of \$7.50.

"Amrad" Induction Coil, regular price,	- - -	\$28.50
"Amrad" Quenched Gap, " " "	- - -	12.50
		\$41.00

Special Price for the Double Buy, \$33.50

Either 32-volt or 6-volt coil may be chosen

How to Order Show this advertisement to your dealer and ask him to order one of these combinations for you. If you have no radio dealer in your vicinity send us check or money order for \$5 and we will ship direct to you by parcel post C. O. D., the balance plus postage. Act promptly, as the standard Signal Corps parts which we secured from the Government were only sufficient to make up a limited number of sets. If you are not ready to buy and want further information send for free Bulletin P which contains complete description and operating directions.

Dealer's Opportunity Write at once for short-term trade discount on this combination. No better opportunity to introduce apparatus of such high quality at such low prices will ever be had again. The offer is made especially to introduce our rapidly growing line of "commercial type" radio apparatus.

Address all communications to New York office

AMERICAN RADIO AND RESEARCH CORPORATION

19 PARK ROW Factory at Medford Hillside, Mass. NEW YORK

Drafting Supplies

We manufacture a full line of high grade supplies made under our own supervision. We know they are right.

Quality Plus
and at prices that appeal.



A Specialty—
Our
MONROE
Drawing Table

A table of general utility made after our own ideas. Stands rigid and lasts a lifetime.

Let us quote on your needs
Ask for catalogue W

New York Blue Print Paper Co.

102 Reade Street
New York City



The Monthly Service Bulletin of the National Amateur Wireless Association

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

Guglielmo Marconi
President

J. Andrew White
Acting President

H. L. Welker
Secretary

NATIONAL ADVISORY BOARD OF VICE-PRESIDENTS

Prof. A. E. Kennelly,
Harvard University.

Maj. Gen. George O. Squier,
Chief Signal Officer, U. S. Army.

Captain D. W. Todd,
U. S. N., Director Naval Communications.

Rear Admiral W. H. G. Bullard,
U. S. N.

Prof. Alfred N. Goldsmith,
College of the City of New York.

Major William H. Elliott,
American Guard.

E. E. Bucher,
Instructing Engineer.

Prof. Samuel Sheldon,
Brooklyn Polytechnic Institute.

Colonel Samuel Reber,
Signal Corps, U. S. Army.

Prof. Charles R. Cross,
Massachusetts Institute of Technology.

William H. Kirwin,
Chief of Relay Communications.

Headquarters, 64 Broad Street, New York

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

ACE

What are the Wild Waves Saying?

You can find out with "Ace" equipment.

We can furnish parts for audion control panels and amplifiers. The panels are 3/16" formica, grained finish, lettering in white. Control panel includes socket, grid leak, grid condenser, rheostat, binding posts and formica panel. Amplifiers include the above and transformer, etc., all ready to wire.

Audion Control Panel	\$7.50
One Step Amplifier	10.00
Audion Control Panel and One Step Amplifier on Large Panel . . .	17.50
Two Step Amplifier on Large Panel	20.00

You may pay more, but you can't buy better.

The PRECISION EQUIPMENT CO.

2437 Gilbert Ave.

Dept. C

Cincinnati, Ohio



MARCONI INSTITUTE

25 Elm Street, New York City

Telephone, Barclay 7610

More than 200 young men are enrolled in our classes preparing for employment in the Merchant Marine.

The demand for EXPERT WIRELESS OPERATORS is enormous. The position is most remunerative and the work is unusually pleasant.

The junior ship operator receives \$100 per month, the senior \$125 per month, to which is added \$3.00 per day subsistence pay when the ship is in port.

You may enjoy the life of a globe-trotter and receive

this salary by studying from three to four months at the Institute.

Prospective applicants are urged to investigate our course before enrolling elsewhere. Remember that by far the greatest number of assignments to the ship service are made in New York City.

The Trans-oceanic Division of the Marconi Company is in need of expert Continental Morse operators.

Write us for facts regarding the present radio situation.

We have more than 6,000 graduates to our credit.

AMERICA'S FOREMOST SCHOOL FOR INSTRUCTION IN WIRELESS TELEGRAPHY

Afternoon and Evening Classes throughout the year.

Branch School: New Call Building, New Montgomery St., San Francisco, Cal.
Address all inquiries to Director of Instruction

JOHN FIRTH & COMPANY, Inc.

81 NEW STREET, NEW YORK

SOLE DISTRIBUTORS OF THE BALDWIN MICA DIAPHRAGM TELEPHONES, BALANCED ARMATURE TYPE. THE MOST SENSITIVE TELEPHONE ON THE MARKET. STANDARDIZED BY ALL THE NAVIES OF THE WORLD. SCIENTIFIC INVESTIGATORS PRONOUNCE THE BALDWIN "TYPE E" THE ONLY PHONE SUITABLE FOR USE WITH THE MARCONI VACUUM TUBE.

Type C—Navy Standard Type E—Newest Type
Type D—Smaller Type Type F—Smaller Type

Write for Catalogue

MANUFACTURERS OF U. S. NAVY STANDARD LEYDEN JARS, SILVER AND COPPER DEPOSIT, KOLSTER PORTABLE DECREMENTERS, WAVE METERS, AND ALL HIGH CLASS MEASURING INSTRUMENTS.

Stromberg-Carlson Radio Head Sets

Equipped with Non-conducting
spool heads and slotted pole
tips which eliminate eddy
current losses

All operating parts of the Stromberg-Carlson Radio Head sets are housed in dust-proof and moisture-proof aluminum cases. Diaphragm is mounted metal-to-metal. Temperature variation will not disturb the airgap adjustments. Each set is wound to a resistance of 2,000 ohms with pure copper wire and furnished complete with 6-foot moisture-proof cord attached. This set, while it is constructed strong and durable, is very sensitive. For use ashore or aboard ship.

*Bulletin No. 1206 Gives
Full Particulars. Write.*

**STROMBERG-CARLSON
TELEPHONE MFG. CO.**
Rochester, N. Y., U. S. A.



A sample set will be sent upon receipt of \$12. Try it in your own station for private and commercial Radio Service. Money refunded if not satisfied.

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

RADIO EXPERIMENTERS, ATTENTION!

Over 1500 other radio experimenters are saving large amounts on their purchases of radio and electrical equipment. They are purchasing through this association almost everything advertised in this magazine. They are saving money on everything they buy, whether it is raw material for the finished instrument.

- \$ 7.00 telephone receivers are purchased at 10% saving.
- \$18.00 loud speaking telephones net them \$1.50 saving.
- \$ 7.00 VT Tubes are being purchased at a 50¢ saving.
- \$ 4.50 Amplifier transformers at a 25¢ saving.
- \$17.00 Audion control cabinets net them \$1.75 saving.

You also can make these savings which bring you the goods of almost every manufacturer advertised in this magazine at a saving of from 5 to 20% on the prices advertised. Write for details immediately. We can save you money on anything electrical which you intend to buy.

By buying through the association you are assured that your order will be filled the day it arrives.

SPECIAL OFFER:

Members can obtain a limited number of 4 Volt, 60 Ampere, Marko storage batteries for \$7.00 net. A limited number of "B" batteries offered at a saving of 25¢ on advertised price \$1.25 (22 Volt fixed).

MUTUAL PURCHASERS ASSOCIATION

2-4 Stone Street

(Dept. A.G.-A.)

New York

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,

C-W

Motor Generator Sets

for

Wireless Telegraphy

and

Wireless Telephony

Embodying the well-known C-W standards of dependability, precision and endurance these instruments carry the indorsement of engineers and operators afloat and ashore. Designed for submarines, land stations, ships, aeroplanes, portable hand operated stations, etc.

For further information please communicate with our nearest branch.



SPECIAL OFFER

1917

Year Book of Wireless Telegraphy and Telephony

Regular Price **\$2.50** Special Price **\$1.75**

With WIRELESS AGE
one year (new or renewal) **Only \$3.50**

SAVE A DOLLAR

This offer may not be repeated as our supply of these books is limited.

WIRELESS PRESS, Inc.

Dept. Y—64 Broad Street

NEW YORK

DUCK'S
No. 14 Big 200 Page
Wireless and 100
Page Electrical
CATALOG

JUST OFF THE PRESS

Any radio amateur will tell you there is no catalog to take the place of Duck's, and that it is a *Beacon Light* to guide you in the selection of your apparatus.

Send 12c for the *Wireless Catalog* and 6c for the *Electrical Catalog*. This amount may be deducted on first dollar purchase.

Great cost of catalogs and low prices prohibit distribution otherwise

THE WILLIAM B. DUCK CO.
239-241 Superior St., Toledo, Ohio

10 DAY SPECIAL

RADIO A 2 YEAR
TELEPHONY N Subscription to The
By A. N. Goldsmith D WIRELESS AGE
Total Value \$6.50 Special \$5.50
Postage Outside U. S. 50c Extra.
WIRELESS PRESS, 68 Broad Street, New York

Advanced Radio Students
read

The Radio Review

The new British Publication devoted to
Radio Science.

A Monthly Record of Scientific Progress
in Radio Telegraphy and Telephony.

Subscription price \$7.15 per year in
U. S. and Canada.

Send all orders to
WIRELESS PRESS, Inc., 64 Broad St.,
New York.

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 mak-

DAYNOR VACUUM TUBE CONTROL • PANEL



This is positively the latest type of Control Panel offered for Amateur use. It is designed to meet the requirements of the exacting operator and experimenter.

It is extremely flexible in operation and can be used in any combination of circuits.

This panel is the forerunner of a new system of unit instruments.

The construction of this instrument is of the best materials obtainable; bakelite panel, dark oak cabinet, graduated dials and large composition knobs, variable grid condenser, rheostat, and tube receptacle mounted back of panel.

PRICE—less Bulb (with base for any tube desired)—\$15.
(Wt. 6 lbs.)

When ordering state base desired.

For full information write

DAYNOR RADIO ELECTRIC COMPANY

BOX 105

WILKINSBURG, PA.



A Real Electric TELEPHONE THAT WILL OPERATE up to 200 feet on 2 ordinary dry batteries

Price per set (2 Phones) **\$1.50**

2 Transmitters and 2 Receivers. **\$1.00**

Send stamp for Catalog
INLAND-SPECIALTY CO.
1560 N. Robey Street
CHICAGO, ILL.

"JUPITER" STRANDED AERIAL WIRE
1c per foot, \$9.00 per thousand

7 strands No. 22 solid copper. The ideal radiator. Strong. Low resistance. Shipping weight 16 lbs. per 1,000 ft. Send postage.

LEE A. BATES Sole 8 Moen St. Agt. Worcester, Mass.

Here Is a Bargain

THE AMERICAN MAGAZINE	12 big issues	Regular price 25c per copy
		\$3.00
THE WIRELESS AGE	12 big issues	
		\$2.00 a year
Total Value \$5.00	Special 10 day Price \$3.50	

State whether new or renewal subscriptions to each
This offer expires April 25

Dept. A WIRELESS PRESS, Inc.
68 Broad St. New York

ing 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

"Ask Anyone Who Has Used It."

WHAT OUR PATRONS SAY

"I can hear the signals three times as loud and clear as I could with my old receivers."
(Name on request).

BRANDES Wireless Headset



"Superior," 2000 ohms, \$7

TRIAL OFFER Buy a Brandes Superior Headset and use it critically for ten days. Then, if it does not come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

Send 4c for Catalog "W."

C. BRANDES, INC. 32 Union Square, Room 818 New York
WIRELESS RECEIVER SPECIALISTS

Do You Read THE Wireless World?

In it you will find articles relating to the PRACTICE of Radiotelegraphy as well as to the THEORY.

The QUESTIONS and ANSWERS SECTION is open to YOU for the SOLUTION OF YOUR DIFFICULTIES.

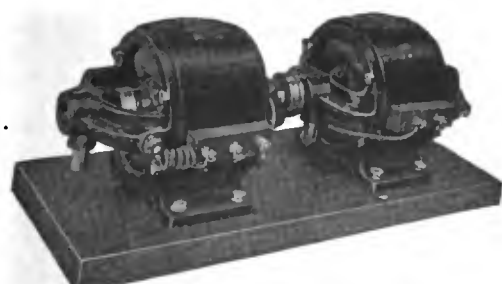
INSTRUCTIONAL ARTICLES for Home Study WRITTEN BY EXPERTS.

REVIEWS OF BOOKS useful to Wireless Students. The interests of Operators are well catered to. Now published fortnightly.

"WIRELESS WORLD," \$4.00 per annum for America. Single Copies, 25c Post Paid

WIRELESS PRESS, Inc.
64 Broad Street New York

A MARK  OF QUALITY



INTERNATIONAL

High Voltage—Direct Current
Motor Generators

This unit has a normal output of 100 watts (200 milliamperes at 500 volts) with a voltage range of 200 to 500 volts. The generator is compounded to insure constant voltage under variable load. It is furnished to operate on either D.C. or A.C.; a shunt motor being supplied for D.C. and an induction motor for A.C. The generator is equipped with a commutator of 48 segments, reducing the commutator hum to a minimum.

Unit is complete with insulating coupling and mounted as illustrated on a finished base 8" x 20". Shipment can be made immediately.

The motor generator illustrated above is only ONE of the many newly designed radio specialties which we have ready for you. Write us for description bulletins which are being issued covering all International Radio products. Address Dept. No. 24.

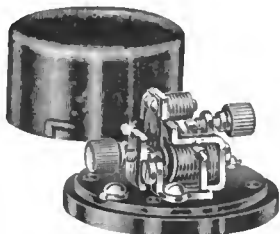
International Radio Telegraph Co., 326 BROADWAY
NEW YORK CITY

A MARK  OF QUALITY

www.americanradiohistory.com

Mesco Radio Buzzer

With Shunt Resistance —
U. S. Navy and U. S. Army
Standard.



The Radio Officers of the NC planes, after testing all other buzzers, decided to use the "Mesco" on their radio equipment. The R-34 was equipped with two of them.

Why? Because of its reliability and constancy in operation; greater output efficiency; ease of adjustment; unaffected by extreme variations in weather conditions; exposed wires eliminated.

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

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

Price
List No. 55. Mesco Radio Buzzer..... \$2.05

Send for Our Manual N 12

WIRELESS TELEGRAPHY

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

We ask twenty-five cents (\$0.25) for it—give you a coupon receipt which can be applied on any order amounting to Five Dollars (\$5.00) or more.

Do not wait until some other time, but sit down now and send your name and address, and get one of the most complete, comprehensive and reliable wireless pamphlets published.

Manhattan Electrical Supply Company, Inc.

New York, 17 Park Place St. Louis, 1106 Pine St.
Chicago, 114 So. Wells St. San Francisco, 604 Mission St.

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.

"Sea, Land and Air"

Published by the Wireless Press,
Sydney, N. S. W.

Controlled by Amalgamated Wireless (Australasia), Ltd.

HERE you have a new monthly journal, published in Australia for radio men everywhere.

Its 72 pages of interesting text, illustrations and diagrams present the very latest developments in wireless work.

All Australasian matters relating to Radio Telephony, Radio Telegraphy, Mercantile Marine, Navy and Aviation are described and illustrated fully—right up to the minute.

Technical subjects are described in simplest terms.

Price \$3.00 per year
25 cents per copy

For sale by

WIRELESS PRESS, Inc.

64 Broad Street,
New York

Amateurs, Attention!

THE "RVA" SERVICE, owing to its need for more room, which was not available at our former location, has moved to the address given below. Increased facilities now make it possible for us to give you better and quicker service than ever. The new Binders for the "RVA" BULLETIN are ready. 10c. brings Binder, Bulletins and Bargain Lists.

J. DONALD VANDERCOOK
Elmhurst, Illinois

CONQUEST New English Publication
Devoted to Science, Invention and Industry. You will like it. Send 30c for specimen copy.

Wireless Press, Inc., 64 Broad St., - New York

STARTING WITH A BIG IDEA, WE ARE GROWING ALL THE TIME

WASHINGTON DISTRIBUTORS FOR WIRELESS IMPROVEMENT APPARATUS

Realizing the great and growing need of a single supply house that could furnish instantaneously all radio apparatus, the National Radio Supply Company comes to you with a message that will appeal to all that have a want in radio apparatus to supply. On April 15, 1919, our concern represented and was authorized sales agency for 40 different concerns. Today 91 of America's foremost wireless firms have placed their apparatus and sales agency with us. Think of the convenience this means to you. You get just what you want in the radio line just when you want it.

Ten cents in stamps will bring you our 74 page catalog No. 2 which shows more approved, dependable radio apparatus than any other similar book ever published by any concern outside of the National Radio Supply Company. To those who already have this wonderful catalog, the new price bulletin issued monthly will be forwarded upon request for same. Our supply of the above becomes obsolete after April 15th as this issue will be entirely exhausted.

SPECIAL NOTICE TO AMATEURS, radio concerns and schools: Our new catalog will be ready for distribution May 1, 1920, consisting of 125 pages of the most interesting display of radio apparatus ever published in any catalog. In addition to the display of radio apparatus, this catalog will contain 75 hook-ups, one page showing radio symbols used extensively by all radio manufacturers. Prompt shipments will be made on any of the apparatus listed in this catalog; and while it is impossible to list every piece of apparatus that we handle, a postal card will bring you prices on any other apparatus not listed in our catalog.

Fifteen cents in stamps will bring this new catalog to your door. The hook-ups alone will be worth many times the price.

Let our radio expert answer your questions without charge. Advice given to those who contemplate putting in a wireless set; stamped, addressed envelope must be included with your inquiry.

NATIONAL RADIO SUPPLY CO., "The Nation's Clearing House," Dept. 124, 808 9th St., N. W., Washington, D. C.

Our storeroom displays several thousand dollars in radio apparatus. When in Washington, we cordially invite you to visit our store and look over our line. Direct outlet for the South.

References: Second National Bank, Washington, D. C.
Members of Merchants and Manufacturers Credit Association, Washington, D. C.



Make Your Own WIRELESS APPARATUS



SAVE 1/2

It's easy to make your own at home with the aid of these 4 up-to-date books that you can understand. Each has over 72 pages and over 60 illustrations. 3 color cover, size 5x7 inches.

LESSONS IN WIRELESS TELEGRAPHY is a course in the elementary principles which you must understand to obtain good results.

WIRELESS CONSTRUCTION AND INSTALLATION FOR BEGINNERS gives complete details with working drawings for making simple but good sending and receiving apparatus and erecting aerials, etc.

THE OPERATION OF WIRELESS TELEGRAPH APPARATUS shows how to obtain best results and greatest ranges with all kinds of apparatus, how to tune the station to 200 meters, use a wave meter, apply for license, etc.

EXPERIMENTAL WIRELESS CONSTRUCTION gives details, with working drawings for making more elaborate and efficient sending and receiving apparatus, complete sets, etc.

35c Each Postpaid Any THREE \$1.00

GET THEM NOW
PRICE MAY ADVANCE ANY DAY
COLE & MORGAN, Inc., Publishers
P. O. Box 473 New York

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

AMERICAN ELECTRO TECHNICAL APPLIANCE CO.
235 Fulton St., New York City



THIS AUDION PANEL

as illustrated without bulb . . . \$13.00
Without cabinet or bulb . . . 10.50

We are not responsible for the delay of an catalog; 10c. will bring it to you as soon as it is from the Printer.

We have all the necessary and interesting apparatus and parts for the Amateur.

SPECIAL Receiving Set . . . \$ 6.00
Arlington Tuner . . . 15 00
SPECIAL Crystal Detector75
SPECIAL Switch Points . . . 20c. per Doz.

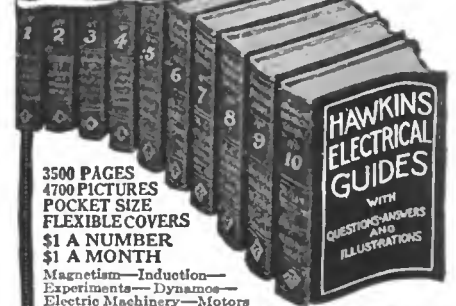
With one year's subscription to
THE NEW NAVY MANUAL OF RADIO TELEGRAPHY
For only **\$3.25**
Send all orders to
Dept. N WIRELESS PRESS
\$1.75 Postpaid Dept. N 66 Broad St., New York

Get Bigger Pay through ELECTRICITY



You will find in **HAWKINS GUIDES** just what you need to know about electricity. In simple everyday language—complete, concise, to the point. In questions and answers. A complete standard course in Electrical Engineering. Send for your set today to look over.

HAWKINS ELECTRICAL GUIDES



3500 PAGES
4700 PICTURES
POCKET SIZE
FLEXIBLE COVERS
\$1 A NUMBER
\$1 A MONTH

Magnetism—Induction—Experiments—Dynamoes—Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamoes—Electrical Instrument Testing—Practical Management of Dynamoes and Motors—Distribution Systems—Wiring—Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors—Transformers—Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switch Boards—Power Stations—Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many modern Practical Applications of Electricity and Ready Reference Index of the 10 numbers.

Shipped to you FREE. Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send coupon now—today—and get this great help library and see if it is not worth \$100 to you—you pay \$1.00 a month for 10 months or return it.

SEND NO MONEY

THEO. AUDEL & CO., 72 Fifth Ave., N. Y. Please submit for examination Hawkins Electrical Guides (Price \$1 each). Ship at once, prepaid, the 10 numbers. If satisfactory, I agree to send you \$1 within seven days and to further mail you \$1 each month until paid.

Signature _____
Occupation _____
Employed by _____
Residence _____
Reference _____

EXPERIMENTAL SCIENCE

CHEMISTRY
A New Magazine of Science for the Experimenter and Practical non-Technical Man.



PHYSICS
First Issue out May 5th.
\$1.50 per year; Canada \$1.75, 'New and Original.'

RADIO
WRITTEN BY AUTHORITIES

Literature Sent on Request

Send In Your Subscription NOW!

Experimental Science Publishing Company
710 Fourteenth Street Washington, D. C.



TYPE 800

Balanced Condenser

Mounted or unmounted. Made in three capacities. Carried by most good dealers, price \$7.50 and up.

Bulletins Y and Z, sent for 4c stamps, show our complete line of high grade moderately priced apparatus for the modern Radio Laboratory.

CLAPP EASTHAM CO.

161 Main Street

Cambridge, Mass.

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 $3\frac{1}{2}$ KW, 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.

HOOK 'ER TO YER BULB

Any single wire aerial 25 x 40 feet will do anywhere

A C/W 20,000 meter tuner for only \$8.00



Wound with the celebrated INVOLUTE coils. The only tuner in the world for amateur use, licensed under Marconi Patent No. 763772, that gets all the European stations with one bulb and one wire aerial anywhere, using no tickler coil. No movable coils, no loose connections, no trouble. Condensers help in the tuning but are not needed to get the arc stations. Only one tuner of each kind sold at this price in each city. Act quick and if you are the second or third we will give the names of those ahead of you.

WE SELL THE COILS SEPARATELY FOR PANELS

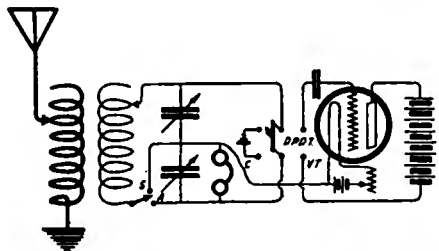
Coils for any of our tuners boxed in small container, waxed, tapt, marked and with wiring diagram, for only \$6.00.

TRESCO-DAVENPORT, IOWA, or Your Local Dealer

Send five cents in stamps for our new catalog, having names and wave lengths of all world stations, wireless alphabet, and International abbreviations. Just off the press.

M. K., Oakland, Calif.:

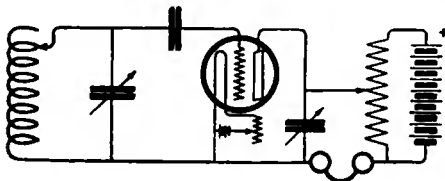
With reference to the circuit diagram on page 34 of the September issue, the reception of arc signals and of spark signals at their natural tone is effected by adjustment of the switch marked "tickler" and the bridging condenser. It is only possible conveniently to switch from spark connection to continuous 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.

Another



Achievement

The Grebe Special Type CR-3 Relay Receiver



Unparalleled performance on Relay wavelengths. Constructed according to the highest engineering and manufacturing standards.

This Instrument was fully described in Q S T for March, 1920 and may be found on display by the following concerns:

Doubleday-Hill Electric Co., Pittsburgh, Pa.
Holt Electric Utilities Co., Jacksonville, Fla.
Manhattan Electrical Supply Co., New York, Chicago, St Louis

Pacent Electric Co., Inc., New York City
Geo. W. Parezo & Co., Washington, D. C.
F. D. Pitts Co., Inc., Boston, Mass.

A. H. GREBE & CO., Inc., 78 Van Wyck Blvd., Richmond Hill, N. Y.



"R.W.4" Size 12"x9"x6 1/2"

Mignon "RW4"

Undamped Wave Receptors

NO Loose Couplers
Loading Coils
Variometers
Amplifiers
Strongest, Most Distinct Signals

IMPORTANT NOTICE

The Mignon System Apparatus, "RW1," "RW2," "RW3" and "RBDS" are no longer manufactured and are superseded by the improved "RW4," "UW1" and "BD1." These apparatus are manufactured exclusively by the MIGNON MFG. CORP., sole owners of the Mignon System Patents. (See U. S. Letters Patent No. 1329672.)

INFRINGEMENTS WILL BE PROSECUTED.

Mignon Manufacturing Corporation :: Newark, N. J.

Damped and Undamped Wave Apparatus for All Purposes

Endorsed by Radio Department of D. L. and W. R. R. Co.

Write for Literature

MIGNON MFG. CORP.

Dept. E NEWARK, NEW JERSEY

Canadian Representative: Canadian Radio Mfg. Co., Blenville, Quebec



RADIO MEN



Make your apparatus up to date. **Indicating dials** now available at a reasonable price. Made of fine black polished composition with radial lines and figures accurately engraved and filled with brilliant white. Diameter of dial is 3 inches and they are 3/16 inch thick. Bevelled edge. We can furnish dial alone or with fine Bakelite Knob mounted. This knob has a set screw to clamp shaft of instrument to which dial is to be applied.

3 inch Dial only 75 cents
3 inch Dial with Knob mounted.....\$1.30
Postpaid Postpaid

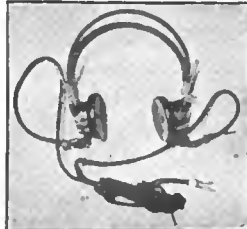
NEW CATALOG JUST OUT, ready for distribution at once. 24 pages of real, live, up to the minute illustrations, news and descriptions of all standard Radio parts, including the above Indicating Dial.

Sent anywhere upon receipt of 10c.

For sale at all Radisco Agencies and by
A. H. Corwin & Co.
 4 West Park Street Newark, N. J.

ARMY AND NAVY

Standard Wireless Head Receivers released for amateur use
Price \$13.00



These head receivers are the exact type used by the Army and Navy wireless operators during the war. The Signal Corps U. S. A. knew them as #P-11. The U. S. Navy knew them as C-W 834.

JAMES O. OLIVER & COMPANY
 20 Nassau Street New York City

NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity

To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors	Charging Generators	Polyphase Motors	Battery Charging Outfits
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley	Suitable for all lighting Battery Charging and Power Requirements.	2 and 3 phase, A.C., 220 v. 60 c. 1750 RPM. complete with base and pulley.	To operate on A. C., 60 cycle, single phase voltage as specified.
1/4 H. P., 110 volts, induction, full load start - -	8 volts, 10 amp. \$16.50	1/2 H. P. - \$42.50	110 volts, A. C., 100 watt, 10 volts, without switchboard \$40.00
1/2 H. P., 110-220 volts, induction, full load start -	10 volts, 10 amp. \$21.00	1 H. P. - \$59.50	110 volts, A.C., 150 watt, 10 volts, with switchboard \$68.50
1/2 H. P., 110-220 volts, repulsion, for compressor	40 volts, 8 amp. \$24.50	1 H. P. - \$72.50	110-220 volts, A. C., 150 watts, 10 volts, without switchboard - \$75.00
1 H. P., 110-220 volts, repulsion, sliding base	110 v, 1 1/2 amp. \$24.50	1 H. P. - \$84.50	120 volts, A.C., 100 watts, 30 volts, without switchboard \$85.00
2 H. P., 110-220 volts, repulsion, sliding base	40 volts, 11 amp. \$38.50	5 H. P. - \$102.50	110 volts, A.C., 370 watts, 10 volts, without switchboard \$85.00
3 H. P., 110-220 volts, repulsion, sliding base	110 volts, 5 amp. \$38.50	1 H. P., high speed, 1600 R.P.M., 120 v 7 phase only - \$36.50	220 volts, A.C., 300 watts, 44 volts, with switchboard \$110.00
5 H. P., 110-220 volts, repulsion, sliding base	80 volts, 10 amp. \$58.50		110 volts, A.C., 750 watts, 72 volts, without switchboard \$125.00
	110 volts, 10 amp. \$58.50		
	Moving Picture Arc Generator \$85.00		

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL
1/4 H.P. A.C. 110 v
 S.P., 1750 RPM.
 Complete, cord, plug & pulley

\$19.75 EACH

MONEY BACK

WASHING MACHINE MOTORS
 Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. Reg. Value \$25.00

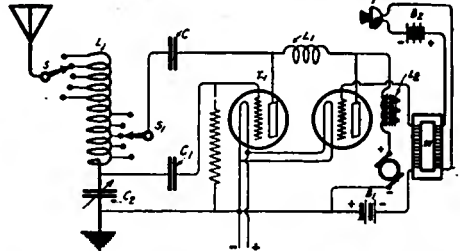
\$19.75 EACH

GUARANTEE

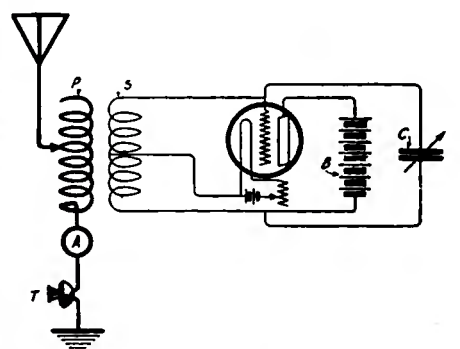
SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURER'S DISTRIBUTOR
CHAS. H. JOHNSTON, Box 8, West End, Pittsburgh, Pa.

H. R. W., Lansing, Mich.:
 Encloses a circuit diagram of the "SCR 67" which is reproduced herewith, and requests complete constructional data concerning the radio frequency inductance L, its taps, etc.; the condensers and the radio frequency choke coils L₁ and L₂, 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 tele-

phone 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, ss.
State of New York,

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.)

PACENT ELECTRIC COMPANY

INCORPORATED

150 Nassau St.

New York

We are builders and specialists in electrical, radio and laboratory equipment suitable for amateur, experimental, research and communicating purposes and are therefore in a position to serve electrical jobbers, operators, amateurs and other interested persons to the best advantage.

You are invited to visit our show rooms which are always complete with the latest equipment; all designed by the best known engineers in the field and includes Genuine Dubilier Mica Condensers, Standard VT batteries, Grebe correctly designed receiving equipment, imported Seibt variable air condensers, Rawson ultra-sensitive instruments, vacuum tubes, standard radio laboratory apparatus, etc.

A. H. GREBE & CO. RICHTER & BYRNE.
DUBILIER CONDENSER IMPORTED SEIBT CON-
CO. DENSERS.
RAWSON ELECTRICAL IN- VACUUM TUBE APPAR-
STRUMENT CO. ATUS.

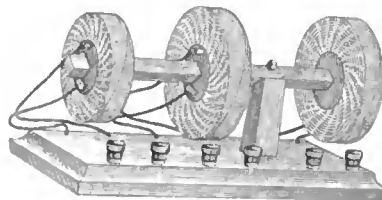
AND OTHERS.

PACENT ELECTRIC COMPANY, Inc.

Telephone Beekman 5810

150 Nassau Street

New York



The B & H Mounting for Radisco, DeForest and other coils

The single support allows easy change of coils with ample length of rod to allow very loose coupling. The square rod prevents coils from turning. Special Stands and Centers Made to Order.

THE MOST EFFICIENT STAND ON THE MARKET

	Radisco	DeForest	Special
No. 1R Complete with 6 Binding posts, flexible leads and 3 Coil centers.	\$6.00	\$6.50	\$7.00
No. 2R Complete with 3 Coil centers, but without flexible leads or Binding posts	4.00	4.50	5.00
No. 3R Extra Coil Centers, (give size)	.35	.40	.50

Parcel Post Charges on 2 lbs. FINISHED IN WEATHERED OAK

HIGH FREQUENCY CABLE (LITZ) 10-38 20-38 16-2-38 16-3-38 DSC, Enameled—any other size and covering to Order. Send stamp for further particulars.

WIRELESS A. T. HOVEY SUPPLIES
61 BELVIDERE STREET Dept. B BOSTON-17-MASS.

AMPLIFYING TRANSFORMER

Type 166A



This instrument is so designed that it combines all of the essentials necessary in the really satisfactory amplifying transformer. The ratio between the coils is such that it is especially adapted to use with tubes having high impedance.

Price—complete . . . \$7.00
unmounted . . . 4.50
mounting supports .75

Have you received Bulletin No. 901?

GENERAL RADIO CO.

General Radio Building
Cambridge 39 Massachusetts



Fleming Pat. No. 803,684
De Forest Pat. Nos. 841,387-879,522

A WARNING

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 oscillations 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: $\frac{1}{2}$ 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

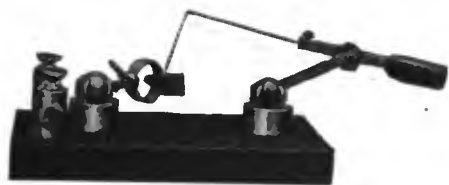
Sole Distributors for De Forest Radio Telephone & Telegraph Co.

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 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 UN DAMPED 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 addition.



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 or that it is EXQUISITELY SENSITIVE. Buy Arlington individually tested Minerals, Galena or Silicon, post paid on receipt of price.

35¢

THE NEWMAN-STERM 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, unexcelled 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 1014 E. Vincennes, Indiana

FREE **POCKET HANDBOOK CATALOGUE**

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.

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.

Red Head Radio Phone

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.

\$7.00

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

RADIO APPARATUS

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

DE FOREST HONEY-COMB COIL INDUCTANCES

Solid wire.			Litz wire			Solid wire.			Litz wire		
Cat. No.	Appx. wave length range with .001 MF. Variable condenser	Price on plug mounted	Cat.No.	Price on plug mounted	Cat. No.	Appx. wave length range with .001 MF. Variable condenser	Price on plug mounted	Cat.No.	Price on plug mounted		
L-25	170-375	\$1.40	LL25	\$1.40	L-300	1340-4800	\$2.10	LL300	\$2.65		
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.

**BATTERIES
MANUFACTURED
BY
THIS COMPANY
ARE USED**

by Large Central Light-
ing and Power Com-
panies.

By Telephone and Tele-
graph Companies and
for Wireless.

For Mine Locomotives,
Battery Street Cars,
Railway Signals, Etc.

For Electrical Vehicles
and Industrial Trucks.

For Automobile Start-
ing and Lighting.

“Exide” Batteries

have earned their right to first consideration for Wireless Service and Emergency Lighting. In this and other fields where the application of storage battery power is an important factor, they have proved their ability to give instant and adequate power, and long life.

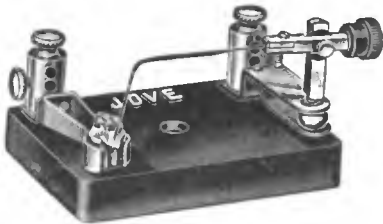
Thirty-one years of storage battery building experience is built into “Exide” Battery. That experience is an assurance of consistent and dependable storage battery performance to the “Exide” user.

THE ELECTRIC STORAGE BATTERY CO.

The largest manufacturer of Storage Batteries in the world.

1838 - PHILADELPHIA - 1919

New York Chicago Cleveland Rochester Minneapolis Washington Denver
Boston St. Louis Atlanta Pittsburgh Kansas City Detroit San Francisco
Special Canadian Representative Chas. E. Goad Engineering Co., 105 Bond St., Toronto



Bunnell Instruments Always Satisfy

Our Jove Detectors Simplest and Best

Sample mailed for \$1.80

Tested and Guaranteed Galena 25 cents

Our Keys, Spark Gaps, Condensers, Transformers, etc., are high grade but inexpensive

Sent stamp for our No. 42-W Catalog.

J. H. BUNNELL & CO. - - - 32 Park Place, New York City, N. Y.

WESTERN ELECTRIC RECEIVERS

These are the same type of receivers furnished to the United States Signal Corps and Navy Department and were known in Army circles as the “P-11.” The Navy knew them as the “CW-834.” They are without exception the best receivers on the American market today. Price \$13.00 per pair.

In addition to these receivers we carry one of the most complete lines of high grade radio apparatus in America.

“We make or sell Everything Radio”

4614 Henry St. THE RADIO ELECTRIC COMPANY Pittsburgh, Pa.

Recognized as the largest and best.



Send ten cents for
descriptive catalogue

900-902 Penna. Ave., N. W. Washington, D. C.



**EASTERN
RADIO**

INSTITUTE

**TEL.
BACK BAY
5 9 6 4**

**899 Boylston St.
Boston - Mass.**



ANNOUNCEMENT!

Arrangements have been completed whereby EVERY MAN who graduates from the EASTERN RADIO INSTITUTE is POSITIVELY GUARANTEED a good position. When you realize that it only takes six months in the Day School or nine months in the Evening School to accomplish the work and that the salaries for beginners are from \$100 to \$125 per month, food and quarters included, and that the entire expense of the course can be returned to you in one month's salary, doesn't this appeal to you? Remember we are the OLDEST, LARGEST, and BEST EQUIPPED telegraph school and have THOUSANDS of satisfied graduates to our credit. This speaks for itself. Day and Evening classes. Start any Monday. Our prospectus for the asking.

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.

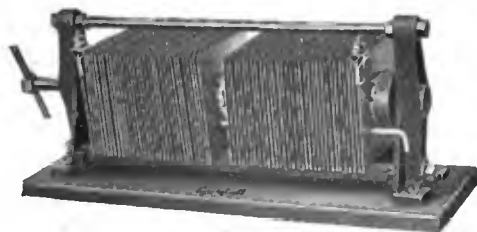
THE CONTINENTAL FIBRE CO.

NEWARK, DELAWARE

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

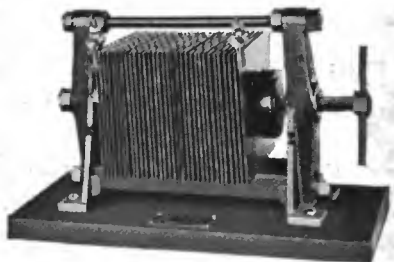
332 S. Michigan Ave., Chicago, Ill.
411 S. Main St., Los Angeles, Cal.
301 Fifth Ave., Pittsburgh, Pa.

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; every user a voluntary purchaser. Enthusiastic reports on file in our office. Intended for moderately long distance work, 500-900 miles. It has 16 sparking chambers and is designed for use 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 transformers delivering over 7,500 volts. This gap will increase the range of any induction coil set and at the same time will permit the operator to comply with the Federal law regulating decrement. It offers the only practical solution to the QRM problem in congested districts. Seven sparking chambers. Maximum capacity 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 selector switch having open circuit point. Moulded base 1/2 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. Adjustment remarkably proof against shock. Postage, 10c, both types.

Single type is the most compact and rugged Detector Stand built. Moulded base 2 1/4" x 1 1/4". Equal in all other respects to our Duplex type. Substantial binding posts with non-removable 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 request 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 our 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.