DECEMBER 1913

MODERN ELECTRICS

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MODERN ELECTRICS

"The Electrical Magazine for Everybody"

ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

Volume 6. December, 1913 No. 9

Contents

MODERN ELECTRICS

DECEMBER, 1913 VOL. 6. No. 9.

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Original contributions of timely interest pertaining to the electrical and affiliated arts, or on any branch of electrical science and invention, especially with practical working directions, drawings or photographs are solicited. No manuscript returned unless postage is enclosed.

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MODERN ELECTRICS Magazine should be on the news stands on the 15th of the month preceding the date of issue. Readers unable to get the magazine on the 17th will confer a favor by notifying the Publishers. News stand patrons should instruct their Newsdealer to reserve their copy of MODERN ELECTRICS, otherwise they are likely to find the magazine "sold out."

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Published by Modern Publishing Co., 231 Fulton St., New York, U. S. A.

Modern Electrics

VOL. VI. December, 1913 No. 9

ANNOUNCEMENT

THIS issue marks the last number of *Modern Electrics* in its present form, for beginning with the January issue it will combine with *Electrician and Mechanic* under the title of *Modern Electrics and Mechanics.*

The new consolidated magazine will be published by the Modern Publishing Co. of New York, the present publishers of *Modern Electrics.*

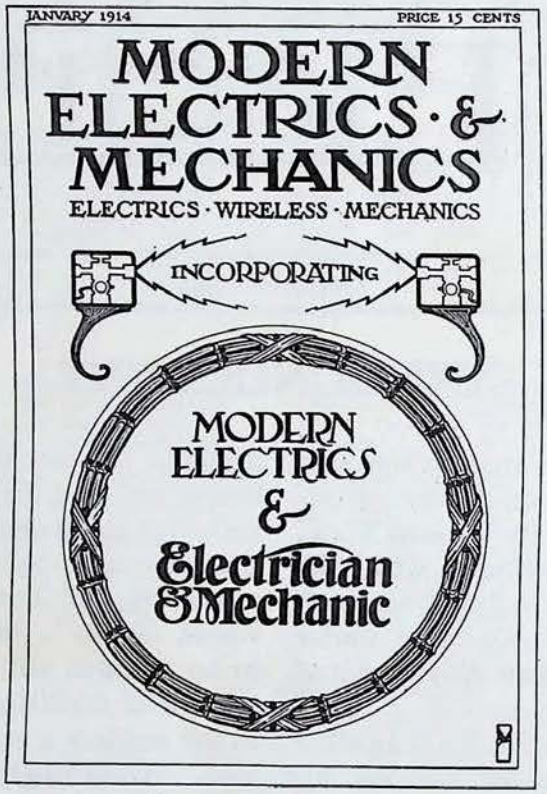
For several years these two publications have covered approximately the same field in electricity, although *Electrician and Mechanic,* having a broader Editorial field, was able to cover many other subjects outside of the electrical topics, to which *Modern Electrics* was strictly limited. It is not surprising, therefore, that in view of these facts the publishers of both publi ations came to believe that the combining of both publications would enable a larger magazine to be founded with a far greater scope and facilities for supplying to the readers a still better magazine. Accordingly, the two publications have been combined and will be known henceforth as *Modern Electrics and Mechanics.*

In the January issue, which is the initial number of the new publication, several novel features are planned that will interest all our readers. A careful study of the requirements of readers of both *Modern Electrics* and *Electrician and Mechanic* has been

ANNOUNCEMENT—*Continued*

made and in the future a new editorial policy will be followed.

In the first place, as the first half of the new magazine's title indicates, we propose to describe every new development in electricity, keeping our readers fully in touch with the progress of this greatest of all modern forces. *Electrician and Mechanic* and *Modern Electrics* have both been of great assistance to wireless enthusiasts, and in this department we propose to make the magazine the world's standard authority on both commercial and amateur progress and practice. There will be no need in wireless, from that of the veriest beginner to that of the seasoned expert, which will not be met.



FACSIMILE REPRODUCTION OF JANUARY COVER OF THE NEW MAGAZINE

We shall also publish constantly full and explicit directions for the construction of electrical apparatus of all kinds, experimental and practical. As an example, we may mention that the experimenter will seek in vain in electrical literature for directions and working drawings enabling him, without machine tools of considerable capacity, to construct an induction motor. Prof. A. E. Watson, an acknowledged authority, has been at work for several years on this problem, and has prepared for us a series of articles, magnificently illustrated with dimension drawings, enabling anyone, with very simple mechanical equipment, to construct induction motors of several practical sizes which will run perfectly and with excellent efficiency. This begins in the January issue. Articles on numerous other types of electrical apparatus desired by readers are in preparation or ready. Every month *Modern Electrics and Mechanics* will contain numerous articles on how to construct new electrical and wireless apparatus—articles of unusual value to every experiment-

ANNOUNCEMENT—*Continued*

er, carefully written and clearly illustrated by detailed drawings.

We shall not neglect the needs of the electrical worker who wants helpful knowledge to assist him in his daily work. The care and operation of electrical machinery, the erection and installation of plants and electrical stations, wiring with its calculations, lighting problems, the mechanical and chemical applications of the electric current, and all the manifold phases of the contact of electricity with daily life, will be peculiarly our field.

The second half of our title opens a field as wide as that of electricity. The worker in wood or metal, of every grade of proficiency, will find the magazine full of interest. From the model maker who wants designs for miniature machines which will work, to the mechanic who desires to learn the intricacies of modern gear cutting or the making of the elaborate patterns for an aluminum automobile body, we can promise helpful articles, finely and accurately illustrated.

The woodworker, cabinet-maker, manual training student and teacher, the home furniture-builder, the boy who desires to build model aeroplanes, all these and many others will find our woodworking departments helpful in increasing measures from month to month.

But the magazine will not be all for the hard worker. The advance of modern science is full of romance and intensely interesting human achievement. We shall chronicle in word and picture every important mechanical triumph of mankind, from the building of a 1,000 ft. steamship to the piercing of a Channel tunnel or the first airship flight across the Atlantic, not to mention lesser things which men of iron will and brilliant brains are every day achieving.

But this is not all. There are many other unique features that we will incorporate in *Modern Electrics and Mechanics* which will be a pleasant surprise. For one thing, there will be one or two editorial pages in which, each month, there will be a heart-to-heart talk between the editor and the readers—a get-together chat—to cement still closer the bonds between the readers and the man that caters to their interests in the preparation of the new magazine.

Modern Electrics and Mechanics has been fortunate in securing the services of Mr. Austin C. Lescarboura as Editor, who has had a long experience in editing and writing articles for the readers of both magazines. He is well known to most of our readers and needs no further introduction.

And now let us all look forward to the new, big magazine—the initial issue of *Modern Electrics and Mechanics.*

New York, Nov. 15, 1913. THE PUBLISHERS.

A Christmas Radiogram

I'M listening, Laddie—listening
Thro' the weary miles between
Your northland and my southland,
Where the Christmas Day is green,

AND, the love-song of your spark-gap,
In the old code, reaches me
Thro' the thin receivers, throbbing
To your calling oil-break key.

FOR, as the tuned condenser
Quickens, to its keynote true,
While you send, my pulses quicken
And my heart is tuned to you!

ACROSS its wireless roadway
To my answering aerial's reach,
The trackless wave train brings me
All the wonder of your speech;

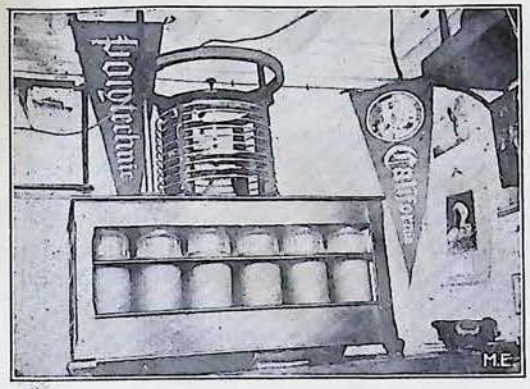
AND, the hot wire meter's finger
Marks the giant voltage strength
Of the current crying to me
Thro' the audion's wire-grid length.

I'M answering, Laddie—answering
"Merry Christmas," in the code—
All the love that's in me flaming
Thro' the flaring electrode!

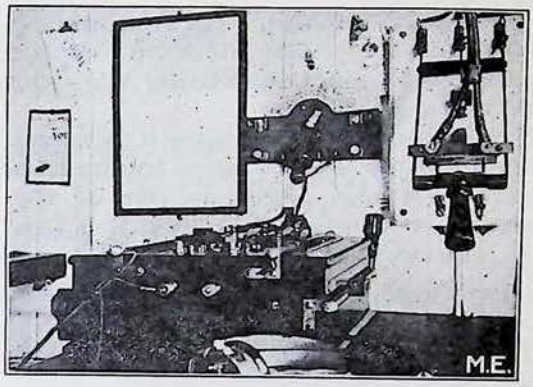
BUT, as the charged clouds flutter
With the static's low recoil,
When my fingers seek to find you
On the restless tuning-coil,

MY heart has ever fluttered
At the mem'ry of your face,
When my arms would reach to draw
you
From the loneliness of space!

Katherine D. M. Simons, Jr.



TRANSMITTING APPARATUS OF S. S. HARVARD



RECEIVING APPARATUS OF THE S. S. HARVARD

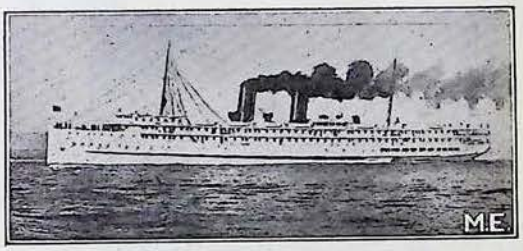
Radio Station of the S. S. Harvard

By Stanley E. Hyde

A RADIO operator's life at sea is not so monotonous as many would imagine, as can be noted in one of the accompanying views. When not on duty he has all of his time to do what he pleases. The accompanying scenes were taken on the S. S. *Harvard,* the fastest passenger steamer on the Pacific Coast. The *Yale* and *Harvard,* sister ships, formerly ran between New York and Boston, but were brought around to the Pacific Coast and now run on a regular schedule between San Diego, Los Angeles and San Francisco.

In one of the illustrations is shown the receiving set and the antenna switch. The receiving set has a three slide tuner of the United Type. The crystal holder on the wall was described in a former issue of *Modern Electrics.*

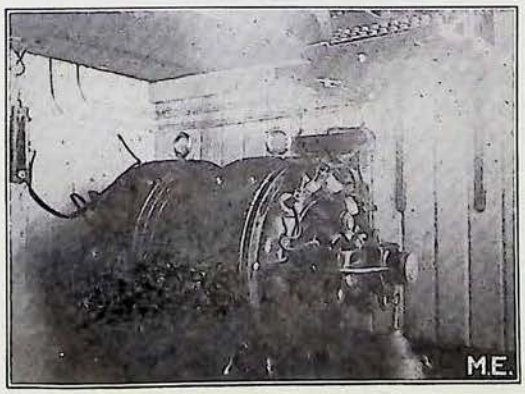
A 120-cycle motor-generator set is employed for supplying alternating current to a 2 kw. transformer. A switchboard



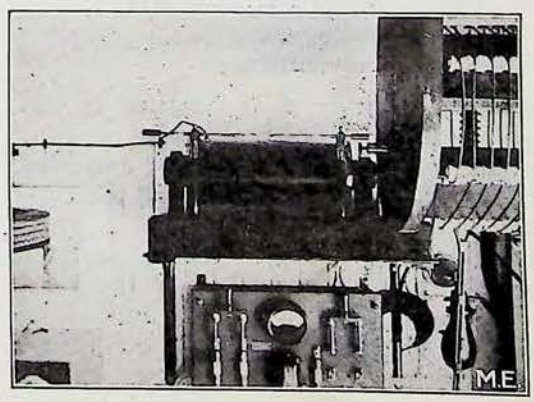
THE TURBINE STEAMER HARVARD

is used for controlling the primary current on which is mounted a D. C. ammeter and voltmeter, field rheostat for alternator, main line switch and a start-

THE MOTOR-GENERATOR SET



AUXILIARY TRANSMITTING APPARATUS

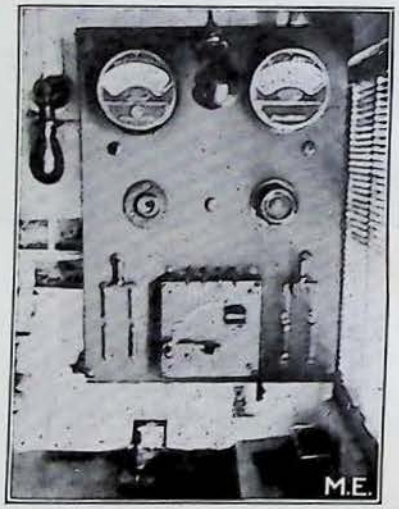


ing-box for the motor. The transmitting apparatus comprises standard copper plated leyden jars, oscillation transformer and a spark gap.

On all passenger steamers it is necessary to carry an auxiliary transmitter, and this is also shown in one of the views. It comprises a 10-inch spark coil, storage batteries, a key and small

WIRELESS OPERATOR AT HIS LEISURE

switchboard (shown below the coil). On the switchboard is a voltmeter for the battery, D.P switch for charging the battery from the ship's generator, fuses, D. P. D. T. switch for connecting the



THE SWITCHBOARD WITH CONTROLLING INSTRUMENTS

sending key either to the coil or to the regular set and an under current cut-out, for the purpose of cutting the batteries off from the ship's supply should the current fall below a certain value.

Ship sets do not have the range they formerly had on account of the very loose coupling, which will be noticed in one of the views, the secondary coil being about 8 inches from the primary.

In such an arrangement there is bound to be a tremendous waste of energy, this being done to conform to the new radio law on decrement, but from experience with commercial sets the writer has found that on spark transmitters the advantages gained by loose coupling are very few, selective tuning being just as hard to secure as before the law was passed, and until up-to-date apparatus such as quenched spark sets, is installed on ships, and a lot of the present "junk" is discarded, selective tuning is as far off as it ever was.

BASEBALL SCORES VIA WIRELESS

During the world's series games the baseball scores were received every half inning at the efficient wireless station at Fordham University. The scores were received from the New York *Herald's* wireless station by two licensed commercial operators, H. K. Fallon and F. W. Lomnitzer.

GERMAN WIRELESS SYSTEM FOR SOUTH PACIFIC

Germany is reported to be planning the establishment of an independent wireless-telegraph system among the islands of the South Pacific. A large station is to be built at Samoa with a range of 1,870 miles, with stations in New Guinea and Marshall Islands, all interconnected and in direct communication with Europe by means of the Dutch cable from Yap, one of the Islands in the Caroline group. Effort is also being made to open wireless communication between Nauen and Togoland, Southwest Africa, and the Cameroons, on the African coast.—*Electrical World.*

PREDICTS TALKS BY WIRELESS TELEPHONY

Mr. Godfrey Isaacs, of the Marconi Wireless Telegraph Company, in a recent statement said that the day is not now far distant when passengers on ocean steamships will talk with those on land over a wireless telephone. He intimated that the Marconi company would be able to turn wireless telephony to practical commercial account at an early date, but until the company is prepared to show exactly what definite results can be obtained he will vouchsafe no further information.—*Electrical World.*

Static Kick-Back—Its Prevention and Cure

By Ellery W. Stone

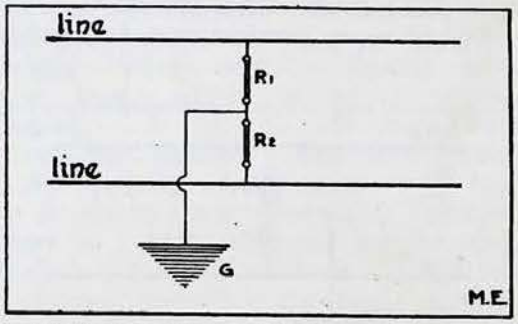
IN the last two paragraphs of an article entitled "Elimination of Interference Between Wireless Stations and Power and Telephone Circuits," by H. N. Umbarger, published in the July issue of *Modern Electrics,* the author sets forth some experiences of his with regard to the operation of kick-back protective devices, and it is the purpose of this article to explain this trouble and to suggest some means for overcoming it.

It is advisable first, however, to set forth just what takes place when kick-back or aerial induction occurs.

The windings of a home-made transformer are often so poorly insulated from the core that the high frequency oscillations set up in the closed or oscillating circuit sometimes leak through the secondary to the core, thence to the primary, and back on the power lines where they cause trouble as will be shown later. Such an occurrence as this is due solely to carelessness in the manufacture of the transformer, and proper insulation will easily rectify it.

But there is far greater trouble due from induction between the circuits of the radio-transmitter carrying high frequency currents of high potential and the power lines. This induction causes currents of moderately high voltage, from 500 to 2,000 volts, to be set up in the mains. This voltage is sufficient to jump the short air gaps which are common in lamp sockets, and once such a spark occurs, the low voltage A. C. current flows across the gap whose resistance, due to the presence of the high frequency spark, has been lowered to but a few ohms. Such a flow of current through this low resistance of course establishes an arc, damages the socket, and burns out the fuses in that circuit. Similarly, the windings of meters or motors on the line may be burned out.

To prevent this annoyance and possible danger, we must drain this induced current from the power lines in some manner. A method which the Underwriters have adopted is to ground the common terminal of two condensers which are connected in series between the mains. This plan is doubtless familiar to all radio operators. But the efficacy of such a device is questionable. Theoretically, the condensers are supposed to be charged with the high potential oscillations, and to discharge them to the ground. But there is just as much chance that after they have become fully charged to a very high voltage, they will discharge back on the mains again, creating more damage than they are intended to prevent. This has always been the writer's theory in the matter, and certainly Mr. Umbarger's experiences, as set forth in his article, seem to confirm it.



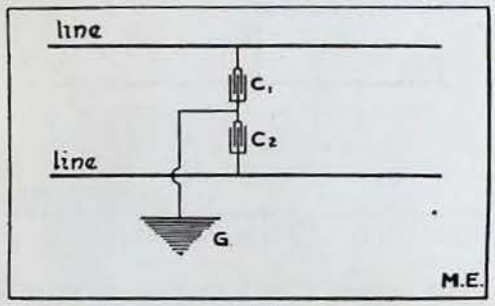
METHOD OF EMPLOYING RESISTANCE RODS

The graphite rod* preventer, as used by the Marconi Company, is without doubt the only efficient device for draining power lines of kick-back currents. The ohmic resistance of this rod is so high that it can be permanently connected to the line without consuming enough current to be registered on the meter, yet it offers practically no resistance to the high frequency surges, which are thus conducted immediately to the ground. The rod as supplied by the company to its stations, is mounted on a slate base on which are three terminals, the outer two going to the mains, the center to the ground. The writer does not know whether this device is on sale by the Marconi people, but there is no reason why it should not be, since this company has shown a willingness to supply the experimenters' demands.

* Carbon Resistance Rods suitable for this purpose are sold by the General Electric Company for use as lightning protectors. Readers might address the company for quotations.—Ed.

Any protective device often causes that part of the line to which it is connected to become the node of the oscillations set up in the power circuits, thus shifting or boosting the loop of potential to some part of the line which may not be easily accessible. Amateurs who have efficiently protected their own circuits, find that they are burning out fuses and sockets in houses perhaps a block away, due to making their own circuits the node of these oscillations. The longer the power circuit, i. e., the farther the wireless transformer is from the step-down power transformer, the greater the magnitude of this loop will become, since the potential of this induced current will become greater the farther away it flows from the radio transmitter circuits, just as the voltage in the antenna is highest at that point farthest from the oscillation transformer.

A good many wireless transformers on



WIRING FOR CONDENSERS TO PREVENT KICK-BACK

the market are wound to give potentials ranging from 15,000 to 20,000 volts. This voltage having been stepped up in the oscillation transformer causes the potential in the antenna to be exceedingly high, consequently causing the induction of quite high voltage currents in the power circuits. Now, if we use a transformer giving only 2,000 or 3,000 volts, using such a gap as the Lepel or Rotary Quenched Dischargers, we would not only obtain more efficiency in the set as a radio transmitter, but, the aerial now being charged to a relatively low potential, the induced high frequency surges in the power circuits would be of such a fairly low voltage that they would either cause no trouble or else could be effectively handled by the graphite rod preventer.

One very reliable means for eliminating the disastrous effects of aerial induction is to have all the wiring done in metal sheathed wire, either wire in conduit, or lead covered wire. If this metal covering is well grounded, it is obvious that no high frequency currents can be induced in the power lines, since the induced currents set up in the protective metallic covering, would go at once to the ground, and consequently cause no annoyance. (Lead covered wire is always used in the installation of radio transmitters by the Marconi Company for just this very reason.) If all the wiring in the house is in conduit, so much the better.

An amateur, who interposes a condenser in the antenna circuit to reduce its wavelength in compliance with the Act of August 13, 1912, would do well to put up a small antenna for transmitting, whose natural period would be low enough to obviate the necessity of using a series condenser. Such a condenser proves a great strain on the transmitting instruments. It not only reduces the efficiency of the transmitter, but the current in the antenna circuit, not finding an easy access through the condenser to the aerial, will go anywhere but there, jumping to the ground through the receiving set if a break-key is used, or kicking back through the transformer, as it very often does, with the usual troublesome results.

As a summary then, a few points to be followed in eliminating kick-back are:

1st. Do not use condensers as kick-back preventers.

2nd. Obtain, if possible, special transformer service from your local power company so that your house service, or better, your wireless service alone, is the only load on the power transformer. Have the transformer placed on the pole nearest your house. This will insure a short power circuit which is easier to protect than one several blocks long, as previously discussed. The cost of such special service is usually not prohibitive by any means.

3rd. Use a low voltage system of transmitting. The Lepel system is easily home-made, as described in previous issues of *Modern Electrics*, and the Clapp-Eastham Hytone is an excellent one on the market.

4th. Use three or four graphite rods, of the type described, throughout the power circuit. By creating several nodes on a short power line, the magnitude of the loops will be so low as to cause no trouble.

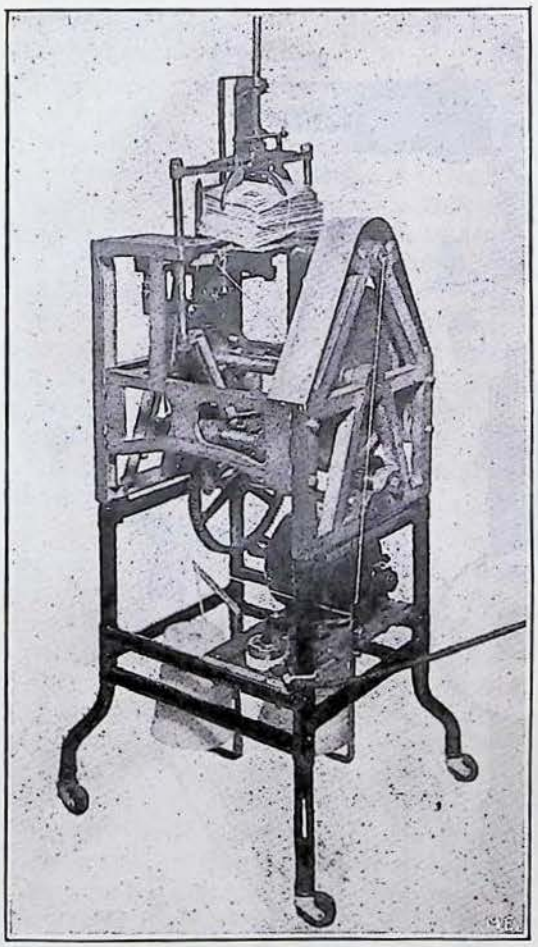
5th. Use metal covered wire in all 60 cycle circuits.

6th. If you are restricted to 200 meters, use a small aerial for transmitting in place of a large one with a series condenser.

A Novel Electric Package Tying Machine

By Frank C. Perkins

THE accompanying illustration shows a novel motor-driven package tying machine designed at Chicago, Ill., that is said to be a great labor saving device. By its employment letters that are sorted in city post offices, are tied up into packages, classified by towns and each bundle marked with its destination.



ELECTRIC PACKAGE TYING MACHINE

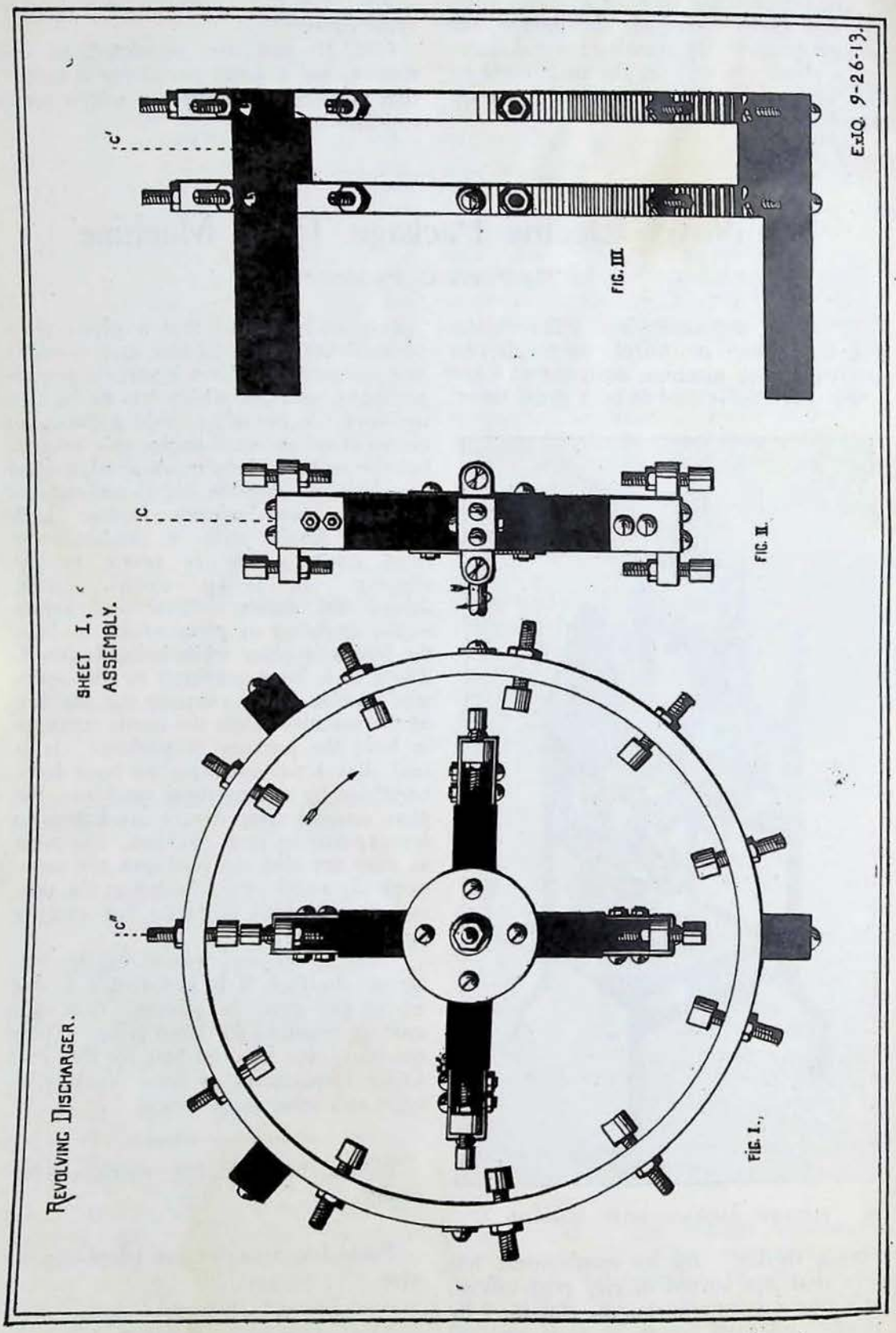
It may be stated that a given piece of mail between post-box and carrier's bag can probably form a part of several packages, each of which has to be tied by hand. It is claimed that a clerk can tie up about six such packages a minute, but the motor-driven machine illustrated herewith is capable of handling 32 packages per minute, tying each package firmly with a double loop, hard knot, which is proof against slipping. A ⅛-h.p. electric motor drives the device. The first action is the applying of compression to hold the letters in place while being fastened. There is a lever actuated by the operator's wrist which controls the starting of the machine while the hands continue to hold the package in position. It is said that 1,500 packages an hour have been tied by one of these machines, the piles ranging from five or six letters to seventy-five in each package. As soon as they are tied the packages are automatically swept into a basket at the side, and the machine is ready for another batch of letters.

There is no cord wasted by the machine. In fact, it is said that a saving of 40 per cent. is effected over the amount required for hand tying. These machines are now on test by the Post Office Department at New York, Chicago and other large offices.

Bolivia has adopted wireless telegraphy.

Pekin has an extensive telephone service.

The suburban system of Paris is being electrified.


EnIQ. 9-26-13.
FIG. III
FIG. II
FIG. I.
SHEET I,
ASSEMBLY.
REVOLVING DISCHARGER.

Construction of the Revolving Discharger of the Non-Synchronous Type

By E. Jay Quinby

ASIDE from the fact that the wireless operator takes pleasure in "copying" a high pitched musical note, it is understood that this type of spark penetrates ether in a state of static turmoil where a rough, low toned spark would be unreadable, if not inaudible. It is, therefore, the ambition of the wireless operator and experimenter to produce a high pitched, penetrating note, emitting from his station. As a quenched spark is not satisfactory on the 60 cycle current supply available in most cases, the revolving type of spark gap has proven the best solution.

Heretofore, it has been deemed necessary to run the revolving spark gap at a terrific speed in order to obtain any kind of a high note, but it is possible to construct a gap of this type which will emit a high note when revolved at a comparatively low speed. The accompanying projections and the following description and directions will enable the experimenter to build a Revolving Discharger, which when run at a speed of say 1,370 r. p. m. will be capable of discharging the condenser over 1,000 times per second, or a frequency equivalent to a 500 cycle current.

LATHE WORK.

The twin rings, one of which is shown on the detail sheet, may each be turned up from brass plate 5/16 inch thick, or it is possible to turn both up at the same time from a plate as much over 5/8 inch thick as the cutting tool will tare. Care should be taken to drill all the holes in these rings radially, which may be done by placing a guide for the drill on the slide-rest of the lathe, and after the rings have been turned down to their greatest diameter (6⅝ inch), and the points on the periphery marked where the holes are to be located, each hole may be drilled in succession by revolving the disc until one of these points faces the hole in the guide, which should be set so as to lead directly towards the center line of the lathe chuck. This work finished and each hole tapped, the work of turning the inside circle may be started. A portion of the stock left over after this operation may be utilized for the two bushings, shown on the detail sheet. The thirty zinc studs may be turned from 36 inches of ¼ inch round stock.

As shown on this sheet, the shaft of the motor to be used as the driver, should be turned down to take the bushings, and threaded for the nut and lock nut which clamp the bushings fast.

FLAT WORK.

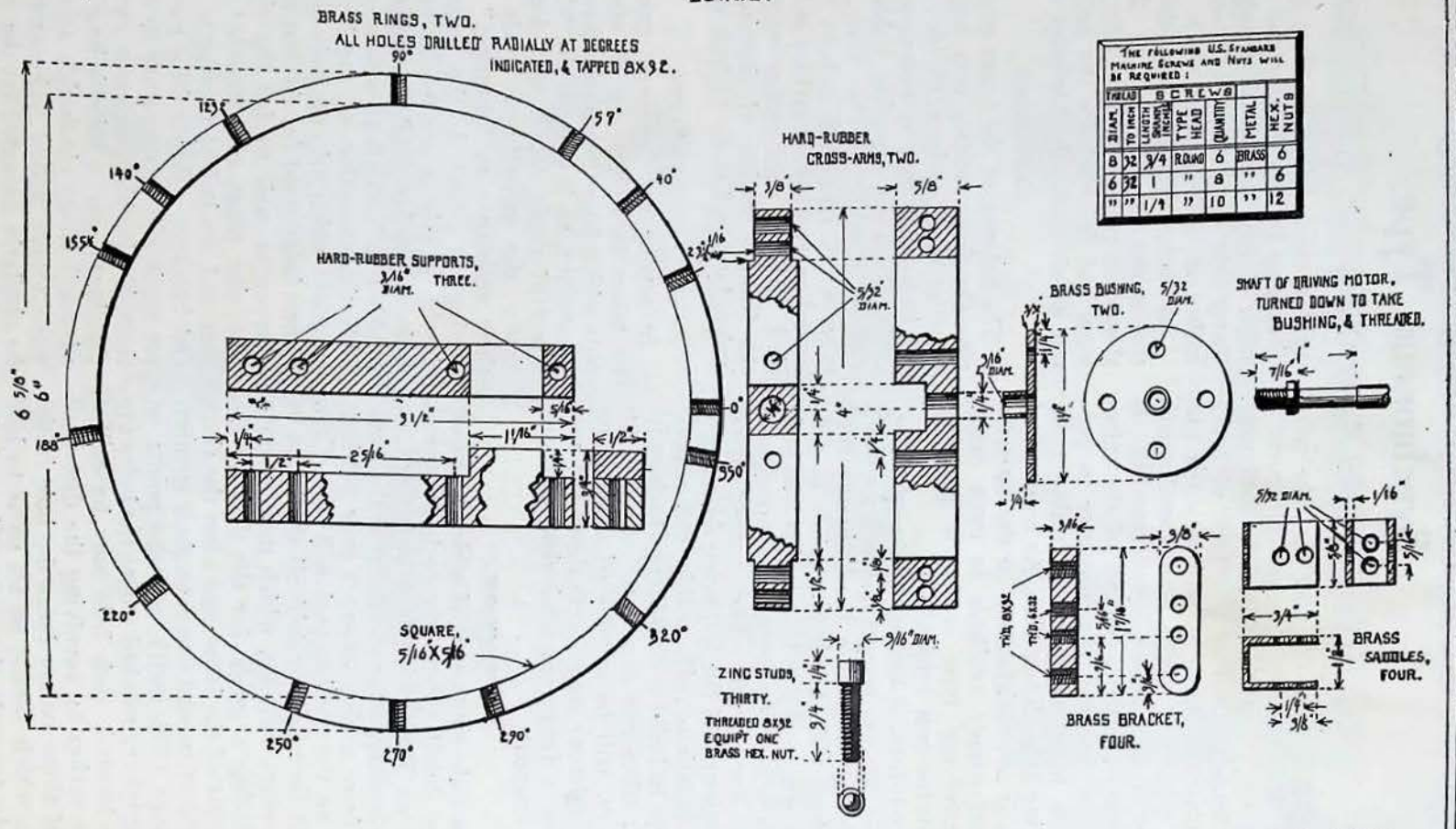
The balance of the brass work is simple—the four saddles may be made by bending brass strip 1/16 inch thick by 5/8 inch wide, and by properly blocking them, the four opposing holes may be drilled correctly. The four brackets may be cut from 3/8 inch by 3/16 inch brass bar, and drilled and tapped as specified. All the hard-rubber work may be cut from a section of sheeting, size 3 inches by 4 inches by ½ inch thick.

ASSEMBLING.

In setting up the rotor, care should be taken to tighten up all screws and nuts which pass through the hard-rubber cross-arms, as it is upon the "clamping" effect of these that it was designed to throw the centrifugal strain—*not* on their resistance to "shearing." By referring to Sheet I, the experimenter should be able to set the instrument up without trouble. All the parts are assembled with the 6-32 screws and nuts, with the exception of the hard-rubber supports which grip the twin rings; 8-32 screws being used for the last mentioned purpose as well as for the zinc studs. The zinc plugs are threaded for 8-32 nuts and are locked thereby to the rings and brackets. When these parts are all set up, it will be necessary to mount the three hard-rubber supports (which hold the rings) upon a suitable base by means of small cleats obtainable at any hardware supply house. The motor should be similarly mounted on the same base, in such a position that the center line of the shaft will coincide with the common center line of the twin rings and so that that rotor when mounted on the

REVOLVING DISCHARGER.

SHEET II.
DETAIL.



THE FOLLOWING U.S. STANDARD MACHINE SCREWS AND NUTS WILL BE REQUIRED:

THREAD		SCREWS				
DIAM.	TO INCH	LENGTH UNDER HEAD	TYPE HEAD	QUANTITY	METAL	HEX. NUTS
8	32	3/4	ROUND	6	BRASS	6
6	32	1	"	8	"	6
"	"	1/4	"	10	"	12

E.J.Q.- 9-26-13.

shaft, will be centered between the two rings.

ADJUSTMENTS.

This much accomplished, the adjustment of the studs should follow. In operation, it will be found that a clearance between the stationary and rotating studs of as little as 1/32 inch is the best. As these studs are slowly burned away, it will be necessary to occasionally readjust those on the rotor as well as—although less frequently—those on the rings.

CONNECTIONS.

The driving motor should be connected to its power supply through a variable resistance and a fused switch. In connecting the high-frequency circuit, the connection to one ring should fall opposite that on the other, in order that the length of leads will not vary.

OPERATION.

Assuming that the transmitting set is ready for operation, when the motor of the revolving discharger is started, and the key depressed, a discharge will apparently take place simultaneously at every zinc stud, although this is an optical illusion. Referring to Sheet I, Fig. I, it will be seen that in the position shown, the discharger in the upper position is furnishing a path for the discharge from the front ring to the imagined ring behind it. As the rotor is revolved in the direction indicated by the arrow, the discharger shown in the right hand position furnishes another path for discharge. Immediately thereafter a discharge appears at the next discharger and the next, etc. It is seen, therefore, that as any point on the rotor moves through 32° of a revolution, four discharges take place. As there are eleven pairs of stationary studs, and each is discharged four times per every revolution of the rotor, 11 x 4 or 44 discharges take place per revolution, and each discharge takes place 98° away from the last; a point to be carefully noted.

As this is a non-synchronous discharger, the note obtained will consist of a chord of three notes, i. e., the predominating note, undertones, and overtones, the latter two varying slightly.[1]

To obtain the most pleasing result, the speed of the driving motor, or if feasible, the voltage supplied to the primary circuit, should be varied, the operator meanwhile "listening in" on the receiver. When the most pleasing note[2] is produced by the discharger, the speed of the driving motor, or the voltage at the primary circuit, should be noted so that either or both may be again obtained at any time.

In conclusion, it may be said that although this discharger was designed for use up to 1 kw., the same principle may be carried out on a larger scale for heavier work, and as long as an *odd* number of stud-pairs on the twin-rings is preserved, their number may be increased, thus producing a higher frequency at the same rotative speed, or the same frequency at a lower rotative speed.

[1] Caused by discharging the condenser at different values resulting from various points on the voltage curve of alternating supply.

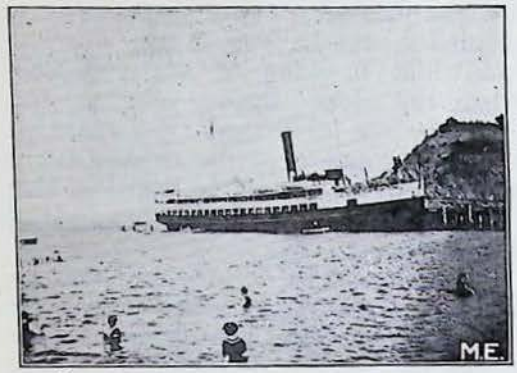
[2] A note consisting of a musical chord, not a discord.

ABANDONING TELEGRAPH LINES IN AFRICA

Wireless telegraphy is interfering with the happiness of natives of Central Africa, for it has deprived them of an unfailing supply of wire to be worked up into ornaments and weapons. Some big mines operated by European capital in Central Africa have recently abandoned their wire-telegraph lines from railroads to the mines, and established communication by wireless. Maintenance of the wire lines has been difficult because of the demand for the wire by native belles, and also because of the occasional wanton destruction of pole lines.—*Electrical World.*

THE INDEPENDENT AMATEUR RELAY ASSOCIATION OF AMERICA

Every wireless club and association in the United States and Canada is requested to communicate with Mr. W. G. Finch, of Cincinnati, whose residence address is 523 Torrence road, East Walnut Hills, for particulars concerning the organization of a relay association whose work will be to establish amateur communication all over the United States and to be of valuable assistance in emergency times. He also suggests the following name for the coming association, "The Independent Amateur Relay Association of America."



THE STEAMER CABRILLO

THE BAY AT AVALON

The Radio Station at Avalon

By Stanley E. Hyde

WAY down in Southern California, twenty-eight miles off the coast, lies Catalina Island, or as it is more often called, "The Emerald Isle." It well deserves this name for here nature in all her grandeur has been left unsullied by the hand of man, and the water there is the clearest in the world. Tourists come from all parts of the country to see the wonderful submarine gardens and to enjoy the exciting sport of catching the "Leaping Tuna," a very gamey fish that will fight to the finish.

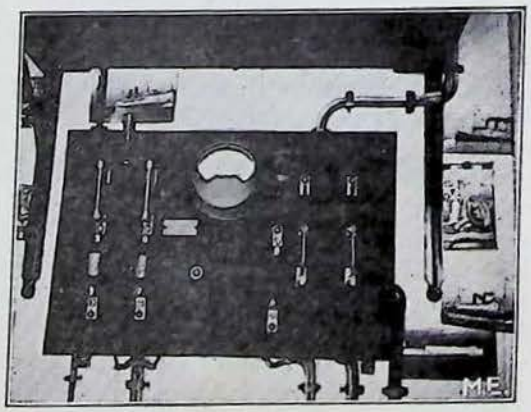
On the southern part of the Emerald Isle lies the little town of Avalon situated on the edge of a bay that is of semicircle shape. The shore of Avalon faces the mainland hence the waters of the bay are as peaceful as any small lake most of the time.

Many years ago when the town was first founded they tried to lay a submarine cable from Avalon to the mainland, but the water is so deep in certain places that the strain of the cable, as it bridged these submarine chasms, was great enough to make it part and the attempt was abandoned.

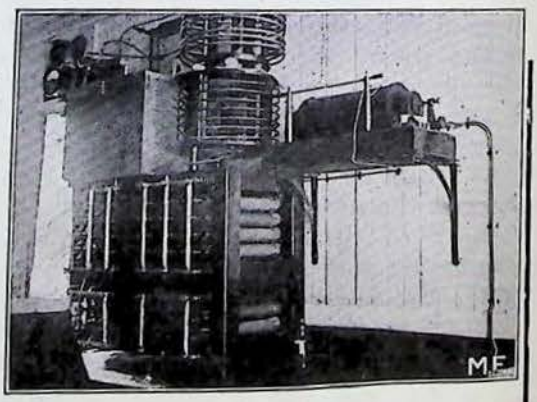
Not so long ago the United Wireless Company installed a station on the hill back of the town to work with their station on the mainland at East San Pedro. This station will long be remembered by all wireless enthusiasts along the California coast for the spark had a peculiar varying pitch of its own.

When the United Wireless Company was taken over by the Marconi Company the station was moved from the hill down into the town, where it is now situated, on the water's edge. The installation is a 2 kw. affair with a rotating spark. The

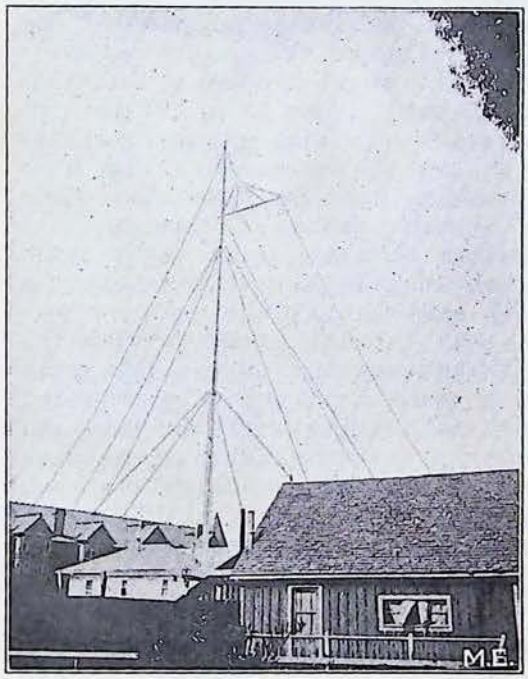
SWITCHBOARD OF RADIO STATION



THE TRANSMITTING APPARATUS



tubes shown in the rack are leyden jars of a somewhat different pattern than is usually found in stations of this type. They are copper plated both inside and out. On top of the condenser is shown the loading coil and oscillation transformer. In the box, to the left of the transformer, is the rotating gap operated by a small induction motor. Most of the time the current for the transmitter is obtained from the lighting system at a frequency of 80 cycles, but in case anything happens to the lighting power plant,



WIRELESS STATION AND AERIAL

resource can be had to a small alternator run by a gasoline engine, situated in the back of the operating room. In case this should get out of order there is provided a 10-inch induction coil fed by storage batteries, the same being on the wall to the right. This coil is controlled by the small switchboard, which has on it a double-pole, double-throw switch for changing the sending key from the regular set to the coil, fuses, double-pole switch for charging the batteries and a volt-meter.

For receiving, the ordinary loose coupled tuner is employed. The antenna slopes down from a 150 foot pole to a small pole back of the station, the distance being about 100 yards.

The station is open for public use and does a large amount of business in the summer months. In the winter Avalon is practically deserted.

Plying between Avalon and the mainland are two small steamers, both of which are equipped with wireless telegraph. These are the *Hermosa* and the *Cabrillo,* the one shown in the accompanying illustration being the *Cabrillo,* a description of whose set was given in this magazine some time ago under the title of "The Average Ship's Set."

Hitherto inexperienced operators applying for a position with the Marconi Company are given a job on either of these two steamers where they get "broken in," and are then transferred to other ships on the Pacific Coast. A position on either one of these steamers is a "cinch" as the trip takes two hours and after docking the operator can "bum around" or go swimming or do anything else he pleases, for three hours, until the boat sails for the mainland again.

ELECTRIC WAVES FROM THUNDER STORMS

It is reported from Hungary that there has been invented an electric apparatus for recording distant thunderstorms. An electric wave, set in motion by a flash of lightning, is registered by a detector resembling in its action that used in the Marconi telegraph system. The impulse is communicated to a pen connected with a disk moved by clockwork, and when the pen makes its record a bell is rung whose vibration resets the coherer. Storms raging invisibly twenty miles away are, it is said, thus recorded, and one occasion, it is added, on a bright day, the apparatus made known the prevalence of a violent storm in Budapest, sixty-eight miles distant.

THE OKLAHOMA STATE WIRELESS ASSOCIATION

The Oklahoma State Wireless Association has accepted the resignation of George Sutton, Box 627, Tahlequah, Okla., and has elected John Stausel, Box 143, Muskogee, Oklahoma, as secretary. All other officers remain the same.

Address Secretary, John Stausel, Box 143, Muskogee, Okla.

High Frequency Wireless Transmitters

By E. C. Graveley

THE so-called "low frequencies" were employed with success in radio communication since its inception. They have been used ever since and will probably be employed for a number of years to come. Although termed "low frequencies," such waves are in reality composed of a number of groups of very high frequency waves, as shown in Fig. 1.

The frequency of the waves in these groups may be several million per second, which is too great to be heard by the human ear, while the number of groups may be as low as sixty a second or less, which are very easily


FIG. 1

heard and sound like a buzz. A similar action takes place when a bell rings, as for instance, the bell of a clock. Here many hundred waves are sent out from the bell at each stroke. But when we want to know the time we only notice the number of groups, which correspond to the number of strokes of the hammer. Similarly, when the hammer of the induction coil breaks the circuit many hundreds of thousands of waves are sent out in a second, but the ear records only the group, which we hear as a click in the receivers. Now the hammer on the interrupter breaks the circuit many times a second, so that the corresponding clicks in the receivers sound like the familiar buzz, known to all who have "listened-in" at a wireless station. Sets emitting such waves as have just been described were used with satisfaction for a number of years and are still used.

As the use of the low frequency sets increased, however, a number of faults were found with their use. All stations caused nearly the same sound at the receiving station, making it very difficult to distinguish the signals of one from another. Static mixed in with the incoming signals to such an extent that these sets were worthless in the tropics and during lightning storms; the same set would not work as far over land as over sea, and its range was greatly affected by daylight; in fact, a set which had worked 1,800 miles during the night would often be unable to communicate 300 miles during the following day. The range of the set greatly fell off during the summer, and it was impossible to produce a pure wave.*

Prof. R. A. Fessenden studied the subject of radio telegraphy scientifically and brought it down to a mathematical basis. Thanks to his work in the field, we are able to make many of the following statements. The high frequencies used by Fessenden make the signals clear and musical, and therefore they are more easily read. Signals of a high note may also be easily read through the ordinary signals and through static. With the high frequency sets there is less noise and a pure wave may be produced which aids tuning. But the principal advantage is the reliability of the service between high frequency stations; the range being practically constant during all conditions, and less power is required for their operation.

We know that in operating a set the sending condensers are charged to a point where the charge breaks through the air in the gap in order to equalize the charges on the opposite plates. The condenser then charges itself in the opposite direction and again jumps

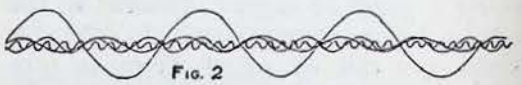


FIG. 2

across the gap (in the opposite direction), the current oscillating back and forth many million times per second; the frequency of these oscillations depending upon the electrical length of the circuit, i. e., its capacity and inductance. Each time the pressure is less and less, till the oscillations finally die out, as a pendulum stops swinging. After the first discharge across the

* When a wireless set is in operation a number of waves of different length are emitted; when none of the lesser waves is over one-tenth of the greater a pure wave is said to be emitted.

gap the air which had insulated the two plates of the condenser becomes a conductor, short circuiting the condenser, and allows the energy which has been stored up in it to dissipate itself in a very few oscillations.

Several methods have been invented to produce high frequency undamped oscillations. Fessenden uses the rotary gap. This device usually consists of a number of electrodes mounted on the circumference of a disk which is revolved at a high speed. The disk revolves between stationary electrodes in such a manner that the revolving electrodes approach the stationary ones, shortening the distance between them and allowing the condensers to discharge once; the gap then immediately widens so that the rest of the energy stored in the condensers is not dissipated, but kept, in order that only a little more energy is needed for the next discharge. It has been found that the best frequencies to use are between 500 and 600, since below 500 the note is too low and the useful properties are lost, while above 600 the note gradually becomes too high to be read, until at 10,000 we are unable to hear it at all.

Several methods have been invented to produce these oscillations. Fessenden insures his results by placing the disk on the shaft of the generator and arranging the studs on the disk to correspond with the frequency of the machine, so that the gap is closed at the moment when the generator (through the transformer) has just charged the condenser to its full capacity. In this way *one* oscillation is obtained for each half cycle of the generator, the stationary studs being movable, so that the sparks may be made to jump when the revolving studs are approaching, or when they are moving away from the stationary ones. This method works very successfully—especially in the tropics where static is very heavy—and is considered by many to be the most perfect system used.

Another system of producing high frequency undamped oscillations is by means of the quenched gap. No reliable theory has been formed as to the working of this gap, but it produces high frequency undamped oscillations and radiates a great deal of energy. It is constructed by forming a pile of metal disks, each being separated from its neighbor by a ring of rubber, mica, or other insulating material and the whole clamped together so as to make the gap air-tight. With large gaps a fan is used to keep the discs cool, for otherwise it would get hot, an arc would form, and practically no radiation would result. This gap is used to a great extent in Germany and on all Hamburg-American ships and works in some respects better than the rotary gap, but the note produced by it is not so clear, while the gap requires frequent cleaning and renewal of the insulating rings.

Another way of producing undamped oscillations is by use of the direct current arc, which was brought to its present stage of usefulness by V. Poulson, of Copenhagen, Denmark. In this system an arc is connected in

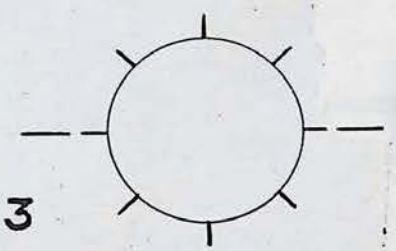


FIG. 3

series with some reactance—electromagnets, for instance—across the terminals of a direct current generator. The arc is formed in a magnetic field and in a chamber filled with coal gas, the capacity and inductance being connected across the arc. Here continuous oscillations take place across the arc—the oscillations being kept from going through the generator by means of the reactance coils, which offer very little resistance to the direct current, but choke out the alternating currents. With this system the condensers are periodically charged and discharged as many as 1,000,000 times per second. It is claimed that waves emitted from stations equipped with this system travel much further than those sent out from other stations. However, the frequency is too high to be heard. In order to overcome this difficulty, Poulson reduces the frequency at the receiving station to an audible note. This system is said to work exceedingly well and good results may be

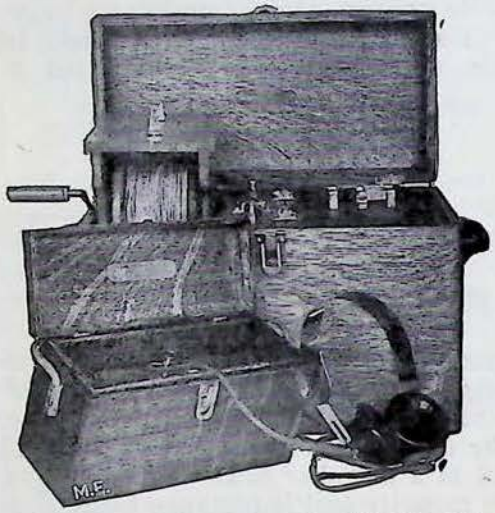
(*Continued on page 992*)

Locating Water Pipes by Electricity

By Frank C. Perkins

IT is stated that the District of Columbia has been saved a considerable amount of money as the result of an electric invention for locating underground pipes, according to the report of George W. Wallace, water register of the District, recently submitted to the Commissioners.

By the use of the electric current, a method has been devised by E. H. Grove of the Water Register's office, by which the line of pipe and the tap in the main can be located, thus avoiding unnecessary excavation and the cutting of improved surfaces in roadways and sidewalks.



ELECTRICAL APPARATUS FOR LOCATING WATER PIPES

It is held that this electric instrument more than paid for itself in the first few jobs in which it was used, which proves it to be invaluable for such work. The report states that 2,582 new service connections and 5,036 repairs were made during the year and sixty-six meters were disconnected, making the total number now in use, 23,912. Over 1,973 repairs to water services and appurtenances were inspected and recorded during the year.

It is pointed out that one of the most important products of modern civilization, which tends to improve the health and add to the convenience of mankind, is the system of water distribution, which is a part of the public service of every community of any size whatsoever.

It is true that the increased wealth of the world in general and the advanced knowledge of domestic engineering have put a water supply system within the reach of even the smaller villages. Hardly second in importance to this are the systems of gas and electric distribution. In fact, these two cover almost as large an area in their distribution as do the water supply systems. This at once pictures to us the fact that present day cities are underlaid with a vast network of pipes and conduits.

It is necessary for the construction and maintenance of these systems to maintain an organization capable of properly keeping things in repair and adding to the existing system as the growth of the community demands it. Even in the best regulated organizations of this kind there often occur errors or omissions in the plans showing locations of conduits or pipes. Furthermore, the abandonment of long used conduits or pipes or the improving of streets by widening may result in what are known among engineers as "lost pipes."

It is clear that if for any reason it becomes necessary to locate any of these "lost pipes" the usual method in the past has been to excavate in the approximate locality of the pipe, removing earth, concrete, brick, stone or other material. In most cases, this is time wasted, as the pipe is not located and it is necessary to do further excavating. When one considers the numerous cases of this kind which come up in the course of a year it can readily be seen that there is an enormous amount of money and time practically thrown away.

During the past year this electric device for accurately locating these pipes has been perfected. This instrument was used in over 1,600 cases and in each one the desired pipe was located without any cost except the time used in operating the instrument.

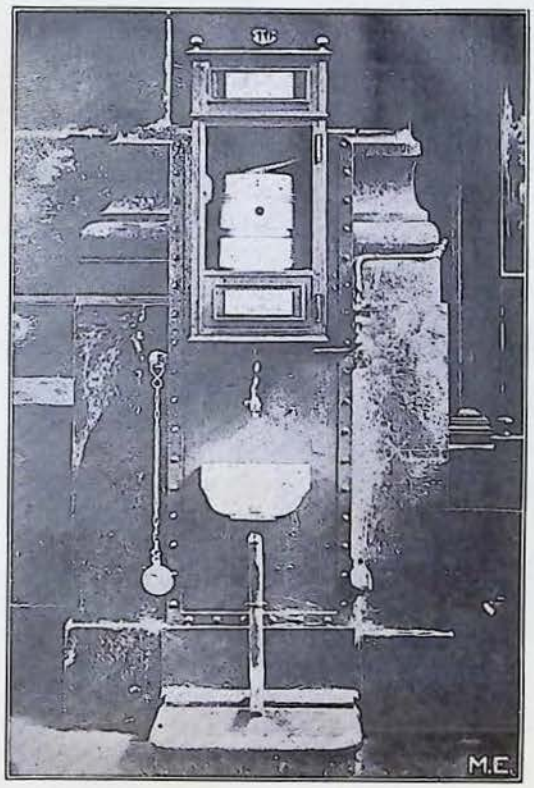
This electric indicator consists of two

(*Continued on page* 996)

An Electric Sterilizer for Water

MANY problems of modern hygiene are solved by the use of perfectly sterile water, and in this use it is often desired to keep the natural taste of the water and retain the salts and gases which are found in solution in the water. While boiling will kill the disease germs, it gives a disagreeable and flat taste which is disliked by most persons.

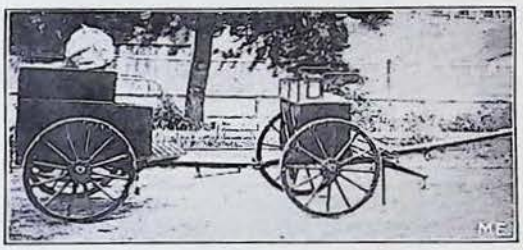
A new Paris apparatus is claimed to



A DRINKING FOUNTAIN WITH ELECTRIC STERILIZER EQUIPMENT

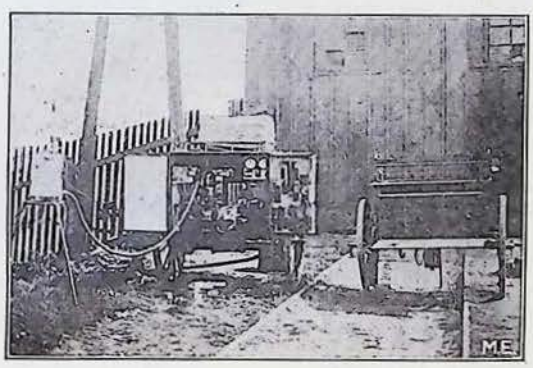
solve the problem of perfectly pure water—free from all disease germs for household use, public schools or other institutions. It also serves in industries such as breweries and the like, and is commencing to be used there with great success. The apparatus works on the property which the mercury vapor lamp possesses of destroying the microbes when immersed in water, owing to the powerful effect of the ultra-violet rays which scientists commenced to notice a few years ago.

The apparatus comprises a neat white enameled tank which is mounted on a wall and connected to the water mains. A small switchboard is used so as to control electric wiring which is connected to the lamp placed inside the tank. All the rest is automatic, and the house-



PORTABLE ELECTRIC STERILIZER FOR ARMIES

holder simply turns the outlet faucet so as to have a stream of sterilized water. Official tests show that such water is extremely pure and free from any disease germs. As the current is cut off automatically when no water is flowing, there



GENERATING APPARATUS OF ARMY STERILIZER PLANT

is no great expense for the current.—*Our Paris Correspondent.*

OFF THE ELECTRIC WIRE

The steam roads in and about Bombay, India, are considering electrification.

Chattanooga, Tenn., is installing a system of ornamental street lighting in its business section.

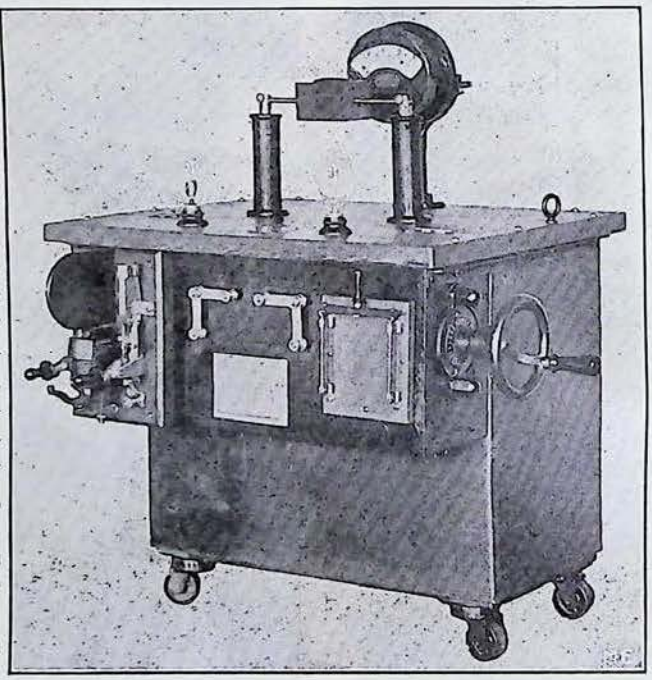
The city of St. Louis is replacing many of its gas "arcs" with high candlepower tungsten electric lamps.

New High Voltage Testing Transformers

By H. Winfield Secor, E. E.

THERE are many commercial industries using or producing materials which must possess high dielectric strength. In order to determine the insulating values of such materials, it becomes necessary to apply a high potential electric current to these dielectrics in the actual testing of them. The photographs and diagrams presented herewith illustrate some newly developed testing transformers built by a leading American transformer manufacturer and representing the very latest practice in this class of electrical apparatus.

In one of the illustrations is shown the general appearance of the smaller testing set, comprising a special step-up transformer operating on 110 or 220 volts A. C., 60-cycle circuit. This is known as the Type TS-2 set, and the maximum secondary potential is 5,000 volts.



Courtesy American Transformer Co.

A 50,000 VOLT TRANSFORMER AND TESTING OUTFIT

The complete equipment includes, besides the step-up transformer, a high reading voltmeter for the secondary circuit, a variable resistance of the potentiometer type for regulating the primary applied voltage and consequently the secondary potential, and a circuit breaker and pilot lamp in the primary side.

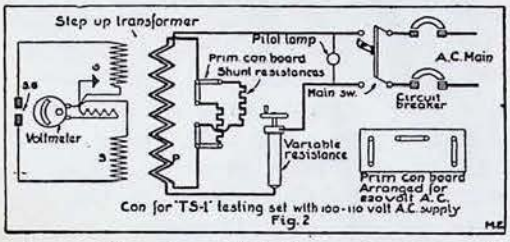
The step-up transformer is very ruggedly constructed and is air insulated. It has a capacity of 2 KVA. continuous service and 5 KVA. for five minutes, and can be operated at any frequency between 50 and 125 cycles.

The variable resistance in the primary circuit, which controls the secondary delivered voltage, is of the potentiometer type. This resistance consists of a fixed shunt unit and a variable series unit, arranged as in the schematic diagram. The shunt resistance is composed of a number of metallic resistor units, connected across the low tension terminals of the testing transformer. The minimum amount of shunt resistance has been carefully determined to prevent wave distortion, from a series of laboratory experiments. The terminals of this resistance are brought out to a connection board, in such a way that they may be entirely disconnected from the circuit if desired. The variable series resistance is of the compression type, operated by a hand-wheel by means of which a smooth gradual variation of secondary potential may readily be obtained.

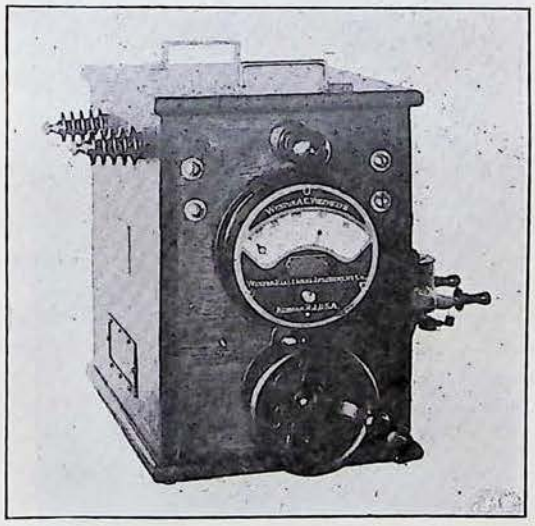
Noteworthy features of this method of voltage regulation are the absolutely smooth potential variation, which cannot be accomplished with any form of metallic resistance, operated in steps by a dial switch, and the absence of the disagreeable characteristics which usually accompany liquid rheostats.

The voltmeter provided with this outfit is really a low potential instrument and is connected to a secondary coil or winding of its own, as will be seen from the diagram. The voltmeter coil is built right into the transformer and has

a definite ratio to the high tension winding proper. Hence, when the secondary potential is at its highest value, the voltmeter coil has induced in itself one-five-hundredth of the actual secondary potential, etc. The voltmeter scale is usually calibrated to read the actual secondary volts, which saves considerable time and is very convenient and simple in operation.



A small ruby pilot lamp is connected across the primary mains, which serves to remind the operator that the transformer is excited, and it also is a simple and positive indicator of blown fuses. A regular type overload circuit breaker is placed in the primary side of the set and can readily be adjusted to open at the instant of the break-down of the insulation under test, or for higher current values if necessary, for obtaining more of a burn at the point of break-down in the insulation for the purpose of identification. These transformers are furnished in larger sizes and voltages, one standard large unit being rated at 50 KVA. and 300,000 volts, and some are even furnished to deliver as high as 500,000 volts.



Courtesy American Transformer Co.
A 5,000 VOLT TESTING TRANSFORMER

The foregoing description of the 5,000 volt testing set applies in general to the larger 50,000 volt testing outfit, also illustrated. In the diagram are shown the connections for this 50,000 volt set, and it will be noted on studying them that the centre of the high tension winding is grounded to the metallic case of the transformer, to protect the operator in handling the voltmeter, etc. The voltmeter coil is also grounded to minimize any leak currents which might become dangerous to the operator. This higher potential transformer is oil-insulated, and is mounted on a very substantial truck provided with castors, making it easily portable about the factory.

Special electrodes are supplied with these testing sets for determining the ultimate dielectric strength or break-down point of various insulators, such as oil, etc. These electrodes are threaded metallic rods and permit of adjusting the spark gap very minutely. The plain open spark gap electrodes are fitted with a micrometer adjustment.

Y. M. C. A. RADIO CLUB OF RACINE

Wireless enthusiasts in and around Racine, Wis., have organized the "Y. M. C. A. Radio Club of Racine," with the following officers: Milhart F. Klicpera, president; Leland H. Hansen, vice-president and examining officer; Edward Rapps, secretary-treasurer, and Harold Jorgenson, sergeant-at-arms.

This club has been organized for the purpose of furthering the knowledge of radio telegraphy and telephony in all its members. Any person may become a member provided he is twelve years of age or over, and providing that he passes the entrance examination.

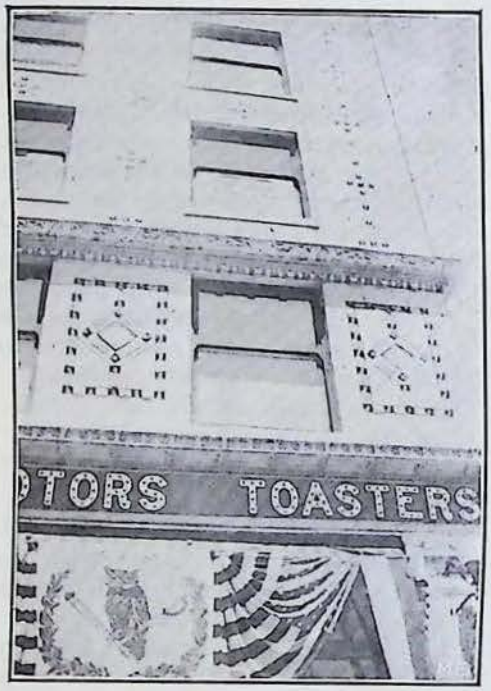
KENTUCKY RADIO ASSOCIATION

Any amateur or amateurs living in Lexington, Ky., who operate radio apparatus are asked to join the Experimental Relay Club of Ohio, Indiana and Kentucky, to make radio communication successful between the above-named states, and we desire several residents of Lexington to join us. For further information, address W. G. Finch, secretary, 1214 Jackson street, Cincinnati, Ohio.

The Best Illuminated City in America

By Felix J. Koch

NO, it isn't Christmas shopping time in Denver, nor is there a convention on; neither are the citizens holding forth an exposition, to invite any and all, from all corners of earth, to come and marvel. It is just any one of the



ARRANGEMENT OF ELECTRIC LAMPS IN WALL

nights of the week of any of the fifty-two constituting a year you may choose, in Denver, Colorado.

Light! Of course it is light! Even daylight, measured by those subtle units that the scientists use, could hardly come up to it—especially if you took the measurements on the square or two where the motion picture theatres are clustered.

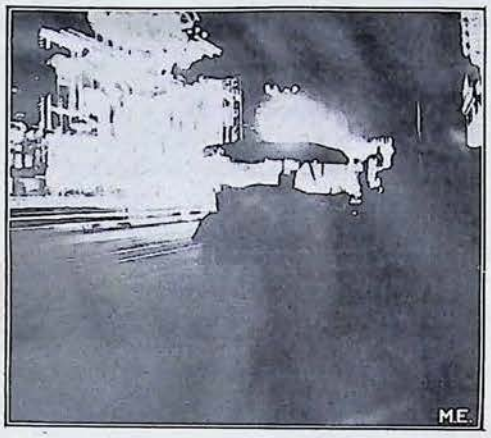
More than that, "Seeing Denver" by electric light is quite as much a thing for the tourist to do as it is to visit the Zoo, or stop for a session in Judge Lindsay's Court and the like. Accordingly, after the banquet, or long after the theatre, the stranger within the city gates can stroll those splendid streets, just to see electric illumination at its best.

Buildings ranging from tiny motion picture theatres to sky-scrapers are veritably outlined by electric lights. Towering over everything else is the People's Gas Building. That building is not outlined in light—it is one livid sheet of light, punctuated with intervals of dark spaces that only serve to make the illumination more pronounced. Down on the ground floor there is a store for the sale of devices intended to boost the use of gas and of electricity, and few stores in all the world are so absolutely flooded with radiance at night as this. Continue on through the illuminated section and one finds things everywhere as light as day. Not Eastertime in Paris nor even Coronation Week in London, nor a Saturday night on New York's "Gay White Way" is an equal to Denver.

NIGHT VIEW OF THE PEOPLE'S GAS BUILDING

Wherever one looks, though, it seems as though the structure of the lighting company itself takes first place for illumination. It is a ten-story building and

it is claimed that the thirteen thousand lights upon its walls are illuminated every evening. That gives some faint idea of the amount of electric force the Colorado capital requires nightly. In addition there are other electric power consuming equipments, such as electric cars. Two hundred and fifty-seven



NIGHT SCENE OF A ROW OF MOTION PICTURE THEATRES

miles of track are covered by 300 cars every day. What adds to the beauty of the whole People's Gas Building is the neat arrangement for lighting. The lights each rest in a little niche, deep in the wall, being protected thus from wind and weather. These niches, in turn, punctuate a pattern which is, primarily, a quadrilateral. From the center of each side of this prolonged square a line runs in and these lines from the four sides then grasp an enclosed diamond. Patterns of this sort, then, alternate with the lower row of windows on the floor just over the store-space.

Upper stories indulge in a simpler but tasty pattern—a squared cross—that repeats itself sufficiently to throw all the space about into light and fairly dazzle the eyes of the beholder.

AUTO DRIVER'S HANDS WARMED ELECTRICALLY

By Frank C. Perkins.

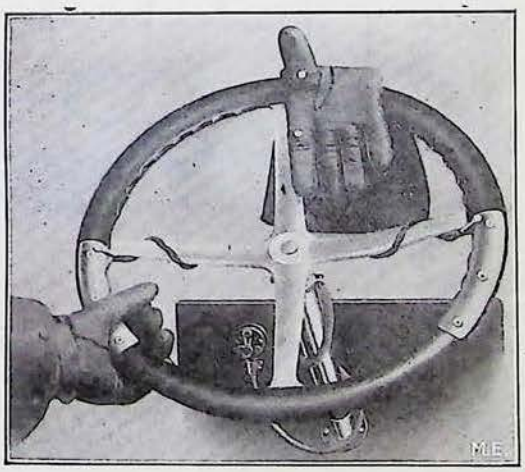
THE accompanying illustration shows an unique scheme of electrically warming the hands of the automobile driver in very cold weather. This electric glove actually carries in itself the warming element and does not depend on the blood heat of the hand to fulfill its mission. It will undoubtedly be hailed by the winter motorist as answering a pressing need.

There is incorporated in the lining of this novel automobile gauntlet a very tough and flexible electrical circuit which terminates on the inner surface of the forefinger in a small disk and at the other end in a similar disk on the inner side of the thumb.

It may be stated that the contact of these disks with metal plates on the upper and under surfaces of the steering wheel when the hand grasps the wheel in steering, closes the circuit and allows the current to flow through the glove lining, thus heating the resistance windings and warming the back of the hand and all of the fingers.

It will be noted that there are metal plates on the surface of the steering wheel which constitute the terminals of another circuit leading from the storage system which lights the car. A 6-volt battery is sufficient to furnish the warmth desired and a current regulator admits of three varying degrees of warmth.

It is pointed out that these electric gloves will immeasurably add to the comfort as well as personal safety of the



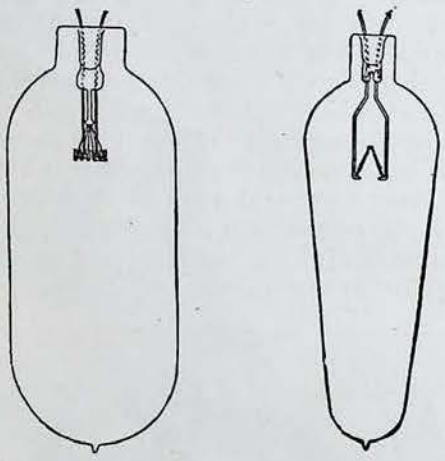
ELECTRICALLY HEATED CHAUFFEUR'S GLOVES

driver in the control of his car by keeping his hands from becoming numb with cold in severe climates.

Sending pictures by wire is nothing new in Germany and France and now they are talking of cabling them across the Atlantic.

The Nitrogen-Filled High-Efficiency Tungsten Lamp

BEFORE the meeting of the American Institute of Electrical Engineers held in New York City, October 10, Dr. Irving Langmuir, Schenectady, N. Y., described the development and present status of the new nitrogen-filled tungsten incandescent lamp, presenting two closely related papers which President C. O. Mailloux in his introduction characterized as marking an epoch in electrical history and electrical progress. The first paper discussed the phenomenon of blackening in tungsten lamps and methods of preventing it. The second, prepared in collaboration with Mr. J. A. Orange, described in detail



Courtesy "Electrical World"

TWO FORMS OF NITROGEN-FILLED LAMPS

the high-efficiency tungsten lamps which have been produced by filling the bulbs with nitrogen vapor at about atmospheric pressure.

The modern tungsten lamp, as pointed out by Dr. Irving Langmuir in the first paper, has an absolute luminous efficiency of but 6 to 10 per cent. based on perfect white-light production at 0.10 watt per candlepower, and monochromatic yellow-green production at 0.06 watts per candlepower. Tungsten lamps of to-day fail not by breaking of the filament, but by reduction in light-giving value due to blackening of the inner globe surface. With attempts to increase efficiency of lamp operation, this blackening process has been found to be greatly accelerated, thus heretofore placing a limit on the consumption efficiencies obtainable consistent with reasonable lamp life.

Such blackening has generally been attributed to disintegration of the filament caused by traces of residual gas in the bulb, although in the case of lamps run at over-voltage evaporation of the filament was assigned as the cause. From analysis of possible sources of gas within lamp bulbs, the following gases were found by the investigators: water vapor, carbon dioxide, carbon monoxide, hydrogen, nitrogen and hydrocarbon vapors. Further tests sho[illegible] that water vapor is the only gas [illegible] produces perceptible blackening. Its part in this cyclic process is that of a carrier, the water oxidizing the tungsten and being itself reduced to atomic hydrogen. The tungsten oxide meanwhile becomes volatilized and deposits on the glass bulb, where it is reduced by the atomic hydrogen back to metallic hydrogen with the formation of water vapor again.

But attempts to reduce the quantity of water vapor have resulted in failure, so that the author's conclusion is that while water vapor reduces the life of poorly exhausted lamps, it can be nothing else than pure evaporation of the filament at high temperature, which produces blackening in the case of well-exhausted bulbs. To prevent such blackening, due to evaporation, two methods are available; (1) to reduce the rate of evaporation by introducing into the bulb at atmospheric pressures such gases as nitrogen and mercury vapor, and (2) to change the location of the deposits by means of convection currents in gases inside the bulb, so that the glass opposite the filament will not darken. At atmospheric pressure this localized darkening effect of the convection currents in the gas becomes very striking, the globe on a level with the filament remaining perfectly clear, while a dark deposit gradually forms on the parts directly above the filament. Thus the introduction of an inert gas into the bulb at atmospheric pressure not only decreases the rate of

(*Continued on page* 1000)

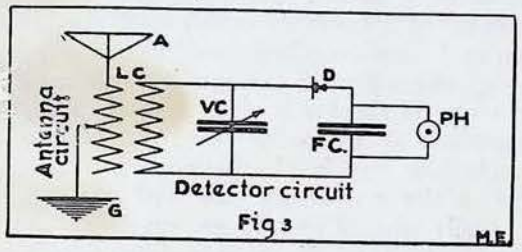
The Electrical Power Losses Occurring in Radio-Telegraphic Sets, Their Determination and Prevention

By Julius Weinberger

PART II

THE RECEIVING SET:

Having considered the power losses that may take place in a sending set, we turn to those that may occur in a receiving set. In the latter case the conservation of the received power is all the more important, as this is very small and very easily wasted. Good connections and



low resistance of wiring are of prime importance, while losses through brush discharge and high voltage leakage are non-existent and hence do not have to be provided for. On the other hand, induction losses through "dead end" effects and induction in neighboring conductors (especially in "portable" sets) may cause a high degree of inefficiency; while, lastly, the kind of antenna used for receiving purposes (whether strongly radiative or the contrary) becomes a large factor in the set's efficiency.

We will take, as our typical receiving set, that shown in Fig. 3, and consider the apparatus from left to right.

(1.) ANTENNA:

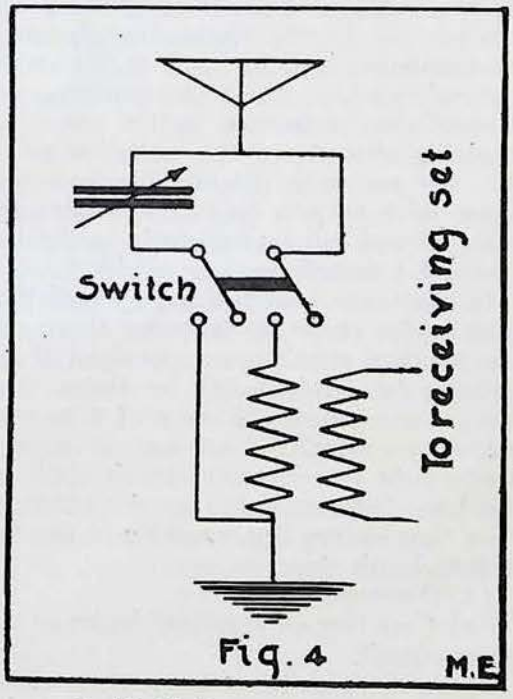
That a good sending antenna is often a poor receiving antenna may have been noticed by some of my readers, though the reason is probably unknown to them. Any antenna radiates energy to a greater or less degree. This energy may be put into it by a sending set, or by an electric wave (sent out from some other set) striking it—that is, the antenna being used in the former case for sending and in the latter for receiving. This energy is to be dissipated in some way and we have two ways of satisfactorily doing it:

(1) We may dissipate it as radiated power, as we endeavor to do purely in sending, or,

(2) We may use it up in a coupled circuit, for example, to create a telephonic sound, as we try to do purely in receiving.

It will be noted that we state that the energy is to be used *purely* in some particular way. But a vibrating antenna tends to do both these things at once. Since the degree to which an antenna radiates can be controlled, and since we desire an antenna for reception which transfers as much as possible of the received energy over into a detector circuit, we must possess an antenna which radiates very little.

Such an antenna would be one of low vertical height and long horizontal length (*i. e.*, of large end capacity). It is therefore recommended, for those who possess only receiving sets, that they do not



try to build high antennae (*i. e.*, 50 to 150 feet) with short horizontal lengths, but rather use low antennae (*i. e.*, 20-50 feet) with long horizontal parts. Other advantages of long, low antennae for reception are that they intercept more wave front of the incoming wave (thereby being able to draw more energy) and

that practically most of the long distance reception is done on those waves which are near the earth's surface.

If the same antenna is used for both sending and receiving the amateur will have to choose between a good sending (strongly radiative) antenna and a good receiving (weakly radiative) antenna. Both cannot efficiently be combined into one.

For this reason, the modern practice

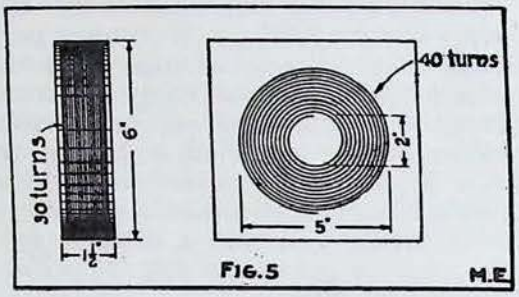


FIG. 5 M.E.

of building long distance stations consists in building the receiving and sending stations separately and a considerable distance apart. Each branch of the station has its own antenna and this is especially designed for the particular use it is put to. In this way a strongly radiative antenna may be used at the sending end, while a maximum efficiency of transmission is secured by the use of a receiving antenna of low radiative power. By properly placing the two antenna with respect to one another and using directional types (such as the inverted L) interference is avoided.

In conjunction with a poorly radiative antenna for receiving purposes there exists another requirement obtained theoretically by Rudenberg; he states that for the maximum efficiency of a receiving set to exist, the amount of energy used up in the detector circuit shall be equal to that reradiated by the antenna. Now, our energy consumption in the detector circuit depends upon

(1) Detector resistance

(2) Coupling of detector circuit to antenna circuit.

Thus, to vary the energy consumption it is necessary for us to vary our detector resistance and our coupling for every incoming message. The former may be done by an adjustable contact on a very low resistance crystal (or by the use of an audion under variable conditions) and by the use of a loose coupled set.

(2) TUNING OR COUPLING COILS:

In ordinary amateur sets the coupling coils which connect the detector and antenna circuits are usually a source of considerable loss of power due to poor basic design or faulty construction. First of all, *no sliding contacts* should be used. They are of high resistance, gather dirt, and cause short circuits between turns by grinding metal dust into the interstices. If the reader desires to tune by varying the inductance of the primary of his coupling coils, it is far better to obtain this variation by the use of a variometer, preferably of the Rendahl type. It is best of all, however, to tune by means of a variable condenser, shunting around the coupling coil primary for long waves and in series with it for short waves, as shown in Fig. [illegible] keeping the number of turns of wire in the coils quite low (30 in the primary and about 60 on the secondary coil will suffice).

Coils *should not* be cut upon into sections and taps taken to a rotary switch, for the purpose of varying inductance. This very common practice is a sure method for incurring "dead end" loss, with a considerable weakening of the incoming energy. In considering the "sending set" I showed how induction takes place between parts of the set and neighboring metal objects. In a sectioned coil we have the same state of affairs—a part of the coil in use, and the rest of the coil (the "dead end") immediately beside this part. Induction takes place easily in the unused part (especially if by reason of its distributed capacity its

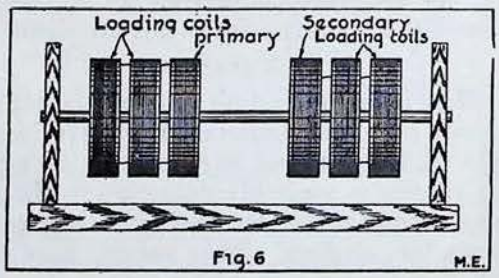


Fig. 6 M.E.

natural wave length may be somewhere near that of the incoming wave) and all the energy used up by it is lost to the detector. Hence, for a stepwise variation of inductance wind your coils on *separate* short tubes or in flat spirals, making up a number of units of equal size and turns. Place connecting clips on each unit and when more inductance is desired than you have on a single unit

place one in back of another and snap the connecting clips in place. Such units should be used in conjunction with a variable condenser in the connection shown in Fig. 4. Their size and number of turns are arbitrary, but a good unit, in my opinion, would be that shown in Fig. 5.

Secondly, what was previously said of the sending set on high frequency resistance holds also for the receiving set. Wiring here should be of stranded lamp or telephone cord and it is recommended that all inductances be wound with such wire. The *form* in which the latter are wound should preferably be of the "flat spiral" type. This is much simpler in construction and far more compact than the cylindrical form. It requires no machine work on the lathe, the winding of wire is not nearly as troublesome as winding the cylinders, and if stranded wire is used, as it should be, it is flexible and easy to handle.

It is therefore recommended that for an efficient receiving set the coupling coils consist of two flat spirals of a fixed number of turns each (and these comparatively few), shunted by variable condensers on the primary and secondary sides for tuning purposes, as indicated in Fig. 4; that for loading to higher wave lengths than the single coils are built for, additional units of inductance be provided, supplied with connecting clips, and placed behind the primary and secondary of the coupler as required. A diagram of such an arrangement is

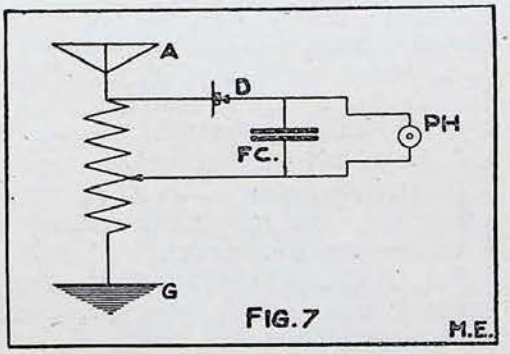


FIG. 7 M.E.

given in Fig. 6. To wind the flat spirals I suggest this method: Upon the board on which the coil is to be wound nail, temporarily, a piece of round wood to use as a center around which to wind the coil. Have a pot of hot paraffin ready, and start winding the wire as a flat spiral around the center piece. As every few turns are wound, each turn lying up against the next, fix them by soaking in paraffin. When through winding, remove the wooden center piece and give the whole coil a final coat of paraffin.

Lastly, a word about direct coupled sets (for example, that shown in Fig. 7): It will be remembered that in discussing the "Sending Set" it was shown how "back action" took place when two circuits are coupled too closely. The same

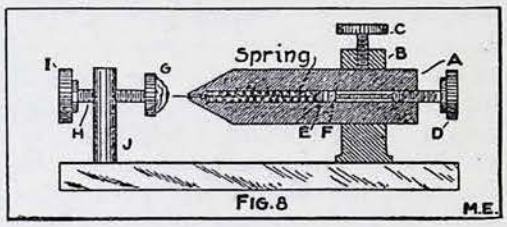


FIG. 8 M.E.

takes place in a direct coupled receiving set, between antenna and detector circuits, and losses therefore occur. Hence a loose coupled set should always be used for highest efficiency.

(3) CONDENSERS:

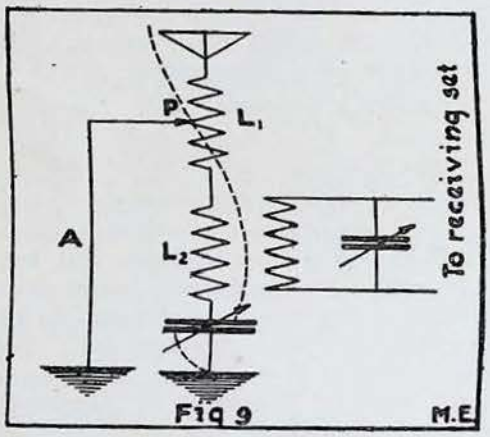
The losses that take place in any condenser are chiefly those that occur under a high voltage stress. In a receiving set we have very low voltages and hence our condensers are usually quite efficient. There are a few considerations, however, that must be thought of. First, the condensers should be moisture and dust-proof or else they will short circuit. Second, they should be kept away from the field of the tuning inductances to avoid losses by induction. Thirdly, the dielectrics used should preferably be those having little hysteresis loss, as in some dielectrics this loss does not depend on the stress under which the dielectric is placed, but is always constant. Dielectrics of low hysteresis loss are mentioned under "Condensers" in the article on the "Sending Set"; where possible, however, air condensers should be used.

(4) DETECTORS:

The detector is, of course, the great energy consuming, and usually energy wasting, device of the receiving set; and, in using crystal rectifiers this is hardly avoidable. The average crystal has usually a resistance of at least several hundred ohms and this causes waste of power through heating. If the audion or heterodyne arrangement is used as a rec-

tifier (although strictly speaking the latter is not a rectifier), conditions are greatly changed and amplification instead of loss of received energy is the result. These types are to be strongly recommended therefore, but if the reader prefers to use crystal, I wish to mention a few things regarding their efficient use.

First, all detector stands should possess sharply pointed and finely adjustable (by means of a fine screw thread) contact points. By experience and theory this sort of contact, rather than large and coarsely adjustable ones, has been found most efficient. A drawing of such a detector stand, lately built by the writer and giving very good results, is shown in Fig. 8. It will be noted that shaft *A* slides in and out of a hole in stand *B*, and may be fastened by the



clamp *C*. Thus a rough adjustment is obtained by this means, and then a fine adjustment by means of the screw thread and spring device at *D*. The contact wire is fastened to a plug, *E*, and *D* ends in a plug at *F* which bears against *E*. The reason the wire and adjusting screw are thus made separate is that the wire shall not turn as the screw is turned but shall continue its motion in a straight line. One is enabled to reach every point on the crystal by putting this in a cup, *G*, which has attached to it a threaded shaft *H* on which runs a clamping nut, *I*; the shaft *H* goes through a slot about ¼" long in the stand, *J*. Thus, the crystal cup may be rotated, slid up and down in the vertical slot, and clamped where desired. The whole is of solid brass. By varying the adjustment of the point for every incoming message it will be found that there is a point for each message at which it "comes in" best; the set is then operating as efficiently as it can with that sort of detector.

Second, different sorts of crystals vary immensely in resistance. To obtain as little loss as possible, low resistance crystals should be used, in so far as they are otherwise good in rectifying qualities. Amateurs should therefore have an assortment of different kinds of crystals which they should try out in the detector stand of Fig. 8 (fastening the crystals in the cup temporarily with mercury-copper amalgam), with a buzzer tester attached to the primary of the coupling coils, and with *loose coupling* of the detector circuit to the antenna (to prevent overloading the detector). Those giving the best sound in the phones for constant coupling, buzzer current and best possible contact point adjustment should of course be used. It is undesirable to measure the resistance of a crystal with direct current on a Wheatstone bridge, as the high frequency resistance may be very different. However, as previously stated, far more efficiency is obtained by the use of an audion, Fleming valve or heterodyne; crystals may be used for temporary work, but are certainly undesirable in comparison with these.

(5) TELEPHONES:

The factors of efficiency in receiving telephones are chiefly the following:

(a) Dust or dampness gets inside the cases and short-circuits some of the windings. There are consequently a smaller number of active turns on the pole pieces and the tone is weakened. To prevent this, the phones should be wound with damp-proof insulated wire and the windings securely covered.

(b) Diaphragms: The diaphragm of a telephone receiver should satisfy the following requirements:

(1) It should be placed as close as possible to the pole pieces, to keep magnetic leakage low; however, space for vibration must of course be allowed.

(2) It should be as light as is consistent with sturdy construction. Factors which increase weight without increasing efficiency, such as heavy enamel, should be discarded. The magnetic field in a telephone is quite weak, and the lighter a diaphragm is, the greater will

be the amplitude of its vibration; consequently, the louder the tone. Also, the smaller the diameter of the diaphragm, the more easily will it move.

(3) It may be known to some of my readers that every object possesses what is called a "natural period of vibration." This is the number of times per second the object will vibrate if struck a blow. Now, if a force acts upon it which strikes it the same number of times per second as is the natural period of the object, it will vibrate to a much greater extent than if the period of the force were something else. Now, a diaphragm vibrates in response to an external force (the pulsating magnetic field in the phones); if the natural period of the diaphragm is the same as that of the magnetic field the resulting amplitude of vibration will be much greater than it ordinarily would be. The practical application of this is as follows: If you are receiving a message which is sent on a 500-cycle spark set (which gives a tone of 1,000 sparks per second) and your diaphragm has a natural period of about 1,000 per second, you will get a much louder tone in the phones than you would with another diaphragm. Now, you may test out various diaphragms in your possession, selecting the one for use in your phones which has a natural period corresponding to the spark tone of the majority of the stations in your neighborhood, or those you customarily receive from. The testing may be done by using a "string" buzzer with an adjustable contact, for supplying the various tones, which is connected to the primary of the coupling coils as a testing buzzer usually is; various diaphragms being then inserted in the phones and the one giving the loudest response for any given tone of the buzzer is selected for permanent use. The frequency of the buzzer tone may be obtained by comparison with a note on a piano. Here "middle C" has a frequency of 256 per second, "high C" has 512, the C one octave above "high C" has 1,024 and so on, each octave doubling the frequency.

(c) Sensitivity: The sensitivity of a telephone receiver is the smallest current which will give an audible response when passed through it. Two different receivers may have their sensitivities compared as follows: Connect a testing buzzer to the set as usual and start it going. Now loosen the coupling between primary and secondary on the loose coupler until the sound in the phones just disappears. Keeping everything the same, connect the phones to be compared to the ones just used in their place and vary the coupling again until the sound just disappears. If the coupling is now looser than it was previously the second set of phones is more sensitive than the first set. If the coupling is closer the phones are less sensitive.

To actually *measure* the sensitivity requires laboratory apparatus not usually possessed by the amateur. But the above method of comparison is sufficient for the purpose of finding out whether one set of phones is any better than another.

(6) Special Topics:

(A) Connections: Nowhere is good contact and low resistance of connections

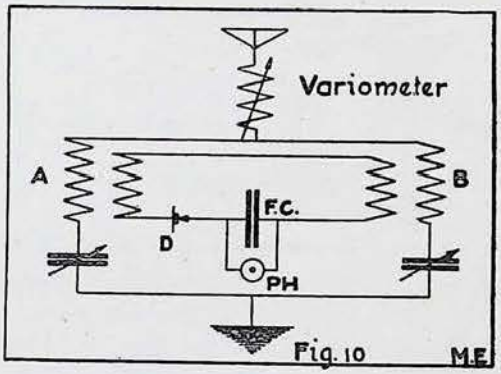


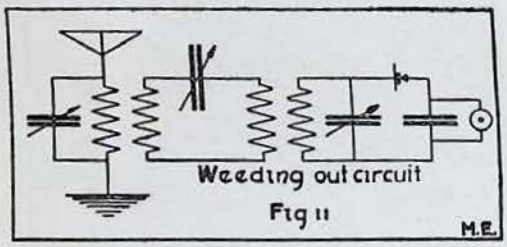
Fig. 10 M.E.

more important than in a wireless receiving set, and nowhere is it a more frequent source of energy loss. Hence connections should all be of stranded wire, and, in permanent "hook-ups", preferably soldered. Switch contacts should be good, especially in button switches, and kept free from oxide and dust. No steel or iron should be permitted in any part of the set (not even steel screws) to avoid hysteresis losses. Also, no nickel plating should be done, since nickel is somewhat magnetic; and as high frequency currents travel on the surface, hysteresis losses will occur. If plating is desired, the modern commercial practice is to use silver plating—which is not so expensive as might be imagined.

(B) "Portable" Sets: Many amateurs today build their sets in the so-called "portable" form; that is, all the appa-

ratus is usually crowded together in a small box. Such sets are frequently constructed with more regard to mechanical compactness than electrical efficiency. For example, wires connecting entirely separate and distinct parts of the set are bunched together; the result is considerable loss through induction. The fact that otherwise efficient apparatus may be rendered very inefficient by such construction is shown by the fact that one of the standard receiving sets of a prominent wireless company that was very beautifully designed theoretically was nearly a failure through extreme induction losses in the mass of wiring within the case of the set.

Hence, if you wish a portable set, reduce your apparatus first to its simplest form of connection; keep your interior connections wide apart; do not crowd any more than you can help; build your tuning coils in flat spiral forms for compactness; tune with a variable condenser as shown in Fig. 4; or else use a variometer connected as a direct-coupled set (although this entails "back action" losses).



(C) "Shielding" of Antennae: By this is meant the structures surrounding the antenna which tend to absorb energy from the electric waves, as do all metal bodies. I mentioned previously the desirability of using a low antenna for receiving purposes; but this holds only for the case in which no absorbing structures surround the antenna. In the city, antennae should in general be swung above the nearby buildings.

(D) Reduction of Interference: Lastly for the benefit of those readers who are somewhat advanced in the study of radio-communication there are given below a few of the methods which have been successfully applied in commercial practice for the purpose of reducing interference, by static or otherwise, since this is a source of inconvenience and inefficiency.

(1) Marconi has advocated the form of circuit shown in Fig. 9. The distribution of voltage in an antenna so connected is shown by the dotted line. The inductance L_1 has a slider on it which is connected directly to the ground at the nodal point of voltage distribution, P. The receiving set is coupled to L_2 as usual, and the operation of the arrangement is as follows:

When an incoming wave to which the antenna is tuned sets it oscillating, no current flows through the path PA since no potential exists at P. If, however, static acts upon the antenna (unless it is in the form of a shock excitation) the current produced flows directly to ground through PAE, on account of the lower impedance of this path, and does not affect the receiving set. The same holds for oscillations of wave lengths other than that to which the antenna is tuned, which will not have a node at P.

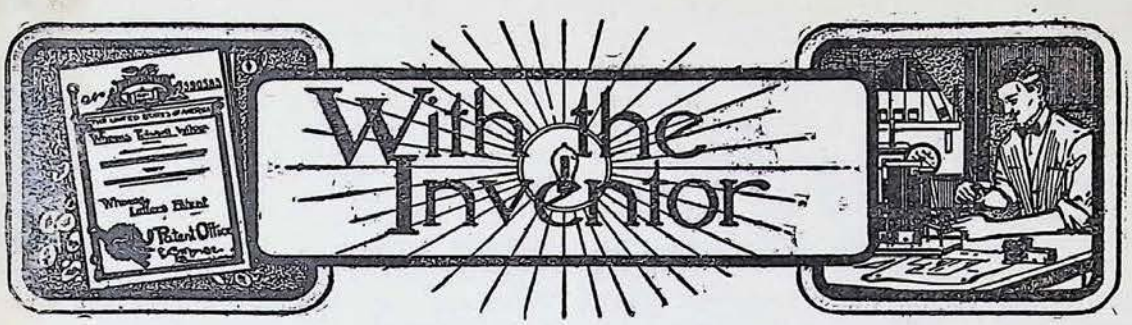
(2) Fessenden's "interference preventer" is shown in Fig. 10. The currents induced in the aerial, from any cause, have two possible paths—through A or B—to earth; one path is tuned to the wave which it is desired to receive, while other waves or static discharges, out of tune with either path, will divide equally between them and produce no effect on the untuned detector circuit (since the currents induced in the two paths of this circuit annul each other).

(3) Use of "weeding out" circuits: This consists simply of the introduction of one or more tuned circuits between the antenna and detector circuits, which will serve to weed out undesirable oscillations and allow only the ones to which they are tuned to go through. The arrangement is shown in Fig. 11. The use of such circuits has been found to be quite a satisfactory way of getting rid of interference and they are employed by most commercial companies.

Summary.

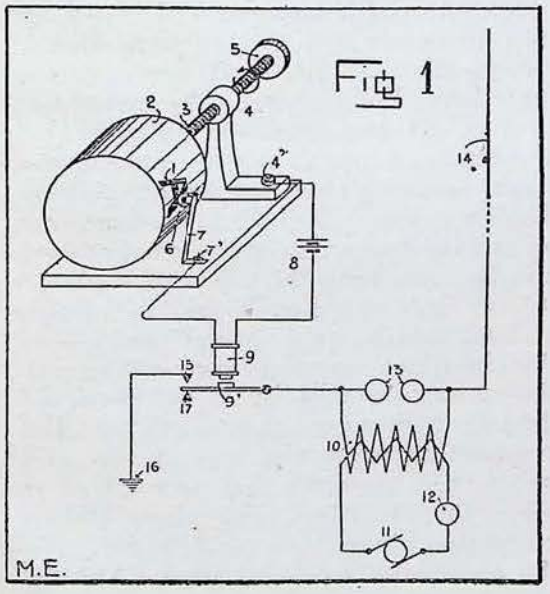
The typical amateur wireless station has been divided into its component parts and the apparatus used in each part taken up. The losses occurring in the various apparata have been indicated and methods for their reduction or prevention shown.

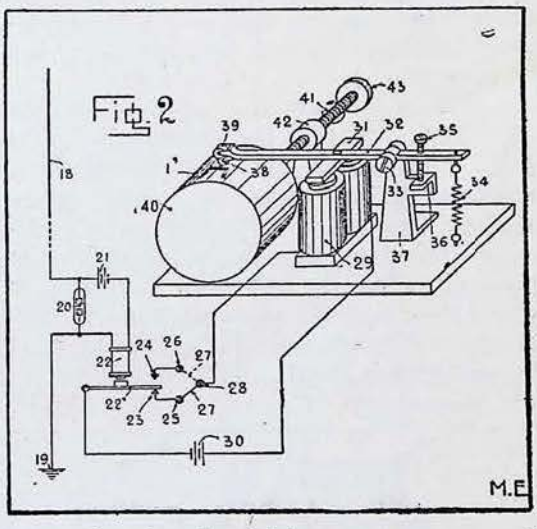
Note: I wish to acknowledge my indebtedness to the "Proceedings of the Institute of Radio Engineers", Vol. I, Nos. 1, 2 and 3, for material aid in the preparation of these articles.—Author.



Recent Electrical Patents

THE wireless transmission of pictures, handwriting, etc., is the object of Francesco De Bernochi, of Turin, Italy, as set forth in Patent No. 1,069,535, Fig. 1, being a diagrammatic representation of the sending apparatus, and Fig. 2, a similar view of the receiving apparatus. The image 1, to be transmitted, is traced by means of insulating ink either on the metallic drum 2, or upon a metallic sheet wrapped around the drum and in contact therewith. The drum is integral with the threaded shaft 3, mounted in a bracket 4, said drum consequently having helical motion when the shaft 3 is turned in the direction of the arrow by pulley 5. The contact member is a metallic roller 6, at the end of a flat spring 7, which urges the roller 6 against the surface of the drum 2. A local electric circuit containing, in series, a source of current 8, and a magnet 9, terminates respectively at terminals 7′ and 4′. The arrangement for generating the electric waves for transmission is composed of a transformer 10, in the primary circuit of which are a source of current 11 and an interrupter 12, while secondary circuit thereof contains the oscillator 13, one of the ends of which is connected to the antenna 14 and the other is grounded through an armature 9′ of the electromagnet 9, said armature contacting, when the magnet 9 is energized, with the contact 15 grounded at 16.

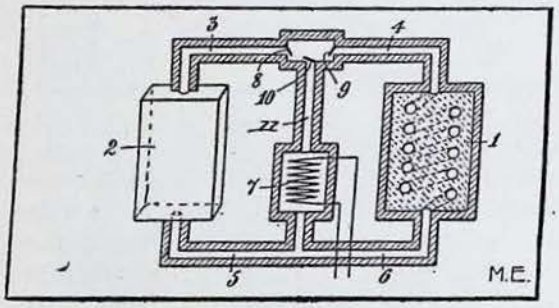




The receiving station is composed of the antenna 18, grounded at 19, through a wave detector 20, to the terminals of which is connected, in derivation, the local circuit containing a source of current 21, and the electromagnet 22, the armature 22′, of which contacts in its positions of rest and of working, respectively, against the contacts 23, 24, connected to the switch points 25, 26. These points may be connected to the contact 28, by

the switch 27. The reproducing mechanism is composed of an electromagnet 29, connected in series with the course of current 30, the contact 28 and the armature 22'. The electromagnet 29, when excited, acts upon an armature 31 on a lever 32 pivoted at 33 in a bracket 37. This lever is provided at its back with a spring 34, which urges the screw stop 35 against a projection 36, on the bracket 37. The said lever 32, is fitted at its front with a reproducing roller 38, in contact with an inking cylinder 39, also mounted on lever 32. When the oscillating lever 32, is down under the action of the electromagnet 29, the roller 38, contacts with a sheet of paper, held on the drum 40. This drum 40 is with the threaded shaft 41 mounted in the bracket 42, and receives, through the pulley 43, a movement which is synchronous with the drum 2, Fig. 1.

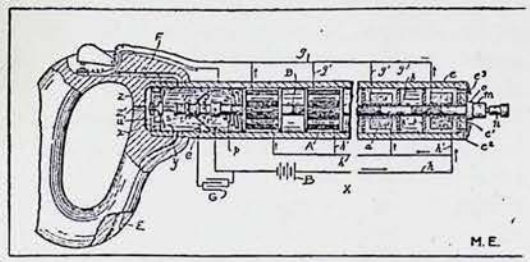
A MAGAZINE for electrically heating water, air or other medium, is set forth in Patent No. 1,069,949 issued to Chas. I. F. Hassler, of Stockholm, Sweden, the accompanying diagram showing the essential features, in which the heat storage magazine is designated by 1, whole 2 indicates the heat delivered body, and 3, 4, 5 and 6, represent the system of closed tubes and 8, 9



and 10 indicates the regulating elements. If rapid heating is desired, the valves 8 and 10 are opened while the valve 9 is closed so as to close the passage to the heat magazines entirely or partly, whereby more or less of the air coming from the electrical element 7 is compelled to pass through the valves 10 and 8 to the radiator of sheet metal or to any other heat radiating surface 2 which then radiates the heat into the locality to be heated. The air after having dispensed its heat returns through the conduit 5 to the element 7 where it is reheated, and from there it ascends through the conduit 11 and repeats its above described circulation. If, however, the heat generated by the electrical current is to be stored, the valve 8 is closed and the valve 9 opened, so that the current of heated air circulates through the conduit 4 into the magazine 1 and then back to the element 7 through conduit 6, thereby heating the heat-storing mass in the magazine. When the circuit is then interrupted and it is intended to deliver heat from the magazine, the valve 8 is opened to such an extent that warm currents of air are allowed to pass and deliver their heat to the radiator 2, whereafter they return to the magazine in order to be reheated. By adjusting the valves 8 and 9, successively and in a suitable manner the transition from the heating of the chambers to the storing is effected uniformly and slowly.

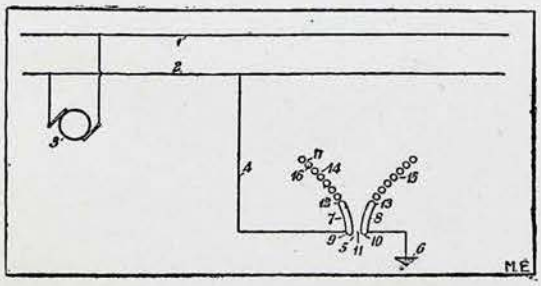
THE object of Alexis Le Blanc, of New York, N. Y., set forth in his Patent No. 1,069,709, is to obtain rapid and powerful vibrations of the core of a reciprocatory motor tool by combining a number of short isolated solenoids with a corresponding number of isolated core pieces and energizing all the solenoids at once. By the term isolated is meant the segregation of the magnetic fields of the individual solenoids by air spaces and the interposition of plates of non-magnetic material. Furthermore, the respective core pieces are separated by pieces of non-magnetic metal, thereby providing a short isolated core for each solenoid. The short length individual solenoids can be rapidly magnetized and demagnetized, and by combining the effect of a plurality of such soleoids, it will be readily understood that the power exerted by the vibrating compound core will be multiplied and the rapidity of vibration will depend only upon the length of time required to magnetize one of the solenoids, and since all are magnetized at once, the resulting blow given by the compound plunger core will depend upon the number of solenoids used. The figure showing a sectional elevation of a riveting hammer constructed on this principle renders descriptive detail unnecessary. The patent claims broadly an electromagnetic reciprocating motor, consisting of a plurality of magnetically iso-

lated axially aligned solenoids, a plurality of magnetically isolated, axially aligned cores within said solenoids, means for simultaneously energizing said solenoids to cause a simultaneous movement of said cores in one direction and



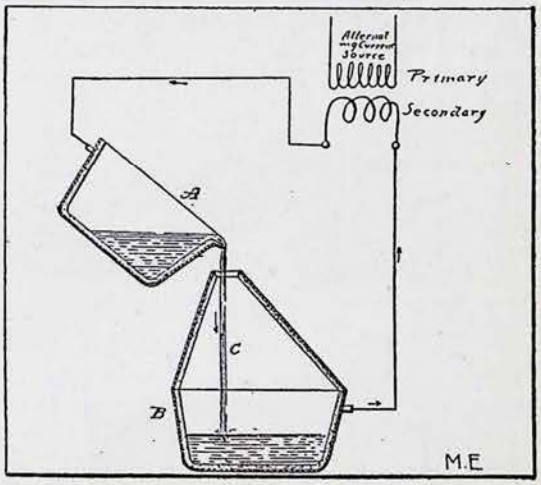
spring mechanism for reversing said movement. There are also numerous other claims to specific details of construction.

THE accompanying drawing is a diagrammatic representation of an improvement of the type of lightning-arrester in which horn-shaped terminals are used, and is the invention of Alexander J. Wurts, of Pittsburgh, Pa., assignor of the Patent No. 1,069,310 to Westinghouse Electric and Manufacturing Company. The distributing conductors 1 and 2 are supplied with electrical energy from any source, as a generator 3, and a protective circuit 4 for the main circuit comprises a lightning arrester, 5, that is connected between conductor 2 and the ground 6. The lightning arrester 5, comprises a pair of horn-shaped terminal pieces 7 and 8, arranged so that



corresponding ends 9 and 10 thereof are adjacent to each other with a narrow air space 11, between them, and so that the remaining portions 12 and 13 diverge. The terminals are composed of conducting material not readily decomposed upon the occurrence of arcs. Extensions 14 and 15 for the terminal pieces 7 and 8 comprise two sets of conducting pieces 16, separated from each other by air spaces 17 and are otherwise insulated from each other. If the main circuit becomes charged by lightning or otherwise a discharge will occur between the ends 9 and 10 of terminals 7 and 8, and if an arc is produced, it will travel from the ends 9 and 10 of the terminals 7 and 8 toward the opposite ends and will continue to travel toward the outer ends of the extensions 14 and 15 until it becomes so attenuated that it breaks. The air spaces between the conducting pieces 15 serve to increase the resistance of the discharge circuit very rapidly, and final rupture of the arc will occur in most cases before surging of the static charge in the main circuit has been afforded opportunity to cause undue strains upon the insulation.

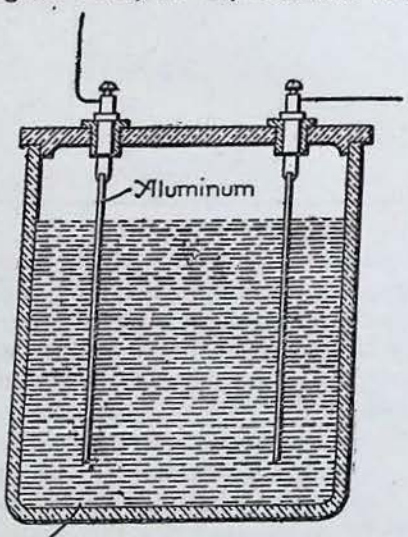
THE object of the invention inclosed in the accompanying illustration and set forth in Patent No. 1,068,643 issued to William S. Franklin, of South



Bethlehem, Pa., is to attain the heating of materials by means which render unnecessary the employment of carbon or metal electrodes, or, indeed, the use of any electrodes in direct contact with the material to be heated. Advantage is taken of the fact that refractory linings of clay, sand, or magnesia of iron or metal-bound ladles or pots used in smelting operations become fairly good electrical conductors at the temperatures which ordinarily exist in the use of such ladles or pots, it being possible to have a very considerable volume of current pass from the lining to the pot or melt, or vice versa, without generating an excessive amount of heat in the lining. Satisfactory results, however, cannot

however, cannot readily be secured by passing the current through so large a body or mass as constitutes the ordinary melt, and therefore the body or quantity of the melt is reduced in proportion to the volume of current, so that the temperature may be raised to the desired degree. One way of doing this is to employ two pots or ladles that, respectively, are the terminals of the circuit, the conductors, of course, being connected to the metal exterior of the pots or ladles, and to pour from one ladle to the other, thereby securing a constricted stream through which the current passes, and by reason of which heat is generated. The size of the stream or jet from one pot to the other may be regulated at will by pouring more or less rapidly from one pot to the other. The material to be heated may be delivered in a melted form into the pot from which it is to be poured, or a suitable melted slag, raised to any desired high temperature, may be placed in the pot, and the material to be heated may be introduced into this slag with which it will flow from one pot to the other.

PATENT No. 1,074,231 issued to James E. I. Zimmerman, administrator of Clarence I. Zimmerman, late of Niagara Falls, N. Y., concerns the em-

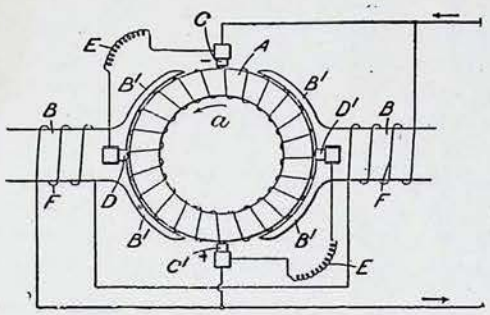


Contains an oxyacid of boron, a borate and glycerine.

ployment in electrolytic condensers of the well-known aluminum condenser type, of a class of electrolytes which afford a reliable operation during continuous or intermittent use, and in some instances allow much higher voltage limits than many of the electrolytes usually employed. The accompanying drawing illustrates an electrolytic cell, at least one of the electrodes of which consists of aluminum. The electrolytes comprise as essentials the aqueous solutions of ortho, meta and pyroboric acids, having the formulae $B(OH)_3$, $BO(OH)$, $B_4O_5(OH)_2$, and their respective alkali and ammonium salts, for example, borax, sodium, pyro-borate, $Na_2B_4O_7$, either alone or in combination. The presence of glycerin has also been found advantageous in reducing corrosion of the electrode, particularly where the air and the electrolyte are in contact. The acid radical of the dissolved substance in the electrolyte must be capable of forming the film when the cell is in operation. The formation of the film will not occur unless certain portions of it are destroyed by corrosion or puncturing. The film grows to, or is maintained at a definite thickness, dependent upon the nature of the electrolyte and the pressure at the cell terminals. Abnormal growth is prevented by its own insulating properties.

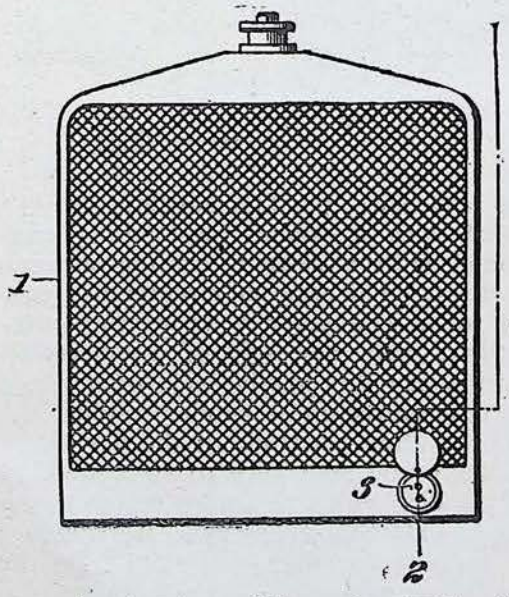
THE accompanying drawing shows diagrammatically a dynamo electric machine according to the invention of Abner Hill, of Warminster, England, as set forth in Patent No. 1,071,920, the machine being of the auxiliary brush type and designed to give approximately constant current over a large range of speed. By way of example a two-pole dynamo is shown having a ring armature A driven in the direction indicated by the arrow *a* and field magnets B having pole pieces B'. The main or ordinary brushes are indicated at C and C' and are set in the ordinary or neutral position. The main brush C is connected through an external resistance E to an auxiliary brush D which is in advance of the main brush by about 90, and the main brush C' is similarly connected through an external resistance E to a second auxiliary brush D'. The amount of the resistance E will vary in accordance with the general design of the machine and it may be divided and be capable of adjustment in any known manner. The field magnets B are excited

by shunt coils F connected across the main brushes C, C'. As C is the negative and C' the positive brush, the current in the resistance connecting the main brush C' with the auxiliary brush

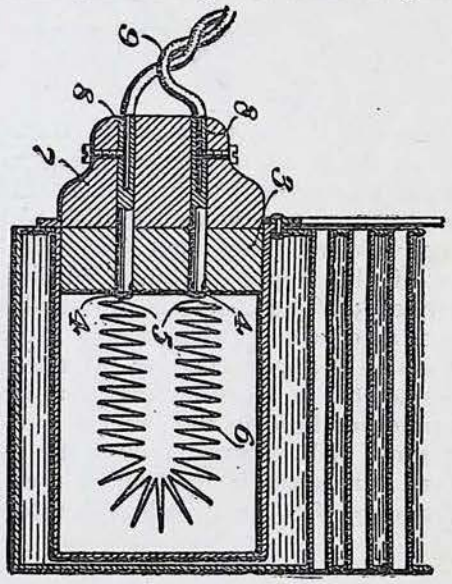


D' will, when the machine is running on open circuit, flow from C' to D' and, in the resistance connecting the other pair of brushes, will flow from D to C. The effect of these currents, which of course, also flow in the armature coils between D' and C', and C and D, is to strengthen the main field.

IN cold weather, great trouble is experienced at times by owners of automobiles because of the water freezing in the radiator and to avoid this it is necessary to build a fire in the garage so as to have a temperature sufficiently high to avoid freezing difficulty. William Galliger, of St. Louis, Mo., pro-



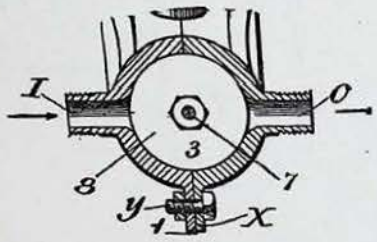
poses in his Patent No. 1,072,595 to obviate this difficulty by a casing inserted in the lower portion of the water containing chamber of the radiator in which casing is arranged one or more electrical heating units, the outer end of the casing being closed by an insulation socket with which co-operates an ordinary insulated plug connected by wires to the usual lamp socket of an electric circuit. In the drawings 1 indicates the radiator of an automobile, 3 indicates an insulation plug having suitable links 4 therein in which are located terminals 5 of the wires which lead to the heating coil or coils 6. 7 indicates a plug of insulation material and having the terminal pins 8



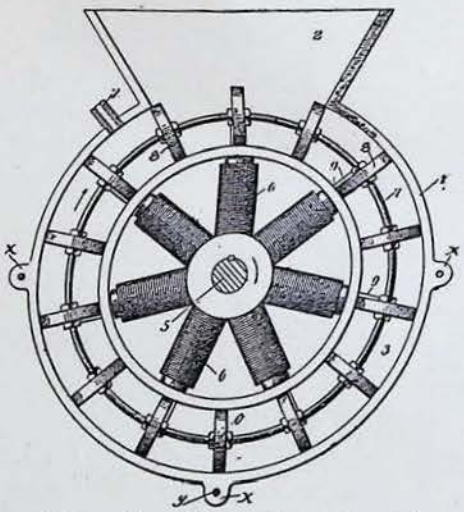
to which the wires 9 from an electric circuit are connected. These wires 9 may lead from a plug arranged in an ordinary lamp socket.

A MAGNETICALLY operated apparatus for conveying concrete aggregates from a hopper in continuous batches is the subject of Patent No. 1,071,847 issued to Wylie G. Wilson, of Elizabeth, N. J. The conveyor casing is made of two halves with perforated lugs *x* clamped tightly together by bolts *y*. This casing is formed with an upper hopper portion 2, with an annular cylindrical chamber 3 with which the lower end of the hopper communicates. 5 is a rotatable shaft on which is fixed a series of magnets adapted to be rotated within the central space of the casing. The chamber 3, contains an endless conveyor comprised of a ring 7 on which at intervals are fixed disk pistons 8 of a diameter to cause them to fit snugly in

the annular and cylindrical chamber 3. The ring 7 also carries at intervals suitable soft iron pieces 9, fixed directly against the sides of the disk pistons 8. When shaft 5 is rotated in the direction of the arrow the ring 7 with the pistons 8 and soft iron pieces 9 will be moved in that direction in con-

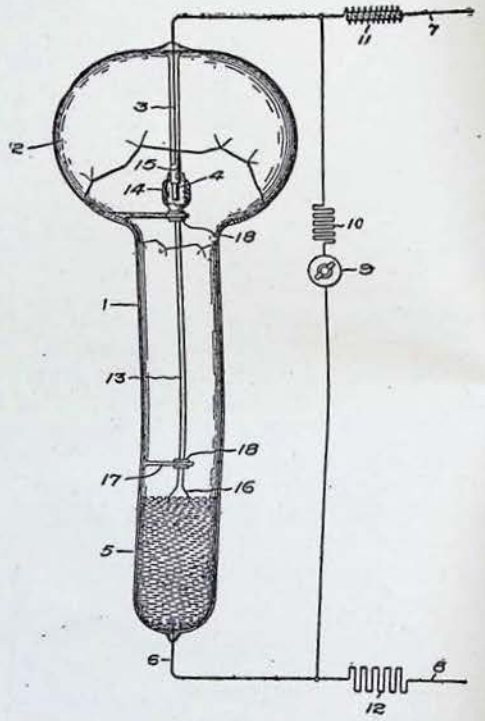


sequence of the pull exerted by the magnets on the soft iron pieces; consequently material supplied to hopper 2 will fall into the spaces between the disk pistons in batches and be carried from the bottom of the hopper around within the chamber 3. The casing is provided with a vent *z* adjacent to that side of the hopper which is approached by the traveling disks so that if there be any compressed air or other fluid in the moving pockets, the same will escape through the vent before it reaches the bottom of the hopper where, if it were suddenly released,



it would tend to blow the material upwardly or out of the hopper or other source of supply to the conveyor chamber 3. The casing is provided with opposite ports I and O at its lower portion, and when a space between two adjacent piston disks is brought between these ports I and O the material therein may be expelled from the casing by any fluid current under suitable pressure entering one of the ports and blowing transversely through the carrier chamber 3 and passing out of the other port.

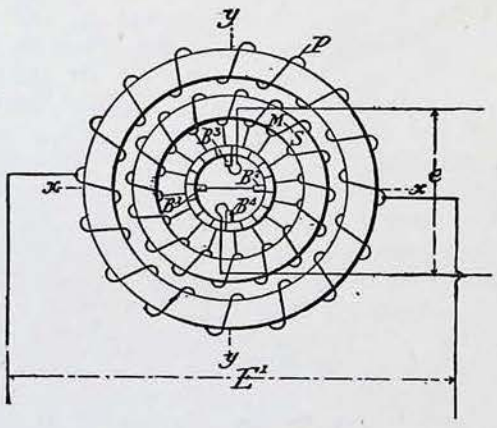
WHAT is claimed as a new method of transforming electrical energy into light by heating a refractory body to incandescence through the medium of electrical energy passed through an attenuated vaporous medium, is set forth in Patent No. 1,074,303, issued to Ezechiel Weintraub, of Schenectady, N. Y. A transparent evacuated envelope 1 has a relatively large condensing chamber 2. An electrode 4 is connected to



the lead wire 3. The envelope is provided with a second electrode 5 connected with a second leading-in conductor 6. The external circuits may consist of a conductor 7 connecting electrode 4 with one side of an electrical circuit, say the positive side of a direct current source and a similar conductor 8 for the other electrode of the device. A switch 9 and resistance 10 are connected in parallel with the device for use during the starting operation. A reactance 11 may be connected in series with the conductor 7, and a resistance 12 may be connected in series with conductor 8. The additional element constituting the gist of the invention is the tube 13 of constricted diameter, say for instance, a

porcelain tube with a bore ranging in diameter from ¼ inch down to 1/64 inch or even less, the operation of the device being as follows: An electromotive force of several hundred volts is impressed across conductors 7 and 8, but no current flows between anodes 4 and 5 because of the non-conductive space which separates them. Switch 9 is then closed to store energy in reactance 11; it is subsequently opened to cause that reactance to discharge its energy at high potential between electrodes 4 and 5. This discharge will take place through the bore of the porcelain tube to the small electrode surface exposed within the cup 16 at the lower end of the tube. This discharge of energy serves to establish a conductive path between electrodes 4 and 5, and through this path a direct current is maintained by the voltage on conductors 7 and 8. Under the conditions above set forth the current is in reality carried by a mercury arc inclosed by the porcelain tube 13. If the tube has a small bore the arc will be of a very small cross-section and of relatively high voltage. The current may be small, say in the neighborhood of a fraction of an ampere. From the above description it will be understood that the inclosed tube 13 may be raised to incandescence even though it is initially non-conductive, solely by heating action of current passed through the vaporous or gaseous medium in proximity to the material to be heated.

DYNAMO electric machines constructed in accordance with Patent No. 1,073,201, can be used as generators, because upon excitation through a determined magnetic field an electromotive force must in all cases arise at the rotating armature, and this electromotive force, quite independently of the number of revolutions of the rotor, is equal in phase and periodicity with the magnetic field. Let the primary and secondary windings (hereinafter called P and S) of an alternating current transformer, be arranged in the manner illustrated in the accompanying diagrammatic drawing, *i. e.*, as separate bi-polar ring windings disposed in such a way that S can move independently of P, while the points of connection of the primary winding to the source and the points between which the secondary winding is short-circuited, and therefore the magnetic poles of P and S are maintained on the line *x x* (constituting the working axis), which can be easily attained by providing the winding S with a segmental commutator and short-circuiting the brushes situated on line *x x*. If now there be added to the windings P and S a magnetizing winding (hereinafter called M) so arranged that the current in it produces a magnetic field having the axis *y y* at right angles to the axis of the field of windings P and S, and if the current supplied to the winding M corresponds as nearly as possible in phase to the currents in P and S; then a torque is produced which is proportional to the field of winding M, to the ampere turns of the rotor S, and to the cosine of the angle of displacement of phase between these last magnitudes.



Upon rotation of the rotor in the field having the axis *y y, i. e.,* the field of winding M, there is generated a counter-electromotive force which has its greatest effective value on the line *x x* and is in phase with the magnetic field having the axis *y y,* since it is generated by rotation in that field.

SOUTHWESTERN RELAY ASSOCIATION

The above association has been recently formed. Its chief object is to carry on wireless communication in the United States. The officers are as follows: Herbert Mills, manager; A. H. Howard, superintendent, and Van Brooks, operator.

Address all communications to H. Mills, 932 So. Washington St., Hobart, Okla.

Early Experiences In Wireless Telegraphy

By Alfred C. Pickells

U. S. Radio Inspector.

TO be a radio experimenter of the present day means that one has to be fairly well posted in three laboratories: the physical, electrical and chemical.

But what did it mean in the early days? The first necessary qualification was that of electrical engineering; the next, a knowledge of gasoline engines. Then he had to be somewhat of a chemist, a draftsman, and he had to be capable of not only handling the pick and shovel, but to raise a mast and place the guys at the places of greatest strain. More than that, he had to be capable of rigging the aerial and to build rough houses beneath it for the operating station. In other words, he had to be an all-round man.

Work is necessary in the development of any science, but what was encountered in raising radio communication from infancy was hard labor. Moreover, eight-tenths of the experiments had to be conducted in the open air under all weather conditions. It meant not labor alone, but labor combined with hardship.

When radio communication began to toddle on its feet Professor R. A. Fessenden began his struggles in the haze which surrounded the secrets of much needed apparatus. There were six assistants associated with him and an unlimited supply of developing material from picks and shovels to the most sensitive electrical measuring instruments.

The experiments were begun at Rock Point, Md., in 1900. Five hundred yards were covered with the apparatus already in use, so that the greater distances required for new apparatus and the secrecy desired for protection until their completion caused their removal to Roanoke Island, N. C.

The trip on a small two-masted schooner, light enough in draught to ply the waters of Albemarle Sound, began one day in October and ended one night in November on a sand bar about two miles north of Roanoke Island. A stiff "nor'easter" had caught the vessel in the middle of Albemarle Sound. Were it not for the cargo, which was composed of some fine electrical apparatus, the party might have weathered the gale comfortably until morning, but shortly after midnight water began to seep into the hold.

Coming out of a warm cabin in the early hours of the morning, with the wind and spray howling about one's ears at a temperature of 38 degrees, is what might be called a hardship. It was the first that this scientific corps had encountered. But water and induction coils especially were not built to agree, and while the schooner lay on an even keel we, wet and cold, rigged slings on the fore and main throat halliards and hoisted the coils to a point where each would escape the action of the spray. It was perhaps the only way by which they were saved.

While the masts were being raised on Roanoke Island another portion of the corps began building the laboratories and operating station. They had to set foundations for the engines and dynamos, as well as align them after mounting them. Afterwards came the rigging. What was considered the most efficient antenna at that time was the vertical, so that the rigging of the mast consisted of a gaff with throat and peak halliards. Last came the task of placing the ground. It required four men digging six hours in loose sand to place the great copper plates that were used, but we were hunting for the ideal ground and found it.

The first test made was a try-out for distance between Roanoke Island and Cape Henry, a distance of 110 miles. In order to reach Cape Henry the testing party had to drive seven miles up the beach from the point where they left the train in the teeth of a 48-mile northwest wind at a temperature of 25 degrees. The results were frosted

hands when most of us reached the shelter of the lighthouse keeper's residence at the Cape, and a delay of a day in which to thaw them out.

Nothing but the old coherers was used at that time, but all known combinations of filings were tried and for two whole days we "listened in." There were no results but an occasional rattle. Static was little known then, but it was considered that some of the signals might have come that far. It was a sort of balm, at least, for the freezing we received while riding up the beach.

A few months after the erection of the laboratory on Roanoke Island, Professor Fessenden tried the experiment of using a substance which decreased its resistance with increase of heat to detect the collected waves on the aerial in place of the coherer, and in order to make this type of detector very sensitive he used the finest platinum wire obtainable. This, however, is only manufactured with a silver coating which counteracted the efforts of the platinum to detect the waves.

It was finally decided to take the silver coating off by chemical decomposition. But to find the acid which would best produce these results without destroying the platinum was a matter of searching around by experiment.

A score or more of these experiments were made with various acids and combinations, and it was while trying these that one of the test tubes exploded and burst a two-quart bottle of 100 per cent. sulphuric acid. One of the experimenters, standing with his back near the table, received the full charge of the acid on his trousers from the waist down, and in a few seconds they became a brilliant red.

Only quick action, with a solution of water and ammonia, saved this young man's flesh from the waist to his feet, but that portion of his trousers was cut out as clean as though with a knife and he was compelled to return to his boarding house with two great patches of burlap.

The first test conducted between Roanoke Island and Hatteras occurred in March, 1901, immediately after the barreter, or detector, had been completed. As it was then made, this little detector was crude, being composed of a minute loop of platinum wire mounted on two small copper plates which were fastened to a hard rubber base. The terminal wires lead from this base and the whole apparatus was enclosed in a brass case.

On this first test many of the loops were burned out by static as fast as they were inserted in the aerial circuit, but signals from a 12-inch coil at Roanoke Island came in clear on days when static did not interfere.

The second part of the test consisted of sending "D's" every fifteen seconds for three days with various combinations of spark points. First, two points were used, then two balls, then two discs, followed by combinations of these. More radiation was developed between the ball and disc than between any other combination.

In order to do away with the sparking vibrator, due to forcing a heavy current suddenly through the primary circuit, a relay connected with the key was used to move one electrode of the gap to the sparking position while the vibrator kept constantly at work. It gave excellent results.

One of the objects of these tests was to develop a greater current at the receiving station with a smaller amount of energy at the sending station than was generally employed at that time, and one of the greatest details to be considered was the capacity of the aerial. When the Hatteras party returned to Roanoke Island they were set to work on the construction of several types and sizes of aerials.

Herein, also, came more hardships. The laboratory was located on the weather shore for that time of the year and for a week or more a cold biting wind blew steadily from the north. But weather conditions were no hindrance. In measuring the capacity of the different aerials we rigged up a bridge method, using instead of the galvanometer a vibrator composed of a mandolin string with a pair of head phones. One variable capacity and the aerial to be measured made up one side, while a fixed resistance and a variable resistance made up the other side of the bridge.

The first aerial measured was a cylinder 6 feet in diameter and 170 feet

long, using eight wires of No. 10 gauge. The same design was used with Nos. 8, 6 and 4 wire. Another cylinder 14 feet in diameter was also tried with the same sizes of wire.

The next design was the fan aerial using the five different sizes of wire. Finally a single wire using the same sizes was tried, then two wires, and so on up to ten. When it is considered that these parallel wire aerials were tried with varying distances between the wires, one can realize the number of hauls that were made. It required twelve days to make these measurements and tabulate the results, because it was necessary to stop every half hour or so and thaw out frozen hands. Altogether, there were 125 tests made, which also meant that those aerials had to be hauled up and down 180 feet the same number of times. The results indicated that six wires in parallel of the largest size and about six feet apart was the combination which possessed the largest capacity.

In the latter part of April preparations were made for an official test of the system as it stood by the representatives of the Army and Navy. As most of the apparatus was already at Hatteras, the schooner took only the four men necessary to put the station in readiness. They left Roanoke Island at noon with a brisk southwest wind blowing, but once out in the sound it grew stronger, until toward late afternoon it had increased to a gale. This meant a lay-in for harbor for the night at an abandoned fishing camp across the sound on the mainland.

While lying at anchor two of the party went ashore for fresh water. A spring lay within fifty yards of the shore, but they had not gone far before they were stopped by the warning of a rattler. Glancing up the path they sighted the gray and white spots of a snake large enough to make them decide that the schooner water was as good as spring water and they returned without it.

Before the Army and Navy party arrived a test message with 127 words in the check was sent to Roanoke Island and was received without a break. The same results were obtained by the Army and Navy party until static conditions arose and prevented further tests. One of the facts noted, however, was that the Morse operators from the Signal Corps, who had never handled the wireless key before or heard the buzz in a wireless receiver, worked the system at the rate of about 30 words a minute with but little trouble.

Static at Hatteras is perhaps worse than at any other place in the United States during the spring season, and at midday it prevented any work at all. Two incidents happened during that time to make us wonder at the physiological effect of static.

As stated before, the apparatus was only temporarily set up in all test work, so that when the party left the station at night a ground wire was connected with a double connector to the aerial. This had apparently worked out one night, for the next morning, when one of the men took the lead from the station outlet to connect the aerial, he did not notice that the ground wire had worked out until he was knocked fully six feet. Apparently a charge of great intensity had accumulated on the aerial. The young man was rendered unconscious for several minutes but revived with no treatment other than a little water on his head.

Several hours after that one of the men caught a black snake, measuring five feet, in the engine room, and decided to electrocute it. He tied the head to the aerial, allowing the tail to hang to within two inches of the ground. When he pressed the key and held it down the reptile became stiff. It was supposed that its end had come, but to make sure it was tied to a stake out in the sand. Barely fifteen minutes later the snake was making a circle around the stake in an effort to get away. It was supposed that the heat from the sun and sand revived it.

During the next few months we spent most of the time in improving the construction of barreters. Each test, however, indicated the same weak point; namely, that static played havoc with them because of their delicate structure. Some of them were tried when only half of the silver had been eaten off, with no better results. But these tests perhaps lead the way to one of the most sensitive detectors

that has been used in radio work—the electrolytic.

A small test station had been constructed at the south end of Roanoke Island from where signals were sent to the laboratory. One morning the sender at the south end, after making "D's," received the message: "Coming clear and loud. Make words."

At the laboratory, Professor Fessenden had inserted in circuit one of the barreters just taken from the acid solution, and he was surprised to note the clearness and steadiness of the signals, although static was present to some degree. Out of curiosity he took the barreter out and placed it under the microscope. What he saw was that the platinum wire had been broken but both ends were encased in a bubble of acid that had been left on the wire. This lead to further experiments with acid.

During the following winter the stations were abandoned in this section and the experiments moved to the Virginian coast at the mouth of Chesapeake Bay. But one incident might be cited which will show the comparison of the days before radio stations were used to warn shipping of storm danger and the present day. Leaving Roanoke Island one morning in February the party which was detailed to close the station at Hatteras were wrecked in a northeast gale on New Inlet bar. They were taken off the vessel toward evening by life savers, but, the gale growing stronger, they were compelled to spend the night at Kinnakeet, a small fishing hamlet on the strip of beach which separates the ocean from Pamlico Sound.

During that night the ocean flooded the beach and entered the Sound. It did not recede until noon of the following day, but the sign it left was enough to convince one that more than one vessel and its crew had met their fate. As it was, four schooners were wrecked and more than twenty lives lost. It so happened, however, that two of the schooners held on until late in the morning and kept their crews safely above water. They could have been saved by help from a vessel.

In these days of radio communication such wrecks, when not reached by the life savers are reported to HA.

HUDSON VALLEY WIRELESS ASSOCIATION

There has been a large wireless club formed at Albany, N. Y., of local amateurs. The members number about thirty and have large and efficient stations along the Hudson River. The object is to stimulate the local communication, to regulate the exchange of messages, to furnish regular time signals, etc. The members elected to office are as follows: Burr V. Deita, of Slingerlands, N. Y., president; Milton Maguire, of Albany, vice-president; Charles Z. Smith, of South Bethlehem, N. Y., recording secretary; Andrew C. Dodds, Albany, treasurer; Lester M. Greff, Albany, reporter, and F. P. Huested, of Albany, critic.

The club wishes to be of service to other clubs or individuals and will communicate with any one through the corresponding secretary.

MULTNOMAH WIRELESS CLUB

The Multnomah Wireless Club of this city was organized October 2, 1912. The purpose is to further the interest of wireless telegraphy among enthusiasts in the vicinity.

The new officers, elected for six months, are: Verne Lazebly, president; Earl McKinney, treasurer; Ira Bettisen, sergeant at arms, and Jonas Folen, secretary.

The club meets every Tuesday evening and would like to communicate with other clubs through its secretary, Jonas Folen, 1021 Mississippi avenue. They would also like to talk with amateurs within the range by wireless on Mondays and Fridays between 7 and 8:30. Their call is MDC.

BRIDGETON RADIO ASSOCIATION

The Bridgeton Wireless Association has been reorganized under the name of the Bridgeton Radio Association. The following were elected: J. Powell Simpkins, president; Paul Van Sant, vice-president and William S. Fithian, secretary and treasurer.

We would like to hear from clubs and individuals in this vicinity. All communications should be addressed to the secretary, 313 East Commerce street, Bridgeton, N. J. (Call 3HO.)

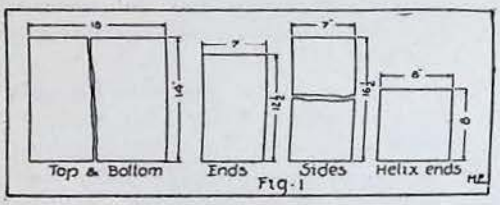
This department is established for the purpose of encouraging the experimenter to bring out new ideas. Every reader is welcome to contribute to this department and new ideas will be gladly received. CONTRIBUTIONS SHOULD BE WRITTEN ON ONLY ONE SIDE OF THE SHEET AND SHOULD PREFERABLY BE TYPEWRITTEN. IF TYPEWRITTEN THEY MUST BE DOUBLE SPACED. SKETCHES MUST BE ON SEPARATE SHEETS FROM THE TEXT. The description should be as short as possible. Good sketches are not required, as our art department can work up rough sketches which are clear enough to illustrate the idea. Return postage must be enclosed if return of unused manuscript is desired.

THREE PRIZES OF FIVE, TWO AND ONE-HALF DOLLARS AND ONE DOLLAR ARE AWARDED for the three best ideas published each month. All other contributions appearing in this department are paid for at regular space rates.

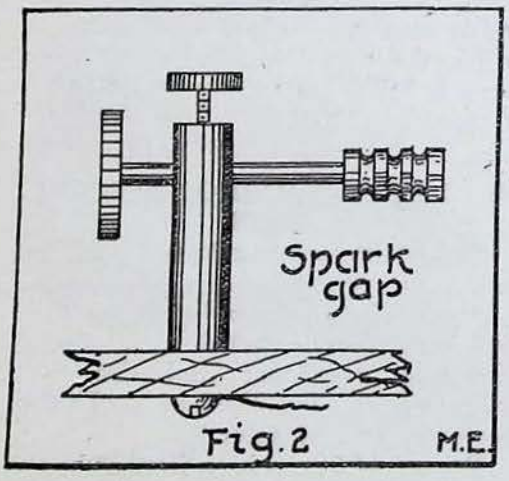
FIRST PRIZE

A CABINET SENDING OUTFIT

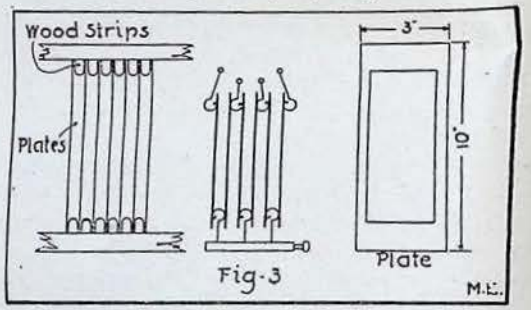
The set I am to describe includes a helix, spark coil, gap, condensers, key, and switches.



The box to contain the instruments is made as follows: Two boards 14"x18" x½" are required for the top and bottom. Two boards 12½"x7"x½" are required for the two ends, and two 16½"x 7"x½" for the two sides. The ends of the helix are 8"x8x"½", Fig. 1. These dimensions cause the top and bottom to overlap the sides by ¾" all round.



The gap is made as follows: Two standards of brass 4"x½"x½" are obtained. Holes are drilled ¼" from the top in each to permit the gap handles to pass. The top and bottom of each standard is drilled and threaded so as to take an 8-32 screw by means of which the handles are held in position, Fig. 2. Connections should be made at base as in Fig. 2. The zinc plugs are best purchased from some firm. They are screwed to a brass rod which has a hard rubber handle on the other end. The



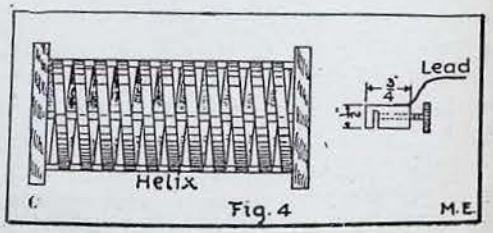
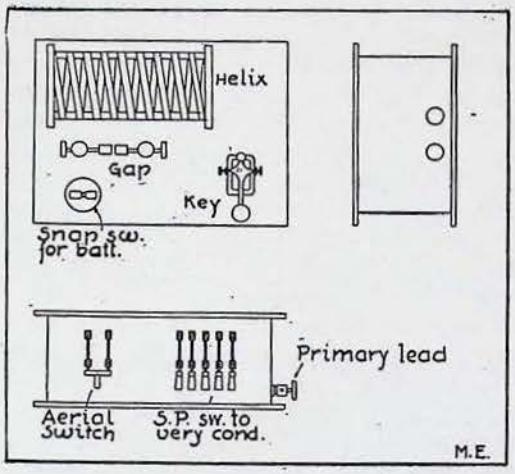
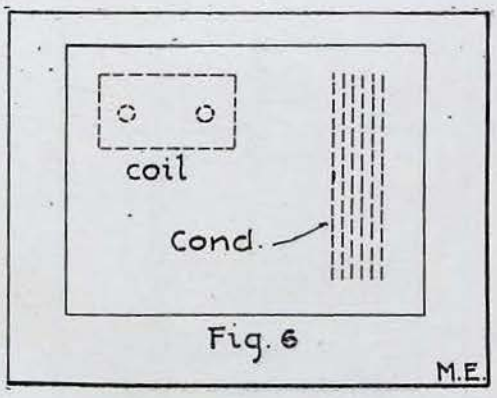


illustration describes the gap very plainly. The condenser used is of the glass plate type and consists of 6 plates, 10" x6". The plates are set up so that the capacity may be varied easily, Fig. 3.



The plates slide in grooves which are made by placing strips of wood on the top and bottom boards as in Fig. 3. Spring brass strips are placed between the plates on each side to make connections, Fig. 3. The plates are all connected at one end while the leads at the other ends are thrown in by means of switches. The foil on the plates should measure 6"x3" and all edges should be rounded as in Fig. 3. The spark coil used should be purchased from some reliable dealer, also the key. The helix is constructed of copper ribbon about 3/8" in width. Five wooden rods 14"x3/4" x3/4" should be used to construct the



frame, Fig. 4. The ribbon is simply wound tightly over the frame and fastened at both ends. The clips should be constructed as in Fig. 4. The dimensions being 1/2"x1/2"x3/4". They are made of brass. Very efficient connections may be made with this type of clip. The arrangement of the instruments is shown in Fig. 5.

Fig. 6 shows the position of the coil in the box, also the position of the condensers. I do not think it necessary to give any hook-up, for different people have different ones which they use themselves. The color used in finishing the set was mahogany, but any will serve the purpose.

Contributed by

John W. Donleary.

SECOND PRIZE
ELECTROLYTIC KICK-BACK PREVENTER

I have read Mr. N. H. Umbarger's article on "The Elimination of Interference Between Wireless Stations, and Power and Telephone Circuits," as published by you in the July number of *Modern Electrics,* with absorbing interest, being especially interested in what he has to say concerning the use of protective condensers across the primary circuits. His article lays bare to me the necessity of an efficient protective device, and has caused me to write this article.

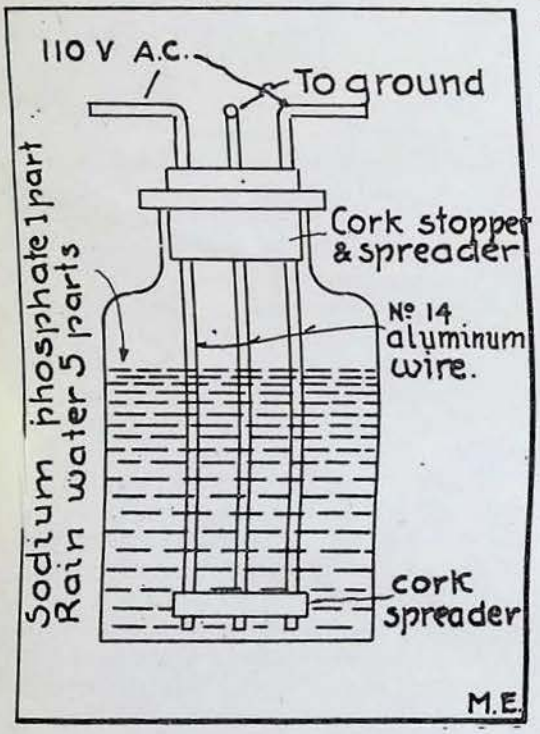
Having never had the opportunity to see such protective condensers in use, I am not prepared to declare them either efficient or inefficient. However, theoretically I should never consider them very efficient, on account of their liability to break down, and because a condenser at its best will allow alternating current to pass through it, and thus it represents a waste of power.

Mr. Umbarger states that in his case the use of the condensers actually increased the static kick-back, rather than preventing it. I should like to suggest that he use a separate ground from his regular wireless ground, for if his ground lead is rather long his sending current will tend to pass through his condensers to the 110-volt circuit, rather than traverse the long lead, and this would cause the trouble he mentions.

As before stated, I have never liked the idea of connecting condensers across the line, so to take their place I have got out the design of a protective device similar to the electrolytic lightning arresters used in high potential power

and sub-stations. One of these can easily be made of the materials at hand in any amateur's laboratory. I should especially like to have Mr. Umbarger try this device, as his station conditions seem to be exceptional and interesting. I also sincerely hope that this device may be of benefit to any of your readers who construct one.

Procure a wide-mouthed bottle (a pickle jar will do very well), two rubber corks—one that will just pass through the neck of the bottle, and one to act as a stopper—and three pieces of



No. 14 aluminum aerial wire. Push the wires through the corks at the three vertices of an equilateral triangle. Slip the smaller cork down to one end of the wire cage thus formed (this is to serve as a spacer for the three wires). Now pour into the bottle a 20% solution of sodium phosphate and rain water. This solution had best be determined by experiment, to suit local requirements. Now press the top cork firmly into the neck of the bottle, space the wire cage in the centre, bend the wire that projects above the cork at right angles, and seal with wax or paraffin.

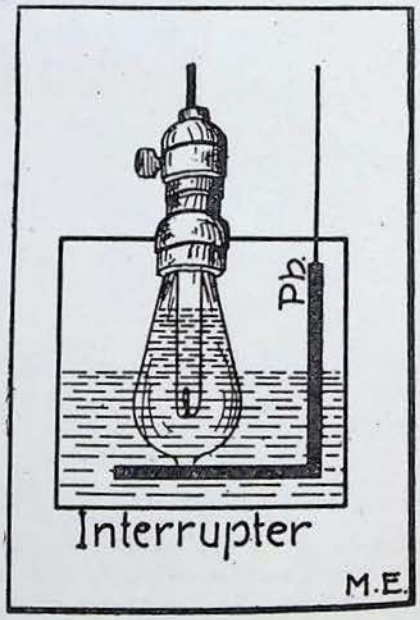
Next "form" your arrester by connecting two of the wires in series with a large lamp across the line. When the lamp ceases to burn the arrester is "formed" and should be placed directly across the line ahead of the aerial switch. The third wire is to be grounded, using a separate ground, as suggested in Mr. Umbarger's case. The action of the arrester is as follows: The chemical and current deposit a non-conducting film upon the wires (this is termed "forming." This film prevents the flow of current at ordinary potentials. However, any high voltage surges puncture the film and pass to the ground. The film immediately heals itself, and is thus ready for constant use.

I have made one of these devices, and find that it works admirably. It does not consume any current, can not be injured, and absolutely protects all apparatus—however, it does not prevent humming in the 'phones. I should like to see it in use by other amateurs than myself and hear their opinions of it, for it is cheap and efficient.—*Asa Bullock.*

THIRD PRIZE

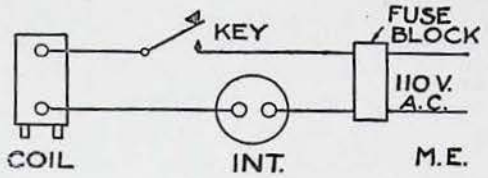
AN "ELECTROLYTIC INTERRUPTER"

The interrupter, as shown in the sketch, is constructed from an old in-



candescent lamp, a strip of lead, a jar, and a few drops of sulphuric acid, the

latter being added to the water. The interrupter works on the principle following: The lamp is placed under the



acidulated water and the tip from the lamp broken off. The water will rush in. When this is connected as usual, you will have an interrupter.

Contributed by *David Kuskin.*

HOW TO MAKE A BICYCLE POWER WHEEL TO GENERATE ELECTRICITY

As I was in need of electricity to carry on experiments, I thought of changing my bicycle into a power wheel. The device is explained in the following paragraphs, and illustrated in figures on which the dimensions are placed. I had this device in practical use for two years. The advantage this device has over the bicycle alone is readily seen. When one operates it he has the same exercise as though he were riding a bicycle. He uses his weight and not his strength, for in operating it he shifts his body from side to side.

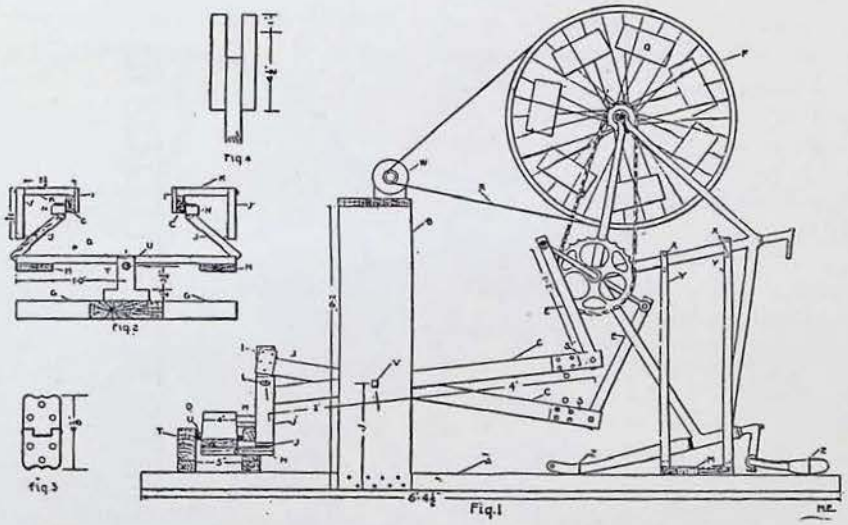


Fig. 1 is a side elevation. A is a 2" x 8" plank used as the base for the complete machine, which consists of a bicycle, and a sea-saw device to transmit a young man's energy to the rear wheel of the bicycle. The bicycle is stood on the front fork and handle bars. The fork and handle bars are fastened to the plank, A, by means of pins, Z, Z. The bicycle frame is braced by means of braces, Y, Y. These are fastened together over the frame by means of ¼" bolts, X, X. These braces are cut out a little so they will fit the frame better. The board, M, is extended about one foot on each side of the base board, A, and the braces are fastened near the edges. If the bicycle can be made rigid against a wall or heavy work bench, this kind of bracing may be done away with.

The plank, B, has a duplicate directly opposite, and they are 7" apart. These are used to support the dynamo, W, switches, etc., and are also used to pivot the connecting arms, C, C, at V, with ½" x 3½" bolts, and must be braced. D is the board the operator stands on, and does his swaying. This board is balanced at its center with a half inch gas pipe, U, and is fastened to this board by drilling two ¼" holes through it and securing it with screws. U is placed in bearings, T. These bearings as all others are bored out and lined with sheet brass. E, E are rods connected from the pedals to the rods, C, C. The details are clearly shown on the drawing.

You will notice in Fig. 2 that the board, D, is connected to the rods, C, C, with a triangular form of rods. This is entirely necessary for the smooth

working of the apparatus. All the connections on these triangular rods are made with hinges as the one illustrated in Fig. 3. A block of wood, N, is fastened under the nut of a ¼" x 2¼" bolt. These bolts are passed through the center hole of the hinges and then through the rods, C, C. At L, is a cut-out in the wood, and it is lined with brass sheeting, and ¼" x 2" wood screws are passed through these into the extensions, K, K, around which are also placed a piece of sheet brass. This prevents any possible binding here. Take notice how the extensions, K, K, are securely fastened, to C, C, by the pieces, I, I, which are screwed and not nailed. G, G are pieces of plank abutted to the base board, A, so D may strike upon them. On H, H, are hinged, J, J, and on J, J, are hinged J', J'.

Joint, S, is clearly shown in Fig. 4 and in putting these together 3½" x ¼" bolts, O, are used so as not to split the wood which can be ordinary spruce flooring.

The power from the wheel, F, is transmitted to the dynamo, W, with a ⅛" round leather belt, R. The bicycle wheel, F, has weights, Q, placed in between the spokes so as to make a flywheel out of it. These may be anything, as split brick, axe heads, etc. Bricks are shown in the drawing.

The above device is best used in connection with a storage battery or accumulator. This is not entirely necessary, and is not necessary at all if two young men are experimenting or working at the same time. Any small D. C. motor may be used as the dynamo. It may have a 250-watt capacity.

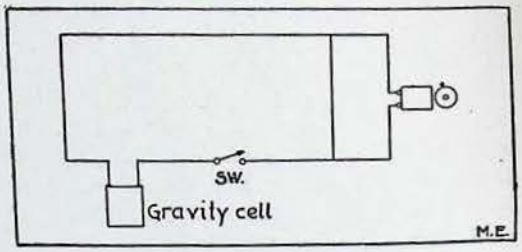
Contributed by

Chas. R. Zickler.

SIMPLE CLOSED CIRCUIT BURGLAR ALARM

I have seen many sketches and diagrams of burglar alarms in the *MODERN ELECTRICS,* but most of them are so complex that they seldom give satisfaction.

Below is an alarm which is very simple in construction but it is sure to work, and will give satisfaction. Instead of having to close a circuit, this one has to be broken, which makes it very simple. A is the wire which keeps the bell short circuited and the moment this wire is broken the bell rings and continues until the switch, S, is turned off. This wire should be placed across a doorway so when the door is pushed open, it will



break the wire; or it may be put at any place where you are sure the intruder will break it. The switch, S, should be kept off when the alarm is not in use as it wastes the battery for nothing.

I think the diagram will serve to make everything clear and show the connections.

Contributed by

Solomon J. Nadler.

A READILY CONSTRUCTED OSCILLATION TRANSFORMER

The following method may be successfully employed in converting an ordinary helix into a serviceable oscillation transformer.

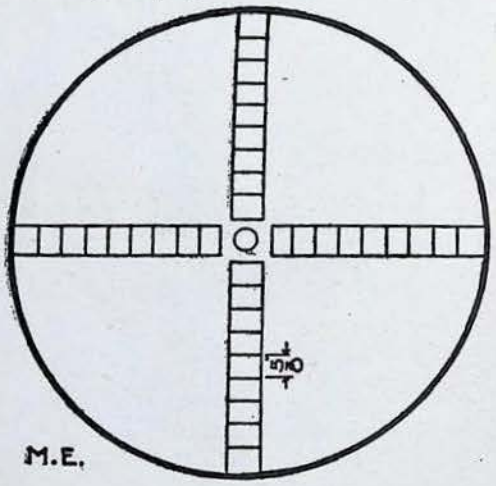


FIG. 1

Dismantle the helix—in my case it was composed of two pieces, ten inches in diameter for heads—and through the exact center of each head a hole is drilled corresponding to the size of rod to be used. If the rod is square, a piece of square brass tubing or a piece of

sheet brass is bent square and forced into the hole, practically making it square.

From a piece of hard wood three-fourths by one-half inches, eight pieces are cut, each four and seven-eighths inches long. Each piece is provided with eight slots, five-eighths of an inch apart, and wide enough to admit tightly the size of wire to be used. These eight pieces are mounted on the two round discs, four to each disc, Fig. 1. Into these slots the wire is coiled.

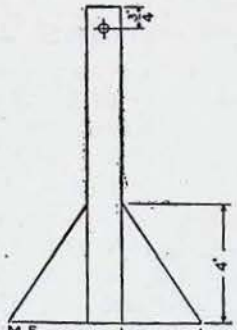


FIG. 2

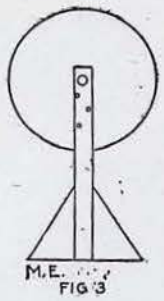


FIG. 3

One of the uprights of the helix is then fitted on the end with two triangular pieces, Fig. 2. Three-fourths of an inch down from the end a hole is drilled. Another upright from the helix is treated in a like manner. An upright with the end pieces fastened on is then screwed to the back of one of the discs, as in Fig. 3, the holes in each exactly corresponding, forming one continuous hole through both upright and disc. This, when completed, will form the stationary winding or primary. The other disc remains free and is to slide on the rod. After mounting both discs

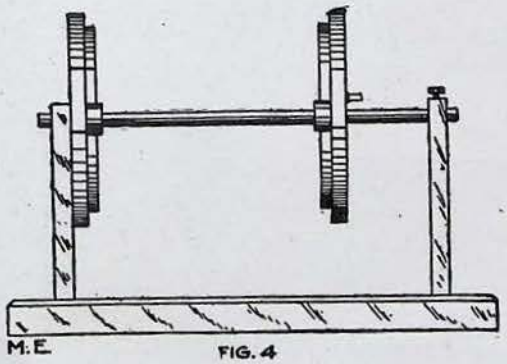


FIG. 4

on the rod the other upright is fitted on the end of it and fastened with a set screw. The hole in the sliding piece should be lined with very thin sheet brass, in order to produce a minimum of friction and cause the piece to slide easily. A hard rubber handle is provided, as shown in Fig. 4. A rod twelve inches long will be found sufficient for most purposes. One end of the wire is brought to a binding post, and variable contact is made by means of clips. When assembled it will appear as Fig. 4. The whole may be mounted on a base board or fastened directly to the table, as desired.

A mission or other oak stain will complete the transformation, and a "lawful" instrument will be provided for the set.

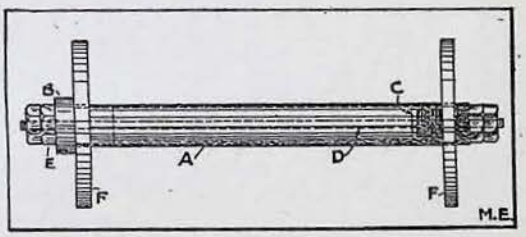
Contributed by

Gregory des Jardins.

AN UP-TO-DATE LEADING IN TUBE

Although it requires a little work to make this tube, it repays you for your work and gives perfect insulation.

Procure a hard rubber or fibre tube, A, ¾ inch in diameter and 1 foot long, or longer if necessary. Next obtain two pieces of hard rubber rod, B, 3 inches long x 1 inch diameter. Turn these down at one end until they fit the inside of the tube tightly, leaving 1½ inch stand out from each end of the tube.



Drill both plugs, B and C, to take ¼ inch brass rod. Thread each end of brass rod, D, for a length of 2½ inches, as shown.

Place plugs in tube and put a length of brass rod through them, leaving 1 inch or 1½ inch of threaded brass rod sticking out, and screw on a nut, E, at each end, hard against the plug. Make two hard rubber washers, F, 3 inches diameter x ¼ inch thick. Bore out one of these washers to slip over tube and press against shoulder of plug, B. Thread the other end of the tube for about 3 inches or 4 inches and screw on the other washer as per sketch.

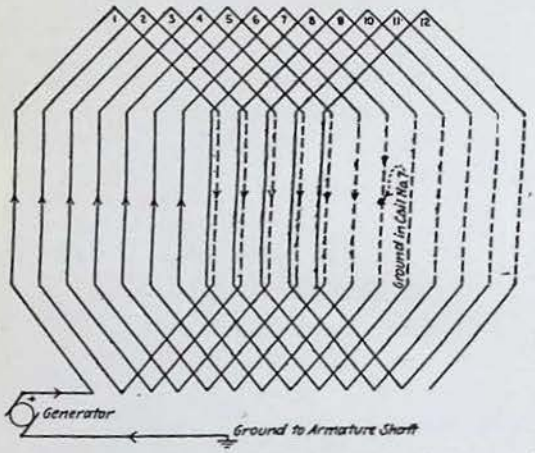
Contributed by *C. Mackenzie.*

METHOD OF LOCATING GROUNDS IN ARMATURES

It is often very difficult to locate a low-resistance or "dead ground" in a low-voltage armature owing to the very low resistance of the windings themselves. In such cases, however, the following method can be employed with very good success:

First, short-circuit all commutator bars by winding several turns of bare copper wire around them; then apply a source of energy, direct current preferred, to the commutator and shaft. The voltage to be used depends upon the resistance of the "ground."

This produces a circuit from the commutator through the grounded coil to the ground and out through the shaft, thus setting up a field around the conductors in this coil. By applying a small piece of iron to the surface of the armature core and gradually moving it around, one can readily locate the grounded coil by means of its field, which attracts the iron.



METHOD OF LOCATING GROUNDS

The same method can also be applied to alternating-current apparatus, although not quite so readily. For example, in the case of a three-phase, single-circuit, Y-connected armature, first disconnect the Y, splitting the winding up into three separate circuits. Then test out each circuit with a magneto or some similar source with which the ground can be located.

Next apply a current to one end of grounded circuit and to the shaft. Assume that there are twelve coils in this circuit, coil No. 7 being the grounded coil, while coil No. 1 is connected to the line as shown in the accompanying sketch.

There will then be a circuit through coils Nos. 1, 2, 3, 4, 5, 6 and 7, which can be readily detected with a piece of iron as previously explained, while coils Nos. 8, 9, 10, 11 and 12 are dead.

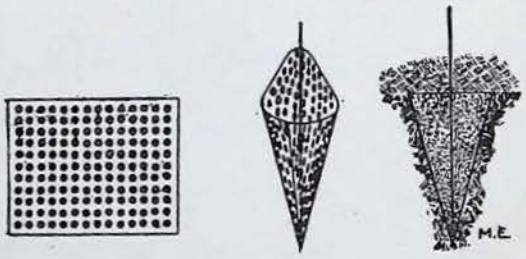
It is then, of course, obvious that if coils 1, 2, 3, 4, 5, 6 and 7 carry a current while coils 8, 9, 10, 11 and 12 carry no current, the ground must be in some section of coil No. 7, the circuit being completed at this point.—*Electrical World.*

AN EFFICIENT GROUND

There are few parts of the amateur's outfit which are more likely to be deficient than the ground connection. Where a water or gas pipe is available a good ground clamp frequently solves the problem, but in many instances the length of pipe traversed before reaching the earth so increases the wave length as to greatly restrict the size of the aerial. In such cases a ground constructed as described will prove much more desirable.

Secure as large a sheet as possible of No. 20 sheet copper or zinc, perforate it with a spike or chisel, roll into a conical shape and thoroughly solder the seam. A stranded wire of at least No. 10 gauge should first be soldered to the inside of the apex.

Fill the cone with coke or charcoal crushed to about the size of a pea and bend the projecting metal corner over the top. Place the completed cone in a hole at least four feet deep and saturate it with several buckets of water. Brine is undesirable in the case of zinc owing to the electrolytic action caused between the metal and the coke or charcoal.



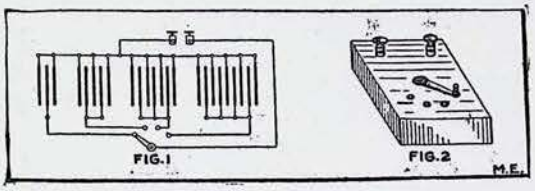
A ground constructed as above has the advantage of not being directional and is equally adaptable to lightning, power, or wireless purposes.

Contributed by *Stuart R. Ward.*

AN ADJUSTABLE CONDENSER

After trying many times to make a variable condenser and failing, I finally succeeded in making an adjustable condenser, of which I here give a description. It consists of four individual condensers thrown in or out by means of a 4-point battery switch mounted on the top.

Each condenser consists of rectangular pieces of tin-foil 3 x 3½ inches, separated by waxed paper. One condenser consists of 3 pieces of tin-foil,



the next of 5, the next of 7 and the last of nine. They are mounted in a box 4 x 4½ x 3 inches and laid one above the other, with a piece of waxed cardboard, or better still, empire paper, between them. After this is completed paraffine should be poured over them, then two bindng posts attached and connected, as in Fig. 1.

Fig. 2 shows it when completed. If thin paper is placed between the tinfoil the capacity will be rather high.

Contributed by

Frank Greenfield.

GOOD LEAD-IN STUNT

In bringing your lead-in through the insulator to your set it is a good idea to make a loop in it and run your insulator at a slight angle to prevent the rain from running through on to your table. The rain will run as far as the loop and drip off on the outside of the house.

Contributed by *Richard Zinn.*

REPULSION EXPERIMENT

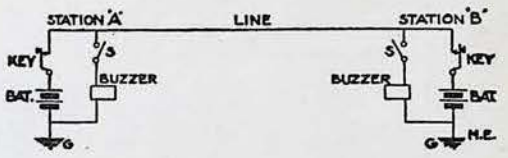
A striking experiment which shows off to good advantage the levitation produced on a piece of aluminum by the employment of an alternating magnetic field may be performed as follows:

A primary coil and core, belonging to a one inch coil, is connected to the low tension side of a step-down transformer. Wind about twenty turns of No. 14 aluminum wire around a tube, so that when the tube is removed and the aluminum wire ends twisted tightly together, we obtain a hollow aluminum cylinder that will slide with ease over the spark coil primary. Place this aluminum cylinder over the primary and support it with the fingers about half way down the core, turn on the lighting current to the step-down transformer and the aluminum will be thrown up into the air clear off the end of the core. If the aluminum be held in the magnetic field it will heat up to make water sizzle.

Contributed by *Alex. Polson.*

BUZZER TELEGRAPH SYSTEM

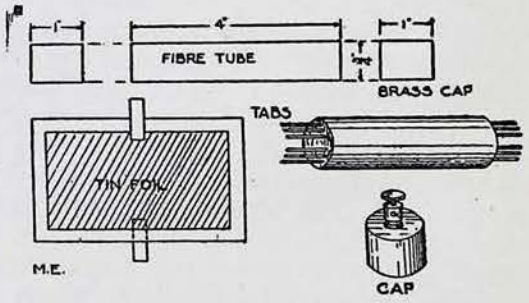
The accompanying diagram shows a buzzer system for learning the code. Everything is made clear by the drawing. By closing the switch at Station B, Station A can operate the buzzer at B, or by closing switch at A, B can operate buzzer at A.



Contributed by *Philip Mentz.*

A FIXED CONDENSER

Secure an old 75-amp. fuse, remove the brass tips from same and clean out contents.



Then either buy or make 15 sheets of thin waxed paper 3½ by 2¾ in. and 15 sheets of tinfoil 3¼ by 2½ in. Three of these will be for the tabs for connecting tinfoil together. Make the condenser like an ordinary fixed condenser.

Condenser is next rolled into a tube, having the tabs come out on the sides instead of the ends.

Fasten the tinfoil tabs on the brass tips, first drilling a hole in the end of each, and inserting a binding post.

This condenser can either be mounted on a base or directly on the table with the rest of your instruments.

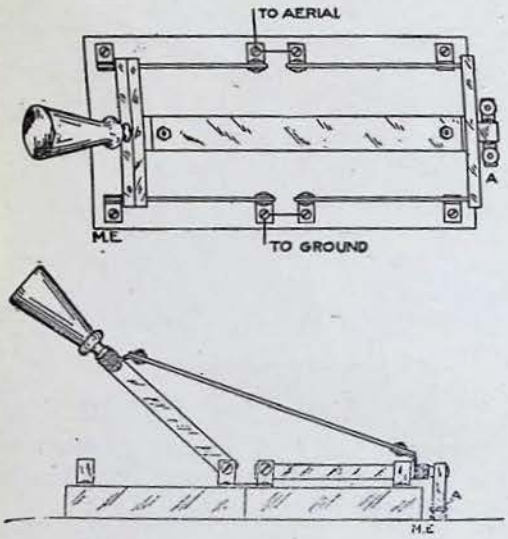
Contributed by

H. Clifford Bullard.

AERIAL SWITCH

The drawing herewith shows an aerial switch, which is purely original in design. I think the drawing explains itself.

The switch consists of two double pole, single throw switches. Almost any size will do. They are placed end to end and connected by a piece of brass strip as shown.

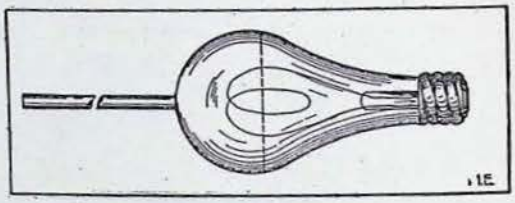


By lengthening or shortening the strip any desired angle may be had, thus making the "throw" of the switch long or short. The writer has one with a throw of less than 35°, making a very quick throw from sending to receiving or vice-versa. The arrangement marked A is a small automatic switch. It consists of two brass springs that are separated by the small hard rubber pillar. This may be of hard wood, fibre or any other non-conductor. When the switch is closed on that side the hard rubber pillar comes between these two springs and separates them. This arrangement may be used to short circuit the detector or in series with the primary circuit of the induction coil. I trust this will be of interest to the readers of *Modern Electrics.*

Contributed by *Edw. J. Wurtz.*

THE CONSTRUCTION OF A THISTLE TUBE

Knock the tip off an incandescent lamp bulb. Hold the broken tip and a piece of chemist's tubing in the flame of an alcohol torch. When both become red, seal them together, being careful not to close the hole. Now use a hot



wire or other suitable means for cutting the glass at dotted line in the figure, and a good funnel tube for handling acids and chemical solutions will be the result. The rough edge may be rounded off and flared out in a flame.

Contributed by *H. W. Offins.*

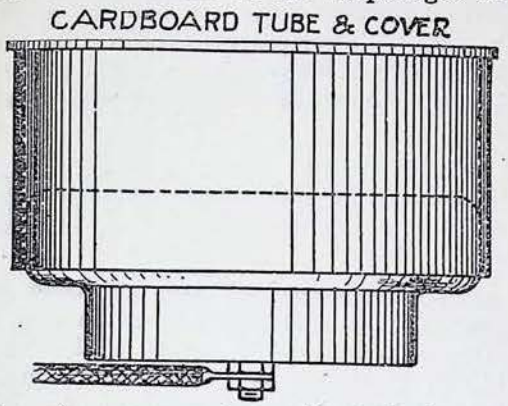
PREVENTING THE RUSTING OF DIAPHRAGMS

To prevent the diaphragm of a wireless receiver from rusting because of moisture which collects on it when the receiver is in use, remove it from receiver, and, after placing it on a flat surface, apply a thin film of 3 in 1 oil to one side. When replacing the diaphragm in the receiver see that the oiled side faces outward.

Covers are necessary to keep dust off this oiled surface when the receiver is not being used. These may be easily made by getting a pasteboard tube, such as pictures are mailed in, large enough to fit snugly over the outside of the receiver ear cap, cut to a length of about 1¼ inches. Over one end of this tube glue a piece of cardboard large enough to completely close that end, and when the glue has dried trim the edges down close to the tube.

When the open end of this cover is gently pressed over a receiver ear cap there will be sufficient friction between the cap and tube to securely hold it to the receiver and prevent any dust from reaching the diaphragm.

If the end cover of the tube is perforated with several small holes there will be no distortion of the diaphragm due



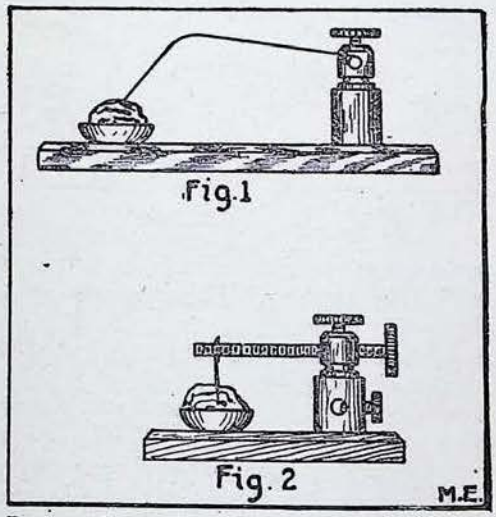
to air compression when placing the cover on the receiver.

Contributed by

Winsor Josselyn.

A NOVEL DETECTOR STAND

The detector stand shown in the illustration is suitable for galena on account of its light adjustment. It is very easy to adjust and may be sealed in as described several months ago in *Modern Electrics*.



It consists of a large double binding post, through the upper part of which passes a threaded brass rod 2½ inches long, which has a porcelain picture knob fastened to one end and 4 inches of No. 34 wire on the other.

The mineral is placed in an ordinary detector cup and the wire bent so that when the knob is turned the pressure on the crystal may be varied.

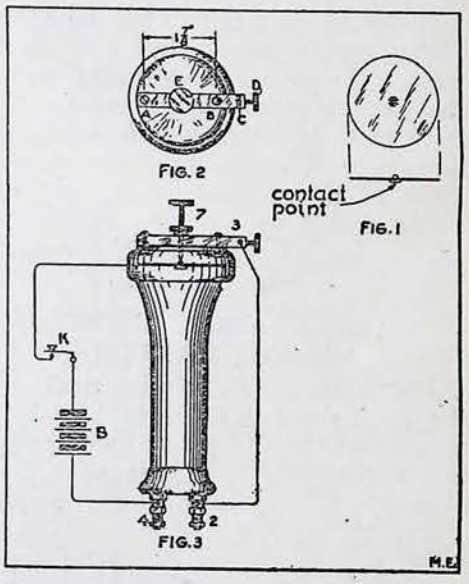
Contributed by

R. S. Crawford.

AN UNIQUE HIGH FREQUENCY BUZZER

I have noticed in the past issues of *Modern Electrics* different kinds of high frequency buzzers but have not seen any like the one shown in the accompanying illustration and described as follows:

Procure an ordinary telephone receiver. Take the diaphragm and solder a small platinum or silver contact in the center as shown in Fig. 1. Then take a piece of ¼-inch brass rod, 3 inches



long, drill a hole ¼-inch from the end A (Fig. 2), and drill a hole 1⅞ inches from the last mentioned hole at B. These holes must be drilled so that an 8/32 screw will slip through. Then drill a hole near the end at C and drill and tap an 8/32 hole at the end D. The last hole is to be used as a binding post. Then drill and tap an 8/32 hole in the center between A and B as shown at E. Solder a platinum or silver contact to an 8/32 screw and insert it in the tapped hole E.

Then screw this bar to the cap on the receiver as shown in Fig. 3. Be sure that the contact on the diaphragm and the contact on the screw are exactly even. The connections are made as follows:

Connect a wire from 2 to 3. Then connect a battery to 4 and the other side of the battery to a key. The other side of the key is connected to 5.

To make the connection to the diaphragm, drill a small hole on the side of the cap as shown at 5 and insert the wire before screwing the cap on tight. Be sure and scrape some insulation off of the diaphragm so the wire will make proper contact.

If this will not work at first change the connection on the battery so that the poles are changed and also adjust the contact 7. When properly adjusted this buzzer will give a high tone such as the quenched sparks used by the Government.

It can be used to practice with, as a buzzer test or for sending a short distance. If used for transmitting connect the aerial to 3 and the ground to 5. A small receiving condenser is used when three or more new dry cells are connected to it.

Contributed by

L. P. Lennard.

A SIMPLE AND EFFECTIVE AERIAL SWITCH

The following description deals with the making of a good aerial switch. It consists of the following: One chestnut board, 9"x5"x⅞" for base; two brass strips 8½"x½"x⅛" for blades; one piece

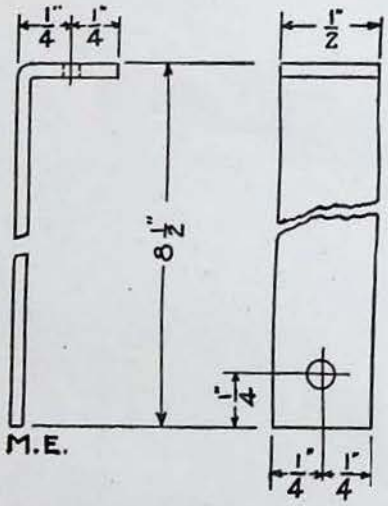


FIG. 1. FIG. 2

of hard rubber 4"x⅛"x¼"; one hard rubber handle; four jaw posts and 2 hinge posts which can be made or bought; one chestnut upright 4½"x1½" x⅞"; one piece of chestnut 4"x1"x⅜" which is to hold the jaw posts on top of the upright; eight battery binding posts; two round head brass screws 1" long, and four small brass bolts ½" long by ⅛" in diameter.

The switch blades are bent as shown in Fig. 1. They are bent by first heating them with a bunsen burner and putting them in a vise, bending them into shape.

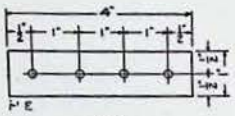


FIG. 4

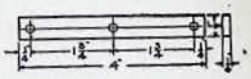


FIG. 3

After these have both been bent bore ⅛" hole near each end, as shown in Fig. 2. After the holes are bored in the hard rubber in Fig. 3 take two of the brass bolts and fasten switch blades to it. The jaw posts on the base may be fastened so that the connections are made underneath and do not show. Then the part shown in Fig. 4 is screwed to the upright and this in turn screwed to the base with 2 screws underneath. Then the jaw

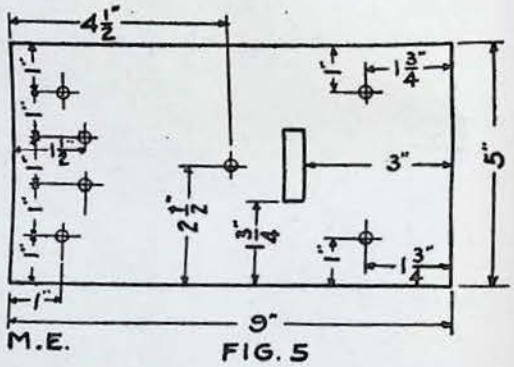


FIG. 5

posts may be fastened to the cross piece with the battery binding posts so that they will come out of the top. The hinge posts at the back are connected with wire to the binding posts 1 and 2 in Fig. 5. The hinge posts may also be fastened on with the binding posts. Before putting parts together the base should have a quarter-inch bevel on it and the woodwork should be given one coat of mahogany varnish stain. I will leave the rest to the maker.

Contributed by *Chester Stephen.*

All amateurs wishing to join in the movement connecting the amateurs of the Middle West and the East together should address all communications to V. F. Pardieck, 320 So. 8th street, Richmond, Ind.

The Mystery of the Ventura Converter Station

By George Frederick Stratton

IT'S the most astounding thing I ever heard of in my life!" exploded the Manager of the great Wasatch Power Plant. "The most astounding! Operating their entire street railway system without power!" and the diamond on his finger flashed through the air as he swung his fist around and crashed it down on the desk.

"It's a mystery!" groaned Marsland. the chief engineer.

"We've been figuring right along to furnish their current," fiercely exclaimed the Manager, "and now you say that they're running their converters and transformers in plain sight; feeding the regular system of trolley wires, and yet they've no power to make the juice!"

"Not one horse power!" asserted the Engineer. "Not in sight, anyway."

"Nor out of sight, I suppose?" sneered the Manager. There was a sharp touch of cynicism in his tones, which was not lost on the Engineer, and the deep furrows in his brow crowded together as he retorted:

"If it's out of sight it's out of sight, Mr. Ballingford."

The Manager forced a smile. "That's of course what I meant, Marsland."

The Engineer's frown mellowed a little. "They're making no steam, that's sure. The capping of their little smoke stack is as white as when they finished it, three months ago."

"But I hear that they put a boiler in," asserted Ballingford.

"A little hundred horse power, for heating only. It isn't even connected up yet, and there isn't even a donkey-engine on the place!"

The Manager gasped again: "And yet they must be using three or four thousand horse power! Isn't there anything, Marsland, to indicate how they are getting their power? Can nothing be obtained from their men?"

"Well, of course, I cannot act as a detective, Mr. Ballingford. But I have asked questions of one or two men and they know nothing. Sinclair, the Engineer, only laughs and says that they have their own private stock of power. Whatever the mystery is, it is in the knowledge only of the few chief men."

"Where do the conductors to the transformers come from?" demanded the Manager.

"I couldn't trace them. There's a room just overhead—a small room—and that seems to be where the mystery focusses. No man ever goes into that room except the engineer and his assistant."

"And it isn't possible for any power to be made there?"

Marsland shook his head gloomily. "The floor beams are very light; there's no foundation for any machinery, and there's not the slightest noise or vibration. Not even as much as a boy's model engine and generator would make!"

"And there isn't a wire running into the house?"

"Nothing but the telephone line!"

"Would an underground cable be possible, Marsland?"

"From where?"

Ballingford shrugged his shoulders, and his eyes narrowed to pin-points. "There isn't any power-plant to connect to nearer than our own, and that's twenty miles away."

Marsland grinnned. "It would be the same if we were within two miles—or one! No trench could possibly have been dug without our knowing it. There's been no permit from the city for such construction!"

The Manager dropped his elbows on his desk and his chin on his hands. Marsland continued, meditatively:

"If their converter station was crowded in among other buildings there might be some trick of transmission—out of sight; although, what would be the purpose? But that building is out in the open. There's no possible way in which it is connected up with any other power plant. No possible way!" And, imitating the Manager, he planted his elbows on the opposite side of the desk, dropped his chin on his hands and blankly stared at his chief.

Presently Ballingford straightened up and with a growl of disgust muttered:

"Well! It's none of our business, I suppose. They've got a right to make their power any way they can, and keep it secret, too, if they wish."

Marsland's eyes focussed on the Manager's. "It'll be our business before long," he murmured. "If they can make three thousand horse power in a little ten by sixteen foot upper room, without using a ton of coal or a gallon of water, they can probably, by bigger equipment, make a hundred thousand horse power—or half a million. We don't know where they begin! How can we judge where they'll end? We may suddenly find ourselves up against the keenest competition in selling power, without knowing why or how! Where would our earnings and dividends come in, then?"

The Manager again dropped his chin on his hands and glared. Marsland continued slowly:

"There's only one unfamiliar thing around their building, inside or out. On the roof, just above that private room, is a light, partially open structure; and inside of that—barely visible —is a metal disc, steel or aluminum, about eight or ten feet in diameter. And it is kept revolving, slowly. None of the men know what that is for; for no one is allowed up there except the two engineers!"

"Just a plain disc?"

"Perfectly plain, as far as I can see. I've viewed it through a field-glass, but can get no details."

"Is it possible they've discovered some method of sun power, Marsland?"

The Engineer, a graven image of helpless perplexity, replied slowly:

"In these times of development, nothing seems to be impossible. But they run without trouble on full cloudy days and at night. If they're making power by sun they must be storing it!"

There were two or three minnutes of silence. Then the Manager's fist again crashed down on the desk:

"We must get on to it, Marsland! The first thing we'll do will be to inspect our transmission line thoroughly. They may be stealing juice from us, although our meters would show that, of course."

Marsland nodded his head moodily.

"Put a good crew on the inspection at once," commanded the Manager. "Let them suspect that there's a serious leak somewhere, and it must be found. We must be sure that we are all right in this matter."

"Yes, sir! I think that's wise. There's no money thrown away on drastic inspection. I'll put Bowditch on it. He's a very careful man, and if he does find anything he'll not talk about it—except to us."

* * * * * *

Inspection of a twenty-mile transmission line over bad country is a matter of days—sometimes many days. While Bowditch and his helpers were on the job Marsland himself tested the meters at the generating house in the Wasatch Mountains and the receiving station at Ventura. He found the leakage along the line very small, and felt a glow of hearty pride at the evident correct installation and fine efficiency of their transmission. But it left him in the dark as to the origin of the Ventura Street Railway Company's power. He knew that Bowditch would find no indication of crooked play on the line, for his own tests showed that there was no current missing.

He was sitting on a big insulator out in the yard, gazing across the short space of sage-brush at the mysterious converter station, when a man approached. His face had the stubby growth of a ten day's beard; his eyes had a hungry, yet hopeful look; his clothes were faded and tattered. He was evidently one of the products of far western irresponsibility—a derelict.

"Well?" said Marsland, questioningly.

"Is there any chance for a man on your works, sir?"

The Engineer started at the voice. It was of a quality entirely out of accord with the dilapidated appearance of the owner. He looked again keenly at the tramp:

"What can you do?" he demanded.

"Rewind an armature, balance a turbine wheel or work on the hooks if I can borrow a pair," replied the man simply.

"Well," retorted Marsland after a pause, "You'll have to confess, my friend, that your appearance doesn't

back up your statement. What's wrong with you?"

"Klondike and whiskey! Too much money one time, too little another!" Then after a pause, during which he fumbled with his buttons, he added, bitterly:

"This is my first appearance in this role. I haven't graduated to this without some pretty strenuous endeavors. Normally I'm only an electrical engineer, you know."

Marsland noted that beneath the assumption of easy carelessness, there was a strong gleam of honesty; also of weary despair.

"Got any more to tell?" he asked abruptly.

"Not about myself; you wouldn't care to hear it. It's just the old miserable story—homesickness; the excitement of success; then taking things as they come—going with the current, mentally and morally. Still——" he added slowly, "I think if I got to handling the juice again, I'd be all right. I don't want to make promises, but—give me a chance, won't you?"

"How much experience have you had on such work?"

"I ran some of the copper on the Mount Ranier lines, which is some running; and I was assistant engineer in installing the Red Bluff plant on the Snake River. I've met a lot of new conditions, although I'll not claim that I know it all." Then his wrinkled face broke into a curious gleam of amusement, and with twinkling eyes he continued:

"I saw something this past week that goes beyond any experience I ever had or heard of. Shall I tell it, sir?"

"Go on!"

"I was tramping across the Mojada range, coming down the Lost Streak Canyon. There's a power house up in there, four miles from the mouth, about three thousand kilowatts; and I stopped in and got a meal, which was sure welcome; and I helped through the day on shifting some transformers. There's only two men there, and it's a smooth running plant—very."

"Then I tramped on, and walked through a cross gulch to make a short cut out. It was along the run of their transmission line, and two miles in I came to a point where the line was down!"

"There's nothing remarkable about a line being down, of course; but this line had been down for two days at least; and——"

"How did you know that?" interrupted Marsland.

"It had been cut down by a big cottonwood which laid in it; and that tree had been torn out two hundred feet up the side hill. There'd been a fierce storm two nights before, and that tree had been uprooted then and hurled onto the wires. It must have been! And yet their generators up at the power house were pumping out juice as if nothing had happened. The ammeters showed a fair normal output. Everything was running steady!"

Marsland's eyes bore into the man's, and with almost a sneer he grunted:

"And I suppose you saw the current bridging from one end of that broken transmission line to the other, eh?"

The derelict grinned. "The line was dead, of course! Now, where is their juice going? They sure didn't know of that break and they didn't care!"

"Another transmission line — of course," sneered Marsland.

"Absolutely not, sir! I was at the power house all one day, and I know what I see when I see it; and I was in plain view of that transmission line until I reached the break. There is no other line—positively!"

Marsland sat silently gazing at the man for several minutes. Then he took a ten dollar bill from his pocket.

"Let's see! This is Wednesday. Take this. Get brushed up and shaved, and come here on Monday morning. I'll give you a chance on the line."

The derelict gasped—it was almost a sob. With eyes partly closed he murmured:

"You'll never regret this, sir," and without another word he turned away towards the town.

Marsland still sat gazing at the mysterious converter station for some minutes. Then he strolled into the office building and entered the Manager's room.

"Mr. Ballingford, I'd like to take two or three days off. I've had some

news which will call me away for that time—no longer, I guess."

"Nothing serious, I hope, Marsland," exclaimed the Manager, sympathetically.

"No, indeed. Just a matter of personal business that I ought to attend to. I'll be back by Sunday, at latest."

He took an early morning train to Green Butes, an insignificant station on the Mojada desert, fifty miles from Ventura. There he hired a horse, and with a sporting rifle slung over his shoulders, he rode out over the twenty mile trail to the mountains. In the foothills he left his horse at a small ranch, saying that he was going to look for a little sport in the hills; and working up the canyon for a mile he struck into a side gulch to the north, for across that gulch in a long sagging arc hung the lonely transmission line of the Mojada power house.

He followed that line for another mile across the wildest and roughest of country. Then his eyes lit up as he suddenly came to the break—the dead ends of the wires buried beneath the gigantic cottonwood. "That derelict told me no lies, so far!" he smiled to himself.

Two hours later, following the line of the wires, he reached the power house, at the foot of peaks rearing fifteen hundred feet around it. From one of these the weird, snake-like flume led in crooked stretches down to the turbines.

He threw himself on the ground and looked at it all. In a few minutes he drew his field-glass from his pocket; and as he gazed through it a grin of satisfaction shaped the curves of his lips. Among the poles and wires about the house he saw, at one end, a structure similar to that on the roof of the converter station at Ventura. He was too distant to get any details—to see if a similar disc was there—but as he slipped the glass back into his pocket, and rose to his feet, he muttered: "The plot thickens! It looks as if there was daylight there!"

As he reached the power house a loud cheery voice greeted him:

"Man dear! It's Jim Marsland himsel'. Gude old Jim Marsland, wi' a khaki suit an' a real gun. Jim, old man, how's a' wi' ye?"

"This is a surprise, MacPhee! I didn't know you were up here."

"Only been here six months, or to be preceese, five months an' a bit; but it seems like six years. It's the gran'est place for monotony ever invented. Come right in to dinner, man!"

And the cordial invitation was extended to supper and bed. Through the afternoon Marsland stayed around the power house, his keen, experienced eyes seeing all that was visible, and some things which were not visible.

"You've got a good plant here, Mac!" he exclaimed admiringly. "I never saw equipment running smoother."

"I'll na say it's not, Jim. It's reesonably gude; forbye the water has its defeeciencies, like us a'."

"Does your transmission line ever give you trouble? It runs over a rough country, I guess."

"We'el, it might be better, an' it might be waur'. The deevidend-huntin' directors dinna think it necessary to pit on a regular inspector an' we have to take our chance wi' the tempests, an' wi' flytin deils o' hunters cuttin' the line wi' bullets. It's irritatin', Jim; just irritatin'!"

Marsland wheeled round to conceal his irrepressible grin. Pointing to the structure on the roof, he asked:

"What's the idea of that rig, Mac? Fire protection?"

"Ye're na so far astray, Jim! It's just a leetle expeerimental contraption of some book engineer; a lightning arrester."

"So! Any chance to look over it?"

"Ye canna!" grinned MacPhee. "It's locked up seecurely, an' na mon sees it but the inventor himsel'; an' it's sma' gude it does him, I obsairve. He comes oot here, whiles, an' dodders round wi' a monkey-wrench an' a blueprint. It's a sheer kytin' nonsense, I mind!"

"Well, I'll take a little tramp up the canyon," laughed Marsland. "It's seldom I get an outing among such hills as these."

"Ye'll maybe find a mountain lion or a coyotte; forbye a sma' deer," grinned MacPhee. Marsland tramped off up the walled-in boulder-strewn canyon, until a sharp bend took him out of sight of the power house. Then he scrambled up the precipitous moun-

tain side, grasping at jutting points of rocks or knarled tough clumps of scrub oak until he reached the flume, a thousand feet above. Skirting alongside of that until he again caught sight of the power house below, he cautiously crept among the sparse brush until he was at the upper end of the acutely descending flume.

There, in its shadow, he laid on the ground, and through his field-glass examined the house. From that elevation he could see over the edge of the curious frame structure, and an emphatic grunt of satisfaction came from him as he saw, just below that edge, a metal disc slowly revolving.

"The trip's given me so much!" he chuckled. "We know now, no doubt, where the Ventura power comes from. The two arrangements are identical. But——" and a fierce grunt of wonder broke from him—"what are they for? Where is the transmission?"

The building laid almost due east of him. Beyond it down the canyon, which widened rapidly, was an open view clear to the outlying desert. Behind him and on either hand were the hoary summits of the peaks rising five or six hundred feet above where he sat; and behind them again the sun had sunk, putting the rough rocky mountain sides and the deep canyon into heavy gloom. Only the bright polished surface of that metal disc, and its revolutions causing some flickers on its surface, enabled the Engineer to correctly recognize it.

But did the movement cause those flickers? He fixed his gaze upon it, straining every nerve of sight and understanding to check his suspicions. For nearly half an hour he sat almost motionless and the shadow on the building darkened. Then with a thrill of surprise he saw that a change had come over the disc—a color of dull cherry. It was hot—almost red hot; and from its surface glittered myriads of tiny sparks. His first thought was of fire, but there was no smoke—not a particle, and the sparks did not ascend as they would in an air current. They sprang from the surface and as instantly disappeared. Nor was there any of the fitful irregularity of combustion. The heat glow was absolutely steady, and he realized that it was continuous through the day, but only visible as the sun went out of competition.

He slipped his glasses into his pocket with a deep sigh of relief: "I guess I've got it, all right!"

Half an hour later he was back at the power-house listening to MacPhee's dissertation on the chances of game in cross canyons farther up the range, followed by an evening full of reminiscences of their old experiences together; but with no allusions to the power-house and its peculiarities.

As he was exchanging hearty farewell greetings with the old Scotchman in the morning, he grinned:

"Mac, you always were a good engineer, and pretty well loaded up with originalities; but you've developed one quality you hadn't before. You've become a colossal liar!"

"Ye're vara jocose, Jim. More jocose than specific, I obsairve."

"I can be specific, Mac! You said that your transmission line was working perfectly; and I know that not one watt has gone over that line for three months, at least. The line even now, is on the ground, cut down by a big cottonwood a couple of miles up that cross canyon!"

"Bosh!" grinned MacPhee. "Did any mon ever hear the like?"

"And that rig you claim is a lightning arrester, is a lightning producer! Blue static sparks, at that!"

"Rin awa' hame an' play at somethin' else an' be damned to ye, Jim Marsland!" laughed Mac. "Ye've got a bee in your bonnet, man! When ye think ye ken what it means come up here again an' I'll tell ye if ye're right. Ye'll always find a bottle of as gude wuskey as ye foun' last nicht; and ye'll na dispute my knowledge an' judgment on that, whatere ye may think of it on the transmission."

* * *

The Engineer reached Ventura on Saturday morning; went directly to the Manager's office, and there, to his great surprise found Sinclair, the engineer of the Ventura Street Railway.

"I'm glad you got back just now, Marsland!" exclaimed the Manager. "You're acquainted with Mr. Sinclair?"

The two engineers shook hands cordially, and the Manager continued:

"Mr. Sinclair has just come in. He

states that he has a new method of transmission to lay before us. That's why I'm especially glad you got back in time to hear him."

"So am I!" grinned Marsland, "for I know what it is, although I'd like to hear something about the details."

Sinclair gasped in surprise and the Manager exclaimed:

"You know what it is, Marsland! Is that what you've been away for?"

"Sure! I've found where the Ventura power comes from—the Lost Streak Canyon, over in the Mojada range—seventy miles from here!"

"Seventy miles!" gasped the Manager. "With the transmission hidden?"

"It's in plain sight!" grinned Marsland, "only you can't see it. It's wireless!"

"Wireless! Three thousand horsepower by wireless? And for seventy miles!"

Marsland smilingly glanced at Sinclair who grinned back.

"That's correct, Mr. Ballingford. It's wireless, all right, and it's perfectly satisfactory"

The Manager dropped back in his chair and gasped:

"It's come at last, eh?"

"At last!" muttered Marsland. "And I suppose, Mr. Sinclair, that those discs are your aerials?"

The engineer nodded: "We've been keeping under cover as well as we could until we had perfected the details; but they're all right now. I want to ask you to make an appointment to come over and examine it all. We're ready now to grant leases to all power-producers—to relegate transmission towers and cables to the junk-heap. Don't you see!"

Wireless Telegraphy More Powerful at Night

It was supposed by Marconi that the sunlight ionizes the air and thus produced losses of energy around the antennæ and a diminution of strength in the signals received. This, according to the inventor of wireless, was enough to explain the relatively greater strength of night messages. Due, however, to the discoveries at the Arlington station, it is now known that the 1 or 2 per cent. differences between day and night messages, cannot thus be explained.

The facts found by the director and chief of the Arlington station make the older explanations unlikely, because it is known that in certain regions and with certain wireless waves, the ground absorption is more than 20 times as great as would be the case if the signals were sent over salt water.

The sun's rays can hardly be thought to affect the losses in the earth to any extent, yet on some nights these waves travel across the same region, reaching the receiving station with as great strength as would have been the case if there had been no absorption at all.

Observations on undamped oscillations from the arc have shown that at night there is a selective strengthening and weakening of the signals with changing waves. During several tests at Arlington, it was found that when the night signals at the receiving station were faint at the usual wave length of 4,100 metres when changed to 3,950 metres there would be always a great increase of strength and vice versa. De Forest explains this by the interference of a set of waves which travel along the earth's surface with another set which has been reflected from the conducting layers of the upper atmosphere.

Calculations prove that the altitude of the reflecting surface would be from 40 to 60 miles. This is where conduction, no doubt, begins. All of this goes to prove that the greater strength of night signals is due not to lessened absorption, but to additional energy which reaches the station by reflection. This difference is much less at long wave lengths than at short ones.—*Dr. L. K. Hirshberg.*

THE RADIO RELAY CLUB OF THE EASTERN COAST

All amateurs living within a radius of 200 miles and having a power of less than a four-inch coil or ¼ kw. are requested to join. The project of the club is to establish communication by radio by relaying to all stations within this radius. It is desired that all amateurs within the radius of Oyster Bay, N. Y. address H. C. Mulford, Oyster Bay, N. Y.

ANNIVERSARY OF INCANDESCENT LAMPS

The thirty-fourth anniversary of the birth of the Edison incandescent lamp occurred on Tuesday, October 21, for it is recorded that on October 21, 1879, Edison, after many patient trials, carbonized a piece of cotton sewing thread bent into a loop of horseshoe form and had it sealed in a glass globe from which the air was afterwards exhausted. This lamp when put on the circuit lighted up brightly to incandescence and maintained its integrity for over forty hours. This was considered to be the first practical incandescent lamp. Shortly afterwards Edison's famous "paper horseshoe" lamp appeared, which was considered by many to have been the first thoroughly commercial lamp, and of which some 700 or 800 were installed in the Edison laboratory and workshops, dwelling houses and through the streets of Menlo Park, N. J. The filament of this lamp was cut out of a piece of bristol board, which in carbonizing shrunk about one-third in size. Before arriving at this form, which in later years was superseded by the squirted filament type of lamp still used to-day, Edison had in common with various other inventors experimented with incandescent platinum as an illuminating agent. Lamp filaments were also made of thread rolled in tar, from graphite and of many kinds of vegetable fibre. From the first Edison aimed to make each of his lamps an independent unit, consisting of a high resistance filament sealed in a glass receptacle with platinum leading-in wires.

Little is known of the characteristics of the first incandescent lamp. Edison's carbon filament lamp had a resistance of 140 ohms hot and more than twice that when cold. With such a high-resistance filament he was enabled to connect his lamps across the electrical conductors like rungs in a ladder, and did not require large conductors as each unit only took a small amount of current. These conditions were essential to the commercial success of the incandescent lighting system.—*Electrical World.*

The Interborough Rapid Transit Co. of New York City has contracted for the installation of three turbo-alternator sets of 30,000 kw. each for their 74th street power house. These three units will be installed in the space now occupied by four engine-driven units of 7,000 kw. each. By this substitution an output of 90,000 kw. will be secured in place of the present 28,000 kw., a gain of 62,000 kw. with no increase of floor space. This very strikingly illustrates the superiority of the steam turbine over the steam engine.

Each of the new units consists of two turbo-alternator sets. The first, running at 1,500 r.p.m., takes steam at boiler pressure and exhausts into a receiver at atmospheric pressure. From this receiver the second turbine takes its steam and exhausts into a condenser. The second set runs at 750 r.p.m., just half that of its mate.

Each of the engine-driven units which will be taken out consists of two compound engines each having a horizontal high-pressure cylinder and a vertical low-pressure cylinder driving the same crank-pin. These two engines have a crank shaft, common to both, on which the revolving field of the alternator is mounted. The speed is 75 r.p.m. or one-tenth that of the slower speed, and one-twentieth of that of the higher speed turbine-sets which will replace them.

The current from the new units as well as that from the present sets is 3-phase, 25-cycle, at 11,000 volts.

The engine sets are not being taken out on account of being worn out in any sense. Indeed they are in excellent condition. The change is dictated by the necessity for more power and the prohibitive price of real estate in New York City.

ELUCIDATED

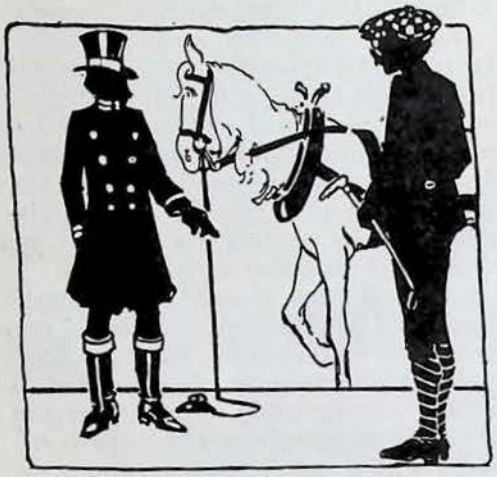
"Henry, it says here that Mr. Jackson pelted the pill for three sacks. What does it mean?"

"Good heavens, Mary, can't you understand plain English? It means that he slugged the sphere safe and landed on the third pillow."—*Chicago Record-Herald.*

EVEN THERE

Just as soon as a man succeeds in getting on Easy street somebody comes along and begins to tear up the pavement there.—*Chicago Record-Herald.*

FLYING SPARKS



PROOF OF INTELLIGENCE

CHOLLY—"Is this horse intelligent, me good fellah?"

GROOM—"Very! Look out he don't kick you, sir!"—*Puck.*

HAD THE GOODS

"I am seeking the light," announced the Pilgrim.

"Well," replied the drug store clerk, "we carry anti-fat and peroxide."—*Cincinnati Enquirer.*

CONCURRING

He—"As I was saying, Miss Maymie, when I start out to do a thing I stay on the job. I'm no quitter."

She (with a weary yawn)—"Don't I know it!"—*Baltimore American.*

TOO RAPID

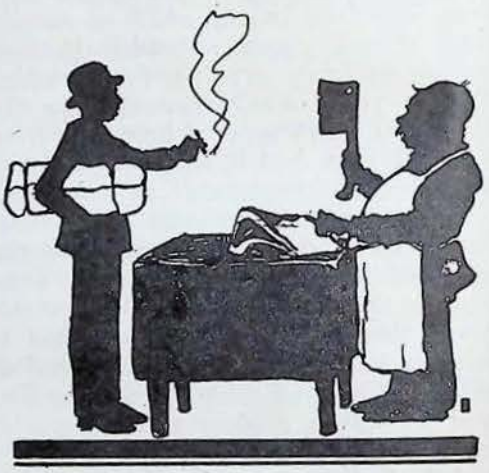
"Isn't it queer the 'movies' never show us any of these Central American revolutions?"

"Not a bit. As a matter of truth, they haven't perfected a film machine yet that can revolve as fast as the revolutions."—*St. Louis Republic.*

EASY METHOD

"I'm tired of life."

"That being the case, go out to California and shout 'Banzai!'"—*Birmingham Age-Herald.*



PERSONAL

Poser for a butcher who gives short weight: If sixteen ounces go to a pound, where do you expect to go to?—*Sacred Heart Review.*

SOME CLASS

"The saleslady's young man was a 'real guy.' He 'never blows his soup like common people—he fans it with his hat."

OLD SAW REFILED

One good way for a man to get ahead and stay ahead is to use a head.—*Dallas News.*

The Wireless Station and Laboratory Contest is continued from month to month. The best photograph, each month is awarded a First Prize of Three (3) Dollars; second best, Two (2) Dollars; third best, One (1) Dollar. If you have a good photograph of your station or laboratory, send it in. If you haven't one, take one, or have it taken.

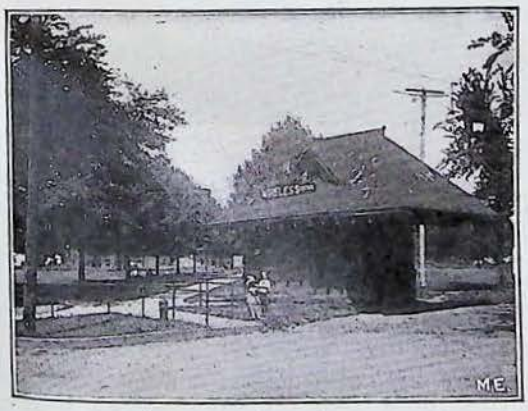
PLEASE NOTE THAT THE DESCRIPTION OF THE STATION MUST NOT BE LONGER THAN 250 WORDS, AND THAT IT IS ESSENTIAL THAT ONLY ONE SIDE OF THE SHEET IS WRITTEN UPON. SHEET MUST BE TYPEWRITTEN OR WRITTEN BY PEN. IF TYPEWRITTEN, USE DOUBLE SPACING. DO NOT USE PENCIL. NO DESCRIPTION WILL BE ENTERED IN THE CONTEST UNLESS THESE RULES ARE CLOSELY ADHERED TO.

It is also advisable to send two prints of the photograph (one toned dark and one light) so we can have the choice of the one best suited for reproduction.

This competition is open freely to all who may desire to compete, without charge or consideration of any kind. Prospective contestants need not be subscribers for (the publication) in order to be entitled to compete for the prizes offered.

FIRST PRIZE

The Wireless Club, of Highland Park College, Des Moines, Iowa, whose members are engineering students, is said to be the only wireless club in the United States maintaining a building used exclusively as a wireless station. Its equipment includes a 2-kilowatt transformer and an aerial of phosphor-bronze wire, size 14, B. & S. gauge. The aerial extends from the pole seen in the right of



EXTERIOR VIEW OF HIGHLAND PARK COLLEGE WIRELESS CLUB STATION

the picture, to an extreme height of 100 feet. The station uses a long wave length and has a transmitting radius of 300 miles. It receives from stations as distant as New York, Washington and Key West. Its station call is "H. P."

INTERIOR VIEW OF WIRELESS STATION

An operator is at the key from 4 to 10 p. m. daily.—*Clyde L. Burrows, Des Moines, Ia.*

SECOND PRIZE

Herewith will be found photographs which were taken while I was experimenting with my portable outfit in the mountains of southern California. I hope that they will be of interest to readers of *MODERN ELECTRICS*.

For an aerial I used two strands of aluminum wire stretched between tall pines. Fig. 3 shows one of my friends

FIG. 1.—USING RECEIVING SET OUTDOORS

fastening a spreader near the top of one of these giant trees.

The set shown in Fig. 2 is very compact and unusually efficient for portable

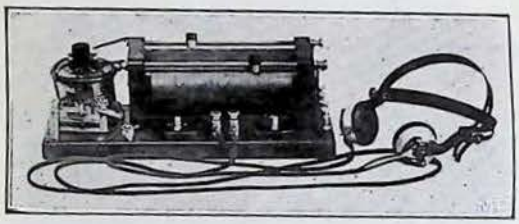


FIG. 2.—RECEIVING SET

apparatus. The receiving instruments are as follows: Murdock double slide tuning coil and variable condenser,

FIG. 3.—FASTENING AERIAL SPREADER TO TREE

Clapp-Eastham detector, fixed condenser, and 3,200-ohm Brandes navy standard 'phones.

A high frequency buzzer is concealed in the hollow base of the receiving set and is used for transmitting messages over a distance of several miles. The necessary switches, binding posts, etc., are mounted on the receiver base.

Fig. 1 shows the set in operation. Many stations were heard, including NPL, NPK, PJ, PI, ship stations and amateurs. I can communicate with another amateur who is experimenting with a portable set several miles distant.

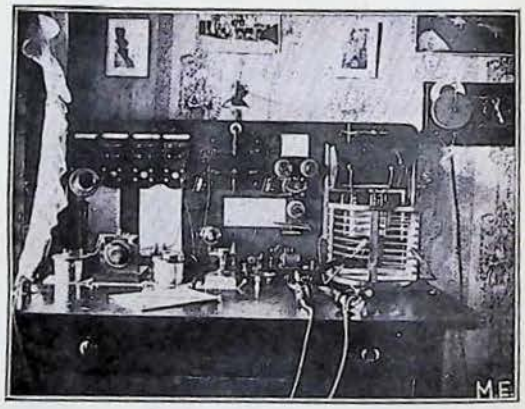
The ranch where the experiments were conducted is about 6,000 feet above sea level.—*Wm. Emmert Lowe, South Pasadena, Cal.*

THIRD PRIZE

I wish to enter the accompanying photograph of my radio station in your contest.

The antenna, which is of the T type, is 75 feet long and 125 feet high, and is composed of 4 wires, which are 7 strand, tinned copper, on 8-foot spreaders.

For transmitting I use E. I. Co.'s instruments, consisting of a 2-inch spark coil, adjustable condenser, helix, spark



WIRELESS STATION OF H. F. HILL

gap and key. The coil is operated by storage battery.

The entire receiving set, except the Holtzer-Cabot 3,000-ohm 'phones, are Clapp-Eastham Co.'s instruments which are as follows: Receiving transformer, variable condenser, fixed condenser, feron detector, and the four duplex loading coils: A. B. C, and D. Any or all of these loading coils may be cut out by simply closing their respective switches. I can cover wide range with these coils, from 100 up to 10,000 metres, and find them the best stepladder there is.

I also have a "Blitzen" wave meter, the condenser of which I use in the primary circuit when not using the meter. By using a variable condenser in both primary and secondary circuits, I get very sharp tuning which is necessary nowadays.

I use silicon and other crystals in the same detector stand when desired.

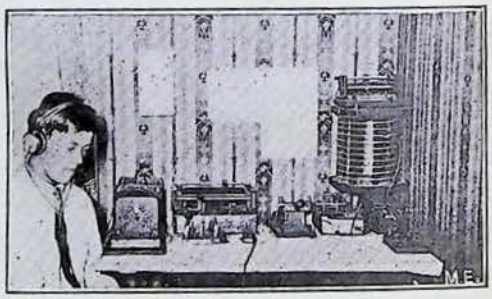
I have had excellent results with my set, and am looking forward to a good season.—*H. F. Hill, Cambridge, Mass.*

HONORABLE MENTION

The flashlight photo herewith shows my wireless station. I have three receiving sets. The first one consists of large loose coupler, fixed condenser, three detectors (two galena, one silicon), and 2,000-ohm 'phones. The second consists of double slide tuner, variable and fixed condenser, two detectors. The third shown on top of the helix, tuner, fixed condenser, and detector.

My transmitting set consists of helix, 1-inch coil, spark gap, condenser, and large home-made key. In the center can be seen a large aerial switch.

My aerial is 43 feet high, 75 feet long. It consists of six aluminum wires spaced 2½ feet apart. I have made nearly all instruments, with the help of *MODERN ELECTRICS.* I have heard stations



WIRELESS STATION OF WM. BILTONEN

nearly a thousand miles overland with this outfit. This is the result of two years experimenting in wireless.—*William Biltonen, Houghton, Mich.*

HONORABLE MENTION

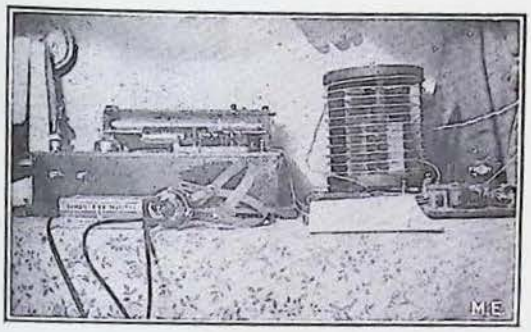
Here is a picture of my wireless station.

My sending set consists of ½-inch spark coil, glass plate condenser, home-made helix, a rotary and a straight spark

gap, and key. The rotary gap is under the table.

My receiving set consists of 13-inch, 3-slide bare-wire wound tuner, single slide tuner used as a loading coil, fixed and variable condensers, silicon and perikon detectors, and E. I. Co. Professional 2,000-ohm 'phones.

The sounder is connected to a private line. All my switches are mounted on



WIRELESS STATION OF WM. T. DUNCAN

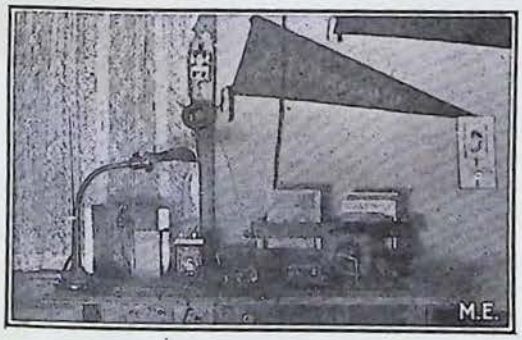
a board on the right hand side of the set and cannot be seen in the photo.

I have done good work with this set and have heard from Boston, all along the coast to NAR, Florida. I hold second grade amateur license No. 93.

My aerial is composed of 7 strands of antenium wire on 12½-foot spreaders.—*Wm. T. Duncan, Brooklyn, N. Y.*

HONORABLE MENTION

My outside apparatus consists of an aluminum four-wire aerial 100 feet long, suspended between a pole on the house



WIRELESS STATION OF J. B. WILBOR

and a high tree, each end being 45 feet high. As you will notice in the photograph, there are two lead-ins leading to a DPDT lightning switch and from thence to receiving instruments and via anchor gap to sending apparatus.

The former comprises one pair Mesco 1,000-ohm receivers, two fixed condensers, one variable condenser, carborundum and silicon detectors, and E. I. Co.'s loose coupler.

The sending set is operated by current from a Thordarson transformer and is composed of one-inch and three-quarter-inch coils, glass plate condenser, Mesco telegraph key and porcelain spark gap, aerial switch, consisting of a DPST and SPST switches, and the anchor gap. I am constructing a rotary from one of the descriptions in the experimental section of *Modern Electrics* and I am sure it will increase my sending range.—*John B. Wilbor, Beaver Dam, Wis.*

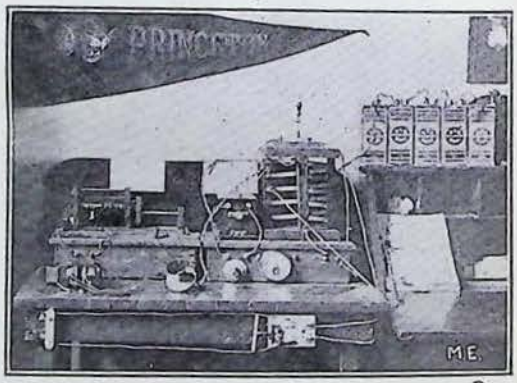
HONORABLE MENTION

I submit herewith a picture of my radio telephone set. The aerial is composed of two aluminum wires 50 feet long on 6-foot spreaders.

The lead-in and ground wire are heavily insulated, No. 8 stranded wire.

The sending set consists of a snap switch, volt meter, ½ inch coil, micrometer, spark gap, helix, condenser and transmitter.

The receiving set consists of a loading coil, two loose couplers, two variable



WIRELESS STATION OF H. A. BEEDENBENDER

and one fixed condensers, silicon detector with a chalcopyrite contact and 'phones. The loading coil and one loose coupler were not connected at the time the picture was taken.

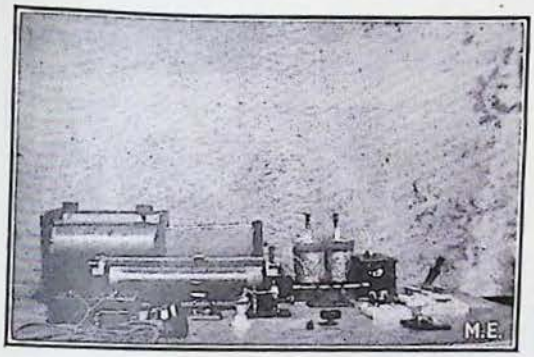
All the instruments were made by myself, except the spark coil, 'phones and transmitter.—*H. L. Beedenbender, Fort Lee, N. J.*

HONORABLE MENTION

The illustration herewith is from a photograph of my radio station.

The sending set, which is seen on the extreme right, consists of a 1-inch sending-coil, two leyden jars of my own type, a flat glass plate condenser made of photograph plates and heavy tin-foil, a zinc spark gap, key and an aerial switch.

For receiving I have a loose-coupler,



WIRELESS STATION OF I. KREIDER

with two slides on the primary; single slide tuner used as a loading-coil; a 51-plate variable condenser; two fixed condensers; one silicon and one perikon detector, and a 1,000-ohm 'phone.

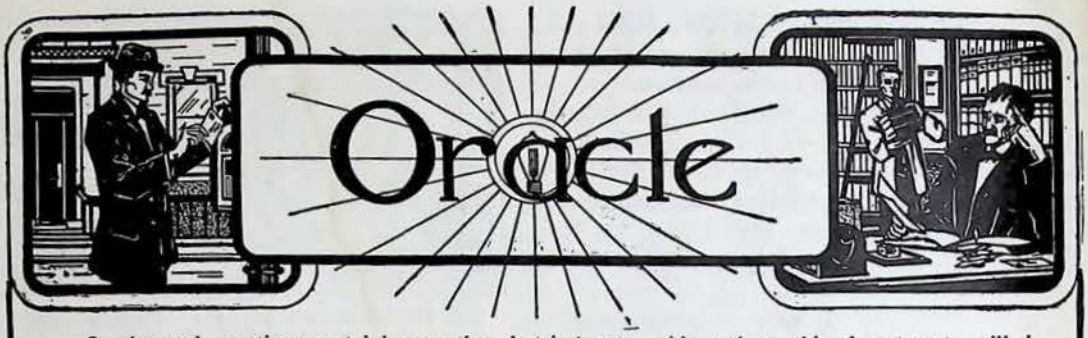
The loose-coupler, loading-coil and condensers are home-made.

All wiring used for connection purposes is laid in grooves underneath the table, excepting from condenser to spark gap and coil. For power I use nine *Red-Seal* dry-batteries. In connecting the receiving set I used stranded lamp cord.

My aerial consists of 6 No. 14 aluminum wires, spanned between two poles 16½ feet above the roof of a 30-foot house. It is 40 feet long and of the inverted L type. With this set I have had as good results as could be expected with such a small aerial.—*Irving Kreider, Philadelphia, Pa.*

NORTH SHORE WIRELESS ASSOCIATION

Amateurs in the art of wireless telegraphy living in Lake View and Ravenwood wishing to form an association which will run under the name of the North Shore Wireless Association, will kindly communicate with Curt Weissmantel, 1700 Nelson street, Chicago, Ill.



Queries and questions pertaining to the electrical arts, addressed to this department, will be published free of charge. Only answers to inquiries of general interest will be published here for the benefit of all readers.

On account of the large amount of inquiries received, it may not be possible to print all the answers in any one issue, as each has to take its turn. Correspondents should bear this in mind when writing.

Common questions will be answered by mail if 10 cents to cover expenses have been enclosed for each question. This class of correspondence has grown to such proportions that we can no longer answer questions by mail free of charge.

Owing to the additional labor required in the gradual advance of the date of publication of this magazine, there will be more or less delay necessary in answering questions and we therefore cannot undertake to furnish quick replies, for the next few months at least.

Special information requiring a large amount of calculation and labor cannot be furnished without remuneration. THE ORACLE has no fixed rate for such work, but will inform the correspondent promptly as to the charges involved.

NAME AND ADDRESS MUST ALWAYS BE GIVEN IN ALL LETTERS. WHEN WRITING ONLY ONE SIDE OF QUESTION SHEET MUST BE USED; DIAGRAMS AND DRAWINGS MUST INVARIABLY BE ON A SEPARATE SHEET. NOT MORE THAN THREE QUESTIONS MUST BE ASKED, NOR SHALL THE ORACLE ANSWER MORE THAN THIS NUMBER. NO ATTENTION PAID TO LETTERS NOT OBSERVING ABOVE RULES.

WE CANNOT ANSWER QUESTIONS REGARDING SENDING AND RECEIVING RANGES.

WIRELESS TELEPHONE, AERIAL CONSTRUCTION AND GROUND CONNECTION

(2556) The Aryan Commercial Company, India, inquires:

Q. 1.—Which is the simplest and best wireless telephone outfit for short distances, as for instance, between two points in a big hall or between adjacent houses?

A. 1.—We would suggest the induction method, *i. e.,* using two large wooden frames on which several turns of wire are wound. One of these windings is connected to a telephone transmitter and several cells of battery, while the other is connected to a telephone receiver. If conversation back and forth is desired, a switch can be employed for connecting either the transmitter and batteries or the receiver to the winding. A description of the construction of such an outfit is mentioned in our publication "The Wireless Telephone," on page 21.

Q. 2.—The lowest height of an aerial to our knowledge should be at least 25 feet. How can an aerial be elevated sufficiently high on a roof that is but 12 to 15 feet high?

A. 2.—You can raise the aerial 10 feet above the roof—giving you a total heighth of 25 feet—by the use of wooden or iron pipe masts. Heavy wooden poles of about four inches in diameter may be used for masts, or, if iron piping is readily available, you can employ iron piping of two-inch diameter. Either of these masts should be well stayed with wires, so as to be rigid. Of course, it would be far better to erect the poles to 25 feet above the roof, for the results would warrant the additional expense and trouble.

Q. 3.—In your book "The Wireless Telephone" you describe two different methods of telephoning by wireless. Could you kindly advise us which is the best method? Are there any special tools for digging down to a depth of 15 feet or more with ease?

A. 3.—We would advise the induction method mentioned in A. 1, for short distances, but for longer distances we would suggest the ground method of connecting wires to two different depths of earth. For digging readily you may obtain a convenient tool known as a post-hole auger that is operated in a very similar fashion to a gimlet, but naturally on a much larger scale. Such a tool may be obtained from The Fenn Manufacturing Company, Charlotte, Mich., U. S. A.

JUMP SPARK IGNITION COIL AND PORCELAIN INSULATORS

(2559) Walter C. Hoffmann, Conn., states:

Q. 1.—I have a two horsepower gasoline engine. Is there any practical way to connect the spark coil to the 110 volt alternating current and thereby eliminate the batteries? The coil is used for jump spark ignition.

A. 1.—No. You had better continue using a battery for operating the coil. If the coil were used on the alternating current supply in series with a resistance or bank of lamps, the contacts would soon burn out and this method is therefore unadvisable to employ.

Q. 2.—Which is the best insulator to employ, glazed or unglazed porcelain?

A. 2.—Glazed porcelain is by far the best insulator of the two mentioned.

CHANGE IN THE CONSTRUCTION OF A CONDENSER

(2560) W. E. Gooden, Man., Canada, writes:

Q. 1.—Kindly let me know if the condenser for a one-inch coil appearing on page 369 of the July issue would be of proper capacity for the same coil if the plates were coated on one side only with foil and pressed together leaving no air space between. If not, what would be the proper area of foil for this condenser?

A. 1.—The capacity of such a condenser as you describe would be satisfactory for use with a one-inch coil, but it is apt to heat up readily because of the lack of provisions for keeping it cool.

CALL LETTERS AND ELIMINATION OF INDUCTION SOUNDS

(2561) Frank Kilander, Texas, states:

Q. 1.—What are the call letters of the United Fruit Company's stations at New Orleans, Cape San Antonio, Cuba, and Swan Island?

A. 1.—The call letters are as follows: New Orleans, W H K; Cape San Antonio, Cuba, U J, and Swan Island, U S.

Q. 2.—A little less than a block and running parallel to where I will be compelled to erect an aerial, there is a

three-phase, 60,000 volt transmission line consisting of three cables. Can the induction from this line be eliminated by the use of a loop aerial? Is the loop aerial better for receiving than a straightaway type and can all induction from arc lights, etc., be eliminated by its use?

A. 2.—It is not probable that you can eliminate all the induction sounds by means of a loop aerial, but it will be materially reduced by using this form of aerial. The loop aerial is said by many to be better for receiving, but this, like many other matters in wireless telegraphy, is the subject of considerable controversy.

RADIO EXAMINATIONS, RECEIVING CONDENSER, AND UNTUNED SETS

(2562) Joseph Hurley, New York, asks;

Q. 1.—When taking an examination for a Radio Operator's License is one questioned about his own apparatus or wireless equipment in general?

A. 1.—The examination consists in testing the applicant's knowledge in general electrical subjects as well as in the theory and operation of wireless equipment of any kind. As, more or less, all wireless apparatus is of the same design, and if one can operate any particular set, he can operate practically any set, the examinations cover wireless apparatus in general.

Q. 2.—Explain how the use of a plate condenser helps to intensify the spark for sending wireless messages.

A. 2.—The condenser stores up energy from the coil or transformer and when it can no longer hold more current, the gap breaks down and the condenser is discharged. By alternately charging and discharging the condenser, a greater amount of current is discharged at one time and accordingly causes greater waves to be generated than if the current of the coil or transformer were allowed to discharge continually across the gap in small quantities. This action is analogous to that of a water pipe that is continually flowing. If the water is allowed to flow out of the pipe, the current is continuous, but will not cause much of a splash if it is dumped into a basin of water. However, if the water first flows into a

bucket and this bucket is emptied each time it becomes filled, the splash will be much greater than by the other means. Thus, the action of the condenser is to store up energy and discharge it in large quantities at regular intervals.

THE RADIO AMATEURS OF DETROIT

A wireless club has recently been organized in Detroit with the following officers: President, Lester M. Ilgenfritz, 2 Forrest avenue, E., Detroit, Mich.; secretary, Sidney E. Anderson, 1320 14th avenue, Detroit, Mich.

While the membership at present is small, we intend to grow during the coming winter. Each member is assessed five cents weekly, the revenue thus obtained to be used in purchasing a wavemeter and like instruments for the use of club members. The President and Secretary are joint operators of a station recently installed at Central High School, conceded by all to be the best amateur wireless station in the city.

THE EXPERIMENTAL WIRELESS CLUB OF LYNBROOK, L. I.

The above named club was formed recently. Its object is to promote the use of wireless and for experimental purposes.

The officers are as follows: Fletcher Jordon, president, and Norman C. Cowper, secretary and treasurer.

They would be pleased to hear from other organizations. Address all correspondence to the secretary, Lynbrook, L. I.

THE COUNCIL BLUFFS RADIO ASSOCIATION

The Council Bluffs Radio Association of the Y. M. C. A. was organized some time ago and elected the following officers: Harold Joseph, president; Clyde Stilwell, vice-president; Harold Kerney, secretary and treasurer, and Arnold Jensen, licensed operator and sergeant at arms.

We would be glad to exchange correspondence with any other club and will do so if they send it to the secretary at 725 Sixth avenue, Council Bluffs, Iowa.

HIGH FREQUENCY WIRELESS TRANSMITTERS

(*Continued from page 933*)

expected from it in the future. But at present it is not used to any considerable extent for commercial purposes.

Although the rotary and quenched gaps are used to a great extent today, the old stationary gap is still used at a number of stations. The only advantages of this gap are its cheapness and simplicity, while besides the disadvantages spoken of above, might be added the necessity of very high voltages, from 30,000 to 50,000 (only 12,500 volts being necessary with the rotary and quenched gaps), the large condensers needed, and the changeable character of the sparks. Nevertheless the stationary gap may be used to good advantage if a stream of air is forced through it that serves to blow away the burnt air and thus preserves the insulation of the gap, allowing only one discharge across the gap per cycle of the applied current. This requires an exceedingly swift current of air and generally a rotary gap is preferable.

The amateur experimenter generally tries one or more of these ways to produce undamped oscillations, expecting to produce a musical note and to increase his range, but he generally fails in both. Why? First, it is most improbable that the speed with which the revolving studs pass the stationary electrodes is correct, and in such phase that the gap will close every time at the moment when the condensers are at their maximum charge. And, if these conditions do exist, a low frequency would be the result probably twice 120 cycles, or the frequency of the applied current (60 cycles)—though undamped oscillations would be produced, with better radiation. Generally, however, the amateur desires more to have a high frequency than to increase his radation, and his rotary gap frequently produces a high pitch for him, though often it does not. This may be caused by the speed of his motor being too low, but generally it is caused by his induction coil giving too high a voltage and not enough amperage. When, on the

other hand, he experiments with the quenched gap his failure is generally due to his having failed to make it air-tight, and also to the voltage being too high and the amperage being too low. The Poulsen system is very seldom experimented with by amateurs, owing to its expense and complexity, and to their inability to obtain high pressure direct current.

The amateur experimenter generally finds that the low frequency set suits his purpose best, because of its simplicity and inexpensiveness. Another reason is that it is not necessary that he should maintain constant communication with another station. However, one's study of radio-telegraphy is far from complete if he has not studied and experimented with undamped oscillations, for it is there only that he reaches the highest branch of the subject. The quenched gap is used entirely by the German and Mexican Governments, the Hamburg-American Steamship Co., and elsewhere. While the rotary gap, in the service of one of the largest American steamship companies, and in the U. S. Navy, has shown its superiority to other systems, especially in the tropics, though the quenched gap gives excellent results. Sets using high frequency undamped oscillations are coming more and more into use each year, and, if for no other reason, they are therefore worth our study. High frequency wireless systems form a very interesting subject and we may expect the greatest discoveries in radio-communication in the next few years to be brought about through their development. Therefore, it is well to advise those interested in radio-communication to study the subject thoroughly before experimenting with it and then to conduct their experiments accordingly.

THE MALDEN AMATEURS

Recently a number of Malden boys interested in wireless and electricity came together and formed a wireless club.

The officers elected are Emanuel Kline, president; Isaac Horowitz, secretary, and Daniel Barrett, treasurer.

Address all communications to the secretary, 378 Cross street, Malden, Mass.

(*Continued from page* 934)

pieces of apparatus, one being the transmitting set, and the other the detecting apparatus. The latter is contained in a case ten inches long, five inches high and four inches wide. The transmitting set consists of a storage battery and a special form of transformer coil with necessary connections and switches, to transmit a current of electricity through the line. Another compartment of the same box holds a reel on which is wound about 500 feet of copper wire.

It may be stated that the indicator or detecting apparatus is composed of a supersensitive current detector of special form, while attached to it by a connecting cord are two special sensitive telephone receivers with a head-band.

In order to operate, one end of copper wire is attached to a faucet or other fixture which connects with the pipe to be located and the other end to one pole of the transmitter. Connection is then made to a fixture in some other house, or to a fire hydrant, or valve in the main, to the other pole of the transmitter by this means forming an electrical circuit. With the throwing on of the switch of the transmitting instrument, the current immediately starts running from the batteries and coil through the copper wire and fixture down the piping to the water main in the street returning to the battery and coils again by way of the connections in the second house or through the fire hydrant or valve. The person handling the indicator then places the telephone receivers to his ears and starts on the trail of the "lost pipe."

As soon as a sound is heard in the telephone receivers the operator is approaching the pipe or main which he wishes to locate. When directly over the pipe the sound will be loudest. By manipulating the indicator, *i. e.*, swinging and turning it, the direction of the pipe can be accurately located and by simply walking along the ground in the direction that produces the greatest sound, when the indicator is swung, the location of the pipe or main can be ascertained.

It is held that the same methods apply to gas services and mains. This instrument will also locate exact points of junction between main and service, indicate change in direction and can be used to locate dead ends. The charac-

ter of the ground does not affect it, as asphalt, granolithic, brick, stone, macadam, wood, plaster, dirt, or any other substances do not interfere in any manner with its successful operation.

It is claimed that the instrument has never failed to locate the main or service pipe and has been used in thousands of cases since its adoption by the Water Department of the District of Columbia.

TRI-STATE WIRELESS ASSOCIATION

On Wednesday, August 6, 1913, the Tri-State Wireless Assocation held its semi-annual election and the following officers were elected:

C. B. De La Hunt, president; C. F. Lyons, first vice-president and consulting engineer; J. Marchisio, second vice-president; W. A. McKelvy, recording secretary; Miss Nadie Dacus, corresponding secretary; Jerry Williams, treasurer; H. B. Horn, custodian, and J. M. Daly, technical adviser.

Then, the various wireless topics of the day were discussed, some of which were: The advantages and disadvantages of continuous wave systems; the rotary synchronous spark gap, the Heterodyne receiver, etc. The intricate details of all were fully gone into and various theories were advanced, all of which were of great benefit to all those present, increasing their store of knowledge of the art of wireless and thereby enabling them in the future to be better able to overcome the perplexities which continually confront the experimenter, and which otherwise might halt him in his progress.

As climatic conditions have a marked effect on wireless signals, the Tri-State Wireless Association would be pleased to hear from clubs and individuals in other climes as to the results of their experiments and we will reciprocate by giving our experience.

SUBURBAN RADIO CLUB

The Suburban Radio Club was recently formed and meet at each member's home to discuss principles of the theory of wireless and to practice the code, etc. John Purssell is president and he would like to communicate with other amateur operators. Address J. Howard Fellows, secretary, 5504 Wisconsin avenue, Washington, D. C.

THE NITROGEN-FILLED HIGH EFFICIENCY TUNGSTEN LAMP

(*Continued from page* 940)

filament evaporation, but by proper design of the lamp parts the presence of this gas may be made to prevent blackening of those glass surfaces through which light is transmitted, the result being to make possible increased lamp life at high efficiencies.

In the second paper of the evening, Dr. Langmuir and Mr. J. A. Orange described practical applications of the principles already outlined. By the use of these they have been able to construct large tungsten lamps which, starting with an efficiency of 0.40 watt per candlepower, have run over 2,000 hours, with an average efficiency of 0.5 watts per candle over that period.

Experiments with filaments of various sizes early indicated the desirability of using large diameters. The larger filaments gave not only a better efficiency at any definite temperature, but also a much longer life. Thus doubling the diameter decreased the consumption from 0.65 to 0.56 watt per candle, and increased the life from 90 to 300 hours. This improvement in efficiency is attributed to the relatively greater heat loss by convection from small wires. The life of the filament is determined largely by the loss of tungsten from the filament by evaporation, and has been found to be dependent on the relative decrease in diameter thus caused. The evaporation of tungsten in nitrogen is largely a diffusion process, and is nearly independent of the size of the wire. The rate of evaporation per unit area is thus inversely proportional to the diameter. Relative lives of very small wires in nitrogen as therefore nearly proportional to the squares of their diameters.

But filaments of large diameter require very large currents to maintain them at the operating temperature, 2850 deg.; hence unless very low voltages are used, the power consumed by the larger wires is so large that only lamps of high candlepower could be made. To increase the effective diameter of the filament without decreasing its resistance, a tubular section might be used, but the more practical construction, and the one adopted, takes the form of winding the filament into a tightly coiled helix. Among the advantages incidentally ob-

tained is the automatic correction of local overheating of thin spots in the filament, which would otherwise magnify themselves rapidly. But in the helical filament such an overheated soft spot will be pulled open by the normal tension and sag of the filament, preventing further progress of overheating by providing increased radiation and convection.

In ordinary lamps about 20 per cent. of the energy radiated from the filament is intercepted by the glass and causes heating of the bulb. In the nitrogen-filled lamp, beside this radiated heat, there is an additional amount of heat carried to the bulb by convection—an amount varying with the type of lamp and ranging from 6 to 40 per cent. The convection currents carrying this relatively large amount of heat, travel vertically upward within the bulb, and if they strike a small area of glass, tend to overheat it. This overheating may liberate enough water vapor to cause attack on the filament and blackening of the bulb. The filament should therefore be placed in the lower part of the bulb, and sufficient area allowed in the upper glass surface for the deposit of tungsten nitride.

For bulbs of the same volume the nitrogen lamps give roughly from five to ten times the candle-power of evacuated lamps, but the bulbs of such filled lamps naturally run much hotter than those of ordinary lamps. The upper parts of the bulbs are often 100 to 200 deg. Cent. or more, while the lower parts are sometimes much cooler than this, although closer to the filament. Several special varieties of heat-resistant glass have been used for the bulbs, making considerably smaller sizes possible, as well as rendering it easier to get rid of water vapor.

Special lead-in wires have had to be devised to convey the heavy currents (20 to 30 amp.) involved in the larger sizes of these new lamps. Platinum has been discarded entirely, even in the smaller lamp sizes, special alloys being substituted which have the same coefficient of expansion as the glass. Bulbs of special glass into which tungsten or molybdenum wire can be sealed directly, have also been tried. Where the leads enter from the top of the bulb, special precautions have to be taken to protect the wires

against the high-temperature convection currents.

For the particular type of nitrogen-filled tungsten lamp at present furthest developed, lives of over 1500 hours at efficiencies better than 0.50 watt per candle have been obtained only in large units taking over 10 amp. Lamps running at 0.6 to 0.7 watt per candle, have been made in units taking at least 5 amp.

No serious difficulty has been met in making high-voltage lamps of this type, for in nitrogen at atmospheric pressure there is no tendency toward arcing, even at 250 volts. Many lamps taking 6 or 7 amp. at 110 volts have been made up and run at 0.6 to 0.7 watt per candle, with a life of over 1000 hours.

A number of special types of nitrogen-filled lamps which have been made and tested are the following:

1. Large units of very high efficiency (0.4 to 0.5 watt per candle with a life of 1500 hours or more). These lamps take currents of 20 to 30 amp. and (except in units over 4000 cp.) are therefore best run from alternating-current circuits by means of small transformers or auto-transformers giving a voltage depending on the size of unit desired. Thus, with 30 volts and 25 amp., the power taken would be 750 watts and this, in a lamp of say .045 watt per candle, would give 1670 cp. Higher or lower candlepower may be obtained by using other voltages. A typical lamp of this kind is shown in Fig. 1.

2. Small units of low voltage. These take currents of 10 amp. or less and work at pressures as low as 4 or 5 volts. The efficiencies with 1000-hour life range from 0.6 to 1.0, or even 1.25 watts per candle, according to the current used. These lamps are adapted for series street lighting on 6.6-amp. circuits(at 0.6 to 0. 7 watt per candle), for stereopticon lamps, for automobile headlamps, and for use in general wherever a source of high intrinsic brilliancy, steadiness and white color is needed.

3. Lamps to run on standard lighting circuits (110 volts). Large units of this type (several thousand candle-power) have efficiencies of 0.5 watt per candle or better. With smaller units the efficiency is ordinarily not so high. A type of this lamp is illustrated in Fig. 2. The leads may be brought in from the top, in which case they are preferably made very long

so that the filament remains in the lower part of the bulb.

Besides high efficiency, features of the new lamps which may prove of advantage are:

1. Color of the light. The temperature of the filament being 400 to 600 deg. higher than that of ordinary lamps, causes the light to be of a very much whiter color, so that it comes closer to daylight than any other form of artificial illuminant except the direct-current arc and the special Moore tube containing carbon dioxide. The color is almost exactly like that which can be had for a few minutes by running an ordinary tungsten lamp at double rated voltage.

Work is at present under way to develop special color screens which, when used with this light, will give a true daylight color (corresponding to the radiation from a black body at 5000 deg. Cent.) Such screens will absorb from 65 to 75 per cent. of the light, so that the net efficiency will be about 2.0 watts per candle for a pure daylight color. With ordinary tungsten lamps, the absorption screens now used give a net efficiency of hardly 10 and 12 watts per candle.

2. High intrinsic brilliancy of the filament. At the operating temperature of the nitrogen-filled lamps the intrinsic brilliancy of the filament is about 1200 candle-power per sq. cm. In ordinary tungsten lamps, on the other hand, running at about 1.25 watts per candle, the filaments have a brilliancy of only about 150 candle-power per sq. cm. This feature, combined with the high degree of filament concentration, renders these lamps particularly useful for projection work in head-lamps and stereopticons.

3. Constancy of characteristics during life. It is often possible to design these lamps so that their current, pressure, and candle-power characteristics remain practically fixed during the greater part of their lives. In any case, however, since there is no deposit on the bulb to cut off the light, the candle-power practically never falls below 75 per cent. (this decrease sometimes being due to sagging). The lamp usually fails by the breakage of the filament, with the candle-power well above 80 per cent. of its original value.

The spherical candle-power of many of these lamps has been measured. The ratio of mean spherical to maximum

horizontal (practically mean horizontal also) candle-power has been found to average about 84 per cent. for the lamps made with single loops of helically wound wire.

As an appendix to their paper, the authors also outlined methods of photometering the new high-efficiency lamps with the aid of blue-glass screens. The constants for these glasses having been once determined, there are available a number of standard temperatures ranging from 2250 to 3600 deg. K. By the use of these screens it is an easy matter to set a lamp up at a voltage such that the filament has a standard temperature, say 2850 deg. To do this it is simply necessary to adjust the voltage so that the color of the light from the lamp is the same as that which comes from the standard lamp when viewed through one of the special blue screens.

Those who took part in the discussion of the two papers were Messrs. John B. Taylor, John W. Howell, Farley Osgood, J. E. Randall, William McClellan, John W. Lieb, Jr., H. M. Fales, and M. G. Lloyd.

Mr. Taylor projected on the screen an enlarged image of a nitrogen-filled lamp backed by a reflector, and called attention to the advantages of the new unit for projection-lantern purposes. Compared with the usual arc source, it is much more convenient and uniform in operation, and almost as white in color.

Mr. Howell complimented the researches of Dr. Langmuir, particularly his painstaking experiments giving rigorous proof of what were hitherto only theories. But taking exception to the author's statement that ordinary tungsten lamps fail chiefly by blackening of the bulbs, the speaker pointed out that this observation was intended to apply only to large lamps, and is not true of the small sizes which constitute 75 per cent. of the present commercial output. Lamps like the 40-watt units remain useful until the filament breaks or weakens due to evaporation. Their bulb area, being relatively large, greatly reduces visible blackening. Mr. Howell said he had long recognized three kinds of blackening, the chief of these actions being that due to evaporation, which advances uniformly during the life of the lamp. Many lamp authorities have in the past held this theory. Irregular or mottled

discolorations, on the other hand, may be traced to the presence of a residual gas. The presence of water vapor affects carbon and tungsten lamps very differently as shown by examples which the speaker exhibited. Water vapor in the carbon lamp renders the filament sooty and black, increasing its radiation and reducing its candle-power, by one-half, although the globe remains clear. Later this soot is deposited on the glass, causing blackening.

Mr. Randall submitted a tabulation representing an attempt to evaluate recent progress in lamp development. If 90 per cent. of the theoretical candle-power-hours are developed in 1000 hours' burning (candle-power maintenance and mortality being both considered) the advance from the raw carbon lamp, fixed as 100, he estimated as follows:

Raw carbon filament (cellulose)	100
Treated carbon filament	119
Graphitized-carbon filament	149
Tantalum filament	206
Osmium filament	270
Tungsten filament	359
Nitrogen-filled lamp (estimated)	600

Mr. Lieb remarked that the central station has long since passed the period of showing fear at improvements in the state of the art, and now looks forward with cheerfulness and satisfaction to the introduction of more efficient lighting units as hastening the hoped-for day when electric light will be as accessible as kerosene in the humblest homes. Under competition with the new incandescent illuminant, the arc lamp, predicted Mr. Lieb, will itself shortly make rapid advances.

Mr. Fales pointed out that the telephone companies look to the new incandescent street lamps to replace arcs and thus to eliminate the "noise" troubles often caused by induction from humming in arc circuits.

In concluding the discussion Dr. Langmuir reviewed a number of the points brought up by the speakers. The greater brilliancy of the inner surfaces of the helix he attributed to cross reflection of light, rather than to reduced radiating aperture which, as he showed, could cause only 10 to 15 per cent. difference. At very low pressures, uniform blackening deposits can be obtained on the glass, while convection currents are set up only

at higher pressures. Dr. Langmuir expressed regret that his paper left the impression that he claimed to have been the first to attribute blackening to water-vapor causes, for this view, he said, has been held by others for many years. His own work, he explained, was intended only to demonstrate that all the other bulb gases are inactive and that water vapor is the only one to be feared.

As to the possibility of making nitrogen-filled lamps in small units, the speaker expressed doubt, although he expressed belief that beginning with the 500-watt size, or even smaller, the new lamps can be made in units ranging up to 25,000 or 50,000 cp., with ultimate efficiencies of possibly 0.3 watts per candle-power. Argon at higher pressures, he said, now holds promise of being a great improvement over nitrogen as a gas filler for incandescent lamp bulbs.

The results thus far obtained indicate that argon will be substituted for nitrogen in the lamps just as soon as the rarer gas becomes readily available on a commercial scale. Being one of the rare constituents of the atmosphere it is very difficult to produce in small quantities, but on a large scale it can be made very cheaply, comparatively speaking.

In the process of exhausting lamps, the author questioned whether the size of the constriction, however large, would have any effect on the completeness with which the water vapor is removed, unless a high temperature is maintained at the same time. On account of their heavy filaments the new lamps, he explained, are quite free from showing frequency flicker, even at 25 cycls.

The pressure at which the present "half-watt" lamps are filled with nitrogen—about two-thirds atmosphere when cold—was selected, said Dr. Langmuir, so that when hot the internal pressure becomes just about that of the atmosphere. No advantage would be gained by using higher pressures, which would only increase the likelihood of lamp explosions accompanied by outward-flying glass particles. The new lamps have proved to be extremely stable, he added, none having been broken in handling or shipment. In closing the author paid a generous tribute to the work of Dr. W. R. Whitney of the laboratory Staff.—*Electrical World.*

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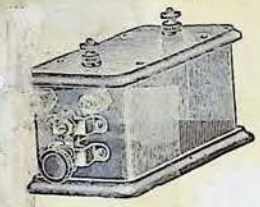

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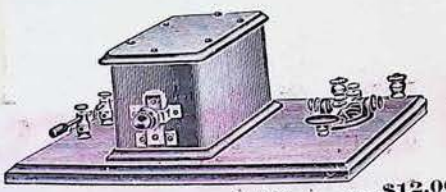

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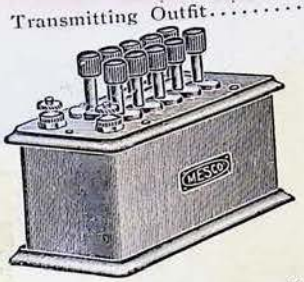

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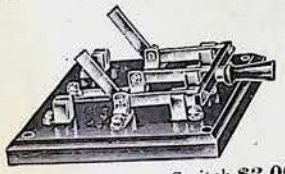

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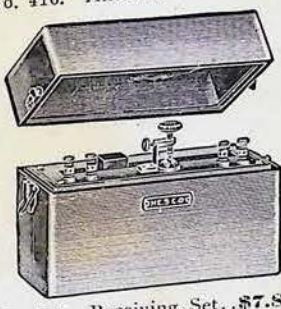

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