THE
ELECTRICAL
EXPERIMENTER

"THE EXPERIMENTER'S MAGAZINE"
A Treatise on Wireless Telegraphy

By H. Gernsback.

On December 13, 1912, the new wireless law went into effect. The average wireless "fiend," who has not followed the topic from the start will be interested in the following facts.

The whole question of Wireless Legislation in the country started in 1908. The writer in his Editorial in the November, 1908 issue of Modern Electrics pointed out that a wireless law was sure to be passed in a very short while. In order to guard against unfair legislation as far as the wireless amateur was concerned, the writer, in a letter Jan. 1, 1909, organized the "Wireless Association of America." This was done to bring all wireless amateurs together and to protest against unfair laws. Previous to this time there was no wireless club or association in the country. In January, 1913, there were over 230 clubs in existence, all of which on the 7th year in the history of the "Wireless Association of America." The association had no sooner become a national body than the first wireless bill made its appearance. It was the famous Roberts Bill, put up by the then defunct wireless "trust." The writer single handedly, fought this bill, tooth and nail. He had representatives in Washington, and was the direct cause of having some 8,000 wireless amateurs send protesting letters and telegrams to their congressmen in Washington. The writer's Editorial which inspired the thousands of amateurs, appeared in the January, 1910, issue of Modern Electrics. It was the only Editorial in the country that fought the Roberts Bill. No other electrical periodical seemed to care a whoopee about the wireless amateur should be muzzled or not. If the Roberts Bill had become a law there would be no wireless amateurs today.

That editorial quickly found its way into the press and hundreds of newspapers endorsed the writer's stand. During January, 1910, the New York American, the New York Independent, the New York World, the New York Times, the Boston Transcript, etc., all lauded and commended the writer's views. (See Editorial article February, 1910, Modern Electrics.) Public sentiment quickly turned against the Roberts Bill and it was dropped.

The first wireless bill not antagonistic to the amateur, the Burke Bill, appeared on March 8, 1910. It had some defects, however, and was dropped also.

The Burke Wireless Bill appeared May 6, 1910, but did not meet with general approval; as the writer pointed out in his Editorial in the June, 1910, issue of Modern Electrics, it had several undesirable features, and the bill was never seriously considered, although it actually passed the Senate. (See Editorial, August, 1910, Modern Electrics.) At last the Alexander Bill made its appearance on December 11, 1911. This bill as far as the amateur was concerned was not quite acceptable to the writer, who had the amateurs' rights at heart, and steps were immediately taken to bring about an amendment as the writer, perhaps, more than anyone else, realized that this bill, in some form or other would become a law sooner or later. This is clearly stated in his Editorial in the February, 1912, issue of Modern Electrics. In that Editorial is to be found also the first and now historical recommendation that if a wireless law was to be framed it should restrict the amateur from using a higher power than 1 kw. and his wave length should be kept below 200 meters. No one else had thought of this before, and it is to be noted that when Congress finally passed the present wireless law, it accepted the writer's recommendation in full, thus paying him the greatest compliment, while at the same time acknowledging the fact that he acted as the then sole spokesman for and in behalf of the wireless amateur.

In March, 1912, the writer, in a letter to the New York Times (See page 24, April, 1912, issue Modern Electrics) pointed out the shortcomings of the Alexander Bill, and protested against unfair legislation. The Times, as well as a host of other newspapers, took up the cry and publicized broadcast the shortcomings of the Alexander Bill. All this agitation had the desired effect and Mr. Alexander for the first time realized that the amateur could not be muzzled, especially when there was such a periodical as Modern Electrics to champion his cause. Promptly in April the Alexander Wireless Bill, amended, appeared and here for the first time in history the amateur and his rights are introduced in any wireless bill.

Mr. Alexander and his advisers accepted the writer's recommendation as set forth in his Editorial in the February, 1912, issue of Modern Electrics. (See Paragraph 15, 2nd Part of this Treatise.) It will be noted that it copied the writer's recommendation word for word.

The amateur had at last come into his own. This is all the more remarkable as this is the only country that recognizes the wireless amateurs.

On May 7, 1912, the Alexander Bill, amended now known as S-612, passed the United States Senate and on May 8th it was sent to the House of Representatives and referred to the Committee on the Merchant Marine and Fisheries.

The bill was signed on August 13th by President Taft, thus making it a law.

This terminated the fight which the writer had waged single-handedly for almost five years in behalf of the American amateur.

Now that it is all over, and that Uncle Sam has set his seal of approval upon the amateur's wireless, the writer cannot
May, 1913

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but extend his heartiest congratulations to the 40,000 American
amateurs; and he furthermore wishes to extend his thanks to all
the amateurs who have supported him in his fight to bring about
a new wireless era in America.

Long live the Wireless Law! Long live the Amateur!

Wireless and the Layman.

PART TWO.

Receiving Wireless Messages.

The question we hear from most beginners is: "What out-
fit do you advise me to use? I know nothing about wireless."

We are not of ANY honest built receiving outfits.

Which one to choose depends upon yourself, your taste and your
pocketbook. This is where YOU must decide.

We consider the receiving instruments as being divided into
three: (1) those used on the station, (2) those used in your
own house, and (3) those used on the road.

1st, the most expensive one, the receiving apparatus on the
station.

2nd, the less expensive one, the outfit used in your own
house.

3rd, the least expensive one, the outfit used on the road.

The first question hurled at us is: "How can I receive mes-

sages if I don't know the codes?"

A wireless telegram, no matter if it is in Chinese or English,
"comes in" in dots and dashes. When you have the telephone
receivers to your ear and a message is coming in, you hear
a series of long and short, clear, distinct buzzes. A long buzz
is a dash, a short buzz is a dot. The E. I. Co. sell a 10c code
changer, which will enable you to connect your regular tele-
phone and make out the dots and dashes. Thus (in the Morse
code), dash, dash, dot, stands for the letter G; dash, dash means M, dash, dot, dot, means J; and so forth. As a rule, a
few weeks practice "listening to the wireless" can master the code,
and read the messages with ease.

Remember there are over two thousand high powered
wireless stations in this country alone, each being able to trans-
smit messages of over a thousand miles distance.

There are almost at any minute, during night and day,
messages in the air, no matter where you are—sending YOU
messages, only waiting to be picked up by you. It is truly won-
derful, to think that as well as the highest elevators, known to
modern man, the most inspiring example of the tri-
umph of mind over matter.

"What is the Wireless Law?", you want to know next.

The law does not apply for stations used for receiving only.

There is no law which forbids you to receive all the messages
you wish. You can receive as many and as long as you please,
Uncle Sam doesn't mind. But you MUST preserve the secrecy
of the message. You must not make use of any information
you receive by wireless, if this information is of such a nature
that makes it private property. Your own conscience will tell
you which message to keep secret and which one you can make
use of. Here is the text of the law:

"Nineteenth. No person or persons engaged in or having
knowledge of the operation of any station or stations, shall
authorize or permit the contents of any messages transmitted
by such station, except to the person or persons to whom
the same may be directed, or their authorized agent, or to an-
other station employed to forward such message to its destina-
tion, unless legally required to do so by the court of competent
jurisdiction or other competent authority. Any person guilty of
divulging or publishing the contents of any messages trans-
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than two hundred and fifty dollars or imprisonment for a period
of not exceeding three months, or both fine and imprisonment
in the discretion of the court.

Of late a great many stations are beginning to use the wire-
less telephone. This art is rapidly being perfected and is the
certainty that if you have a good, big, strong aerial, you can
read about some new wireless telephone and some new

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distance work use excessive wave lengths, thus the Marconi Transatlantic station at Glace Bay has a wave length of about 7000 meters, while the new Government station at Washington has a wave length of about 4000 meters. By consulting the "Wireless Blue Book" the wave length of all important wireless stations can be found, as each station usually uses a certain fixed wave length. (See Lessons No. 4, 5, 6, 7, 8, 9, 10 of The E. I. Co. Wireless Course.)

The best all around aerial is about 75 feet long, composed of four strands E. I. Co. "Antenium" wire No. 14, or stranded "Antenium" cable. One of the forms is shown herewith. We recommend E. I. Co. No. 10007 insulators, although others can be used. For a 75 foot aerial, the strands should be about two feet apart and for a 150 foot aerial from free to free about two feet apart and so on. The strands should never be less than two feet apart even for a very small aerial. All connections should be soldered or silvered. Use as many insulators as feasible, remember you have but little energy when receiving; few and poor connections waste 50 per cent. of the little incoming energy. If you have a good spacious roof it is not necessary to use poles to hold up the aerial. It may be stretched between two chimneys, etc. to hold the wire strands apart might be of bamboo, wood, metal, etc. If metal is used, the wire strands should be insulated from the former. (See Lesson No. 11 of The E. I. Co. Wireless Course, on Aerials.)

The ground is quite important. The best wire to use is a No. 18 B. & S. copper wire (Annunciator wire). Connections must be made as shown. Now every time you press the key you will get a "click" and you might be "listening" or signals between points situated in the same State; Provided, That the effect thereof shall not extend beyond the jurisdiction of the said State or interfere with the reception of radiograms or signals from beyond said jurisdiction.

**General Restrictions on Private Station.**

Fifteenth. No private or commercial station not engaged in the transaction of bona fide commercial business by radio communication or in experimentation in connection with the development and manufacture of radio apparatus for commercial purposes shall use a transmitting wave length exceeding two hundred meters or a transformer input exceeding one kilowatt except by special authority of the Secretary of Commerce and Labor contained in the license of the station: Provided, That the owner or operator of a station of the character mentioned in this section shall not be liable for a violation of the regulations of the third or fourth regulations to the penalties of one hundred dollars or one hundred dollars for each violation, as prescribed in this section unless the person maintaining or operating such station shall have been notified in writing that the said transmitter has been used when tests conducted by the Government, to be so adjusted as to violate the said third and fourth regulations, and opportunity has been given to said owner or operator to adjust said transmitter in conformity with said regulations.

**Special Restrictions in the Vicinities of Government Stations.**

Sixteenth. No station of the character mentioned in regulation fifteen situated within five nautical miles of a usual or military station shall use a transmitting wave length exceeding two hundred meters or a transformer input exceeding one-half kilowatt.

Let us explain in plain English just what this means: As you notice from the first paragraph, the part which we understand is pointed out to you, and if you do not send messages from one state to another, you therefore do not require a license as long as your messages do not reach over the border of your state and if you do not interfere with a station's business (in your state) which requires messages from another state. Of course, you want to know how you can tell what your transmitting range is. We will explain. It has been proved by experiment with spark coils, that in almost all cases a one-inch spark cannot overcome a load over 1000 miles. From this information the following table has resulted:

<table>
<thead>
<tr>
<th>Transmitting Distances of Spark Coils.</th>
<th><strong>Transmitting Construction</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-inch. col. Max. trans.</td>
<td>16 Miles.</td>
</tr>
<tr>
<td>1½-inch. col. Max. trans.</td>
<td>32 Miles.</td>
</tr>
</tbody>
</table>

(To be concluded in June issue.)

* Wireless Telegraph for Telephone sending stations included.
The Quenched Spark Gap
How to Make It and Use It.

H. Winfield Secor.

A GREAT many wireless experimenters and amateurs are very desirous of using the quenched spark gap, of the type employed by the Telefunken Co.

The quenched spark gap should be the means of increasing the transmitting range and activity of every amateur wireless station, and this is a most important point, now that the wireless act is in effect limiting the transformer input to 1 K.W. of energy.

In general a quenched spark gap causes from 40 to 60 per cent. of the energy delivered by the charging transformer, to be sent out on the antenna, while ordinary spark gaps deliver about 6,000 volts.

This gap may be adapted to various sizes of transformers, by cutting out some of the gaps by short-circuiting some wires, or their length being .01 inch long, and in small size sets, the best thickness and length of gap for good results.

It should be understood, however, that while the Telefunken sets have been designed for use with the quenched style of gap, it is a matter of record that a 5 K.W. Telefunken set has transmitted fully as good and as far as a 20 K.W. set, employing the usual open type of spark gap.

It is assumed that it is to be used on transformers up to 1 K.W. capacity, and probably 8 to 10 gaps will be sufficient, providing they are long enough.

If this number of gaps are to be used on quite high voltage, say 15,000, the mica washer Fig. 4, should be made more than .01 inch thick, but this is the best thickness.

The Electro Importing Co. furnishes these Mica Rings at 35 cents each.

As regards the voltages used with quenched gaps, the Telefunken Co. allow about 1,200 volts per gap, each gap being .01 inch long, and in small size sets, the transformer delivers about 6,000 volts. Hence, for this potential, 5 gaps in series would be sufficient. For higher voltage transformers more gaps in series can be employed, or their length may be made a little greater.

For the above voltages paraffined paper or mica condensers are usually employed. For higher voltages, regular glass plate or Leyden jar condensers can be used. Quenched spark gaps may be purchased from the Electro Importing Co., their regular size consisting of eight gaps in series, with mica rings and cast brass plates.

This gap may be adapted to various sizes of transformers, by cutting out some of the gaps by short-circuiting some of them.

Many amateurs would probably like to make a quenched gap, and details for constructing one are given here.

This gap and its parts are shown at Figs. 1-6.

It is possible to make up a quenched gap quite simply by combining a series of brass plates, so the groove shown here does not have to be cut into the plate; but such methods are at best only a makeshift, and it is very difficult to use thin plates and get their faces properly aligned.

It is recommended that those who can, should employ solid cast or turned plates, resembling the one illustrated at Fig. 3, as this pattern permits of good alignment and also the best cooling of the gap.

For those who cannot avail themselves of the solid gap plate, a very good one can be constructed as depicted at Fig. 2. This plate consists of two gap faces of 4½-in. hard brass sheet preferably, and between the two face plates is placed a cooling vane of 1/16 to 1/8-inch hard brass sheeting.

This sheeting is smooth and even stock, and the ⅛-inch plates can be scribed out, and then cut from the sheet by drilling a series of small holes around the edge, after which it can be filed up true, or turned in a lathe. The best way would be to cut out all the heavy plates as described; and then place all of them in a lathe between the live chuck or face plate, and a moving tail centre, when they can all be turned down at one time. If they are filed nearly round, they will be good enough for all practical purposes.

The vane plates can be cut out of sheet stock by means of timbers' snips, or large scissors.

The voltage relations aforementioned should be borne in mind in building this gap. It is assumed that it is to be used on transformers up to 1 K.W. capacity, and probably 8 to 10 gaps will be sufficient, providing they are long enough.

The cutting is accomplished quite easily if a lathe is at hand, or any machine shop will do the work reasonably. A jig is shown at Fig. 5, which can be used to cut out the groove in the plates. It does not have to be made very elaborate, and the base and top plate may be of fiber, hard wood, or iron. Through the top bar is drilled a hole, to accommodate a threaded shaft, A, having lock nuts, as shown, enabling it to be gradually lowered or raised, by slackening up the lock nuts. The cutting is accomplished by two steel tools or cutters, C1 and C2, and these are made of tool steel or Stubbs steel rod. They may be sharpened on a fine emery or compared with scissors, and then tempered to a straw color. Two steel set screws hold the cutters in place, in holes drilled through the cross bar, D. This bar is held permanently in place by a steel pin passed through it as shown. The top of the shaft, A, is provided with a handle to permit of turning it around. After making a few turns of the shaft and cutters, they are lowered by shifting the lock-nuts, and after tightening them again, a few more turns are made.
given the handles, etc., etc., until the desired depth of groove
is obtained. The groove on this metal need not be round,
and may be made elliptical, so as to leave as much body as
possible to the plate itself. The principal thing to be watched
in making a quenched gap, is to have the plates perfectly flat
and parallel, also the gaps should be air-tight, otherwise the
faces will become blackened.

The assembly of the gap can be similar to the method
outlined at Fig. 1. The two end pieces, BB, can be of slate,
metal rods, GG, etc., with the aid of machine screws tapped
into them as shown. At the center of the top is placed a
large set screw which serves to tighten up the gap, and it
is then fastened by the lock-nut.

At either end of the gap plates, are placed 1/4-inch or
thicker brass plates, the one un-
der the set screw having a coned depression on its upper face, to
permit centering the gaps read-
ily.

Connection to the gap is made by two heavy stranded copper
cables, about No. 6 B. & S.
gauge at least, embedded in
holes drilled in the end plates.
The leads, T, T, should have their ends firmly wedged in the
holes with a piece of copper or brass wire, as solder may run out
due to heat from the gap heating up.

For short distance work the number of gaps in use should be
reduced, by short-circuiting some of the gaps; and simultan-
iously reducing the voltage ap-
plied by control of the trans-
former primary voltage. This is
useful in keeping the gap cool.

As mentioned previously, the marvelous efficiency and
carrying power of the waves produced by the quenched gap,
is not alone due to the gap, but is also a function of the fre-
quency of the transformer current. Thus, 60 or 120 cycle
alternating current, is not nearly so good as 500 cycles, which
is the primary current frequency employed by the Telefunken
condenser, and Q. T. an oscillation transformer; A is the aerial,
G the ground, and A. M. the hot wire meter to register the
radiated energy in amperes. With 500 cycle A. C. the trans-
formers should be wound for this frequency, and are generally
considerably smaller than corresponding sizes of 60 or 125
cycle transformers.

**Wrinkles—Errata—Formulas—Hints.**

*By S. Gernsback.*

Under this heading we will publish every month useful
information in Mechanics, Electricity and Chemistry.

Contributions from our readers are welcome.

**Waterproof Glue.**

A very good glue cement resisting the effect of moisture
is obtained in the following way. Take:
4 parts of powdered Glue (any ordinary glue will do.)
4 parts of black Resin.
1 part of red Oil.

Mix together with a very small quantity of water.

**How to Drill Holes in Glass and China.**

Take a three cornered file—any old file will do—preferably
a broken one. If the file is not broken, take a hammer and
break off a piece of same, so as to present a very sharp sur-
face.

Put the other end of the file in one of the E. I. Co., Hand
Drills No. 6981 or better No. 6949 and drill the hole, where
required.

To cause the drill to bite, the place to be pierced must
always be kept moistened with Turpentine. Soak the file every
few seconds in the turpentine. Don't use too much pressure
at the beginning and work very slowly.

**How to Metallize and Electroplate Insects, Flowers, Small
Household Goods, Etc.**

A nice Rose bud, an uncommon Insect, the first shoes of
baby, and hundreds of other things can be conserved indef-
ine by Metallizing them. The methods given below, enable
any one to do this work very skillfully at a very small outlay.

To begin with, the object to be metallized has to be ren-
dered conductive.

First, after cleaning it in methylated Alcohol, cover the object
thoroughly with plumbago (powdered graphite) and brush it
carefully with a soft brush.

This method can only be employed if the object can stand the
brushing.

If it is a delicate flower or an insect, the object has to be
dipped in the following solution, to render the surface con-
ductive:

In a china vessel heat very slowly 1/2 ounce of silver nit-ate, dissolved in 25 ounces of good alcohol. After dipping
the object let it dry in the air and expose afterwards to the
fumes of hydrogen sulphide.

(To generate hydrogen sulphide, take a glass bottle with
large opening, fit a small tube through the cork and
put a few cents worth of iron sulphide in the bottle. Now
pour some strong muriatic acid over the iron sulphide.
Instantly the hydrogen sulphide gas will be formed and escape
through the glass tube. In leading this tube under a hood
containing the object to be fumed, this operation is easily
performed.)

After having rendered the object conductive in any one of
these manners, it is hung in the porous cup of the "Electro-
Copper Plating Outfit No. 4400 (price, complete, $1.25), and
the plating begins at once.

When thoroughly metallized the object is carefully dried
and may be lacquered if desired.

An improved aluminum solder, comprises a mixture of
approximately 38 per cent. pure tin, 32 per cent. phosphor-
tin, and 30 per cent. pure zinc.

**New Wireless Phone.**

Professors Chaffee and Pierce of the Harvard School
of Applied Science, report that they have invented a
cheap and effective method of wireless telephony. They have suc-
sessfully operated their system between Cambridge and
Gloucester, a distance of 35 miles, and will operate longer
distances as soon as stations can be established.

Rear Admiral Stanford has completed plans for the con-
struction of the second set of great naval wireless towers
which will be erected on the naval zone. There will be
three 600-foot steel towers. It is believed this station should
be able to communicate directly or relay with similar high
power stations, to be erected by the navy in the Hawaiian
Islands, Tutuila, Samos, Guam and the Philippines.

*This journal is not for sale on newsstands.*
May, 1913

THE ELECTRICAL EXPERIMENTER

Building Large Spark Coils

By H. Gernsback.

The average experimenter using a large coil, very often desires to know how such coils are built, and those who desire to build their own coils, often have a wrong conception of how they are constructed, for several reasons:

One reason is that by referring to textbooks, insufficient data, especially as far as the secondary coils go, is given, and the writer is almost daily in receipt of letters from individuals who have spent fair-sized sums of money in the attempt to build a large coil and have given up the work with utter disgust. The writer does not wish to condemn the textbooks for the data which is furnished in such, but rather for insufficient data, which they do not furnish. While it is comparatively easy to build the primary and other parts of a coil, the stumbling block usually is found in the shape of the secondary, and here the greatest blunders are made.

The most important part of any coil is centered in its secondary. This holds especially true for large coils, once the spark length goes above 3 inches. Very careful and excellent insulation becomes at once an absolute necessity. It is, however, not here that usually the greatest mistakes are made, but rather in the winding or constructing of the secondaries. The writer would strongly advise all private builders of large spark coils not to attempt to wind their secondaries themselves until they have access to automatic winding machines, and there are mighty few of these in the country.

Most of the textbooks advise simply to wind so many "Pies," using such and such wire, and to insulate the wire by letting it run through a molten paraffine bath. This is unsatisfactory for several reasons, the first one being that it is absolutely necessary, if a good coil is desired, that the wire should be wound with the greatest uniformity, that is, the wires themselves shall not cross, but must be wound absolutely straight in order that the different convolutions lie side by side without crossing. Of course it is almost impossible to do this unless a winding machine is used, and if the experimenter attempts to do the work by hand, which, of course, is really not impossible, he will find that it will take a very long time to even wind a small secondary. However, his efforts will be crowned with success, as the coil will be vastly more efficient than if the windings were made by any other method. Not alone this, but the saving of wire is tremendous. By looking over textbooks it will be found that for instance an 8-inch wireless or X-ray spark coil requires from 12 to 14 lbs. of No. 34 enameled wire. The coil described in this article only uses about 7 1/2 lbs. of No. 34 wire. Consequently it will be seen that not alone a large amount of wire will be saved, but the saving in space and thereby increased efficiency of the machine wound secondary, is remarkable. The secondary of this article, as per illustration herewith, has an outer diameter of 4 1/2 inches, while the diameter of the hole is 2 1/2 inches. The width of the coil is 3 inches. Weight of such a completed secondary, including all the paraffined paper and the paraffine impregnation, is only 2 1/2 lbs.

Heavy leads are brought out from the two ends of the coil to guard against breaking. The coil illustrated herewith, which gives a fat 8-inch spark has 4 such secondaries, all mounted on a heavy, hard rubber tube, as shown. Between each secondary there is a fibre wall, 1/8 inch in thickness, that fits the hard rubber tube perfectly. The purpose of these walls is to do away with internal sparking between the secondaries, and they fulfill their mission admirably. After all the parts are assembled as per Fig. 3, the primary with its primary tube, secondaries and the dividing walls are set in a large oak case, and this is filled with a special insulating compound. After cooling the coil, it is ready for use.

It has been found that large coils, that is coils above 6 inch spark should not be operated with vibrators that operate from the end of the core. For this reason a special independent vibrator, as shown in Fig. 4, is used. The vibrator is mounted at one end of the coil, as is clearly shown in Fig. 1, and the 8-inch coil, as described herewith, uses from 14 to 20 volts storage battery current, and will operate well on from 4 to 6 amperes. The independent vibrator is really composed of two vibrators in one. The large break interrupts the primary current, while the small break operates the make and break vibrator electro magnets. The large condenser is, of course, bridged across the heavy contacts, and this condenser must be nicely balanced in order to produce the right results. If the condenser capacity be too small, there will be too much sparking on the contact points, and the secondary spark will be reduced.

A condenser that has too large a capacity, while cutting down the contact spark, also decreases the secondary spark. For that reason the right capacity must in all cases be used; and such capacity can really only be found by experimenting and adjusting until the best results are obtained. The vibrator illustrated herewith is the latest model brought out by the E. I. Co., and is very remarkable. The E. I. Co. sells these secondaries complete, as described, for $8.00 each.

*The E. I. Co. sells these secondaries complete, as described, for $8.00 each.

This coil is sold by the E. I. Co. at the price of $88.00 complete.

Dimensions: 33 1/2" long, 11 1/2" wide, 12 1/2" high. Weight 96 pounds.
efficient. Its platinum contacts are exceedingly large and heavy, and the diameter of these contacts is ½ inch. The instrument is mounted on a polished hard rubber base ½ inch thick. Large coils, as the foregoing, are naturally worked for long hours at a time, and for this reason it is necessary to have very substantial contact points. Thus, for instance, the platinum used in this vibrator costs some $8.00, which, however, considering the size, is not too much. Using such a vibrator every day for two hours, the contact points ought to last from 1½ to 2 years.

**DIELECTRIC STRENGTH OF VARIOUS INSULATING MATERIALS.**

<table>
<thead>
<tr>
<th>Material</th>
<th>Dielectric Strength per 0.001 of an Inch in R.M.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AETNA</td>
<td>35</td>
</tr>
<tr>
<td>ASBESTOS</td>
<td>125</td>
</tr>
<tr>
<td>BRISTOL BOARD</td>
<td>180</td>
</tr>
<tr>
<td>CELLULOID</td>
<td>90</td>
</tr>
<tr>
<td>FIBRE (Vulcanized)</td>
<td>175</td>
</tr>
<tr>
<td>LAVA (Talc.)</td>
<td>125</td>
</tr>
<tr>
<td>LAVITE</td>
<td>200</td>
</tr>
<tr>
<td>LEATHEROID</td>
<td>150</td>
</tr>
<tr>
<td>LINSEED OIL (Boiled and impregnated on Bond Paper)</td>
<td>600</td>
</tr>
<tr>
<td>MICA (Pure White)</td>
<td>900</td>
</tr>
<tr>
<td>Micanite (Flexible Cloth)</td>
<td>190</td>
</tr>
<tr>
<td>Mica (Paper)</td>
<td>420</td>
</tr>
<tr>
<td>Mica (Flexible Paper)</td>
<td>300</td>
</tr>
<tr>
<td>MICA (Plate)</td>
<td>700</td>
</tr>
<tr>
<td>OILED CAMBRIC</td>
<td>650</td>
</tr>
<tr>
<td>OILED PAPER</td>
<td>800</td>
</tr>
<tr>
<td>PARAFFIN BOND PAPER</td>
<td>125</td>
</tr>
<tr>
<td>PRESSBOARD</td>
<td>125</td>
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<tr>
<td>PRESSPAHN</td>
<td>300</td>
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<tr>
<td>SHELLACKED CAMBRIC</td>
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<td>VOLCANITE</td>
<td>940</td>
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<tr>
<td>HARD RUBBER</td>
<td>900</td>
</tr>
<tr>
<td>GLASS (Common)</td>
<td>203</td>
</tr>
<tr>
<td>(Head)</td>
<td>140</td>
</tr>
<tr>
<td>(White Alabaster)</td>
<td>220</td>
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<tr>
<td>(Plate)</td>
<td>280</td>
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<tr>
<td>PORCELAIN</td>
<td>1800</td>
</tr>
<tr>
<td>HERMSDORF HARD PORCELAIN</td>
<td>2900</td>
</tr>
<tr>
<td>LINSEED OIL</td>
<td>1200</td>
</tr>
<tr>
<td>&quot; (Boiled)</td>
<td>1600</td>
</tr>
<tr>
<td>OLIVE OIL</td>
<td>1650</td>
</tr>
<tr>
<td>SPERM OIL</td>
<td>1300</td>
</tr>
<tr>
<td>&quot;TRANSIL&quot; OIL</td>
<td>2000</td>
</tr>
<tr>
<td>VASELINE OIL</td>
<td>1500</td>
</tr>
</tbody>
</table>

*The E. I. Co. sells this independent vibrator, as described, complete for $25.00.


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**Our Cover**

By H. Gernsback.

The idea of our cover was conceived by the writer, with the intention to inspire the electrical experimenter at large. There is nothing fantastic about this cover, nothing impossible. It will all be very real in a comparatively short time. It is up to our experimenters to make it an accomplished fact.

The scene is laid near the coast, in almost any part of the globe. The time, let us say is in the year 2013. It is night. The large aerial and aerial system in the foreground, not feebly telegraph impulses, but a tremendous power. This power is furnished by the large "Powerhouse," beneath the aerial system, some 30,000 Kilowatts being radiated by the other constantly. Naturally, such a tremendous power going out into the air gives rise to peculiar phenomena. The air becomes luminous for several miles around and above the aerial. An inverted bow-shaped light dome, with the aerial system as its center, is produced, and this light illuminates the landscape for miles around. The lower antenna acts partly as a reflecting aerial which prevents the energy from being absorbed by the earth. It has been found that by using a curious vibratory pulsating wave of a tremendous amplitude, almost no energy is lost in transmission through the ether, and for that reason the etheric power station as illustrated can supply energy within a radius of several hundred miles. The power is derived solely from the tidal energy of the ocean—a tremendous force, which lay unhearnessed through aeons.

On top of the "power-house" we see two towers with curious light balls. These are the "radiofer." You must understand that the "power-house" which shoots forth such a colossal force, can not be frequented by humans. As a matter of fact, no human being could come near the house, or within 500 yards. For that reason the power is entirely controlled from a distance, by wireless of course. The control is exercised through the "radiofer." In the left foreground we see a curious wheelless railroad. The cars float actually in the air, some feet above the broad, single iron track. The power is obtained from the distant power aerial, by wireless of course. One will notice the aerial wires on top of the cars, which receive the energy. The train is suspended by electro-magnetism, and glides smoothly along, at the rate of some 200 miles an hour.

In the left foreground also we see an immense 1000 foot "optophor" tower. This tower shoots a dazzling colored light shaft of some ten million candle-power straight into the sky. Such "optophor" towers are stationed exactly 50 miles apart along the coasts, and every tower has a different colored light shaft. This light beam can be seen some 300 miles out at sea, and by its light, transatlantic aerial as well as aquatic craft, can steer with unfailing accuracy towards their point of destination.

**STIPPLING DRAWINGS WITH AN ELECTRIC BUZZER.**

The draftsman making a drawing where concrete sections are shown in a stipple will find the device illustrated very handy to accomplish the effect, as described by Jacob Goldberg, in Popular Mechanics. An old bell, very handy to accomplish the effect, as described by Jacob Goldberg, in Popular Mechanics.

The gong and the lugs that hold it together are considered as described by Jacob Goldberg, in Popular Mechanics. An old bell, very handy to accomplish the effect, as described by Jacob Goldberg, in Popular Mechanics.

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The Vacuum Detector

By H. Winfield Secor.

The Vacuum Detector or cymoscope has come into widely extended use at the present time, and this article is intended to give a resume of its development, and operation, in general.

Probably the simplest form of vacuum detector, usually called the "Audion," or "Fleming Valve," was the flame audion, and its arrangement is depicted at Fig. 1. As seen in the drawing, an ordinary Bunsen flame is utilized, and in this flame are placed two conductors or electrodes. It was found that the best form of the flame audion was that involving the use of a Bunsen flame, burning coal gas, and having in its flame two electrodes as shown, one of them (the lower) being a small platinum trough or cup, and the upper electrode a platinum point. In the cup shaped or lower electrode, some alkaline salt is placed, and so located in the flame that it is at a comparatively cool spot, yet well maintained, hot enough to continually vaporize the salt; while the point, which may be a small (0.01-inch) platinum wire is placed in the very hottest part of the flame. The point should be kept from ¾ to ⅛ inch above the trough. The salt preferred is potassium hydroxide. The flame must be kept well saturated with the gas from the vaporizing salt in the lower electrode cup.

The electrical circuits for this simple flame audion, as shown at Fig. 2, the polarity always being as shown. The battery, B, should be equipped with a multi-point switch, so that any voltage from 6 to 35 or 40, may be readily obtained, step by step. With this arrangement the battery is best employed in series with the battery to permit of very fine regulation of the applied voltage, as the critical or optimum potential at which the flame is most sensitive, is sharply defined. This detector is wonderfully sensitive, when properly adjusted, but is not of any commercial importance, for the reason that the flame could not be maintained evenly, especially on ships at sea, which are constantly rolling and swaying. The principle of this detector is the shattering of the column of conducting gas, by incoming wireless waves, and the change in resistance of the conducting flame between the two electrodes, manifests itself in the telephone receivers, which should be of the wireless type, i.e., having a resistance of 1,000 to 2,000 ohms.

Another ingenious form of gas detector, tried some years ago, consists of an ordinary carbon arc, a pair of high resistance telephone receivers, and a platinum electrode, arranged as in the sketch, Fig. 3. The arc length should be adjustable, and the platinum electrode so arranged, that its position in the arc can be varied at will. The arc itself has to be formed between cored carbons, and should be fed from storage battery giving at least 40 volts. The variation in ordinary power circuits, fed by dynamos, are too pronounced, and would cause too much noise in the receivers. This detector also depends upon the shattering of a column of conducting gas by Hertzian waves. We now come to the later class of audion or vacuum detectors, and these have been developed to a high degree; in the audion now in use in a great many commercial and amateur stations.

* Electrical Engineer, Electra Importing Co.

The peculiar qualities of gaseous conductors, especially rarified gases in so-called vacuum tubes, have been utilized for the detection and measurement of electric oscillations, and therefore of electrical forces.

Professor Righi availed himself of one striking peculiarity of rarified gases as conductors, as follows.* It is well known, as first shown by Valenciennes, that if by a vacuum tube having platinum electrodes sealed into it, and a vacuum of about one-thousandth of an atmosphere made in it, is subjected to electromotive force, no current will flow until a critical value, say of 300 volts or so, is exceeded. Beyond that limit the current which flows is almost exactly proportional to the excess of the voltage above this critical value. Hence if a small vacuum tube be connected in series with a battery of voltaic cells giving some voltage a little less than the critical value, no glow will take place in the vacuum tube, because no current passes. If, however, the same circuit includes a coil in which electric oscillations are excited, then the electro-motive force of these induced oscillations will, in one direction, be added to the electromotive force of the battery, and will send a current through the gas and cause it to glow. Righi employed a vacuum tube in which a very small space intervened between the electrodes, and employed a water battery or some simple form of primary voltaic cell to produce the required "boosting" or auxiliary electromotive force.

The vacuum tube then glowed when electric oscillations were set up in the coil in series with it.

L. Zehnder employed a vacuum tube in a slightly different manner as a detector of Hertz oscillations. He took advantage of another well-known fact connected with electrical discharge through rarefied gases.

A vacuum tube of the ordinary kind has, in addition to the usual platinum electrodes, two other pair of electrodes at right angles, placed with their ends very close, Fig. 4. If, then, a high potential battery, say of 300 or 400 cells, is applied in series with a high resistance, and the tube used in the ordinary way, we may adjust the number of cells until the electromotive force is just not sufficient to cause a glow discharge in the tube. Then if a very small discharge is sent between the transverse electrodes, this glow discharge causes the general mass of the rarefied gas to become a conductor for the steady battery electromotive force, and the vacuum tube bursts into glow. This arrangement is sometimes called a Zehnder "trigger tube," because the small transverse discharge, so to speak, sets off the longitudinal discharge in the tube. The transverse electrodes which convey the oscillatory discharge through the gas are placed quite close to the cathode of the continuous current electrodes, since it is known that at the cathode the great resistance to discharge is situated. In this manner a Hertzian spark too feeble to be visible at a distance can be rendered manifest by its power to start off another discharge from a powerful battery acting on the same mass of rarefied gas. This property of rarefied gases was first discovered by him in the course of some investigations upon incandescent electrical lamps.

A third method of utilizing the properties of rarefied gases for the purposes of a cymoscope or detector was discovered by Dr. J. A. Fleming. In 1901 he noticed a fact discovered by him in the course of some investigations upon incandescent electrical lamps.

* See Dr. Fleming's Treatise, "Principles of Etheric Wave Telegraphy."
rarefied air left in the bulb is far enough.

When the valve is to be used for detecting electric waves, or as a receiver in wireless telegraphy, the oscillation transformer associated with it, has its primary circuit included between two collector wires, or between an aerial wire, A, and the earth, G; see Fig. 8. Then electric waves falling on the aerial produce in it electric oscillations, and these are detected by a sensitive dead-beat mirror galvanometer, such as a “speaking galvanometer,” as used in cable telegraphy.

The electrical properties of these valves have been exhaustively studied by Dr. Fleming, and others. It was furthermore dis- covered that the conductivity of rarefied gases differs in qual-

ity from that of metals or electrolytes. If we apply a steadily increasing electromotive force to a mass of rarefied gas by means of two electrodes, the negative one being incandescent, then the current through the gas does not increase proportionately to the electromotive force. The current rises up to a maximum value, at which it is said to be saturated. Hence the gas, as a conductor, does not obey Ohm’s law. Also the conductivity, which is the ratio of current to voltage, rises to a maximum and then falls.

The resistance of the vacuous space may therefore vary from millions of ohms to a few ohms, according to the volt-
age applied and the tem-

perature of the filament.

The valve rectifies the oscillations or becomes more completely unilat-
eral in conductivity the colder the metal cylin-
der is kept. If we al-

low the cylinder to be come warmed by radia-
tion from the filament, then the flow of elec-

tricity between the car-

bon filament and cylin-
der is not altogether in one direction. When made as shown in Fig. 7, and used with a carbon filament at that temperature at which it is working, at about 3 watts per candle, the rectification is from 80 to 85 per cent.

There are at present two principal types of audion de-
tectors, one being the Fleming valve, employed by the Mar-
coni-Wireless Telegraph Co., and as shown at Fig. 8, with a pair of high resistance telephone receivers connected in the place of the galvanometer. The other type is that evolved by Dr. Lee de Forest, and commonly termed the “Grid audion.” The latter form is similar to that of the “Electro” audion detector.

A cut of this detector is shown at Fig. 9 and its working connections at Fig. 10. As will be readily seen, a four volt battery, SB, (preferably two storage cells), supplies the fila-

ment, Fl, of the detector, through a finely adjustable re-
sistance, of about 10 ohms; the E. I. Co., No. 5,000 rheostat regulator being ideal for this purpose. The receiver circuit contains a high voltage battery, H. B., and this detector acts also as a relay, letting more or less of the high voltage

battery current pass through the vacuous space within the detector, when influenced by wireless or Hertzian waves. The high voltage battery is usually composed of 7 or 8 cells, this device could be used to separate the constituent currents of an electrical oscillation and so render it possible for an electrical oscillation to affect an ordinary galvano-

meter. To do this the valve, now called an oscillation valve, is used as described below.

One of the above-described bulbs, Fig. 6, has a sensitive galvanometer, G, placed in series with the secondary coil of an oscilla-
tion transformer joined in between the metal cylinder and the negative terminal of the carbon filament, Fig. 7. If oscillations are induced in this secondary circuit by a primary coil, P, then when the carbon filament is made incandescent by an insulated battery, B, only one of the currents forming the oscillation is allowed to pass, viz., that in which the move-

ment of negative electricity is from the carbon filament to the metal cylinder, through the vacuous space. The galvanometer, therefore, is affected only by the flow of elec-

tricity in one direction, and its needle or coil is therefore de-

flected. In each train of oscillation the positive currents are, as to speak, sifted out from the negative, and only one set allowed to pass. We are therefore able to employ a sensitive mirror galvanometer of the ordinary type to detect the ex-

istence of electric oscillation in the circuit.
How to Make a Loud Speaking Telephone

By H. Gernsback.

There is nothing easier than to make a loud speaking telephone. Such an instrument comes in very handy in many places, and I will mention only a few.

The mistress wants to speak to the kitchen and she can do so without having to wait till the maid or cook steps to the phone to take down the receiver and hear what it wanted. The lady upstairs simply talks into the transmitter and the order is passed on, and almost instantly the cook or maid goes on her errand.

The loud speaking telephone is one of the most convenient of all devices for handling messages.

The idea of this department is to accomplish new things with old apparatus, or old material. In order to win a prize, the apparatus, goods, supplies, parts or materials must be of "E. I. Co." makes. The more original the idea, and the more "E. I. Co." goods are used in accomplishing the new thing or the new effect, the better the chance to win the first prize.

Read the following article by Mr. Gernsback. You will note that he uses nothing but regular "E. I. Co." stock material, except the phonograph horn. He has found a new, useful purpose for the Pony receiver, as well as the other articles. This is the kind of article which wins a $5.00 prize. Suppose you try an article; you will be surprised how easy it is to win a prize. And remember, it's the idea for which we pay the prize, never mind if it is well written up or not—we'll attend to that part, if you have no experience in writing articles.

Construction.

Procure an ordinary E. I. Co. 75 ohm pony telephone receiver and take out the wire bobbin. Unwind the fine enamel wire entirely, and in its place wind carefully, so that the different turns don't cross each other, about 1 ounce of No. 24 enamel wire. This will just fill the spool nicely. It is, of course, understood, that if one desires to speak, one talks into the transmitter.

The ordinary telephone receiver is wound to about 75 ohms; naturally but little amperage will pass through the windings of such a receiver, and the diaphragm consequently is not energized greatly. For that reason sounds can hardly be heard a foot from the receiver, unless a very large battery is used. Obviously we must wind a coarse wire on the receiver spool if we want a strong current to pass around the mouthpiece, the receiver will talk loud and distinct, the mouthpiece, the receiver will talk loud and distinct, the mouthpiece.

For that reason sounds can hardly be heard a foot from the receiver, unless a very large battery is used. Obviously we must wind a coarse wire on the receiver spool if we want a strong current to pass around its core.

Connect the ends to two binding posts, or bring the ends out to two binding posts as shown in illustration. The receiver shell should be fastened with several screws to a neat, hard wood, hard rubber or fibre base, about 4 x 4 inches, and about ½-inch thick, as clearly shown in sketch. A fairly heavy diaphragm must be used, and if such cannot be produced, two thin ones placed on top of each other will do. Now screw on the cap tightly, and the receiver proper is ready.

In order to operate it well, we must have a good transmitter which passes at least 1 ampere, and I will mention only a few.

For instance, the loud speaking phone is placed centrally in the office; now, if the manager wishes the office it wanted. The lady upstairs simply talks into the transmitter and everyone in the kitchen will hear what is wanted.

There are, of course, a thousand different real uses for the loud speaking telephone, and the up-to-date experimenter will not have much trouble to find new uses, and install a few of these instruments.

Let us see first, what is required to make a loud-speaking telephone. The entire secret may be expressed in these few words: The more current used the louder the telephone will reproduce.

The E. I. Co. has such a transmitter;* this instrument should be mounted on a base of the shape as shown. In the handle, Fig. 2, we have a small push button; the E. I. Co. "Liliput" push is admirable for this purpose. The entire contrivance may be made to hang from the ceiling as shown. A heavy wire (or cord), at least No. 14 B. & S. connects the transmitter and loud speaking telephone, as in Fig. 3. From six to eight volts should be used, either good dry cells, such as the "Electro" or else the "Columbia." A good storage battery will, of course, be better. If now the transmitter button is pressed down and one speaks in an ordinary loud voice in the microphone, the receiver will talk loud and distinct, the voice being audible in a large office, with a surprising clarity and fidelity, as well as good articulation.

It is well to observe that too strong a current produces a harsh, "nasal" voice and for this reason a current regulator, such as the "Electro" Rheostat-Regulator, will accomplish wonders. This rheostat is put in series in the line, as shown in diagram and an assistant should regulate it, while some one talks into the transmitter. After the best results have been obtained the rheostat is not touched any further, and it should be placed out of reach, so that no one can tamper with it.

It is, of course, understood, that if one desires to speak, it is necessary to press the transmitter button, as no current flows unless the button is pressed. Thus no current is used except when the device is actually in use.

If an especially loud talk is required, two loud speaking telephones, or even three can be placed in series, at different parts of the room or office.

Always remember that the connecting wires must be

* Their No. 6080. Price $1.25.
The Steel Ball is caused to roll around on the inclosing the mechanical parts should be placed out of sight. The steel ball E is put on the thin cover of the box, and the magnet causes it to roll around as the wheel turns. The box axle that runs in metal bearings.

An incandescent lamp held near the disks will glow with a bright light. The following table should be used when installing a loud speaking telephone system:

<table>
<thead>
<tr>
<th>Distance (feet)</th>
<th>Copper Wire</th>
<th>B. &amp; S. Copper Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 100</td>
<td>No. 14</td>
<td>No. 16 B. &amp; S. Copper Wire</td>
</tr>
<tr>
<td>100 - 200</td>
<td>No. 10</td>
<td>No. 16 B. &amp; S. Copper Wire</td>
</tr>
<tr>
<td>200 - 300</td>
<td>No. 8</td>
<td>No. 18 B. &amp; S. Copper Wire</td>
</tr>
<tr>
<td>300 - 400</td>
<td>No. 6</td>
<td>No. 22 B. &amp; S. Copper Wire</td>
</tr>
<tr>
<td>400 - 500</td>
<td>No. 4</td>
<td>No. 28 B. &amp; S. Copper Wire</td>
</tr>
<tr>
<td>500 - 600</td>
<td>No. 3</td>
<td>No. 32 B. &amp; S. Copper Wire</td>
</tr>
<tr>
<td>600 - 700</td>
<td>No. 2</td>
<td>No. 40 B. &amp; S. Copper Wire</td>
</tr>
<tr>
<td>700 - 800</td>
<td>No. 1 1/2</td>
<td>No. 50 B. &amp; S. Copper Wire</td>
</tr>
</tbody>
</table>

The following instrument has a variety of uses, but was originally intended as a portable code practitioner and was described by S. R. Ward, in the December Modern Electrician. It consists of four parts, a small wooden box with sliding cover, such as small tapers, are packed in, or the E. I. Co., No. 10,000 fixed condenser case of polished oak, at 25 cents; a midget buzzer, battery and key. The battery is a vest pocket flashlight type, such as "Electro," No. 1056.

The buzzer can be the "Electro" Lilliput type No. 965; the spring finger, X. Both buzzer and battery are held in place by means of tightly wedged strips of felt or leather. In the hood of the spring finger, a key mounted on a long stem is placed on the cover box. This key, which is made of phosphor bronze, is of the shape shown in Fig. 2. By using a binding nut for a contact and the apparatus is greatly simplified and by merely pulling back the cover a new battery may be inserted. When not in use a short length of rubber tubing slipped over the nut prevents accidental contact.

Although the finished instrument may be carried in a vest pocket it will transmit indelible signals across a room and when placed near the ground wire forms a simple efficient detector.

A GOOD PROPOSITION.

If you can't find 4 1/10 cents' worth of instruction and diversion in this journal, we don't wish your subscription. If, however, you do, and if we don't get your subscription, then both you and we suffer equally.
The Tufts College Wireless Society has just installed its new wireless station in Page Hall on the top of College Hill. The station is one of the most efficient supported by any college in the country.

This station was first advertised two years ago through the efforts of Harold J. Power and Joseph A. Prentiss, wireless enthusiasts. Through the efforts of Harry G. Chase, former professor of physics in the college, apparatus was obtained last year, and was installed in Robinson Hall. Last June when Professor Chase resigned the society found itself without a set and immediately began work to obtain another. In September Harold J. Power was presented a fine outfit by a friend and he immediately placed this at the disposal of the club. The college faculty then granted the society the use of the old Page Hall on the top of College Hill, an admirable location.

After much work the apparatus has been finally installed. The aerial wires are stretched between Paige and Minter halls. There are four wires having a span of 175 feet and are separated by twelve-foot spreaders. The four lead wires drop from the centre of the aerial, coming direct into the operating room on the ground floor of Paige Hall, and a safety device to protect the building during electrical storms is on the outside of the hall.

Mr. Arthur Haake, of Norwood, N. J., using one of the E. I. Co.'s ½ K.W. Transformer coils No. 8050 on 110 volts D.C. and a Delectrical Interrupter, reports that his Gernsback type in transmitting signals day and night to Philadelphia, Pa., a distance of about 92 miles. The aerial is used is about 130 ft. long and 75 ft. high.

Good results are being obtained by Mr. Edward Nell, Jr., of Indianapolis, Ind., using the ½ K.W. Transformer coil, and a Delectrical Interrupter. He is sending over a distance of 83 miles day and night with a very small aerial consisting of six wires 30 ft. long and about 40 ft. high.

Part of the apparatus for establishing a wireless telegraph office at the State University campus at Lexington, Ky., has been received by Prof. W. A. Freeman, of the Electrical Engineering College. As soon as the remainder of the equipment arrives, work on setting up the station will be commenced. It is planned to make arrangements so that messages can be received, and sent to other stations throughout the country.

Fifteen members of the Paterson Newsboys' Association plan to start a wireless telegraphy class at 226 Main St., Palisades Park, N. J. Mr. Janda, who has a station rigged up at his home on East Holmsman street, will instruct the boys in their first lesson.

The Wireless Association of Atlantic City held its regular monthly meeting at its headquarters, 314 Bartlett Building. Several new members were admitted, including Jerome Haas, 201 Atlantic avenue, and Alfred H. Ely, 7 Prestoon Apartments.

Mr. Joseph J. Janda, Stangelville, Wis., writes us that with an 8000 E. I. Co. transformer coil and a 6-volt 60 ampere hour storage battery he can get a spark of over 2 ft. which is very much more than he expected in as much as the Company only claims 1½ inch maximum for a transformer coil. Mr. Janda claims that he has sent over 40 miles with this transformer coil.

Richard Johnstone, of San Francisco, Cal., has done some extraordinary work with a ½-inch E. I. Co. spark coil. He claims to have communicated with a certain amateur friend in Palo Alto, Cal., in broad daylight, using a space of only 2½ miles by a friend who lives about 35 miles to San Francisco, the result is certainly extraordinary. Mr. Johnstone has written proof of the achievement and also has as witness a friend who was listening on his home set.

Although the performance is quite unusual, it has been proved that on the Pacific Coast a 1-inch coil has transmitted as far as 90 miles. The reason for the satisfactory results is that the air conditions in California are very much better than in any other place in the United States. We frequently hear of long distance work done with but little power in California.

Correspondence

Mr. H. Gernsback, 233 Fulton Street, New York City.

Dear Sir:

This is something which I believe will interest you. Last summer I was spending my vacation at a place called Gayhead (about 3 miles from Craig, Greene County, New York). The above-mentioned place is in the Catskill Mountains about 1800 feet above sea-level. About the first of August, Elmer Rave, a boy of 15½ years, of 12 Raleigh place, Port Antonio, a member of the club, came to the same farmhouse where I was staying with a wireless equipment. He sent messages to the following stations, viz., E. I. Co.'s one (1) transformer, which contained batteries, E. I. Co.'s one detector, and the necessary switches, including one pound of aluminum wire. A station was set up with the aforesaid equipment and an aerial consisting of the following dimensions, viz., 50 feet long, 15 feet high one end, 25 feet high other end, 4 wires on a 3-foot spreader.

The aerial was quickly erected and as soon as E. Rave started to receive (I knew nothing of the code then, but as I had been interested before, I became "assistant") he heard the following stations: Cape Cod, Boston (about 150 miles), Brooklyn Navy Yard (about 100 miles), Fire Island, and at night Portland, Me., Cape May, N. J., and vessels on the ocean of New York, New Jersey, and Massachusetts.

When the weather was very good, it was possible to read messages from all stations and received an answer! For the next two weeks until we came home together on the 12th of August, we were in constant communication with stations by day or by night.

People may wonder or deny that this was accomplished, but I will try to prove it with the aid of witnesses. The result was very high. We kept this a secret for a long time, but as we were "fierce high" and asked us to tune down, which was impossible. For several days the weather report was received from Brooklyn, N. Y., and it was absolutely correct in its predictions. Two "S.O.S." signals were transmitted from a small steam launch on Long Island Sound which sank off Cape Henry and another from a steamer off the eastern coast between Portland and Boston. Incoming steamships were heard off New York City. Elmer Rave read all messages off as he received them and I, the "assistant," wrote them down word for word on paper, and I can truthfully say that I never wrote anything so fast in my life.

Reading in the newspaper of the wreck of the "Shinnecock," a paddle wheeler which ran aground near New York and Block Island, R. M., the father of Elmer Rave, asked if details and final results could not be secured from some operator. Fire Island was asked and ½ pages of news about the Shinnecock was sent us, at a very fast rate of speed. We were allowed to keep it down on foolscap. It is self-evident that Elmer Rave couldn't have faked the message or all the others, because such speed would not allow him to write the speed at which they were received I quote the following:

Mrs. and Mr. Rave, 12 Raleigh Place, Brooklyn.
Mrs. Hechler and Missispais Park, N. J.
Mrs. and Mrs. Bogardus, Gayhead, New York.

Other stations, such as Syracuse, Saratoga, Richfield Springs, Springfield, and Albion, were spoken to on one occasion.

I have the foolscap papers on which the messages were written by me as they were read out by Elmer Rave and I will forward them to you if you want to look over them.

Very truly yours,

ERNEST HECHLER.

Palisades Park, New Jersey.
SPARK COILS IN SERIES.

Q. 1. What two minerals constitute the Perikon Detector and which mineral forms the point of same?

A. The minerals are zirconite and chloropryites, the latter being used on the point.

Q. 2. What is the average sending range of the "Bull Dog" one-inch spark coil used with medium size aerial?

A. 3. How can I utilize two spark coils so as to work simultaneously?

A. Connect the primaries and secondaries in series and use one vibrator for both primary windings.

CHARGING VOLTAGE.

Q. 1. What is the meaning of the tap sizes as given in the E. I. Co.'s catalogue, such as No. 6-32, 8-32, etc.?

A. In giving tap numbers, the first number, such as 6 in your question, is understood to mean the number of the tap and corresponds to some empirical distance according to a standard gauge, and we are giving herewith the corresponding diameters of the common tap sizes in general use—No. 2 = .08416 inch outside diameter; No. 4 = 11048 inch; No. 6 = .1368 inch; No. 8 = 1.6312 inch; No. 10 = .18944 inch; No. 12 = 2.1576 inch; No. 14 = 2.4208 inch.

Q. 2. What is the normal charging current passes into the battery. The standard charge and discharge rate for lead cells is the eight hour rate. I.e., if a storage cell is rated at 80 ampere hours capacity, its charge or discharge rate in general would be ten amperes for eight hours.

Q. 3. How many Gordon primary cells will be required to properly operate a 2-inch "Bull-Dog" spark coil; the cells to be of the 100 ampere hour size?

A. 2. This will require about eight Gordon cells, which give approximately 70 volts with a circuit closed.

Q. 3. Would you recommend the use of a small battery motor of sufficient power to drive a bench lathe, the motor to derive its energy from primary cells, such as above mentioned; or do you think it advisable to employ instead a small gasoline engine, and where could I purchase a suitable one at a reasonable cost? A small gasoline engine, about 1/2 H.P. would form the best source of power to drive your lathe with, and you can purchase such an engine of the very best type, complete with all equipment, and ready to run, at $25.50 from the Electro Importing Co., New York City.

OPERATING A 2 INCH "BULL-DOG" COIL.

Q. 1. How many feet are there to one pound of No. 14 B. & S. and No. 18 B. & S. enameled magnet wire?

A. No. 14 B. & S. magnet wire weighs about 79 feet to the pound and No. 18 B. & S. about 200 feet to the pound.

Q. 2. How many Gordon primary cells will be required to properly operate a 2-inch "Bull-Dog" spark coil; the cells to be of the 100 ampere hour size?

A. 2. From six to seven Gordon cells, which give approximately 79 volts, will be sufficient.

Q. 3. How can the secondary output of the Bull-Dog coil be increased? The secondary output of the 11/2-inch "Bull-Dog" spark coil is about 220 watts or 22 kilowatt.

A. 2. What is the largest size enameled magnet wire carried on stock by the E. I. Co.?

A. No. 14 B. & S. enameled magnet wire is the largest size carried in stock or made at the present time, with larger wires than No. 14 B. & S. it becomes difficult to make the enamel adhere properly to the conductor.

CHARING DYNAMO.

Q. 1. Which one of the small dynamos sold by the E. I. Co. would you recommend for recharging a six volt, 100 ampere hour storage battery, and how long would it take the dynamo to recharge same?

A. You will probably find their No. 810 dynamo delivering eight volts and ten amperes power for recharging purposes; and this dynamo could recharge your 100 ampere hour storage battery in about ten hours at a ten ampere rate.

Q. 2. What precautions are necessary to avoid such a storage battery in parallel with the charging dynamo, on an automobile, where the dynamo speed is constantly fluctuating?

A. 2. In such cases it is, of course, necessary to guard against the storage battery discharging back through the dynamo and regenerating power, so that the dynamo shall not deliver too great a voltage and thus overcharge the storage battery from discharging back through the dynamo, in case the speed of the latter should fall below normal, consequently lowering its voltage below that of the storage battery. An automatic cut-out is usually connected in series between the dynamo and storage battery, and you can procure one from the E. I. Co. at $5.00. To prevent the dynamo
from reaching too high a speed or overcharging the storage battery, as a magnetic clutch, or pulley, is generally supplied, which diverts the dynamo drive when the engine speed reaches a predetermined voltage operating by means of a centrifugal governor.

QUENCHED SPARK GAP.

F. Kantor, Reading, Pa., asks:

Q. 1. Where can I obtain quenched spark gaps, complete, ready to use?
A. 1. You can obtain quenched spark gaps, consisting of eight individual gaps, mounted complete on base and ready to connect, at $30.00, from the Electro Importing Co., New York City.

CAUDMIUM.

George Emmich, Newark, Ohio, writes us:

Q. 1. Where can I obtain metallic cadmium, price of same, and for the metal invar?
A. 1. You can procure metallic cadmium from the E. I. Co. at $3.15 per lb. and invar may be obtained from Elmer & Amend, Chemists, New York City.

Q. 2. What is the coefficient of linear expansion per degree Fahrenheit, for hard rubber and also for vulcanized fibre?
A. 2. The coefficient of linear expansion per degree Fahrenheit for hard rubber is approximately .000002 inch, and for vulcanized hard fibre it is approximately .000003 inch.

Q. 3. Is it the best material for insulating spark coils, such as the insulating tube between the primary and secondary, and also the separators between secondary sections?
A. 3. Hard rubber is the best material for this purpose, but fibre can be used, but it should always be somewhat heavier than hard rubber for the same voltage stress.

TELEPHONE DIAGRAMS.

C. Lintel, Peak, Mass., asks:

Q. 1. Kindly give me working diagram of interior connections for your No. 9204 Telephone, as I have several of these, and wish to experiment with same.
A. 1. We are giving below diagram of connections as used in No. 9204 Telephone.

Q. 2. Please give me a diagram for the connection of four No. 9204 instruments on one system, with selective ringing and common talking wires, and state kind of wire to be used in making the cable for such a system for a distance not exceeding 100 feet.
A. 2. We are pleased to give you herewith diagram of a combined system for utilizing four of our regular No. 9204 Telephones, with selective ringing push buttons at each station; as will be seen by looking at the diagram all of the instruments talk over a common pair of wires. These talking wires are supplied with centralized battery power through a choke coil, which may be the electro-magnet coils of an electric bell; an ordinary gas lighting coil makes a very good impedance for this work. The centralized battery may be composed of six to eight “Electro” dry cells or sal-ammoniac wet cells. The conductors used in the cable for this system may very well be No. 18 or 16 B. & S. cotton covered bell wire; and one of the wires of the system can be eliminated by utilizing the ground as a conductor, in place of one wire; gas pipe or water pipe ground can be employed for this purpose.

Q. 3. Could you give me a diagram for connecting three of your Telephones, so that No. 1 instrument can talk to No. 2 or No. 3, and the instruments and normally Nos. 1 and 2 are to be joined together through the above mentioned switch. It is not necessary for No. 3 to talk to either No. 1 or No. 2 except when No. 1 party wishes to, and this is to be accomplished by using as few wires as possible, and also a ground return.
A. 3. Diagram is given below for the connection of the instruments as stated in your question, and, as will be seen, a two-point switch is all that is required at No. 1 instrument, so that by moving the switch lever to No. 2 or No. 3 contact points, No. 1 party can talk to either No. 2 or No. 3, but normally the switch lever is left at No. 2 point, so that No. 2 party can at any time call up No. 1 if desired, and vice versa.

WET BATTERIES.

J. F. Prendergast, New York City, writes us as follows:

Q. 1. Can you give me the dimensions and solution proportions for constructing sal-ammoniac wet batteries, such as used for telephone and bell work; and where can I obtain sal-ammoniac, and at what price?
A. 1. The proportions of the common sal-ammoniac wet battery with carbon and zinc elements are as follows: A glass jar, either round or square, about 5 inches across and 6 inches high, is filled half full of clean water, and ¾ lb. of sal-ammoniac is thoroughly dissolved in same. You can obtain sal-ammoniac at 20 cents per lb. from the E. I. Co.
The carbon element is usually made in the form of a hollow cylinder about 1 inch smaller all around than the glass container, and the wall of the same may be ½ to ¾ inch thick, with a length about ½ the depth of the jar, but carbon plates ¼ inch thick and about 5 x 2½ inches may be used instead. The zinc pole, which forms the anode of the cell, in most cases takes the form of a ½ inch zinc rod, but sheet zinc, of about the same dimensions as the carbon plate, may be used.

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