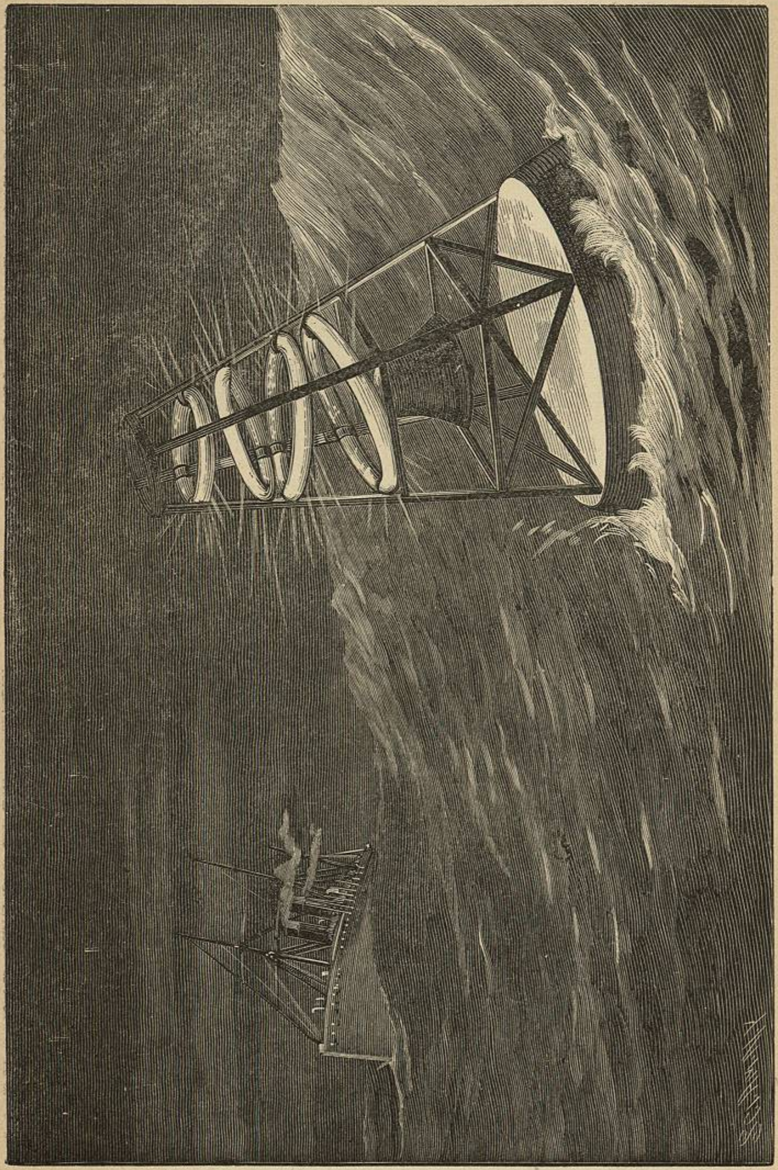
Fig. 354.



Self-luminous Buoy.

cury. The inner tube is sealed to the outer tube near one end, and in the inner tube, a short distance above this sealing, is formed an aperture which determines the amount of mercury to be retained between the inner and outer tubes when the tube is inverted preparatory to use, as all of the mercury between the two tubes and above the aperture will run through the aperture into the lower end of the tube. In this manner the mercury is equally divided, so that when the tube is reversed, one-half of the mercury flows through the inner tube, and the other half flows downward between the inner and outer tubes.

The full effect is realized only when the mercury is allowed to flow quickly from one end of the tube to the other, but any agitation of the mercury in the tube produces some phosphorescent light. This tube is a beautiful object in a dark room.

Fig. 354 illustrates illuminating apparatus designed as an auxiliary to bell buoys and whistling buoys. It is based upon the generation of electricity by the agitation of mercury in a high vacuum or in an attenuated gas. It involves the same principle as the self-exciting vacuum tube just described. The buoy represented in the cut is adapted to ring the bell by the rolling motion imparted to it by the waves. Advantage is taken of this motion to agitate mercury in the annular tubes placed in the upper portion of the frame of the buoy. The tubes are made very heavy and strong, and each contains barriers for causing friction of the mercury against the sides of the tubes.

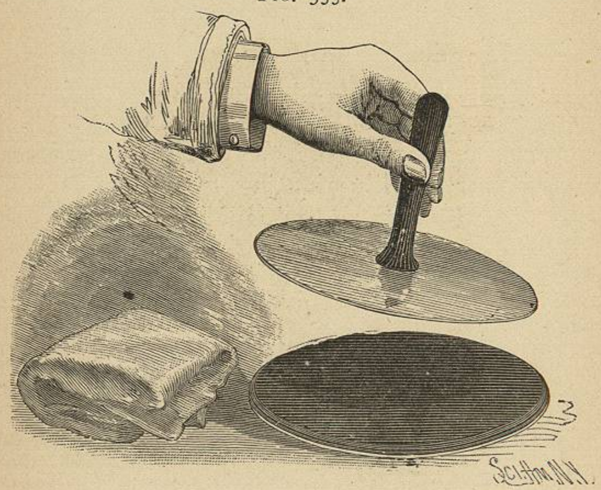
To insure the action of one or more of the tubes at all times, they are inclined at different angles. A slight motion of the buoy causes the mercury to travel circularly in the tubes and generate sufficient electricity to render the tubes luminous.

Among devices tried for rendering buoys luminous are lamps arranged to burn for a long time, phosphorescent mixtures, electric illuminators supplied with the current from the shore by means of a cable, and the more recent luminous paint, which absorbs light by day and gives it out at night. Compressed gas has been employed with great success, some of the buoys having been designed to carry six months' supply of gas and to serve as lightships.

ELECTRICAL MACHINES.

The simplest machine for supplying electricity in small quantities is the electrophorus, invented by Volta. It consists of two parts, one being a vulcanite disk secured to a metallic sole plate, the other a metallic cover plate provided with a handle of hard rubber or other insulating material.

FIG. 355.



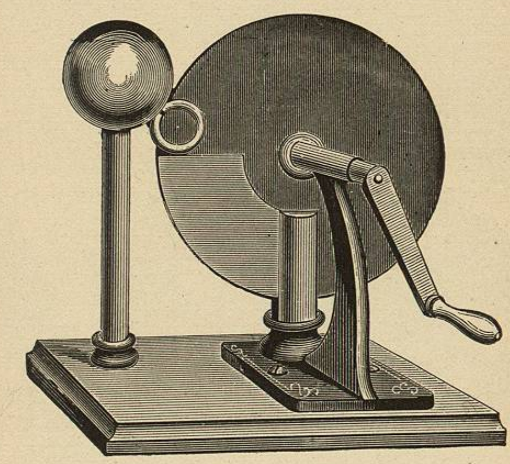
Electrophorus.

To secure the best results, the vulcanite disk and metal cover plate should be warmed, dried, and freed from dust. The vulcanite disk is rubbed with a piece of warm flannel or a cat skin, when it becomes charged with negative electricity. The cover plate is then placed on the vulcanite disk. The negative electricity of the vulcanite disk acts inductively upon the cover, positive electricity being attracted to the lower side of the cover, while negative electricity is repelled to the upper side. By touching the upper side of the cover while it is still in contact with the vulcanite disk, the negative electricity will pass from the cover through the

body of the operator to the ground, and only positive electricity will be retained by the cover. If now the cover be raised from the vulcanite disk by means of the insulating handle, a spark may be drawn from it. This is due to the combination of the positive charge on the cover with the negative induced in the hand by this charge.

The cover may be replaced upon the vulcanite disk, and the operation may be repeated indefinitely, when the conditions are favorable, without further excitation. Instead of a vulcanite disk, a cake formed of resin, shellac, and a small

FIG. 356.



Winter's Electrical Machine.

proportion of Venice turpentine may be used. The materials are melted, thoroughly mixed, and poured into a circular tin pan. The cake thus formed is allowed to remain in the pan, and is used in the same manner as the vulcanite disk.

Winter of Vienna devised a simple frictional electrical machine, an inexpensive form of which is shown in Fig. 356. In the top of the cast iron standard is journaled a shaft having at one end a crank by which it may be turned, and furnished at the opposite end with a pair of collars between which is clamped a vulcanite disk. In a socket at the base of the standard is inserted a forked bar of wood which extends upwardly and embraces the vulcanite disk, each arm of the fork being provided on its inner face with a silk or woolen cushion charged with bisulphide of tin and arranged to press on the disk. Upon a vulcanite column rising from the base board near the edge of the disk is supported a metallic ball,

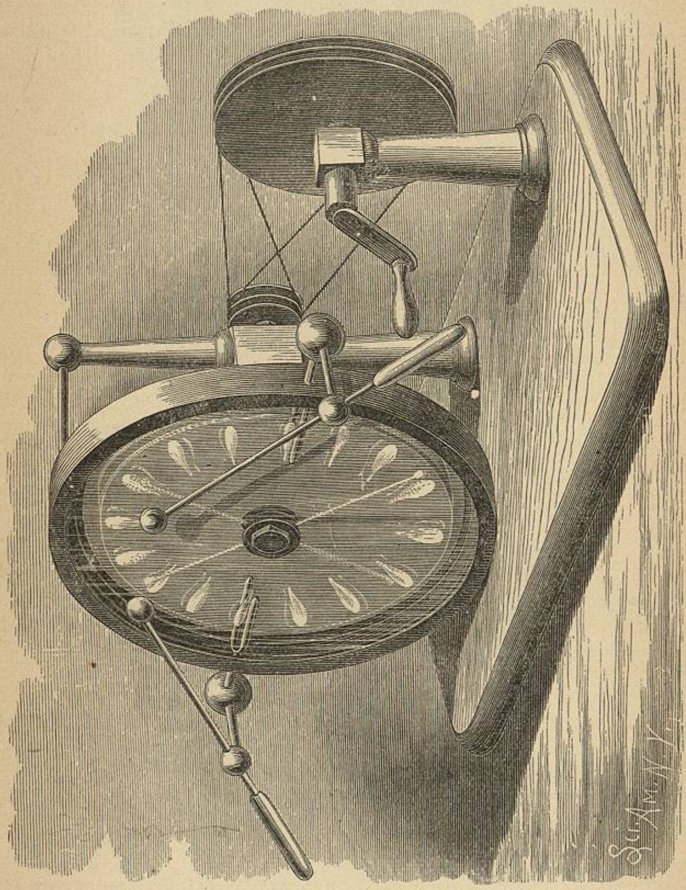


Fig. 356*a*.

Modified Wimshurst Induction Machine.

to which are attached metallic rings arranged on opposite sides of the vulcanite disk, and provided with a number of short points projecting inwardly. To the forked wooden bar is attached one edge of a segmental silk case, which incloses a portion of the disk between the cushions and the collector.

When the machine is turned in a right-handed direction, electricity is generated by the friction between the cushions and the disk, and the negative electricity is carried along to the collecting points, where it is drawn off and accumulated upon the ball. The positive electricity escapes to the ground through the rubbers and the base. If the rubbers were insulated, positive electricity could be taken from them by connecting the insulated ball with the ground. The machine will yield a spark having a length equal to about one-sixth of the diameter of the disk.

The Wimshurst electrical machine is the most recent, and on some accounts it is the best that has been devised. It is less affected by atmospheric conditions, and may be relied on in all weathers for results of some kind, while the frictional machines and the induction machines of Holtz and Toepler generally fail in a damp atmosphere.

The Wimshurst machine here shown differs from the ordinary type, mainly in having the rotary disks inclosed by a hoop, and glass cover disks to exclude dust and moisture, the stationary disks being provided with brushes which are connected electrically by strips of tin foil secured to the inner faces of the outer disks by means of shellac.

This machine is shown in perspective in Fig. 356*a*. Fig. 357 is a vertical section taken through the center of the disks, and Fig. 358 is an enlarged horizontal section taken on the line of the collectors.

The column supporting the revolving disks is provided with a hollow arm in which is journaled a tubular shaft, upon one end of which is mounted a disk of common window glass between two collars, the glass being centrally apertured* to receive the shaft, the outer collar being screwed on.

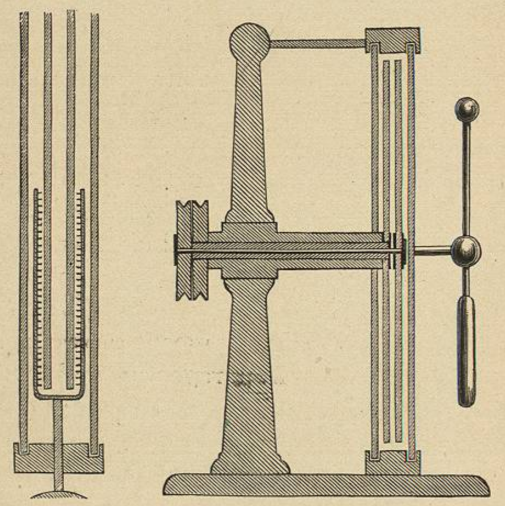
The opposite end of the tubular shaft is provided with a grooved pulley. A solid shaft placed within the tubular shaft, and projecting beyond the ends thereof, carries upon one end a glass disk, and upon the other a grooved pulley, as in the first case. The glass disks are separated from each other about $\frac{1}{8}$ inch. They are both coated with shellac var-

* For hints on perforating glass, see chapter on mechanical operations.

nish and allowed to dry. To each glass disk near its periphery are secured sixteen radial sector plates of tin foil or thin brass, arranged at equal angular distances apart. These sectors are coated on one side with shellac varnish and allowed to dry, when they are placed in position on the varnished glass disks, varnished side down, and secured by rubbing each one quickly with a warm, smooth iron.

A drawing should be made of a glass disk with the sectors to be placed under the disks as a guide in locating the

Figs. 357 and 358.



Sectional Views of Modified Wimshurst Machine.

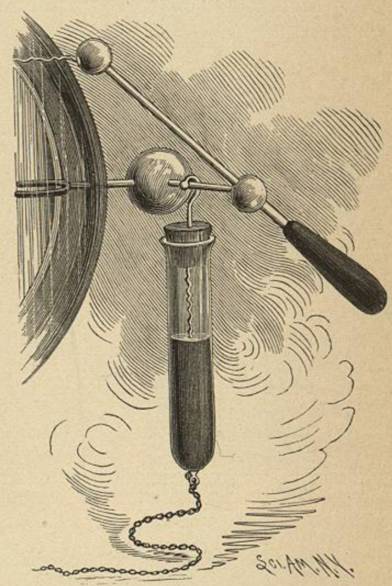
sectors. Brass sectors are preferable on account of their superior wearing qualities.

The glass disks are placed on their respective shafts with the sectors outward. A ring of vulcanite surrounds the glass disks and is grooved internally to receive the stationary glass disks, which inclose the rotary ones. The vulcanite ring is divided at the top and bottom to allow of applying it to the stationary plates. The rear plate is centrally apertured to admit the tubular support of the shafts. The vulcanite ring is provided, at the top and bottom, where it is

divided, with vulcanite dowels, and is supported by attachment at the bottom to the base board, and at the top to a wooden rod projecting from the upper end of the column.

In diametrically opposite sides of the vulcanite ring, and on a level with the axis of the disks, are inserted brass rods, provided on their inner ends with metallic forks, the arms of which extend along the outer surfaces of the rotary disks and are provided with collecting points, as shown in Fig. 358. The outer ends of the brass rods are furnished with knobs into which are inserted the supports of the discharge rods or conductors. The latter are provided with vulcanite handles by which they may be moved in these supports as may be required.

Fig. 359.



Attachment of the Leyden Jar.

The stationary glass disks are each provided on their inner faces at diametrically opposite points with small metallic sockets, attached to the glass with cement, and containing brushes of tinsel or very fine brass wire, which touch the rotary disks lightly. The brushes of each pair are connected by a narrow strip of tin foil attached to the glass. The stationary glass disks may be turned in the vulcanite ring to adjust the brushes at the required angle, which is about 45° with the plane of the collecting forks.

One of the rotary disks is driven by a straight belt, the other by a crossed belt, both belts being carried by a doubly grooved wheel fixed to a shaft journaled in a standard attached to the base. This shaft is furnished with a crank, by which it is turned.