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DESCRIPTION

OF AN

ELECTRICAL MACHINE

OF A

NEW FORM,

CONSTRUCTED WITH REGARD TO THE PRINCIPLES OF

ELECTRICAL LAWS,

BY

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EXPLANATORY NOTICE.

The law after which an Electrical charge is diffused over the surface of an Electrical conductor, has been known long ago; yet thus far the least advantage has not been taken of those well established principles, in the construction of our Electrical Machines, in order to insure that the greatest amount of electricity may be obtained from a given source.

We refer to the fact that in any elongated Conductor, the greatest Electric intensity will exist towards the extremities, and that the tension to escape at those extremities will be greater in proportion that the conductor is more elongated, and that this tension to escape will be the smallest towards its centre.

This long since recognized fact is founded on the property of the Electric Fluid or Force (*) to repel its own substance, or, to speak more distinctly, the mutual repulsion of the parts constituting that which we call Electricity.(†) A parallel to this we find in the gases, of which the elasticity is so great that their

(*) The real nature of Electricity being still one of the many secrets not yet revealed by science, it is indifferent if we name it a *fluid* or a *force*. Notwithstanding the latest discoveries are tending to make this latter supposition the most probable, the question cannot be considered as perfectly settled.

(†) This property is possessed equally by the two kinds of Electricity, Vitreous or Positive, and Resinous or Negative, if taken separately; that those two kinds attract, and in combining neutralize each other, is a different property having no relation to our improvement of the electric machine, and for that reason not mentioned above.

atoms would be diffused in space if they were not kept together by gravitation, and the consequent pressure of the upper layers on the lower ones, as is the case in the atmosphere of our planet; in a similar way the Electricity distributed over a conductor, is kept there by our atmosphere, to the isolating property of which we are indebted to all our knowledge of Electricity, and without which we would not possess the remotest notion of this force,(*) as it would be carried off as soon as developed by any of the usual means.

This property is the cause of many phenomena which we will enumerate:

1. The Electric Charge is always present at the surface of the conductor and not in its interior; the experiments demonstrating this are quite common and described in most text-books on Physics.

2. The Electric Charge is only equally distributed over the surface if every part of this surface is equally distant from a common centre, as is the case on the globe.

3. An Electric Charge will also be equally distributed over the circumference of a circular ring; the tension, however, will be smaller on those parts of the ring's surface turned towards its centre, and the greatest on the outside.

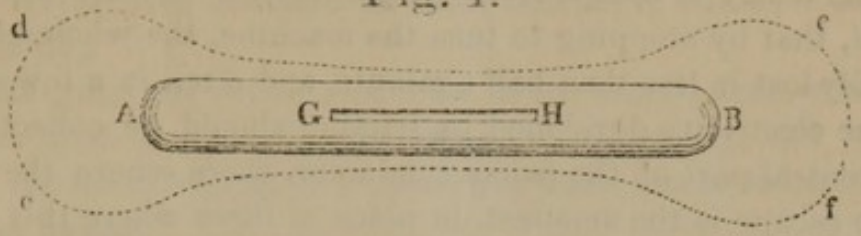
4. In an elongated conductor the tension will be greater towards its extremities, and smaller in those parts of its surface which are nearer to its centre.

Coulomb, in France, was more than 50 years investigating this property and gave a representation of this increase in intensity

(*) If our atmosphere had the conducting power of water, we could not possibly have any idea whatever of Electricity, and so there may exist other natural forces or matters, of which we can have no idea, as they never reveal themselves to us, on the surface of our planet in the circumstances in which we are placed. So for instance it is certain that Comets are of a nature of which we have not the remotest idea; we know what they are not, we don't know what they are; they are not solid, not liquid, not gaseous, not anything we are acquainted with, in short a something not existing on the surface of the earth, at least not in such a form that it is tangible to us.

of the electric charge by a curved line drawn around the surface of the figure of a charged conductor.

Fig. 1.



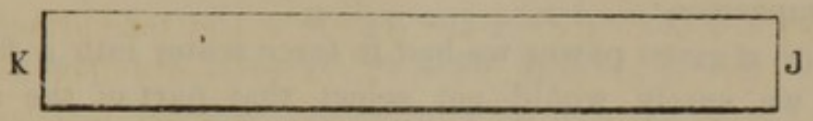


Fig. 2.

Let A B. fig. 1, represent a metallic conductor, then will the distance of the curved line *c d e f* from its surface represent the intensity of the electric charge at different points of its surface.

5. This tension, and consequently the tendency to escape, will be greater in proportion that the length of the conductor is greater.

6. This tendency to escape will also be greater, in proportion that the diameter of the conductor is smaller; so that when a conductor ends in a point, the tension of the electric charge at that point will overcome the isolating power of the atmosphere, and most of the charge will escape in the air and be lost.

7. Roughness of the surface of a conductor, presenting many small points to the atmosphere, favors escape to the electric charge, and vice versa, a careful polish favors the retention of the electricity.

8. Humidity in the atmosphere, making it a semi or even a good conductor, will carry off the electricity from every part as soon as developed, so that in some circumstances it will be impossible to obtain even the smallest trace of electricity, with the best machines thus far constructed.

If we now compare the general arrangement of our electrical machines with the requisites of a construction advantageous to effectiveness, we find them very deficient in the following respects :

1. The Electricity developed by friction of the glass disk or cylinder, is collected by the prime conductor at one or two of its extremities, there where the intensity when charged is greatest; the tendency to escape from the points at those extremities is so great, that by stopping to turn the machine, the whole charge is usually lost in less than half a minute, and often in a few seconds.

The electricity developed by friction should be collected near the central part of the prime conductor, there where the tendency to escape is the smallest, in place of there where this tendency is the greatest. We may illustrate this action by the following comparison:

If with a given power we had to force water into a filled reservoir, we surely would not select that part of the reservoir where the pressure of the fluid, or the tendency to escape, is the greatest, that is at the bottom; but we would force it in. there where this pressure was smaller, that is near the surface. Now with our present Electrical machines we do exactly what we would disapprove of in all other cases, we try to force the electricity in, there where there is the most resistance to absorbtion, and the greatest tendency to escape; we present the extremity of our prime conductor to the glass or other substance in which the electricity is excited.

2. The usual conductors, notwithstanding that in general care enough is taken to have them smooth and polished, possess too many angles and projections to be able to retain any considerable electric charge, their form is far different from that of the theoretically perfect conductor, the Globe or the Ring.

3. All the metallic surface is exposed to the atmosphere, which is entirely unnecessary and serves only to charge the atmosphere surrounding it, and which of course is in continual motion, all at the expense of the original charge.

4. In many Machines the extremities of the Conductor, collecting the Electricity from the Plate, are so near its Axis or Rubbers, that sparks fly over continually, and it becomes impossible to charge them with intensity. However in *Van Marum's* and *Winter's* Machines this defect is in a great measure obviated.

SUMMARY OF THE PECULIARITIES OF THE NEW ELECTRICAL MACHINE.

We believe to have obviated all those defects in our new electrical machine:

1. By charging our prime conductor in the centre, there where there is the least tendency for the escape of electricity, and consequently the least resistance to absorb or collect more electricity of the same nature.

2. By adopting as the form of the prime conductor one or two large rings, and carefully avoiding any part from projecting except there where it is intended to draw sparks, that is to discharge.

3. By covering the conductor with one of the best isolating substances, except that part which absorbs and that which discharges the electricity.

With a revolving round disk or cylinder a conductor may be charged in the neighborhood of its centre, but it is clear that a long rectangular plane will serve this purpose better if we pass it through the centre of the conductor. So in my first machine was the conductor *AB* fig. 1, perforated with a long slit *GH*, through which the long rectangular plane *KJ*, fig. 2, was passed, being provided with the necessary rubbers for friction at both sides.

Next, to avoid the extremities to be charged so intensely as to lose a great part during the operation, I adopted a large brass ring and passed the plate through its centre which was provided with two smooth conducting wires, near and parallel to its diameter, between which the plate was passed; afterwards I fixed the rubbers to those wires, passed the exciting plate through two rings provided with the rubbers, and had those thus charged with one kind of electricity, collected the electricity from the plate by two wires attached by their extremities to two large conducting rings, which were thus charged with the other kind of electricity.

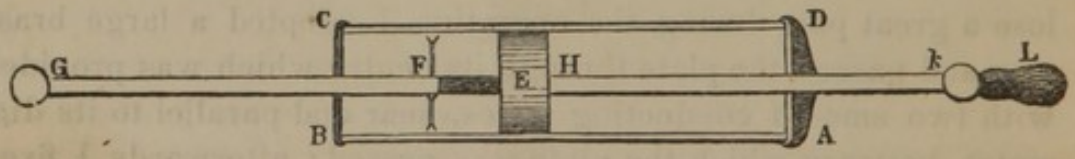
Finally, trying to cover every part of the conductors, except where the electricity is collected and where it escapes, with an isolating substance, I have the ring-shaped conductors made of vulcanized india rubber, cast hollow, and filled with a conduct-

ing substance, which substance communicates to the metallic collector and the spark producer; the only parts exposed.

In this way almost the whole machine may be constructed out of vulcanized india rubber; this substance becoming by friction much stronger electric than the best kind of glass, is better for the exciting disk; besides this, it is by its resinous nature not so subject to attract moisture from the atmosphere, and works under many circumstances when common glass machines do not give a trace of electricity.(*) For the same reason it is also better than glass for isolating supports, so that in my machine the annular prime conductor and its isolating support are made of one single piece of vulcanized india rubber, only the support being solid and the

(*) This is most strikingly illustrated by the Electric Syringe, invented in Germany, and improved some 10 years ago by Dr. Riesz in Berlin. Originally it consisted of a glass tube, in which a piston developed Electricity by friction; it is described in Zimmerman's Naturkrafte, Berlin, 1856, Vol. 1, p. 54. The Author of this Pamphlet used a Gutta Percha, and later a Vulcanized India Rubber Tube, instead of the Glass Tube, and a few of the Students of his Class in the Cooper Institute constructed such Syringes, in 1860, with varied success. The best arrangement is represented in Fig. 3, which is simply made of

Fig. 3.



a common large India Rubber Syringe, about 8 or 10 inches long The Tube, ABCD, is perfectly cylindrical and polished inside; a piston of leather E, connected by a brass rod, H*k*, to a handle, *k*L, may be moved by means of said handle, developing — Electricity in the cylinder, and the opposite kind (+ Electricity,) in the piston; that of the piston may be carried off by touching the end of the brass rod in *k*, and that of the inside of the cylinder is collected by the points in F, communicating by the brass rod FG with the brass ball G, and prevented from being lost in the piston by the piece EF, made of India Rubber, or some other isolating substance.

By moving the piston from B to A, and in the same time touching *k*, the — Electricity of the inside of the tube will be collected in G, and

annular conductor hollow, to be filled with a conducting substance.

The base is wood, and the rubbers (exciting electricity by their friction) are made in the usual way of leather. For further particulars the following description of figure 4 will give all the necessary information.

DESCRIPTION OF THE NEW ELECTRICAL MACHINE.

On the wooden base are erected four perpendicular supports of solid vulcanised India Rubber; each of those supports carries a hollow ring of the same material filled with a conducting substance. The extreme rings at the right and left are connected by two straight horizontal brass wires, which are about one inch apart and communicate with the conducting substance inside the rings, and are intended to collect the Negative Electricity from the long rectangular disk, which passes between them, and in which the Electricity is excited, by the alternate to and fro motion between the leathern rubbers, placed

may be discharged as a spark; by taking hold of the cylinder in BC, and touching the rod FG, the piston being also moved in the same direction from B to A, but not touched in *k*, the opposite or + Electricity developed in the piston, may be obtained in *k*, as the spark will demonstrate.

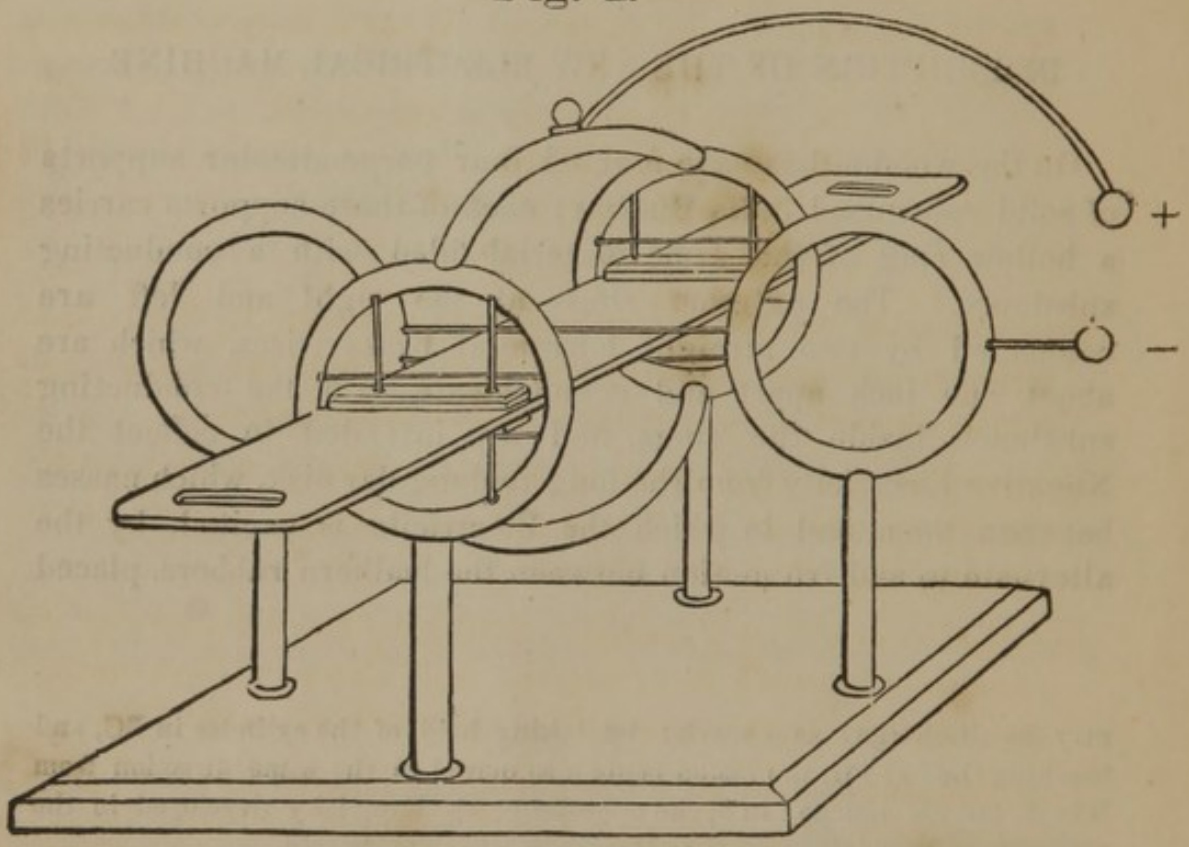
We need not explain that when neither G nor *k* is touched by the hand, both kinds of Electricity are collected, but in a much more feeble condition, than when one kind is given occasion to discharge itself.

The principal fact demonstrated by this machine, is the superiority of India Rubber to Glass, as this Syringe gives Electric charges during such states of the Atmosphere, that a similar Syringe, constructed of a Glass tube gives not the least trace of Electricity.

A certain individual, who had in 1861 made such a Syringe, which at first he could not make to work at all, called repeatedly upon the Author for information and advice; the isolating piece EF had, by ignorance of the properties of Electricity, simply been left out; the advice was every time freely given, and when finally the little machine worked well, that individual applied in Washington for a Patent, and, what is very curious, *it was granted!*

above and below the horizontal diameter of the other two hollow rings, of which, for reason of their connection with those rubbers, the interior conductor becomes Positively Electric. Those last two rings are connected by two conducting arcs, one above and one below, also communicating with their inside conductor; the upper one carries a long curved brass wire, provided with

Fig. 4.



a ball at each extremity, to conduct the Electricity where it is wanted. One of the first mentioned rings, which collect the Negative Electricity from the disk, carries a brass wire and ball, connected with the inside conductor, intended to carry the Negative Electricity there where wanted. When the two balls, Positive and Negative, are placed in the position represented in the figure, a long spark will pass over between them.

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