N° 12,408 A.D. 1901

Date of Application, 18th June, 1901—Accepted, 20th July, 1901

COMPLETE SPECIFICATION.

Improvements in and relating to Static Rectifiers and other Electrical Apparatus for Producing or Maintaining Continuous or Unidirectional Discharges

I THOMAS BURTON KINRAIDE, of 38 Spring Park Avenue, Boston, State of Massachusetts, one of the United States of America, Electrician, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is shown as embodied in an electrical machine of the kind known as static rectifiers, but the invention considered in its broader features is not restricted to this particular electrical machine, but is of wide application to various kinds of electrical apparatus, and embodies certain important discoveries which I have made, whereby I am enabled to positively maintain an electrical discharge in one direction only, and under proper conditions to maintain said discharge continuously, producing, for instance, without the intervention of a commutator, a continuous current, directly from an alternating or intermittent current.

Without necessarily stating that such is the fact, it may be supposed that there is simply electrical energy and that the presence of said energy is what we call a positive condition, and the absence of said energy is what we call a negative condition, and this, taken with my discovery that electric energy in its positive condition discharges reluctantly from a plane (without edges, or angular or pointed surfaces) and discharges with perfect freedom from a point, enables me to control the direction of discharge of the current and hence the accumulation of potential.

The requisite conditions are provided by means of what I term an extensionless point which provides, as nearly as it can be done mechanically, the ideal discharge electrode or positive condition for the outward flow of the electrical energy, and by means of what I term a limitless plane which provides in the same manner the receptive electrode or negative condition in which there may be said to be an absence of energy (or a lower potential than that of the point from which the discharge comes), analogous to a vacuous condition or absence of electrical pressure.

By this means, the electrical energy tends to discharge continuously in one direction only, *viz* : from the extensionless point to the limitless plane.

I have applied my invention in various ways, as, for instance, in a static machine in which the receiving electrode has an extended plane surface or large flat area of the limitless plane type and the discharge electrode has a point discharge or preferably a series of points like a usual cone; but for the purposes of fuller explanation of my invention as well as being covered by certain of the claims in this application, I have illustrated my invention more elaborately in an electrical apparatus for producing unidirectional discharges of high potential.

In the drawings Fig 1 is a view, partly in perspective and largely diagrammatic, of one form of machine embodying my invention;

Fig 2 is a vertical cross-sectional view showing the most approved form of two of the cooperating electrodes;

Fig 3 illustrates the application thereof for transforming an intermittent current into a constant current;

[*Price* 8*d*.]

Fig 4 illustrates the application of my invention to Leyden jars for converting an intermittent discharge into a continuous discharge.

Referring now more particularly to Fig 2, in order that the foundation idea of my invention may be first clearly understood, it will be seen that the electrode *a* is pointed or pencil shaped and that the extreme discharge point *b* is in or projected slightly through a small aperture *c* in a rubber or other flat disc *d* which extends at right angles thereto, the purpose of this disc being to cut off the attracting area which would otherwise be present in the converging walls or surfaces of the electrode *a*.

By this means I provide an extensionless point, speaking electrically. By this term, I mean a point in which the attractive area of the electrode relatively to the opposite electrode is limited to the point itself or, in other words, in which the rubber disc *d* shields all the surface of the rod or electrode behind the very point thereof.

The rubber disc constitutes means for cutting off the receptive area about the discharge point.

Opposite the electrode point *b* is the receptive electrode *e* which maintains a negative condition relatively to the electrode *a*, and which I have termed the limitless plane, speaking again electrically, this electrode having a large receptive area and being provided with means for preventing the tendency to discharge, said means residing in presenting a receptive surface or plane without angles or points, and this plane is secured by providing a flat surface *f* of considerable relative extent and curving its edges back and inwardly as indicated at *g*, whereby, viewed electrically, the surface is limitless inasmuch as it has no termination within the influence of the discharge point *b*.

In operation, the positive energy discharges invariably from the point *b* to the plane *f* and there is no discharge from the latter back to the point, one reason therefor being that the attraction of the limitless plane is compelling, there being practically no attraction in the opposite direction, due to the shielded point.

From the foregoing the extensionless point and limitless plane feature, which is at the basis of my invention, will be readily understood, and it will be seen that its field is important and large.

For example, in Fig 3 I have indicated a typical source of intermittent or alternating energy in the form of an induction coil *h* (operated by an alternating current) whose terminals *i*, *j*, are provided with electrodes *a*, *e*, of the kind already described, and opposite these electrodes which are arranged in pairs are complementary electrodes *e a*, connected to a working circuit *k* which it is desired shall have a continuous current.

Remembering that, as already explained, the extensionless point and limitless plane electrodes compel the discharge to take place in one direction, it will be seen that the intermittent or alternating discharge from the coil *h* is automatically transferred into a continuous current by the lower sets of electrodes as arranged in Fig 3.

Referring now to Fig 1, where I have shown a more complete machine constructed to employ my invention in an elaborate manner, I have mounted on suitable insulating posts 2 a series of these electrodes *a*, *e*, arranged in opposite sets, there being herein shown three pairs in each set, on opposite sides of the machine.

On the right hand side of the machine the point electrodes are mounted in a rail 3 and screened by a shield 4 (although they may be screened by any other suitable means, as may be convenient, and, in fact, the machine will operate to advantage for some purposes without any screen), and the plane electrodes are mounted in a conductor rod 5, while on the opposite side of the machine the arrangement is reversed, the plane electrodes *e* being mounted in the rail 3, and the point electrodes in the rod 5.

In a suitable position, herein shown as the end of the right hand rod 5, is

mounted a point electrode a^1, and opposite thereto mounted in the opposite rod 5 is a plane electrode *e*, while suitably connected thereto is any form of apparatus with which it may be desired to use the machine, herein shown as a condenser 6 connected by wires 7, 8, to the conductor rods 5.

On the base or table 9 are carried a plurality of high potential generating units, as they may be called, herein shown as usual induction coils 10, 12, 13, the terminals of whose secondaries are connected respectively to the lower set of electrodes immediately above them, as is clearly shown, and whose primaries are connected to a battery or other current source 14, an interrupter *m* being interposed in the circuit and a series of condensers 15, 16, 17, being properly interposed.

The condensers may be thrown into the circuit, as may be desired, by switches *n*, n^1, n^2.

While the machine will work with other forms of interrupters, yet for the best efficiency thereof I have found it necessary to employ a special interrupter consisting of a cup m^1 provided with a quantity of mercury m^2, above which is a bath of kerosene oil m^3.

A fixed conductor m^4 from the interrupter *m* leads into the mercury, and above the same is arranged a series of plungers or contact makers m^5, m^6, m^7, connecting respectively with the several high potential units 10, 12, 13, and operated by a shaft m^8 driven by any suitable means, as by a motor m^9, belt m^{10} and pulley m^{12}.

On the shaft m^8 are eccentrics m^{13} relatively adjustable by means of set screws m^{14}.

I have described my mechanism in all its preferred details of construction, as herein embodied, but it will be understood that many changes and substitutions may be resorted to without departing from the spirit and scope of my invention, and that the form and general make up of the apparatus will usually be modified to conform to the particular situation and purpose for which it is intended.

The operation is as follows When quantitative effect of discharge is desired, the interrupter is set as shown, the eccentrics all being placed the same, so that the coils are all broken simultaneously, the coils being in multiple, and thereby the lower electrodes *a* at the right hand, simultaneously discharge their respective coils, and this combined discharge is received by the opposite electrodes *e* and conveyed by the conductor 5, thereby giving an enormous discharge from the point a^1 to the receiving electrode e^1, the circuit being completed therefrom through the upper electrode *a* to the electrode *e*, and meanwhile the condenser 6 is charged, according to its capacity.

If, on the other hand, continuity of discharge is desired, the eccentrics m^{13} are adjusted in step with each other, so that the interruptions in the mercury cup are made dissimultaneously, or in succession, thereby discharging the coils 10, 12, 13, successively, and hence producing a continuous discharge between the electrodes a^1, e^1, this discharge being at a given voltage, according to the capacity of the condenser 15, 16, 17, or such part thereof as may be used.

By having a plurality of induction devices or high potential generators arranged in step in connection with the point and plane electrodes, I am enabled to obtain a continuous discharge, yet employ a slow interruption, the result being that a maximum output is made certain.

This result has not heretofore been feasible, as it would be necessary to operate the interrupter with great rapidity in order to get the high potential required, and when the interruptions of a coil are exceedingly rapid the output from the secondary, as is well known, is below its capacity.

This invention makes possible obtaining a purely direct discharge, *i.e.*, free from oscillations, such as has heretofore been obtained only from a static machine; accomplishes the handling or control of any quantity, however great, of high potential current; is a most powerful generator for X-ray work, and ideal in its control of the quality of X-rays, on account of the discharge being

wholly in one direction, continuous, and from a condenser; besides various other advantages which will occur to those skilled in the art.

In Fig 4 I have illustrated my electrode invention applied to two Leyden jars 18 having their outer coatings electrically connected by a wire 19 and their inner coatings connected by posts *p* in which are mounted usual discharge rods *r*, said posts, however, being provided on their upper extremities with the electrodes *a*, *e*; opposite to electrodes *e*, *a*, at the terminals of a coil *h* (operated by an interrupted current).

By this means, it is possible to maintain constant discharge at an approximately fixed potential similar to the discharge from a static machine, as the intermittent discharge from the induction coil which is the source of supply for the Leyden jars, is enabled to keep the Leyden jars at a practically saturated point, so that the latter can maintain a constant discharge between their rods *r*.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. The herein described means for producing a continuous or unidirectional discharge, consisting of electrodes one of which has a discharge point and is provided with means for cutting off the receptive area about said point, and another of which has a large receptive area provided with means for preventing the tendency to discharge, as set forth.

2. An electrode terminating in a plane conducting surface, having its edges curved or rolled rearwardly and inwardly.

3. An electrode terminating in a comparatively fine point, and a flat shield extending approximately at right angles to said electrode and having a small aperture in which said point is located.

4. In an electrical apparatus, a source of intermittent electrical energy having at its opposite terminals electrodes one of which has a discharge point provided with means for cutting off the receptive area about said discharge point and the other of which has a large receptive area provided with means for preventing the tendency to discharge, said means residing in presenting a receptive surface without angles or points, and other electrodes cooperating with said terminal electrodes, there being a discharge point electrode arranged to cooperate with a receptive area electrode and *vice versa*.

5. An electrical apparatus, comprising a plurality of high potential generating units, and means uniting them in a unidirectional discharge.

6. An electrical apparatus, comprising a plurality of high potential generating units, means for giving them a unidirectional discharge, and mechanism for discharging them simultaneously or dissimultaneously, as desired.

7. An electrical apparatus, comprising a plurality of induction coils whose secondaries have at one end a point electrode, and at the other end a plane electrode, cooperating electrodes therefor, and a condenser and interrupter in the circuit of the primaries of said coils, said interrupter comprising a mercury cup having a series of movable contact makers movable in oil above said mercury

8. An electrical apparatus, comprising a plurality of induction coils whose secondaries have at one end a point electrode, and at the other end a plane electrode, cooperating electrodes therefor, a condenser and interrupter in the circuit of the primaries of said coils, said interrupter comprising a mercury cup having a series of movable contact makers movable in oil above said mercury, and means for varying the movement of said contact makers with relation to each other.

9. An electrical apparatus comprising a plurality of induction coils whose secondaries have at one end a point electrode, and at the other end a plane electrode, cooperating electrodes therefor, a condenser and interrupter in the circuit of the primaries of said coils, said interrupter comprising a mercury cup having a series of movable contact makers movable in oil above said mercury, said condenser having a plurality of independent parts, and switching mechanism for throwing said parts independently into the circuit of said primaries.

Dated the 18th day of June 1901.

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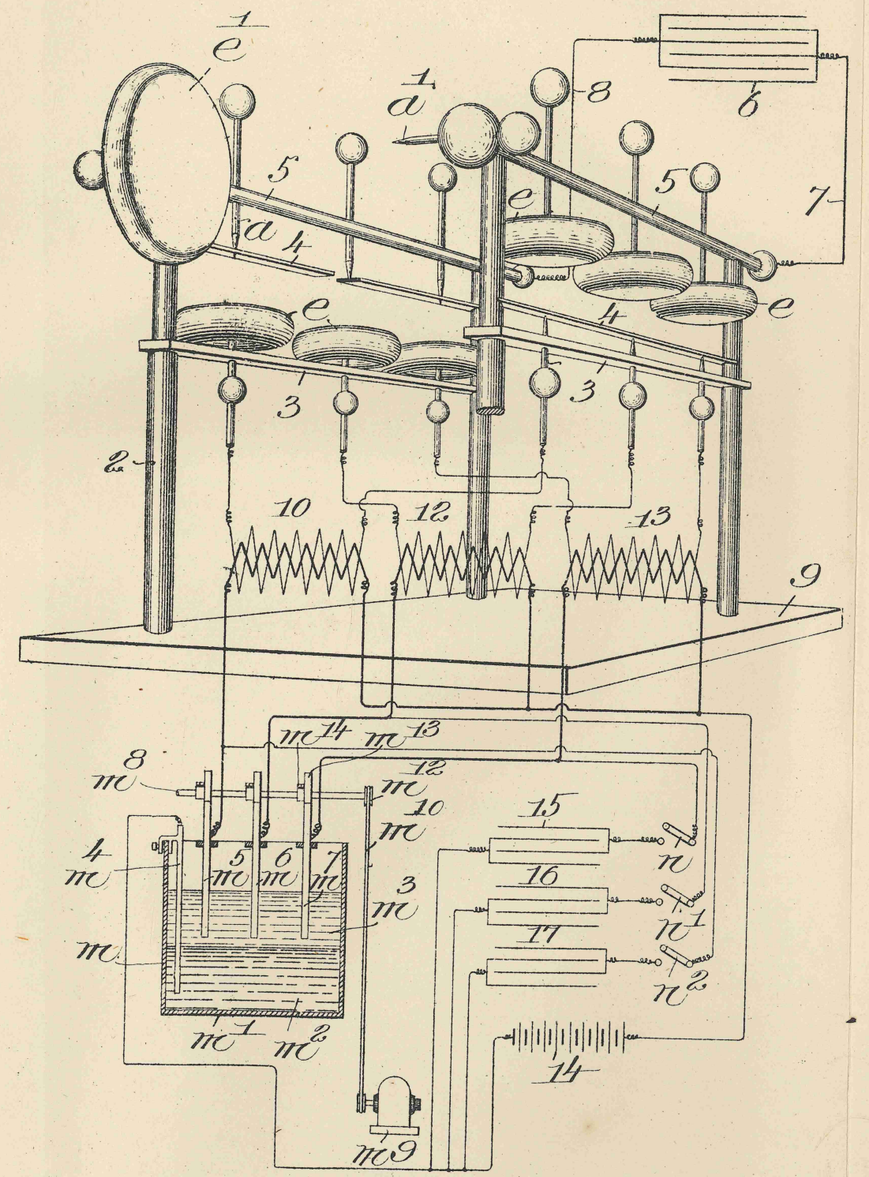
Agents for the Applicant

Redhill: Printed for His Majesty's Stationery Office, by Malcomson & Co., Ltd.—1901.

SHEET 1.

Fig. 1.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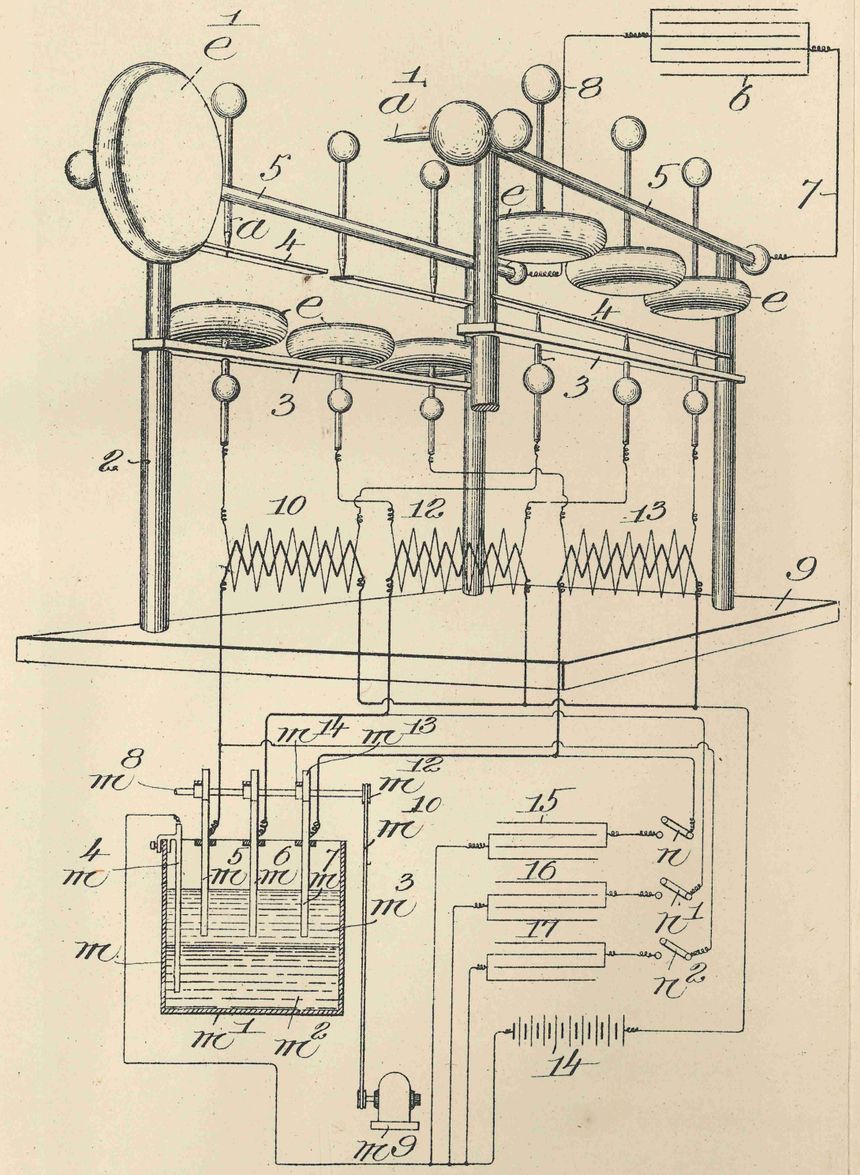
SHEET 1.

Fig. 1.



SHEET 2

Fig. 2.

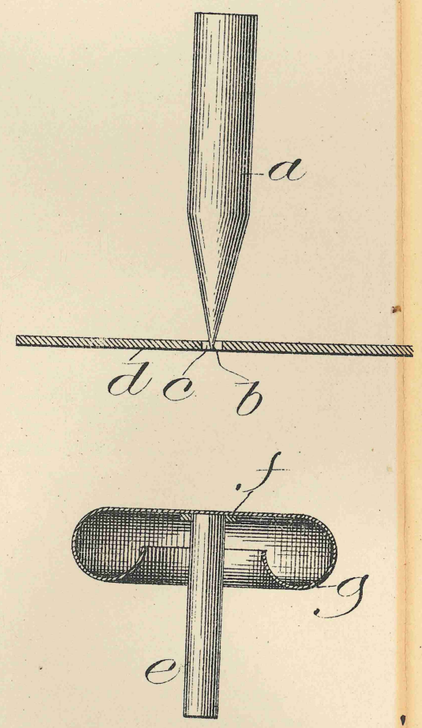


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Fig. 3.

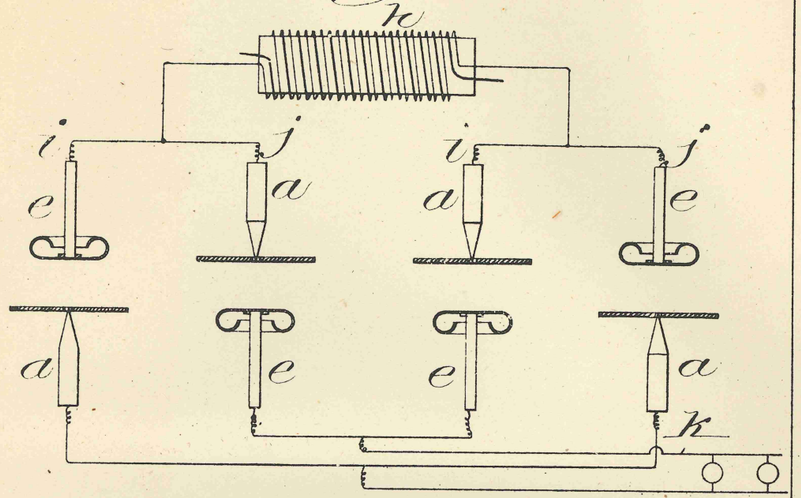

Fig. 4.

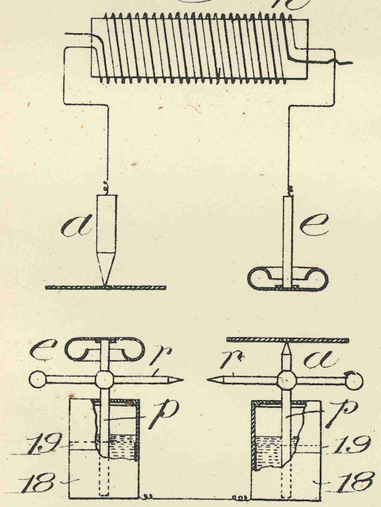

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Fig. 3.

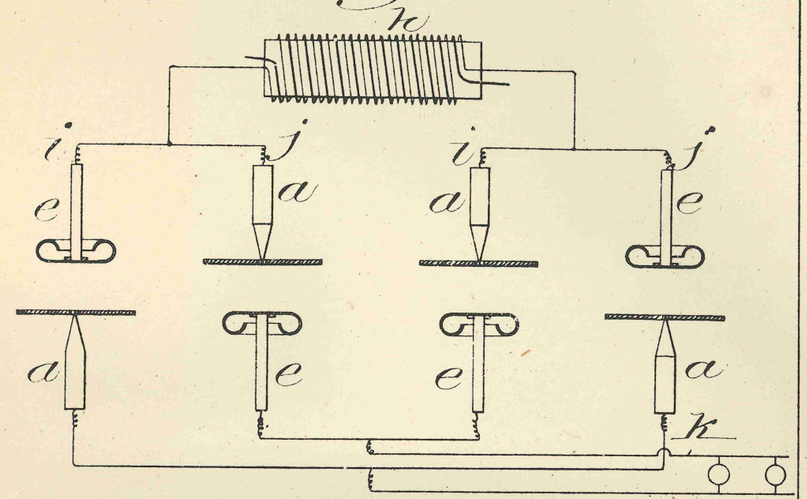
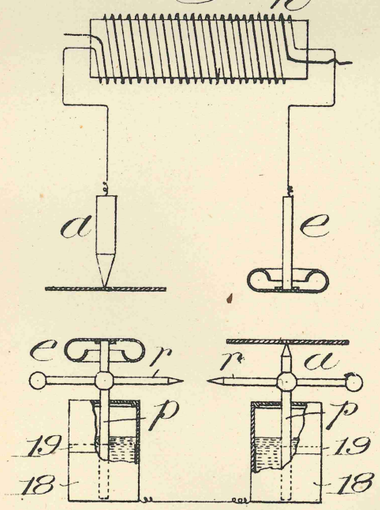


Fig. 4.



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