N. TESLA.

APPARATUS FOR THE UTILIZATION OF RADIANT ENERGY.
(Application filed Mar. 21, 1901.)

(No Model.)

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Witnesses:

Inventor

by

The Norris press co., Photo-litho., Washington, D.C.
To all whom it may concern:

Be it known that I, NIKOLA TESLA, a citizen of the United States, residing at the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Apparatus for the Utilization of Radiant Energy, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

It is well known that certain radiations—such as those of ultra-violet light, cathodic, Roentgen rays, or the like—possess the property of charging and discharging conductors of electricity, the discharge being particularly noticeable when the conductor upon which the rays impinge is negatively electrified. These radiations are generally considered to be ether vibrations of extremely small wave lengths, and in explanation of the phenomena noted it has been assumed by some authorities that they ionize or render conducting the atmosphere through which they are propagated. My own experiments and observations, however, lead me to conclusions more in accord with the theory herefore advanced by me that sources of such radiant energy throw off with great velocity minute particles of matter which are strongly electrified, and therefore capable of charging an electrical conductor, or, even if not so, may at any rate discharge an electrified conductor either by carrying off bodily its charge or otherwise.

My present application is based upon a discovery which I have made that when rays or radiations of the above kind are permitted to fall upon an insulated conducting-body connected to one of the terminals of a condenser while the other terminal of the same is made by independent means to receive or to carry away electricity a current flows into the condenser so long as the insulated body is exposed to the rays, and under the conditions hereinafter specified an indefinite accumulation of electrical energy in the condenser takes place. This energy after a suitable time interval, during which the rays are allowed to act, may manifest itself in a powerful discharge, which may be utilized for the operation or control of mechanical or electrical devices or rendered useful in many other ways.

In applying my discovery I provide a condenser, preferably of considerable electrostatic capacity, and connect one of its terminals to an insulated metal plate or other conducting-body exposed to the rays or streams of radiant matter. It is very important, particularly in view of the fact that electrical 60 energy is generally supplied at a very slow rate to the condenser, to construct the same with the greatest care. I use, by preference, the best quality of mica as dielectric, taking every possible precaution in insulating the 65 armature, so that the instrument may withstand great electrical pressures without leaking and may leave no perceptible electrification when discharging instantaneously. In practice I have found that the best results are obtained with condensers treated in the manner described in a patent granted to me February 23, 1897, No. 577,071. Obviously the above precautions should be the more rigorously observed in the slower the rate of charging and the smaller the time interval during which the energy is allowed to accumulate in the condenser. The insulated plate or conducting-body should present as large a surface as practicable to the rays or streams of energy after a suitable height in the atmosphere or to a grounded conductor, the former, as is well known, furnishing positive and the latter negative electricity. As the rays or supposed streams of matter, I having ascertained that the amount of energy conveyed to it per unit of time is under otherwise identical conditions proportional to the area exposed, or nearly so. Furthermore, the surface should be clean and preferably highly polished or amalgamated. The second terminal or armature of the condenser may be connected to one of the poles of a battery or other source of electricity or to any conducting body or object whatever of such properties or so conditioned that by its means electricity of the required sign will be supplied to the terminal. A simple way of supplying positive or negative electricity to the terminal is to connect the same either to an insulated conductor supported at some height in the atmosphere or to a grounded conductor, the former, as is well known, furnishing positive and the latter negative electricity. As the rays or supposed streams of matter.
ter generally convey a positive charge to the first condenser-terminal, which is connected to the plate or conductor above mentioned, I usually connect the second terminal of the condenser to the ground, this being the most convenient way of obtaining negative electricity, dispensing with the necessity of producing an artificial source. In order to utilize for any useful purpose the energy accumulated in the condenser, I furthermore connect to the terminals of the same circuit including an instrument or apparatus which it is desired to operate and another instrument or device for alternatingly closing and opening the circuit. This latter may be any form of circuit-controller, with fixed or movable parts or electrodes, which may be actuated either by the stored energy or by independent means.

My discovery will be more fully understood from the following description and annexed drawings, to which reference is now made, and in which—

Fig. 1 is a diagram showing the general arrangement of apparatus as usually employed. Fig. 2 is a similar diagram illustrating more in detail typical forms of the devices or elements used in practice, and Figs. 3 and 4 are diagrammatical representations of modified arrangements suitable for special purposes.

As illustrative of the manner in which the several parts or elements of the apparatus in one of its simplest forms are to be arranged and connected for useful operation, reference is made to Fig. 1, in which C is the condenser, P the insulated plate or conducting body which is exposed to the rays, and P another plate or conductor which is grounded, all being joined in series, as shown. The terminals T T of the condenser are also connected to a circuit which includes a device R to be operated and a circuit-controlling device d of the character above referred to.

The apparatus being arranged as shown, it will be found that when the radiations of the sun or of any other source capable of producing the effects before described fall upon the plate P an accumulation of electrical energy in the condenser C will result. This phenomenon, I believe, is best explained as follows: The sun, as well as other sources of radiant energy, throws off minute particles of matter positively electrified, which, impinging upon the plate P, communicate continuously an electrical charge to the same. The opposite terminal of the condenser being connected to the ground, which may be considered as a vast reservoir of negative electricity, a feeble current flows continuously into the condenser, and inasmuch as these supposed particles are of an incomendably small radius or curvature, and consequently charged to a relatively very high potential, this charging of the condenser may continue, as I have actually observed, almost indefinitely, even to the point of rupturing the dielectric. If the device d be of such character that it will operate to close the circuit in which it is included when the potential in the condenser has reached a certain magnitude, the accumulated charge will pass through the circuit, which also includes the receiver R, and operate the latter.

In illustration of a particular form of apparatus which may be used in carrying out my discovery I now refer to Fig. 2. In this figure, which in the general arrangement of the elements is identical to Fig. 1, the device d is shown as composed of two very thin conducting-plates t t', placed in close proximity and very mobile, either by reason of extreme flexibility or owing to the character of their support. To improve their action, they should be inclosed in a receptacle, from which the air may be exhausted. The plates t t' are 85 connected in series with a working circuit, including a suitable receiver, which in this case is shown as consisting of an electromagnet M, a movable armature α, a retractive spring b, and a ratchet-wheel w, provided with a spring pawl v, which is pivoted to armature α, as illustrated. When the radiations of the sun or other radiant source fall upon plate P, a current flows into the condenser, as above explained, until the potential therein rises sufficiently to attract and bring into contact the two plates t t', and thereby close the circuit connected to the two condenser-terminals. This permits a flow of current which energizes the magnet M, causing it to draw down the armature α and impart a partial rotation to the ratchet-wheel w. As the current ceases the armature is retracted by the spring b, without, however, moving the wheel w. With the stoppage of the current the plates t t' cease to be attracted and separate, thus restoring the circuit to its original condition.

Fig. 3 shows a modified form of apparatus used in connection with an artificial source of radiant energy, which in this instance may be an arc emitting copiously ultra-violet rays. A suitable reflector may be provided for concentrating and directing the radiations. A magnet R and circuit-controlling device d are arranged as in the previous figures; but in the present case the former instead of performing itself the whole work only serves the purpose of alternately opening and closing a local circuit, containing a source of current B and a receiving or translating device D. The controller d, if desired, may consist of two fixed electrodes separated by a minute air-gap or weak dielectric film, which breaks down more or less suddenly when a definite difference of potential is reached at the terminals of the condenser and returns to its original state upon the passage of the discharge.

Still another modification is shown in Fig. 4, in which the source S of radiant energy is a special form of Roentgen tube devised by
me, having but one terminal \( k \), generally of 
aluminium, in the form of half a sphere, with 
a plain polished surface on the front side, 
from which the streams are thrown off. It 
may be excited by attaching it to one of the 
terminals of any generator of sufficiently high 
electricity; but whatever apparatus 
be used it is important that the tube be 
exhausted to a high degree, as otherwise it might 
prove entirely ineffective. The working or 
discharge circuit connected to the terminals 
\( T'T \) of the condenser includes in this case 
the primary \( p \) of a transformer and a circuit- 
controller comprising a fixed terminal or 
brush \( t \) and a movable terminal \( t' \) in the shape 
of a wheel, with conducting and insulating 
segments, which may be rotated at an arbitrary 
speed by any suitable means. In 
inductive relation to the primary wire or coil \( p \) 
are two or more secondary windings, usually of 
a number of turns, to the ends of which is con-
ected a receiver \( R \). The terminals of the 
condenser being connected, as indicated, one 
to an insulated plate \( P \) and the other to a 
grounded plate \( P' \), when the tube \( S \) is excited 
from the primary \( p \) may be any form of 
Roentgen or Lenard tube; but it is 
obvious from the theory of action that in 
order to be very effective the electrical impulse 
exciting it should be wholly or at least 
preponderatingly of one sign. If symmetrical 
alternating currents are employed, provision 
should be made for allowing the rays to fall 
upon the plate \( P \) only during those periods when they are productive 
of the desired result. Evidently if the 
radiations of the source be stopped or inter-
cepted in any manner, as by periodically interrupting or rhythmically 
varying the current exciting the source, 
there will be corresponding changes in the 
action upon the receiver \( R \), and thus signals 
may be transmitted and many other useful 
effects produced. Furthermore, it will be 
understood that any form of condenser which 
will respond to or be set in operation when a 
predetermined amount of energy is stored in 
the condenser may be used in lieu of the device 
specifically described with reference to Fig. 2 
and also that the special details of construction 
and arrangement of the several parts of the 
apparatus may be very greatly varied withou 
departure from the invention.

Having described my invention, what I 
claim is:

1. An apparatus for utilizing radiant en-
ergy, comprising in combination a condenser, 
one armature of which is subjected to the ac-
tion of rays or radiations, independent means 
for charging the other armature, a circuit 
and apparatus therein adapted to be operated or 
controlled by the discharge of the condenser, 
as set forth.

2. An apparatus for utilizing radiant en-
ergy, comprising in combination, a condenser, 
one armature of which is subjected to the ac-
tion of rays or radiations, independent means 
for charging the other armature, a local cir-
cuit connected with the condenser-terminals, 
a circuit-controller therein and means adapted 
for charging the other armature, a local cir-
cuit connected with the condenser-terminals, 
a circuit-controller therein and means adapted 
to be operated or controlled by the discharge of 
the condenser when the local circuit is 
closed, as set forth.

3. An apparatus for utilizing radiant en-
ergy, comprising in combination, a condenser, 
two armatures of which is subjected to the ac-
tion of rays or radiations, independent means 
for charging the other armature, a local cir-
cuit connected with the condenser-terminals, 
a circuit-controller therein dependent for 
operation on a given rise of potential in the 
condenser, and devices operated by the discharge 
of the condenser when the local circuit is 
closed, as set forth.

4. An apparatus for utilizing radiant en-
ergy, comprising in combination, a condenser, 
one armature of which is subjected to the ac-
tion of rays or radiations, and the other of 
which is connected with the ground, a circuit 
and apparatus therein adapted to be operated 
by the discharge of the accumulated energy 
in the condenser, as set forth.

5. An apparatus for utilizing radiant en-
ergy, comprising in combination, a condenser, 
one armature of which is subjected to the ac-
tion of rays or radiations and the other of 
which is connected with the ground, a local 
circuit connected with the condenser-termi-
inals, a circuit-controller therein and means adapted 
to be operated by the discharge of 
the condenser when the local circuit is 
closed, as set forth.

6. An apparatus for utilizing radiant en-
ergy, comprising in combination, a condenser, 
one armature of which is subjected to the ac-
tion of rays or radiations and the other of 
which is connected with the ground, a local 
circuit connected with the condenser-termi-
inals, a circuit-controller therein adapted to 
be operated by a given rise of potential in the 
condenser, and devices operated by the dis-
charge of the condenser when the local circuit 
is closed, as set forth.

7. An apparatus for utilizing radiant en-
ergy, comprising a condenser, having one terminal connected to earth and the other to an elevated conducting-plate, which is adapted to receive the rays from a distant source of radiant energy, a local circuit connected with the condenser-terminals, a receiver therein, and a circuit-controller therewith which is adapted to be operated by a given rise of potential in the condenser, as set forth.

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Witnesses:
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RICHARD DONOVAN.