No. 662,785. Patented Nov. 27, 1900.

W. GRUNOW, JR.

APPARATUS FOR RUPTURING HIGH POTENTIAL ELECTRICAL CIRCUITS WITHOUT DANGEROUS ARCING.

(Application filed June 13, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

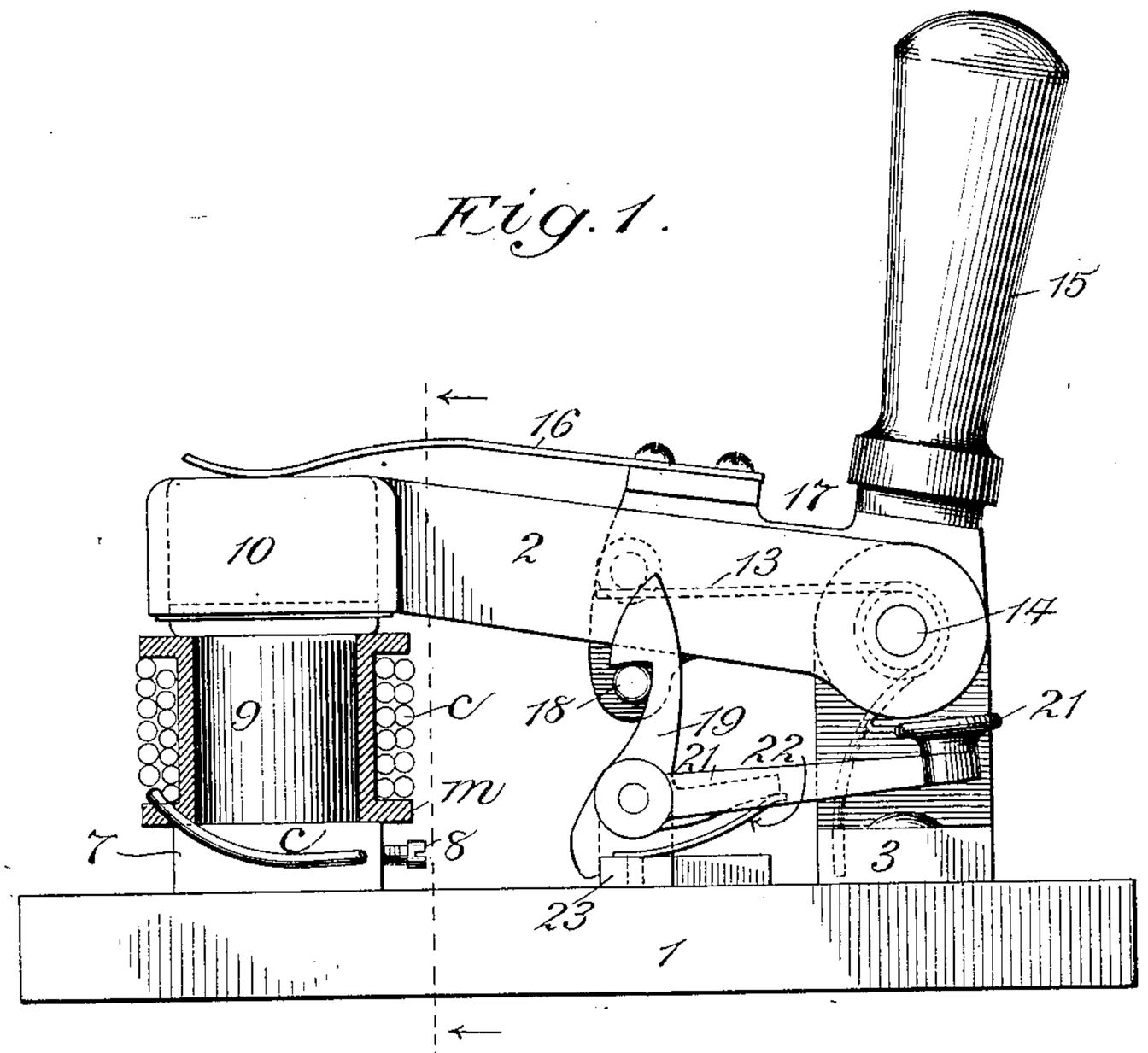
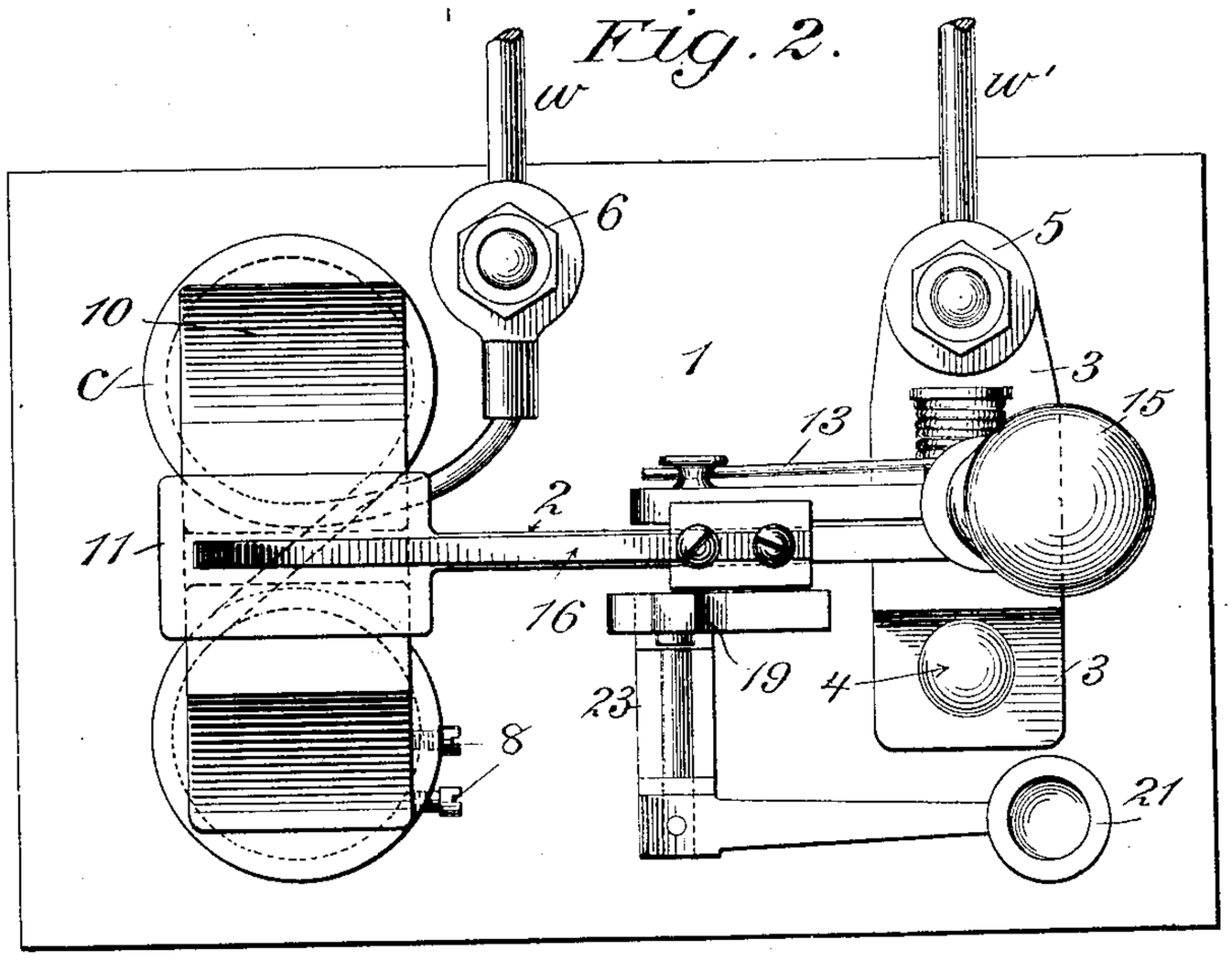


Fig. 2.



Witnesses
Edward C. Rowland.
M. F. Keating

Inventor
William Grunow Jr.
By his Attorney
Charles J. Kintner

No. 662,785. Patented Nov. 27, 1900.

W. GRUNOW, JR.

APPARATUS FOR RUPTURING HIGH POTENTIAL ELECTRICAL CIRCUITS WITHOUT DANGEROUS ARCING.

(Application filed June 13, 1900.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

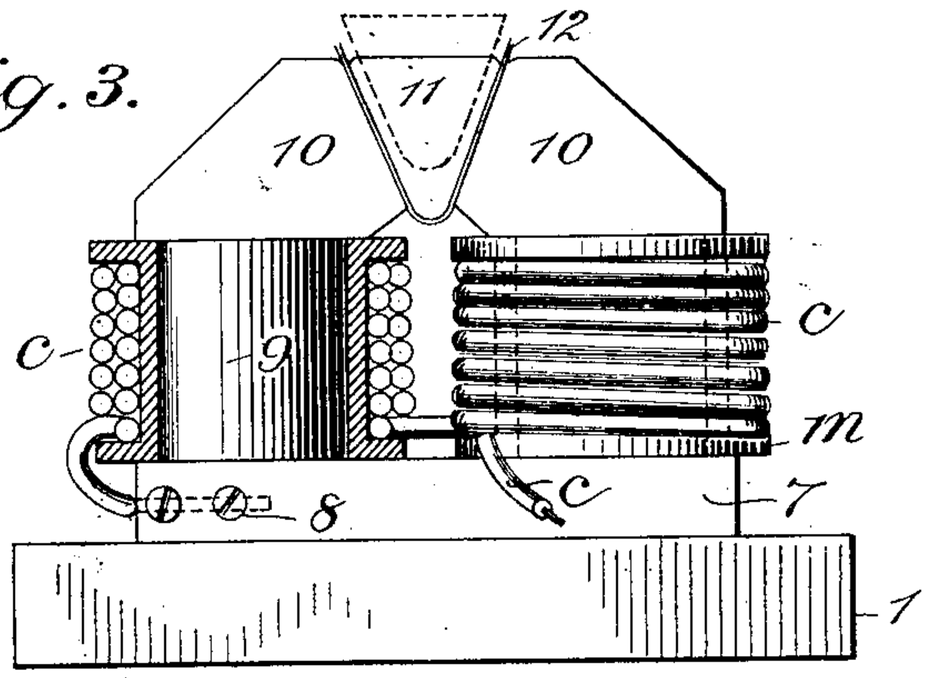
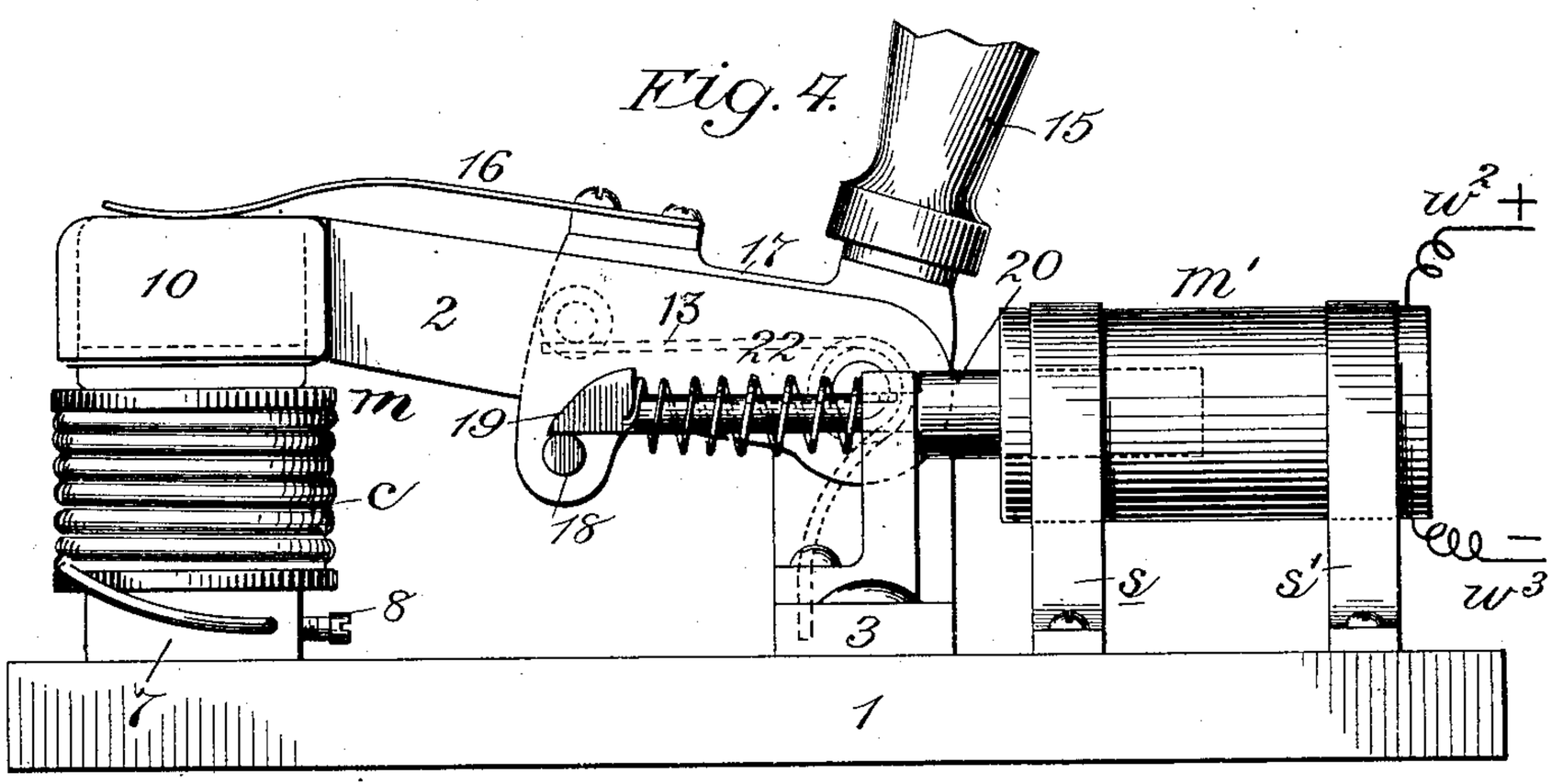


Fig. 4.



Witnesses
Edward C. Howland.
M. F. Keating

Inventor
William Grunow Jr
By his Attorney
Charles J. Kintner

No. 662,785. Patented Nov. 27, 1900.

W. GRUNOW, JR.

APPARATUS FOR RUPTURING HIGH POTENTIAL ELECTRICAL CIRCUITS WITHOUT DANGEROUS ARCING.

(Application filed June 13, 1900.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 5.

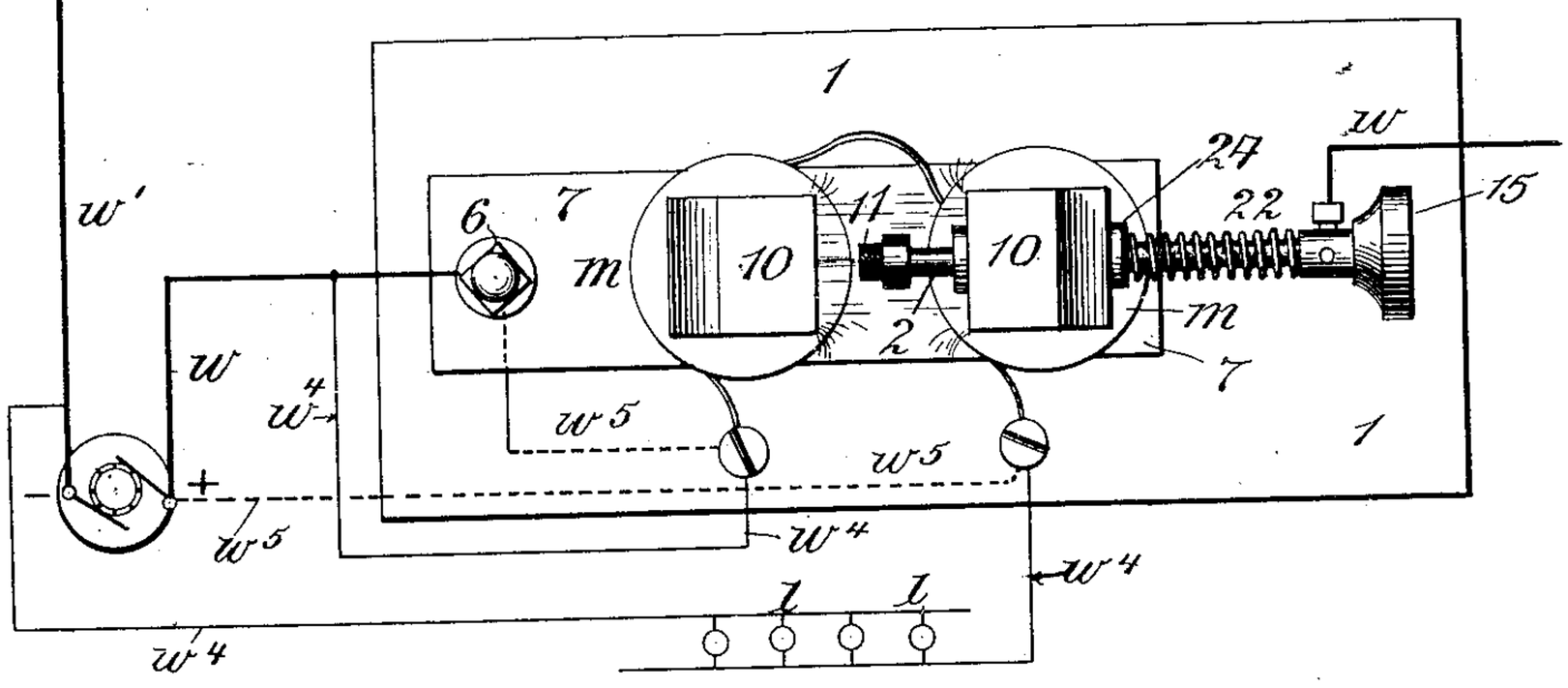
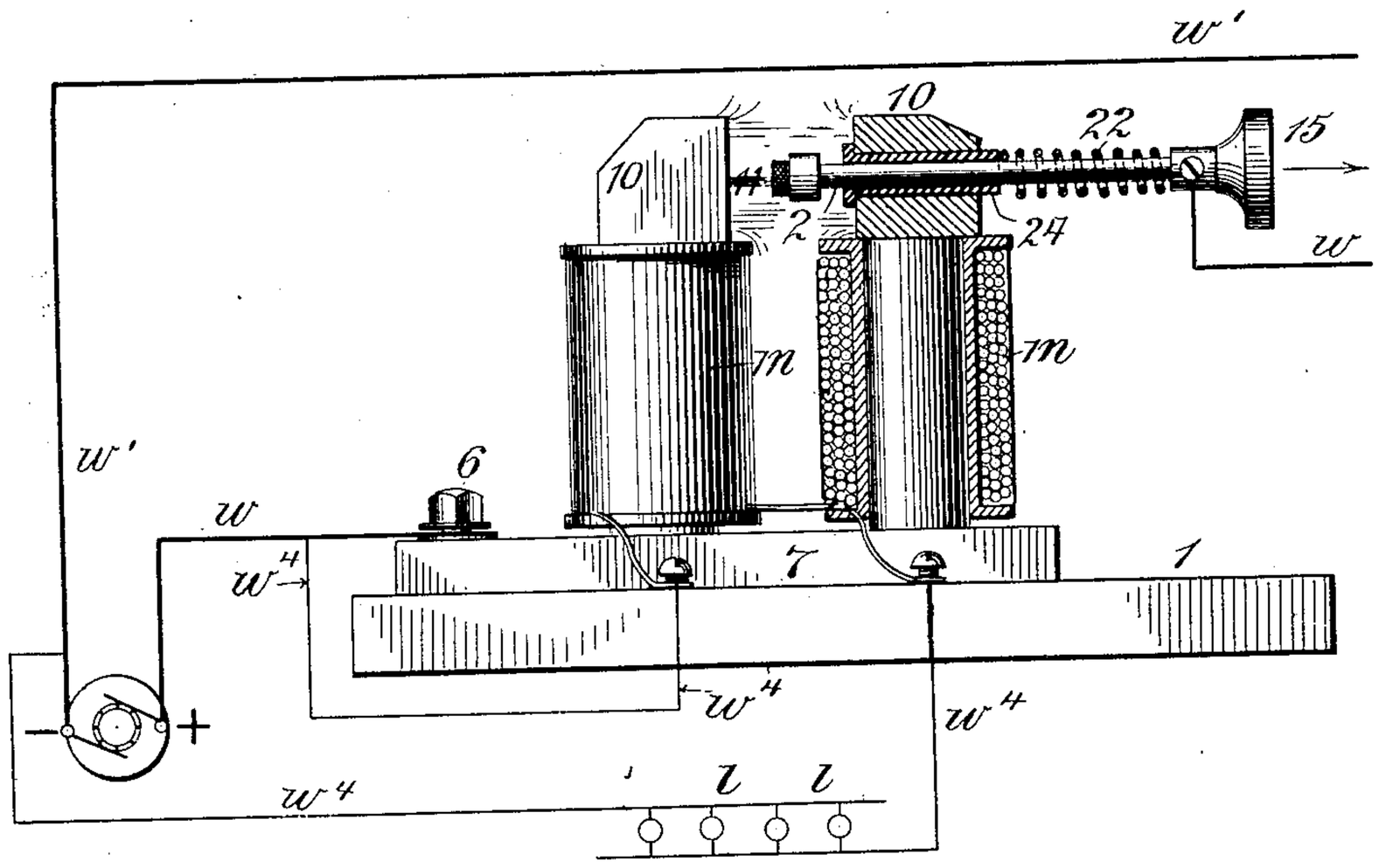


Fig. 6.



Witnesses
Edward Lowland.
M. F. Keating

Inventor
William Grunow Jr.
By his Attorney
Charles D. Kintner

UNITED STATES PATENT OFFICE.

WILLIAM GRUNOW, JR., OF BRIDGEPORT, CONNECTICUT, ASSIGNOR TO THE McELROY-GRUNOW ELECTRIC RAILWAY SYSTEM, OF SAME PLACE.

APPARATUS FOR RUPTURING HIGH-POTENTIAL ELECTRICAL CIRCUITS WITHOUT DANGEROUS ARCING.

SPECIFICATION forming part of Letters Patent No. 662,785, dated November 27, 1900.

Application filed June 13, 1900. Serial No. 20,114. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM GRUNOW, Jr., a citizen of the United States, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have made a new and useful Invention in Apparatus for Rupturing High-Potential Electrical Circuits Without Dangerous Arcing, of which the following is a specification.

My invention has for its object to effect the interruption of a relatively high potential electrical circuit without forming an arc which will either be dangerous to the operator or damaging to the apparatus, and this I accomplish by the use of the apparatus hereinafter described, the essential and novel features of my invention being particularly pointed out in the claim at the end of this specification. Prior to my invention this result had been accomplished by the establishment of a magnetic field about the point where the circuit is interrupted in such manner that the magnetic lines of force flowing in the magnetic field passed at substantially right angles to the direction of the current-flow in the circuit or to the direction of the arc when established. Such a method of and apparatus for accomplishing it are disclosed in United States Patent to Elihu Thomson, No. 283,167, dated August 14, 1883. It is also old in the art to extinguish an abnormal arc established in an electrical circuit, including an electrical generator and translating devices, through the agency of superimposed currents of enormously high potential, such as lightning, by setting up a magnetic field at a point where the arc is thus established, in which field the magnetic lines of force flow in lines substantially parallel with the flow of the arc-establishing current, as disclosed in United States Patent to Elihu Thomson, No. 470,721, dated March 15, 1892. An arc-interrupting device has also heretofore been devised in which the movable part is composed of two arms adapted to be withdrawn from between the poles of a pair of independent electromagnets, said poles and the movable arms being included in the circuit to be interrupted, as disclosed in United States Patent to Frank B. Rae, No. 454,496, dated June 23, 1891, and I make no claim broad enough to include such a structure, my claim hereinafter being to a current-interrupting device in which the movable terminal is located, when in contact with the fixed terminal, wholly within the magnetic influence of all of the magnetic lines of force of a complete or closed magnetic circuit and in such manner as to obtain, when the circuit is interrupted, the maximum current-interrupting effect of all of said magnetic lines.

My invention contemplates the use of means for preventing abnormally-long arcs between any two circuit-interrupting terminals of an electrical circuit, including a generator of relatively high electrical potential and translating devices, and I effect this result by establishing a magnetic field about the terminals where the circuit is to be interrupted in which the magnetic lines of force flow substantially parallel to the current-flow of the circuit which it is desired to interrupt, and it will be fully understood by referring to the accompanying drawings, in which—

Figure 1 is a side elevational view of a hand-switch embodying the principles of the invention, the magnetic coil being shown in sectional view. Fig. 2 is a plan view of the same as seen looking at Fig. 1 from the top toward the bottom of the drawings. Fig. 3 is a side elevational view of Fig. 1 as seen looking thereat from right to left in the direction of the arrows upon the supposition that all of the switching apparatus to the right of the line $x\,x$ is removed, only the circuit-interrupting portion of the switch being shown in dotted lines and one of the coils of the magnet in sectional view. Fig. 4 is a side elevational view of the same apparatus as is seen in Fig. 1, illustrating, however, a modified means of releasing the switch. Fig. 5 is a part plan and part diagrammatic view illustrating the application of the principle of the invention and also showing how the apparatus may be connected either in series or multiple circuit with an electrical system with which it is designed to be used. Fig. 6 is a side elevational view of the apparatus illustrated in Fig. 5, one coil of the electromagnet being shown in sectional view and the movable terminal of the switch in elevational view.

Referring now to the drawings in detail and first to Figs. 1, 2, and 3, 1 represents the insulating base-board of a hand-switch embodying my invention, 3 being one of the conducting-standards secured thereto by a screw 4 and adapted to support on trunnions 14 the piv-

otal conducting part 2 of the switch and also the operating-handle 15, together with an arm or extension which supports at its outer end a yielding spring 16 and at the lower side thereof a locking-pin 18, adapted to take behind a lock or catch 19 operatively connected with a hand-operated releasing-lever 21, said lock or catch and releasing-lever being pivotally secured by a plate 23 to its base 1. 22 is a leaf-spring secured to the plate 23 and adapted to hold the locking parts in a locked or closed position, as shown. 13 is an operating-spring adapted to act in the usual manner for causing the switch to operate upon the principle of well-known forms of snap-acting switches when the locking-pin 18 is released.

The features already described are well known in hand-switches and constitute no part of the present invention, being simply shown and described here for the purpose of illustrating the application of my invention in connection with hand-switches proper. The standard 3 is provided with a binding-post 5, adapted to receive one of the current feeders or mains w', while a similar binding-post 6 is provided for the other current feeder or main w, which is connected in turn to an insulated conductor c, constituting the coils or windings of a horseshoe-electromagnet m, the other end of said conductor being connected directly to the yoke 7 thereof by two screws 8. (See Fig. 3.)

9 9 are the cores of the electromagnet and the poles 10 10 thereof are constructed, preferably as shown in Fig. 3, with inclined faces, the arrangement being such as to give the strongest possible magnetic field between said faces. 11 constitutes the movable terminal of the switch, and its lateral faces are substantially parallel with the lateral faces of the pole-pieces 10 10.

12 is a thin sheet of copper or other non-magnetic material secured to the inner faces of the pole-pieces 10 10 for the purpose of preventing the movable terminal 11 from adhering or sticking to the cores when the switch is closed.

In Fig. 4 I have illustrated means for releasing the switch from a distance through the agency of a solenoid m', supported by standards $s\ s'$, secured to the base 1, $w^2\ w^3$ being the conductors running to a source of electrical supply. (Not shown.) 20 is the core of the solenoid, secured to the lock or catch 19, and 22 is the locking-spring, which performs the same function as does the spring 22 in connection with Figs. 1 and 2. The other parts of the structure shown in Fig. 4 are identically like those illustrated in Figs. 1, 2, and 3.

In Figs. 5 and 6 of the drawings I have illustrated another form of the apparatus, in which the strongest possible magnetic field is obtained, and this whether the current be conveyed in series through the magnet, the pole thereof, the generator, and the translating devices or whether the coils of the magnet be in shunt-circuit therewith.

In the arrangement shown in Figs. 5 and 6 the movable terminal 2 of the switch is secured in one of the poles of the magnet in such manner as to move laterally in an insulating-sleeve 24. 11 is a piece of carbon secured to the inner end of the movable terminal for the purpose of giving an elongated arc between the terminals and also for the purpose of preventing any sticking or welding together thereof. With this arrangement of circuits and terminals I have in practice established an arc by passing a current through the current-feeder w, binding-post 6, yoke 7, left-hand pole-piece 10, carbon 11, movable part 2, current-feeder w, and return-current feeder w' to the generator by withdrawing the movable part against the stress of the spring 22 and by the aid of the handle 15 in the direction of the arrow and afterward close the shunt-circuit w^4 through the coils of the magnet m and lamps or translating devices l, thus causing an abnormally-long arc to be instantly extinguished. The same effect is had also with this apparatus when the circuit connections are in series relation through the conductor w^5, coils of the magnet m, binding-post 6, yoke 7, left-hand pole 10, carbon 11, movable terminal 2, and the current feeders or mains $w\ w'$ to the generator. (See Fig. 5.)

For the purpose of obtaining the best effects it is desirable that the magnetic field between the movable and fixed terminals shall include as many magnetic lines of force as possible, and therefore I prefer the apparatus disclosed in Fig. 3, in which the pole-pieces 10 are as close together as possible and the movable part 11 is of soft magnetic iron, the usual adhering action between said part 11 and the poles being prevented either by attaching to the poles one or more thin sheets of copper 12 or by electroplating the faces of the poles and the faces of the part 11 with copper.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

A current-interrupting device consisting of a fixed and a movable terminal, the fixed terminal being the poles of a horseshoe-magnet and the movable terminal being, when in contact, located wholly between said poles and in the complete or closed magnetic field, the arrangement being such that the magnetic lines of force flow entirely through and around the movable terminal and in a direction parallel to the movement thereof at all parts of its movement; in combination with means for effecting said movement, substantially as described.

In testimony whereof I have hereunto subscribed my name this 12th day of June, 1900.

WILLIAM GRUNOW, JR.

Witnesses:
M. F. KEATING,
C. J. KINTNER.