

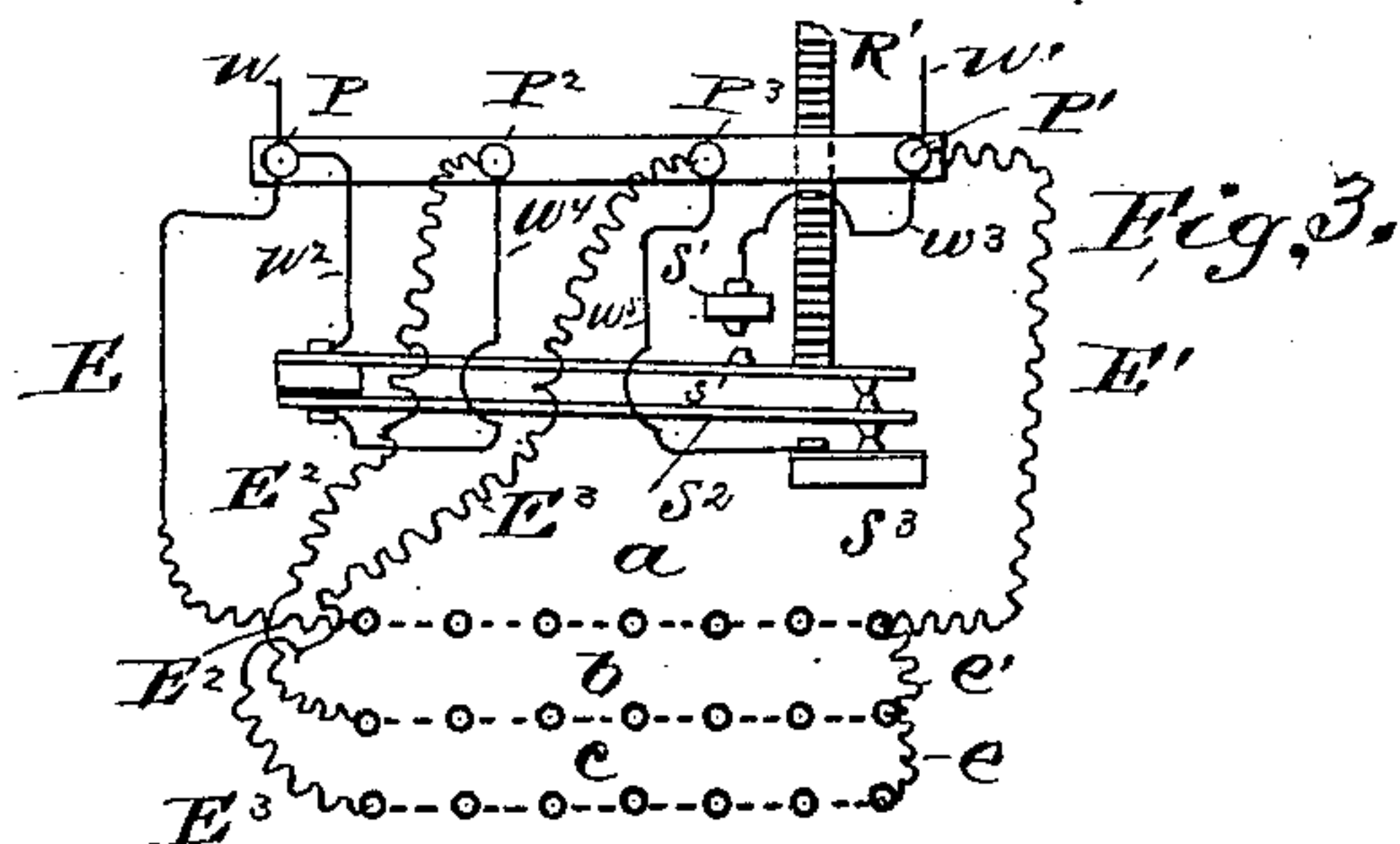
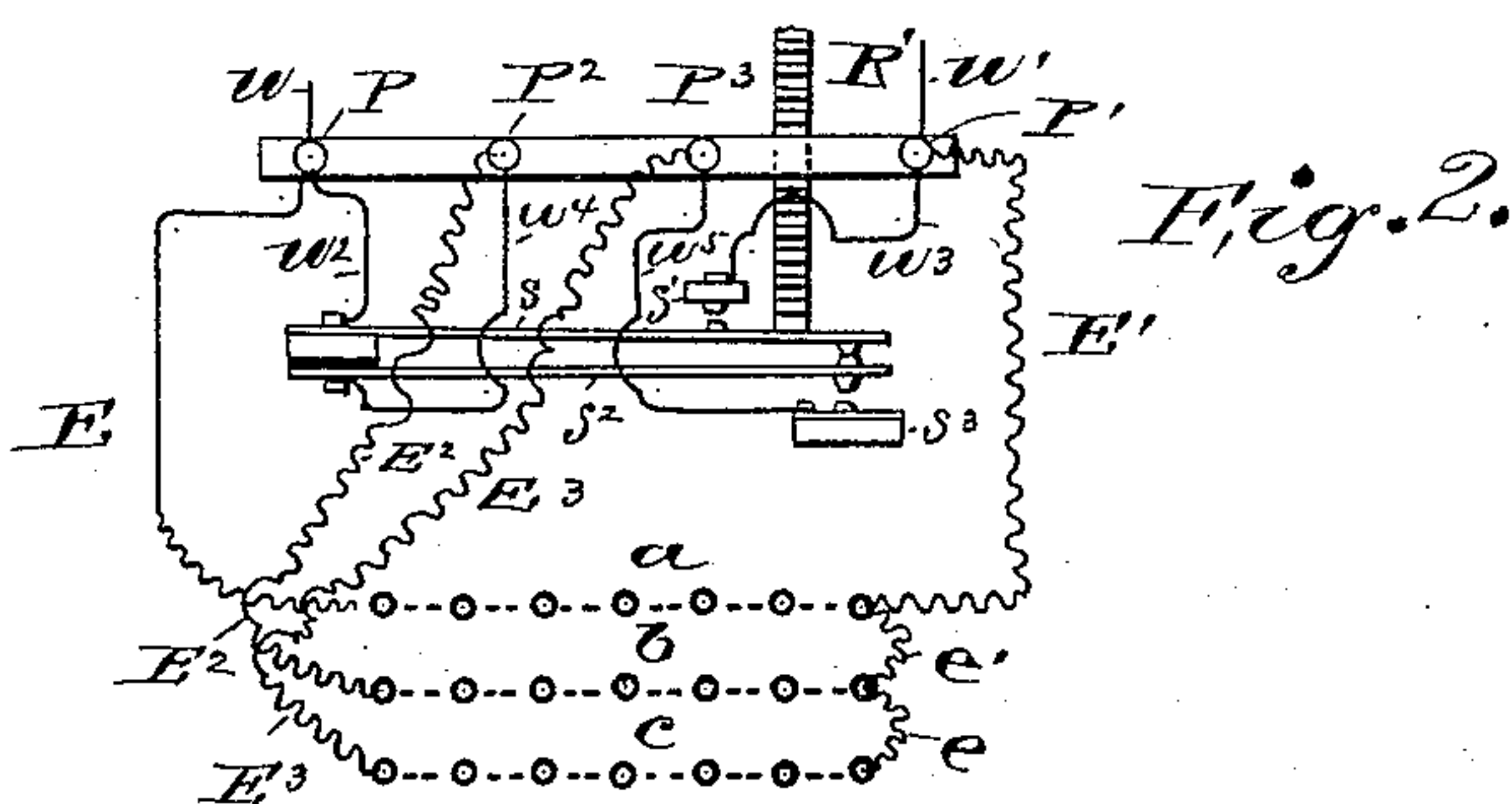
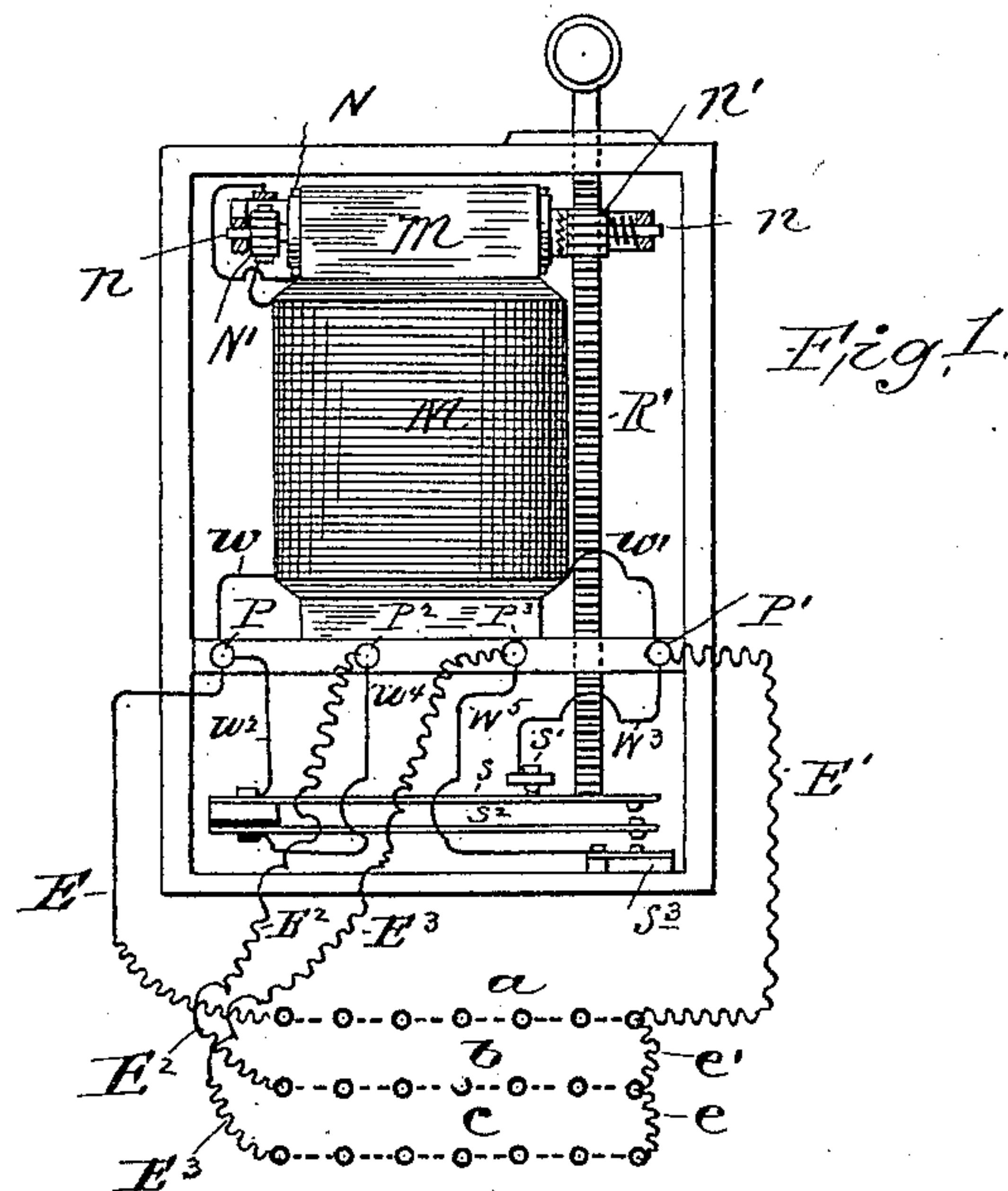
(No Model.)

2 Sheets—Sheet 1.

H. J. SMITH.
ART OF BLASTING.

No. 534,289.

Patented Feb. 19, 1895.



Attest:
A. W. Benjamin
A. T. Fales.

Inventor:
H. Julius Smith
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att'y.

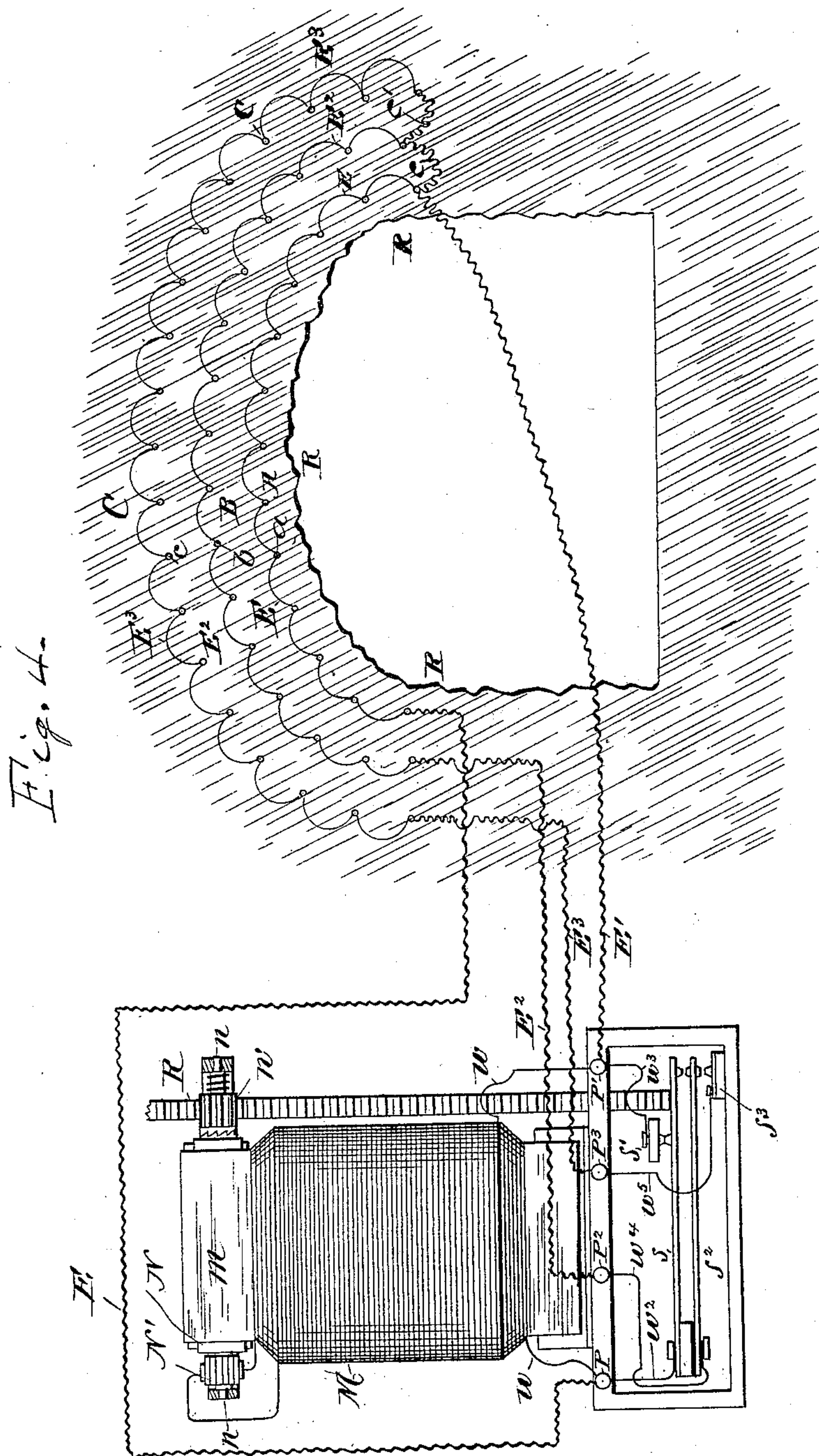
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2 Sheets—Sheet 2.

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WITNESSES:

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C. W. Benjamin
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UNITED STATES PATENT OFFICE.

HENRY JULIUS SMITH, OF POMPTON LAKES, NEW JERSEY.

ART OF BLASTING.

SPECIFICATION forming part of Letters Patent No. 534,289, dated February 19, 1895.

Application filed June 8, 1894. Serial No. 513,957. (No model.)

To all whom it may concern:

Be it known that I, HENRY JULIUS SMITH, a citizen of the United States, residing at Pompton Lakes, county of Passaic, and State of New Jersey, have invented certain new and useful Improvements in the Art of Blasting, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to blasting operations, wherein an electric current is employed to ignite the fuses for the explosion of the blasting charges in the rock or other material to be dislodged.

In the utilization of electricity for the purpose of igniting fuses in blasting operations, it has been the prevalent custom to employ a portable appliance, such as the dynamo-magnetic machine now in general use, for the generation of the electric current at such various places in the field of operations as may be necessary and expedient for its effective application to an electric-circuit in which the fuses are interposed, in which appliance, or machine, it is usual to accomplish the generation of the current by a single impulse, or the movement through a definite and predetermined interval, of the generator-actuating device at the hands of the operator. Means have been provided whereby when the generated current accumulated in the appliance, or machine, has attained the requisite volume and intensity, it is passed to and traverses a single working-circuit containing the fuses or ignitable devices; but, owing, in part, to the fact that the energy accumulated in the generating and accumulating appliance, or machine, is not instantly dissipated when the current is passed therefrom to and traverses the said single working-circuit, and, in part, to the conservation of such energy by a continuance, in a degree, of the generation of the current subsequently to its passing to the said circuit, the current will possess or maintain a potency which will endure at least until the force imparted by the current to the ignitable devices is exhausted.

One object of my present invention is to utilize for purposes of ignition, in blasting and analogous operations, this said enduring potency of the electric current.

To this end, my invention consists, primarily, in the method of utilizing electricity for purposes of ignition in the art of blasting, &c., which comprises passing an electric-current, from a circuit in which it is generated and accumulated, over a circuit in which ignitable devices are interposed, and, subsequently, and before the potentiality successively imparted by the said current to the ignitable devices in the several circuits is exhausted, respectively, passing the said current over an additional independent circuit, or circuits, one or more, successively, in which are interposed further ignitable devices.

In many cases, in blasting operations, and particularly in the excavation of headings or tunnels, it is desirable to dislodge several layers or portions of the rock in succession, first breaking and throwing down that portion at the rock-surface, and following this dislodgment with the successive breaking and throwing down of layers or portions which are progressively farther distant from the surface, and to accomplish this by a single operation of firing of the blast-holes.

My present invention also comprises the method of blasting which consists in locating blast-holes, in the rock to be dislodged, at progressively increasing distances, successively from the surface or outward face of the rock-wall; constituting a series of independent electric-circuits extending, severally, from an electrical-generator to the blast-holes, respectively, with the fuses, or other ignitable devices, of the blasting-charges in said several holes, interposed in said circuits respectively; and causing a single electric current to traverse said several circuits, successively, before the potentiality thereby successively imparted to the blasting charges interposed in the said several circuits is exhausted respectively; whereby the blasting-charges in the holes nearest to the rock-surface may be initially fired, and the charges in the holes which are progressively farther distant from the rock-surface may be subsequently successively fired.

In the dynamo-magnetic machines which are generally employed to develop an electric-current for the purpose stated, the developed current is accumulated in the electro-magnet until a sufficient volume and intensity

to effect the desired purpose have been obtained. The current during its development passes over a circuit which is divided through a portion of its length into two unequal parts, the shorter of which comprises the magnet-coils and their intermediate connections and to the pole-posts of the machine, while the longer consists in the line-wires leading from said posts to the blasts and in which the fuses are interposed. The said shorter part of the circuit is commonly called the "condensing-circuit," it being that part in which, owing to its lesser resistance, the current accumulates as it is developed; while the longer portion is denominated the "working-circuit," or circuit of application, the resistance of which is the greater; whereby, during the development of the current, only a minor portion thereof traverses it. In heretofore utilizing the current accumulated in the said condensing-circuit in said machines, the said condensing-circuit has been broken when the current has been fully developed, which has obliged the said developed and condensed current to traverse the outside or working-circuit, wherein it encounters resistance in each fuse of a platinum-wire bridge, which, by that resistance, is heated to redness, or more, thus igniting the priming in each fuse and firing the blasts.

In the drawings, Figure 1 illustrates a means which may be employed to carry out the primary feature of my invention, the condensing-circuit being, in this view, shown closed. Fig. 2 illustrates the relative position of the devices after the condensing-circuit has been broken and connection established between the first working-circuit, after such circuit has been traversed by the condensed current, and a second working-circuit. Fig. 3 illustrates the relative position of the devices after the second working-circuit has been traversed by the current and connection has been established with a third working-circuit; and Fig. 4, illustrates my invention as applied to an improved method of blasting, as set forth.

In practicing my invention, the electric-current may be, and is, preferably and conveniently, developed by means of the well-known dynamo-magnetic machines now generally in use for generating electricity in blasting-operations. The essential parts of such a machine are illustrated in Figs. 1 and 4, comprising an electro-magnet *M* between the cores *m* of which is arranged the rotary armature *N*, with the commutator *N'* attached on one end of the armature-arbor *n*. These parts are of the ordinary construction and have the usual connections in such apparatus. Motion is given to the armature by a rack-bar *R'*, gearing with a pinion *n'* on the armature-arbor, as shown; the downward movement of the bar serving to rotate the armature for the development of the electric current.

A circuit is established by the magnet-coils,

the opposite terminals *w*, *w'* thereof, which are connected to the pole-posts *P*, *P'*, respectively, the wires *w*², *w*³, which connect said posts respectively to a spring-terminal *s*, and a bridge *s'* with which said terminal is in contact, and the line-wires *E*, *E'*, extending outside the machine between the posts *P*, *P'*, and in which the fuses, as at *a*, are interposed. The circuit thus established, it will be seen, is divided, at the posts *P*, *P'*, into two unequal parts, the longer consisting of the line-wires *E*, *E'*, which constitute the working-circuit running to the blasts and in which are the fuses; and the shorter comprising the magnet-coils, their terminals *w*, *w'*, the wires *w*², *w*³, the terminal *s* and bridge *s'*, constituting the condensing-circuit.

It is evident that while the current is being developed by such a machine, but a very small portion only of the volume of the current will pass through the outside, or working-circuit, as the resistance of this long circuit is the greater; but that by far the greater portion of the developed current will pass to the condensing-circuit, owing to its lesser resistance. The rotation of the armature being effected by the descent of the bar *R'*, as stated, and the free end of the spring-terminal *s* being in the path of said bar in its descent, when said bar impinges upon said terminal, it will force said terminal from contact with the bridge *s'*, thereby breaking the condensing-circuit, so that the fully developed and accumulated current will be obliged to pass over the outside or working-circuit, and thus ignite the fuses therein.

I make no claim herein to the described dynamo-magnetic machine with its arrangement of circuits and the means for breaking the short, or condensing-circuit, as set forth; the same having been patented to me under Letters-Patent No. 201,296; nor do I wish to be understood as confining myself, so far as my present invention is concerned, to the use of this described dynamo-magnetic machine as a means for carrying out my invention. Any other known or equivalent apparatus or appliance for the generation of an electric-current may be employed in practicing my invention; it being necessary, only, that such appliance should comprise a "condensing-circuit," or equivalent means for effecting the accumulation of the current to produce the requisite volume and intensity thereof, together with means for passing the fully developed current from the condensing-circuit to the outside or working-circuit.

In carrying out the primary feature of my invention, I pass the current, subsequently to its traverse of the working-circuit heretofore described, to an additional independent circuit, or circuits, successively, in which further ignitable devices are interposed, and before the potentiality successively imparted by said current to the ignitable devices in the several circuits is respectively therein exhausted.

An additional working-circuit is shown consisting of a line-wire, E^2 , connected with a post, P^2 , and a wire, e , connected to the wire, E' , running to post P' , together with a terminal s^2 connected by wire, w^4 , to post P^2 , and adapted to have connection established with it, as illustrated in Fig. 2, by the spring-terminal s , after contact has been broken between said terminal s and the bridge s' by the movement of the terminal s actuated by the descending bar R' . In this additional circuit are interposed fuses b .

In Fig. 3 is illustrated the operation of means which may be employed to establish connection with a third working-circuit composed of a line-wire E^3 connected to a post P^3 and a wire, e' , connected to wires, e , E' , running to the post P' together with a wire, w^5 , connecting an anvil s^3 to post P^3 . In this circuit are interposed fuses c .

It is evident that the terminal s^2 may be arranged relatively to the terminal s , and the anvil s^3 relatively to the terminal s^2 , so that a very limited, though appreciable, space of time will elapse between the instant when the movement of the terminal s , by the descending bar R' , breaks the condensing-circuit, and that at which contact is established between said terminal s and terminal s^2 , by the further descent of the bar; and that a similar limited, though appreciable, space of time will elapse between the instant when the terminals s and s^2 are put in contact and that at which contact is established between the terminal s^2 and anvil s^3 , by the movement or flexure of the terminal s^2 which may be a spring similar to terminal s , actuated by bar R' in its still further descent; whereby both said terminals, s and s^2 , are depressed in unison until the contact between terminal s and anvil s^3 is established, as set forth, and as illustrated in Figs. 2 and 3; and it obvious that the arrangement of the described terminals relatively to each other and to the bar R' may be such that the spaces of time which will successively elapse between the establishment of the several described successive contacts, will be so limited that such several contacts will be established, successively, before the potentiality thereby imparted by the current to the ignitable devices in the several circuits is therein respectively exhausted, and as the energy accumulated in the aforesaid condensing-circuit will not instantly dissipate when the current is passed therefrom to the first working-circuit, but will remain and exist in the condensing-circuit during a brief but appreciable interval of time; and as such energy will be conserved by a continuance, in a degree, of the generation of the current, by the prolongation of the rotation of the armature, due to the progressive movement of the rack-bar in its descent to break the condensing-circuit and establish the aforesaid contacts, the current will be passed over the first working-circuit and will fire the fuses interposed therein; and subsequently, and before the potentiality

successively imparted by the said current to the fuses in the several circuits is therein respectively exhausted, will be passed to and over the additional working-circuit or circuits, successively, and will fire the fuses therein respectively interposed.

I do not limit myself to the employment of these described means and devices for carrying out the essential feature of my invention, as it is obvious that any known or equivalent means by which connection may be established between the said several circuits, successively, subsequently to the initial passing of the current from the condensing-circuit or accumulator to, and traverse thereby of, the first working-circuit, before the potentiality thereby imparted, successively, by the current to the fuses interposed in the several circuits, respectively, is exhausted, may be used in practicing my invention.

In practicing my improved method of blasting, blast-holes, as shown at A, B, C, Fig. 4, are located, in the rock to be dislodged, at progressively increasing distances, successively, from the surface, or outward face R of the rock-wall. It will be understood that these holes may be a succession of single ones, or, as illustrated in the drawings, may be a succession of series of holes.

The independent electric-circuits E, E' ; E^2 , e , E' ; and E^3 , e' , E' , are arranged to extend from the hereinbefore described electrical generator, as shown in Fig. 4, severally to the respective blast-holes A, B, and C, or the respective series thereof, with the fuses, or other ignitable devices, of the blasting-charges in the several holes, interposed in said circuits, respectively, as indicated at a , b and c . The blasts are now ready for firing in pursuance of this feature of my invention; and, in conformity therewith, a single electric-circuit is caused to traverse the described several circuits, successively; that is to say, the current may be first sent over the circuit E, E' , whereupon the charge or charges of the hole, or series of holes A, located nearest to the surface of the rock-wall, the fuses a of which charges are interposed in this circuit, will be initially fired and the outermost layer or portion of said wall will be first dislodged and thrown down; the current then being sent successively over the circuits E^2 , e , E' , and E^3 , e' , E' , the charges in the holes or series of holes, B, and C, the fuses b and c of which are interposed respectively in said circuits, will be thereby successively fired, and the several layers of rock in which they are located will be successively dislodged and thrown down.

To generate the aforesaid electric current and to cause it to traverse the said several circuits successively, as set forth, the means shown in Fig. 4 and heretofore fully described may be conveniently employed.

It is apparent that by my described improvement in the art of blasting, the rock, or other material to be dislodged, may be broken off and thrown down in layers or portions, be-

ginning with that portion which is at the surface of the rock-wall, and progressing successively into the body of the rock.

I make no claim herein to such of the devices as are novel whereby I carry out this present invention, but I reserve the same herefrom and make them the subject-matter of claims in a separate application for Letters Patent, Serial No. 513,956.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The method of utilizing electricity for purposes of ignition in blasting operations, which consists in passing an electric current, from a circuit in which it is generated and accumulated, over a circuit in which ignitable devices are interposed, and subsequently, and before the potentiality successively imparted by the said current to the ignitable devices in the several circuits is therein respectively exhausted, passing the said current over an additional independent circuit, or circuits, one or more, successively, in which additional circuits further ignitable devices are interposed, substantially as and for the purpose set forth.

2. The improvement in the art of blasting, which consists in locating blast-holes, in the rock or other material to be dislodged, at progressively increasing distances, successively, from the surface or outward face of the rock wall; constituting a series of independent electric-circuits, extending severally from an electrical generator to the blast holes, respectively, with the fuse or other ignitable devices, of the blasting-charges in said several holes, interposed in said circuits respectively; and causing a single electric-current to successively, traverse said several circuits, before the potentiality thereby imparted, successively to the blasting-charges interposed in the several circuits, is therein respectively exhausted; whereby the blasting charges in the holes nearest to the rock-surface may be initially fired, and the charges in the holes which are progressively farther distant from the rock-surface may be subsequently successively fired, substantially as specified.

H. JULIUS SMITH.

Witnesses:

ARDEN S. FITCH,
A. T. FALES.