(No Model.)

3 Sheets—Sheet 1.

L. M. SABIN.

ELECTRIC ENGINE.

No. 538,351.

Patented Apr. 30, 1895.

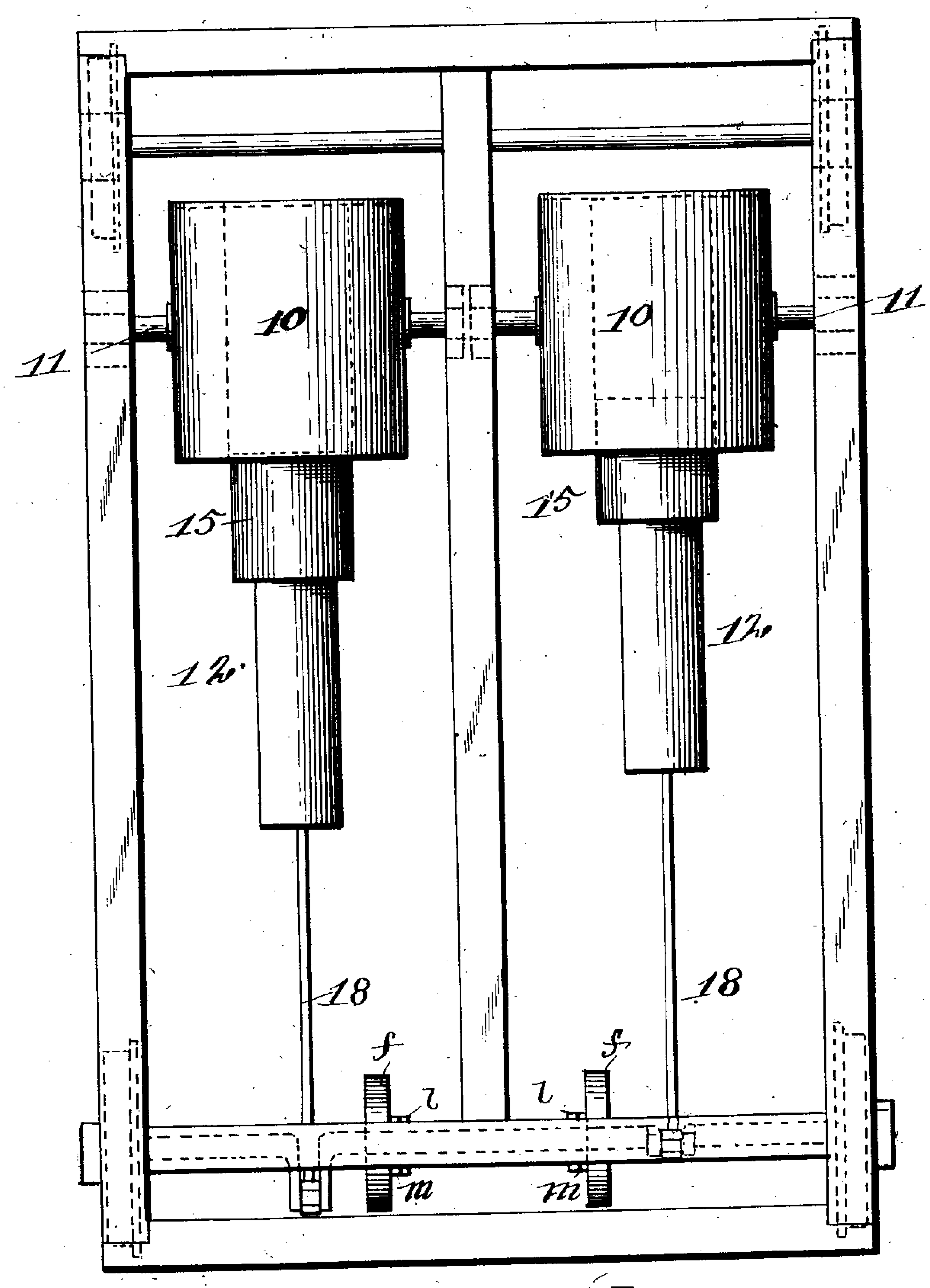

Fig. 1.

WITNESSES

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3 Sheets—Sheet 2.

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Fig. 2.

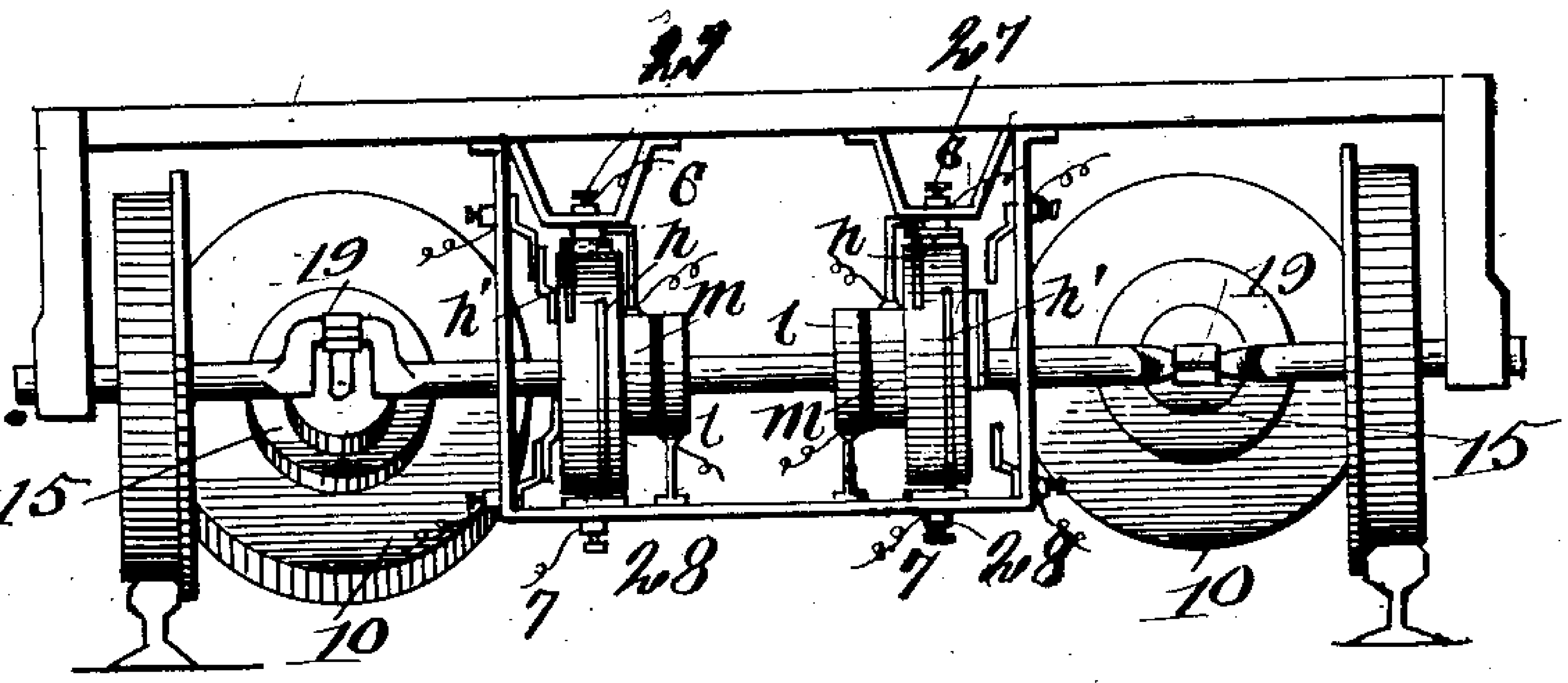
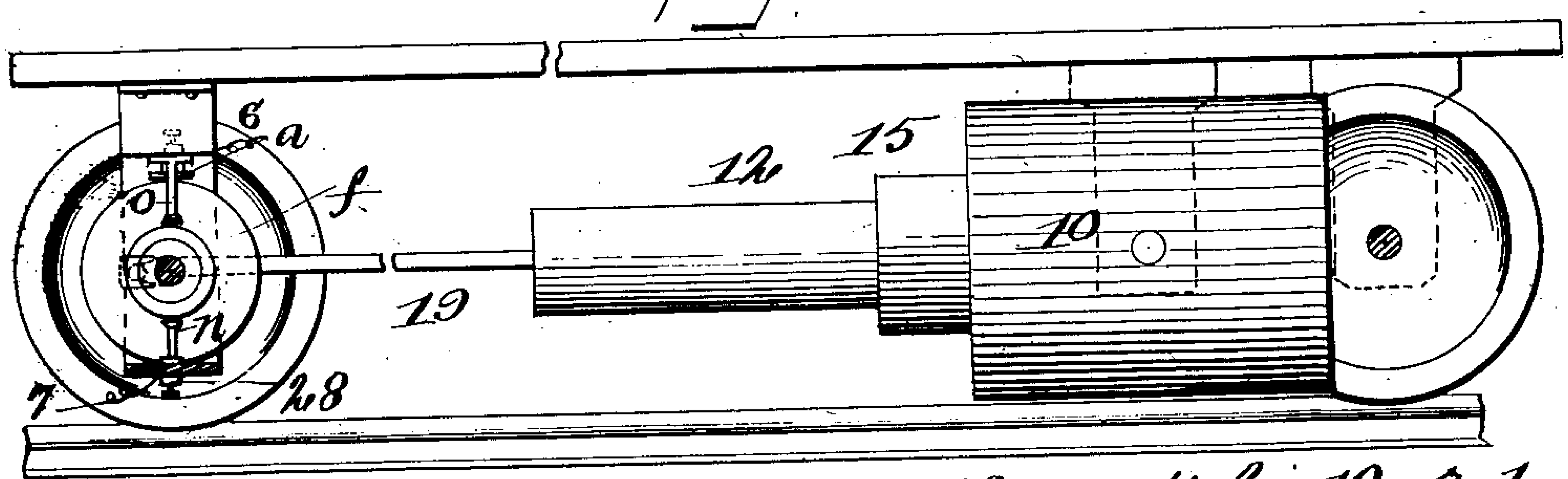


Fig. 3.



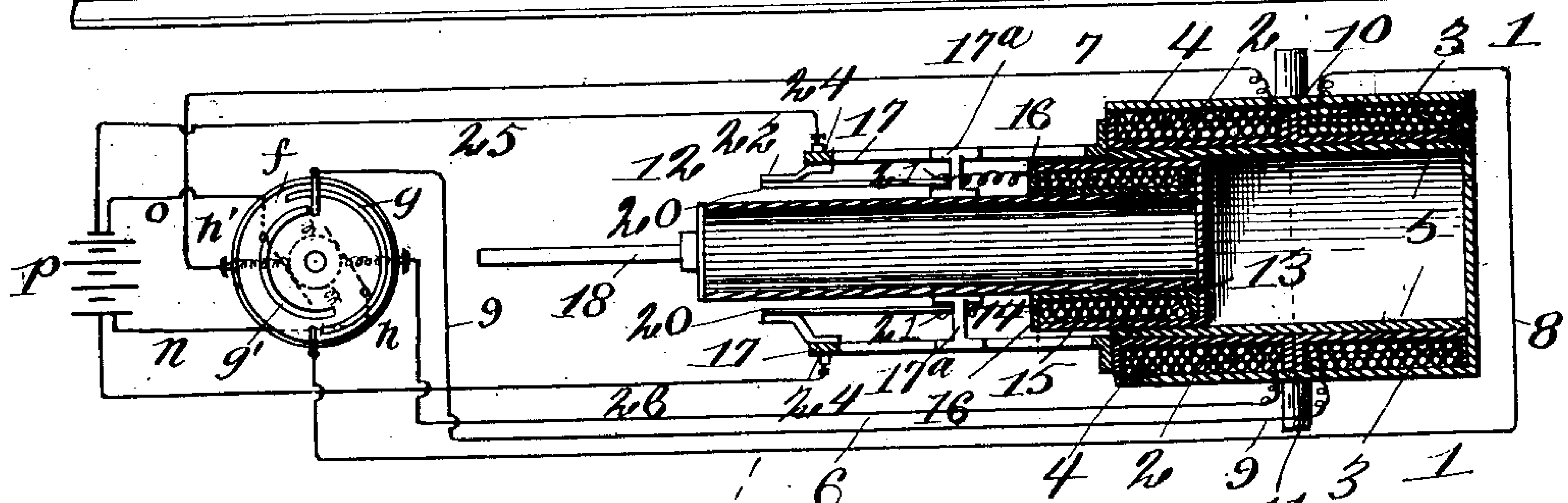


Fig. 4.

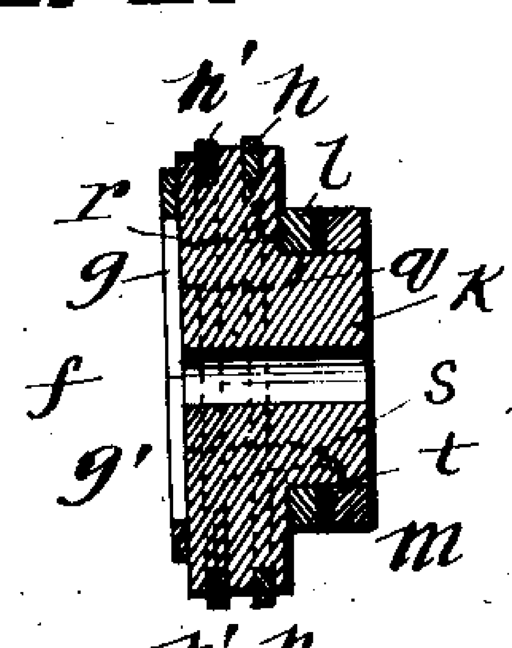


Fig. 5.

WITNESSES-

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(No Model.) 3 Sheets—Sheet 3.

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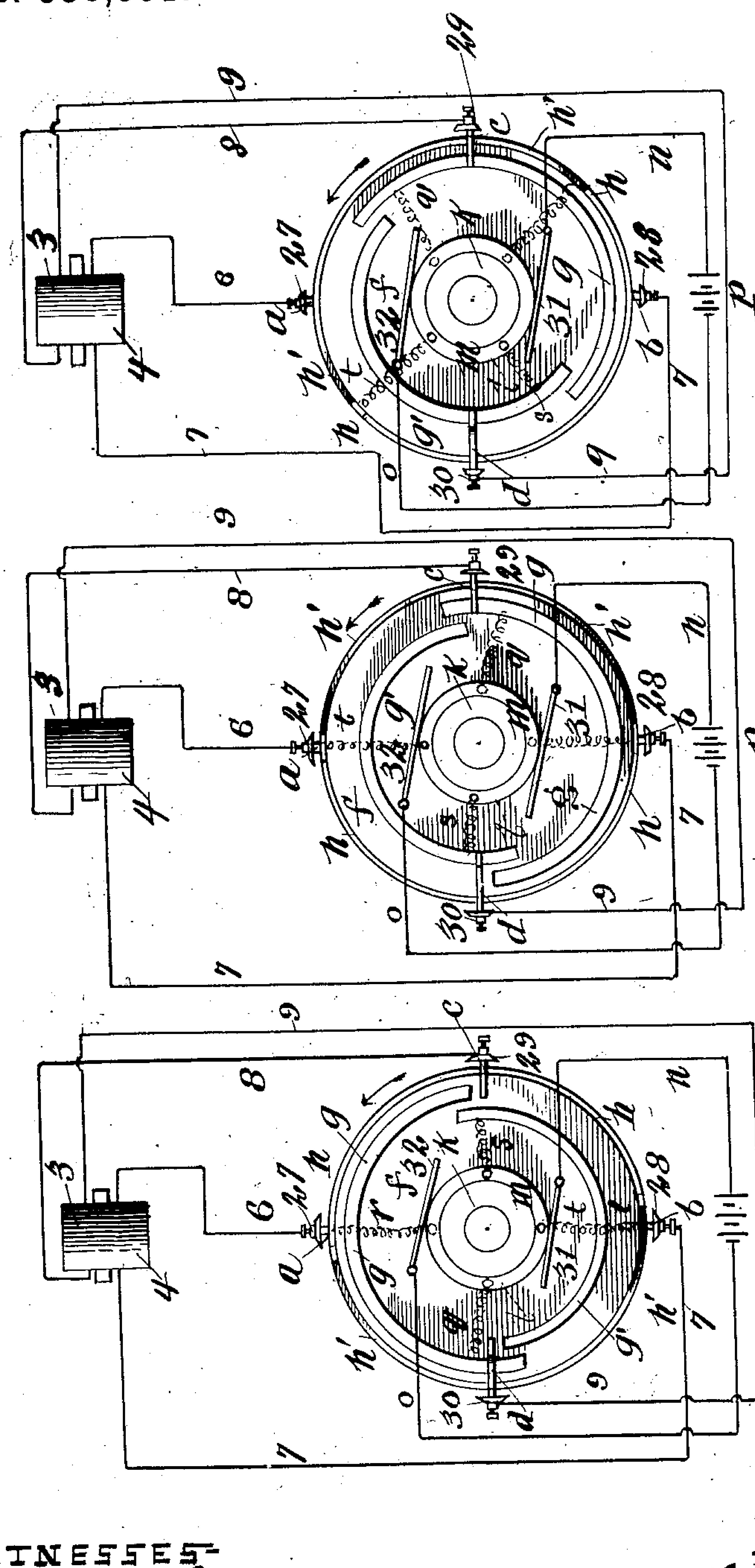

Fig. 8.

Fig. 7.

Fig. 6.

Witnesses-

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UNITED STATES PATENT OFFICE.

LUTHER M. SABIN, OF WASHINGTON, DISTRICT OF COLUMBIA.

ELECTRIC ENGINE.

SPECIFICATION forming part of Letters Patent No. 538,351, dated April 30, 1895.

Application filed April 27, 1894. Serial No. 509,271. (No model.)

To all whom it may concern:

Be it known that I, LUTHER M. SABIN, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Electric Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to certain improvements in electric engines; and has for its objects, first, to so construct the magnet and its armature that a substantially continuous pull, of uniform strength, will be provided; second, to utilize the induced currents, generated, to assist the primary currents instead of retarding them, as is the case, generally, in electric engines of the ordinary construction, and, third, to reduce, or practically obviate, the sparking at the commutator contacts and the consequent burning or destruction of the same, as will be hereinafter more fully described and specifically set forth in the claims.

These objects are attained by the means illustrated in the accompanying drawings, in which—

Figure 1 represents a top plan view of my improved electric engine; Fig. 2, an end elevation of the same; Fig. 3, a longitudinal section between the two motors; Fig. 4, a longitudinal section of one of the motors, and a diagrammatic view of the conductors and the commutator employed for shunting the currents through the coils of the electro-magnet; Fig. 5, a vertical section of one of the commutators; Fig. 6, a side view of the same, showing the relative position of the contact bearings when the current is passing through the first coil on the inward stroke; Fig. 7, a similar view, showing the relative position of the contacts when the current is flowing through both coils or divided, and Fig. 8 a similar view, showing the relative position of the contacts when the current is passing through the second coil.

Referring to the drawings, the numerals 1 and 2 indicate two spools of non-magnetic material, such as brass, which are wound with coils 3 and 4 of insulated wire, and constitute a compound electro-magnet. These spools are of the same diameter, and are placed end to end upon a soft iron tubular core, 5, of a length equal to the combined length of said spools. The said core, when alternately magnetized in opposite directions, causes the armature to reciprocate half the length of the same instead of the whole length, as would be the case with a simple solenoid, or coil of wire. The terminal conductors 6, 7, 8, and 9, of the respective coils, are connected with suitable commutator-contacts or bearings, to be hereinafter described.

The numeral 10 indicates a shell or casing inclosing the wound spools, except at one end, and is provided with trunnions or journals 11, at diametrically opposite sides, which set in suitable bearings secured to the frame of the engine, so as to permit the motor to freely oscillate.

The numeral 12 indicates the armature, which consists essentially of a plunger arranged to reciprocate within the tubular magnet. The said armature is preferably constructed of a tube of soft iron, packed internally with laminated soft iron or soft iron wires, to reduce tendency to heat. At its forward end, the armature is provided with a spool, 13, constructed of brass, or other nonmagnetic material, and wound with a coil, 14, of insulated wire, the terminals of which are carried off and connected with the terminals of a dynamo or other source of electric supply. Over the spool and its coil, is fitted a pole-piece, 15, of soft iron, which is of a diameter such as to fit closely within one end of the hollow electro-magnet and reciprocate freely therein, when the engine is in operation. The closed end of the pole-piece covers and sets in contact with the end of the armature-magnet and the soft iron wires located therein, and the open end abuts against the flanged end 16 of the spool 13, so as to reduce magnetic polarity at that end of said pole-piece. The length of the pole-piece is about equal to that of the magnet-spool, surrounding the hollow core of the magnet within which said pole-piece is arranged to travel, and the armature, over which one end of said pole-piece is fitted, is about three times the length of the pole-piece, so that the polar influence, at its uncovered end, will be virtually out of the polar influence of the hollow electro-magnet, before mentioned, leaving the preponderance of the influence in the neighborhood of the pole-piece. By this construction, the electro-magnet is made to act, virtually, only upon the end of the armature reciprocating within the said electro-magnet, the outer end of said armature opposing no counteracting force, as would be the case in a short armature, which, by reason of the proximity of its outer end to the pole of the electro-magnet, would be affected thereby. The advantage to be derived from such construction is that, the outer end of the armature is entirely out of the influence of the lines of magnetic force of the electro magnet, so that no counteracting effect to the working end of the armature is produced.

While it is preferable to employ an electromagnetic armature, it is evident that, as the polarity of the said armature-magnet is always the same, a permanent magnet may be employed, as an armature, instead of the electro-magnet above described.

The incasing shell 10, of the electro-magnet, at one end, is provided with two diametrically located guides, 17, which are provided with longitudinal slots in which are set and adapted to travel the lateral T-head lugs 17^a^, which extend from opposite sides of the armature and serve to guide said armature longitudinally in its movement, keeping it centered within the spool in which it works.

To the uncovered end of the armature, is secured one end of a connecting-rod, 18, the other end being connected to a crank, 19, secured upon the driving-shaft of the engine, as shown in Figs. 1, 2, and 3. The terminals of the coil of the armature are in electrical contact with metallic brushes 20, which are secured to the bases of the T-head lugs 17^a^, upon insulated seats, by means of binding-screws 21. Secured to the free ends of the guides 17, upon insulated supports, are spring contact-plates 22, arranged to bear against the brushes 20, so as to maintain a sliding contact during the reciprocatory movement of the armature. The contact plates 22 are connected with the wires or conductors 25 and 26, respectively, and thus serve to maintain a constant current from the battery, or other electrical supply, through the coil 14.

The terminal wires 6 and 7, of coil 4, conconnect, respectively, with binding-posts 27 and 28, which are in electrical contact with stationary contact-bearings *a* and *b*, secured to a suitable frame depending from a cross-beam of the frame of the engine. The terminal conductors 8 and 9, of coil 3, connect, respectively, with binding-posts 29 and 30, which are in electrical contact with stationary contact-bearings *c* and *d*, also supported on the depending frame.

The commutator for each motor consists of a disk, *f*, of non-conducting material, mounted on the driving-shaft of the engine. Each disk is provided on one face with contact-bearings *g* and *g'*, which consist of metallic segmental brushes or plates attached to said face. These brushes or plates start, respectively, at diametrically opposite points, but are so arranged that the starting-point of one slightly overlaps the terminal point of the other, and vice versa. The periphery of each disk is provided with contact-bearings *h* and *h'* which, in like manner, start at diametrically opposite points and terminate at slightly overlapping points, as shown in Figs. 2, 4, 5, 6, 7, and 8.

Each commutator disk is formed with a boss, *k*, upon which is mounted electrically insulated rings *l* and *m*, against which are arranged to bear brushes *n* and *o*, respectively, leading from the respective poles of a battery *p*, or other source of electrical energy. The segmental brush or plate *g* and the contact-bearing *h*, are connected with ring *l* by wires *q* and *r*, respectively, and the brush or plate *g'* and contact-bearing *h'*, are connected with ring *m* by wires *s* and *t*, respectively.

The operation of both commutators being alike, it will only be necessary to describe the operation of one.

Referring to Fig. 6, it will be observed that the peripheral contact-bearing *h* is in contact with the stationary contact *a*, and the other peripheral contact-bearing is in contact with the stationary contact *b*. In this position, the current from the positive pole of the battery *p* passes through the conducting wire *n*, to brush 31, which bears against the ring *l*; thence, by wire *r*, to the peripheral contact-bearing *h*; thence to the stationary contact *a*, and, by means of binding-posts 27, onto the wire or conductor 6, which is connected with coil 4 of spool 2. The current passes through coil 4, out onto wire or conductor 7, to binding-post 28, to stationary contact *b*, to peripheral contact-bearing *h'*; thence by wire *t* to brush 32, which bears against ring *m*, and from thence, by wire *o*, back to the negative pole of the battery. While the current is thus passing, the commutator is being rotated in the direction of the arrow, and just before it has made a half revolution, or just before the armature magnet has completed its inward stroke, the face contact-bearing *g* will be in contact with the stationary contact *c*, and the other contact-bearing *g'* will be in contact with the stationary contact *d*, as shown in Fig. 7. In this position the current divides, a portion going through conductor 8 to coil 3, and through said coil in a direction opposite to that going through coil 4. Reference to said figure will show that the respective ends of the contact-bearings *h* and *h'* are just about to break contact with their respective stationary contacts, and that the face contact-bearings have just made contact with their respective stationary contacts, and as the face contact-bearing *g* is in electrical contact with ring *l*, by means of wire *q*, and face contact-bearing *g'*, in electrical contact with ring *m*, by means of wire *s*, it will be seen that a portion of the current will be shunted through conductor 8, and passing through coil 3 returns to the negative pole of the battery by way of conductor 9, binding-post 30, stationary contact *d*, face contact-bearing *g'*, wire *s*, ring *m*, brush 32, and wire *o*. A further rotation of the commutator, causes the peripheral contact-bearings *h* and *h'* to break contact with their respective stationary contacts, and sends the entire current through coil 3, as shown in Fig. 8, and the static charge, previously established therein by induction, passes off in the same direction to the negative pole of the battery. At the instant contact is broken between the peripheral contacts and their respective stationary contacts, it will be understood that the armature-magnet begins its return stroke, having completed its inward stroke during the shunting of the current. When near the completion of its outward stroke the current will again be shunted, a portion passing through coil 4, and a portion continuing to pass through coil 3 until the stroke is completed, when the entire strength of the current will pass through coil 4. Thus it will be observed, that as the current of the armature always travels in one direction, this magnet is maintained of one polarity throughout the operation of the engine. The commutator, at the beginning of its rotation, first sends the current through the coil 4 of the tubular field magnet, and continues it up to approximately the end of the stroke, when the current is divided, one-half of it going through coil 3 in an opposite direction; so that, at this point and until the inward stroke is completed, the magnetism in the field magnets is neutralized, but the instant the inward stroke is completed the full current is sent through coil 3, continuing until the backward or outward stroke is nearly completed, when the current is again divided, one-half going through coil 4 in a direction opposite to that in coil 3, thus again neutralizing the field magnets until the inward stroke is about to again commence, when the full strength of the current is sent through coil 4. During this operation, one revolution of the driving-wheel of the engine has been completed, or, in other words, one inward and one outward stroke of the armature magnet has been made. It will be observed, that from the commencement of the inward stroke and until the current is divided, there is a current passing through the armature magnet which makes the end entering the field-magnet constantly positive, while by the action of coil 4, the end of the field magnet, at which the armature enters, is made negative, and during the entire movement there is substantially an even and uniform pull. At the time the commutator divides the current, sending one-half through coil 3, in an opposite direction, said coil is in such condition that, by reason of its temporary relation to coil 4 there is a charge statically formed and ready to flow in a direction opposite to the flow of the current in coil 4, and consequently in a direction with that of the divided portion of the current that is to be sent through the said coil 3, so that, when divided, the induced and primary currents act in unison, that is to say, the charge induced in coil 3, and the divided primary current pass through said coil in the same direction, thus making the induction do work instead of having to be overcome as a resistance to the working current, as is the case in many dynamos and motors. When the stroke has been completed, and the full strength of the current, which has just been divided, is sent through coil 3, the counter current, which always sets up in an opposite direction through the coil when the primary current is cut, has a tendency to reverse the polarity of the field magnet and usually has to be overcome as a resistance, the overcoming of which tends to produce heat in the magnets and coils. In this case, the counter current does useful work, as it sets up at the moment the full primary current is beginning to flow in coil 3, and works in unison with this current, but as the counter induced current is only momentary it will be seen that as soon as the outward stroke begins the coil acts somewhat as a secondary on a converter, and to some extent as a condenser, and when the time arrives to again divide the current the static charge, impulse tends to move in the direction of the primary current, which is sent in coil 4, at near the end of the outward stroke. Thus coils 4 and 3 act alternately, to some extent, as induction coils and condensers and at all times the power of the induced current to work is employed usefully, and further they work in unison and the induced charges are utilized.

For railway car propulsion, I employ duplicate motors, as shown in Figs. 1 and 2, one being arranged at either side of the engine frame in a manner similar to the arrangement of the cylinders and connecting-rods and running gear of an ordinary locomotive. In like manner, also, the armature or plungers have their driving-rods connected to cranks secured upon the driving-shaft, in such manner that while one rod and crank is at a dead center the other is at its most effective propelling position, or, in other words, at a quarter stroke.

While it not my intention to claim, in the present application, the commutator herein shown and described, I reserve the right to make it the subject-matter of a future application.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an electro-magnetic engine, the combination of a compound magnet, having independent coils located on a single hollow core, a magnet armature of constant polarity, one end arranged to reciprocate within the first coil, a commutator connected with the coils of the compound magnet, and means for operating the same, to direct, first, a primary current through one coil, second, to divide said current and send it in opposite directions through both coils and finally to carry off the induced current in one coil with the primary current established through the same.

2. In an electro-magnetic engine, the combination, with the compound tubular electro-magnet, having independent coils, and means for commutating an electric current through the same, of an electro-magnetic armature, having a spool of non-magnetic material wound with a conducting coil, a cap or pole-piece oversetting the spool and coil, and conductors, whereby the coil may be connected with a source of electric energy.

3. In an electro-magnetic engine, the combination, with a tubular electro-magnet and mechanism whereby alternately opposed currents may be passed through said magnet, of a reciprocating magnet, having one end adapted to travel within the tubular magnet and of such length as to keep the opposite end virtually out of the polar field of said tubular magnet.

4. In an electro-magnetic engine, the combination, with a tubular electro-magnet and means for shunting the current through the coil of the same, of an armature magnet, having a spool of dielectric material, at one end, wound with insulated wire and connected by suitable conductors with a source of electrical energy.

5. In an electro-magnetic engine, the combination, with a tubular electro-magnet, provided with a tubular core, having coils of insulated wire located thereon, and mechanism for producing a current alternately in opposite directions through said coils, of a reciprocating magnet, composed of a hollow core filled with laminated soft iron or soft iron wires and provided with a cap or pole-piece, at one end, working within the field magnet.

6. In an electro-magnetic engine, the combination, of a compound magnet having a hollow magnetic core, independent coils located thereon, an outer casing having trunnions located in suitable bearings, whereon said magnet is adapted to oscillate, a magnetic armature of constant polarity, and means for commutating the current through the coils of the electro-magnet.

7. The combination, with the tubular electro-magnet, having a hollow soft iron core, independent spools, means for commutating the current through the same, and an incasing shell having trunnions on which said magnet oscillates, of an electro-magnetic armature arranged to reciprocate within that portion of the core surrounded by one of the coils, the said armature being provided with an exciting-coil and with an oversetting pole-piece, at the end reciprocating within the electro-magnet.

8. The combination, with the hollow electro-magnet, its spools and mechanism for commutating the current through the same, of the electro magnetic armature having a spool at the end reciprocating within the electro-magnet, the said spool being constructed of non-magnetic material and wound with a coil of insulated wire, which has its terminals connected with a dynamo or other source of electrical supply.

In testimony whereof I affix my signature in the presence of two witnesses.

LUTHER M. SABIN.

Witnesses:
JAMES G. JESTER,
EDWARD A. PAUL.