No. 712,619. Patented Nov. 4, 1902.

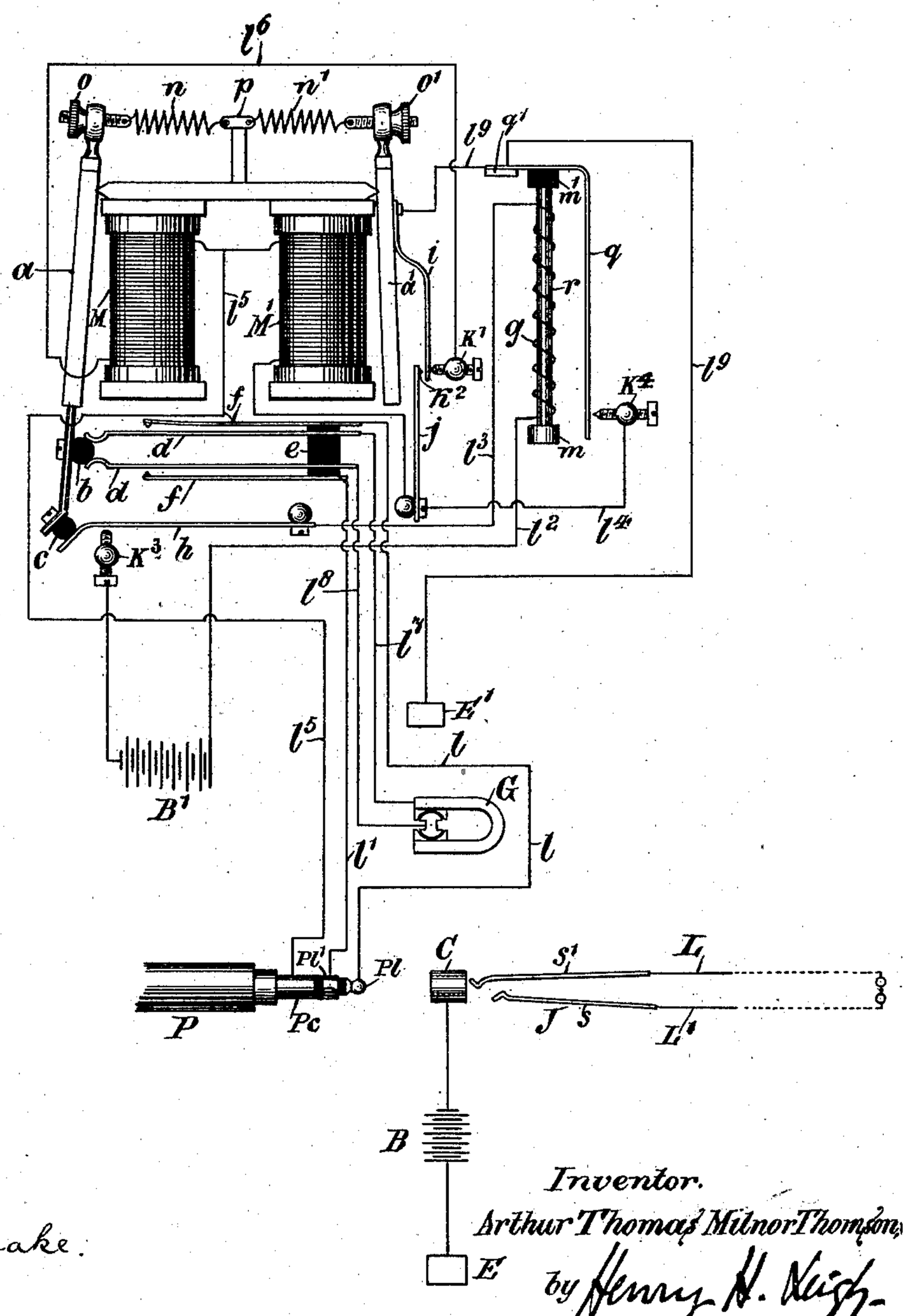
A. T. M. THOMSON.

ELECTRICAL RELAY.

(Application filed Feb. 4, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



Witnesses.

Robt. A. Blake.

R. A. Smith.

Inventor.

Arthur Thomas Milnor Thomson,

by Henry H. Leigh

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(No Model.) 3 Sheets—Sheet 2.

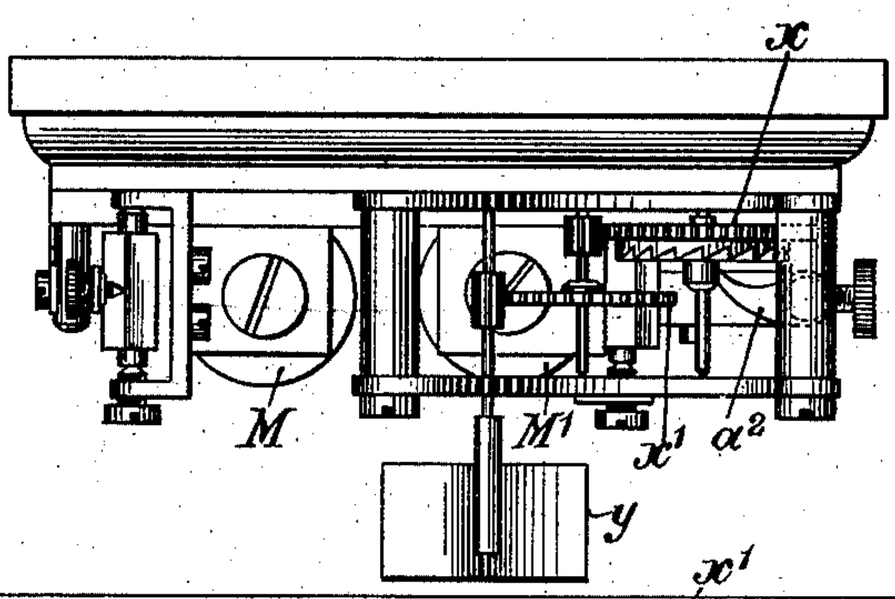

Fig. 3.

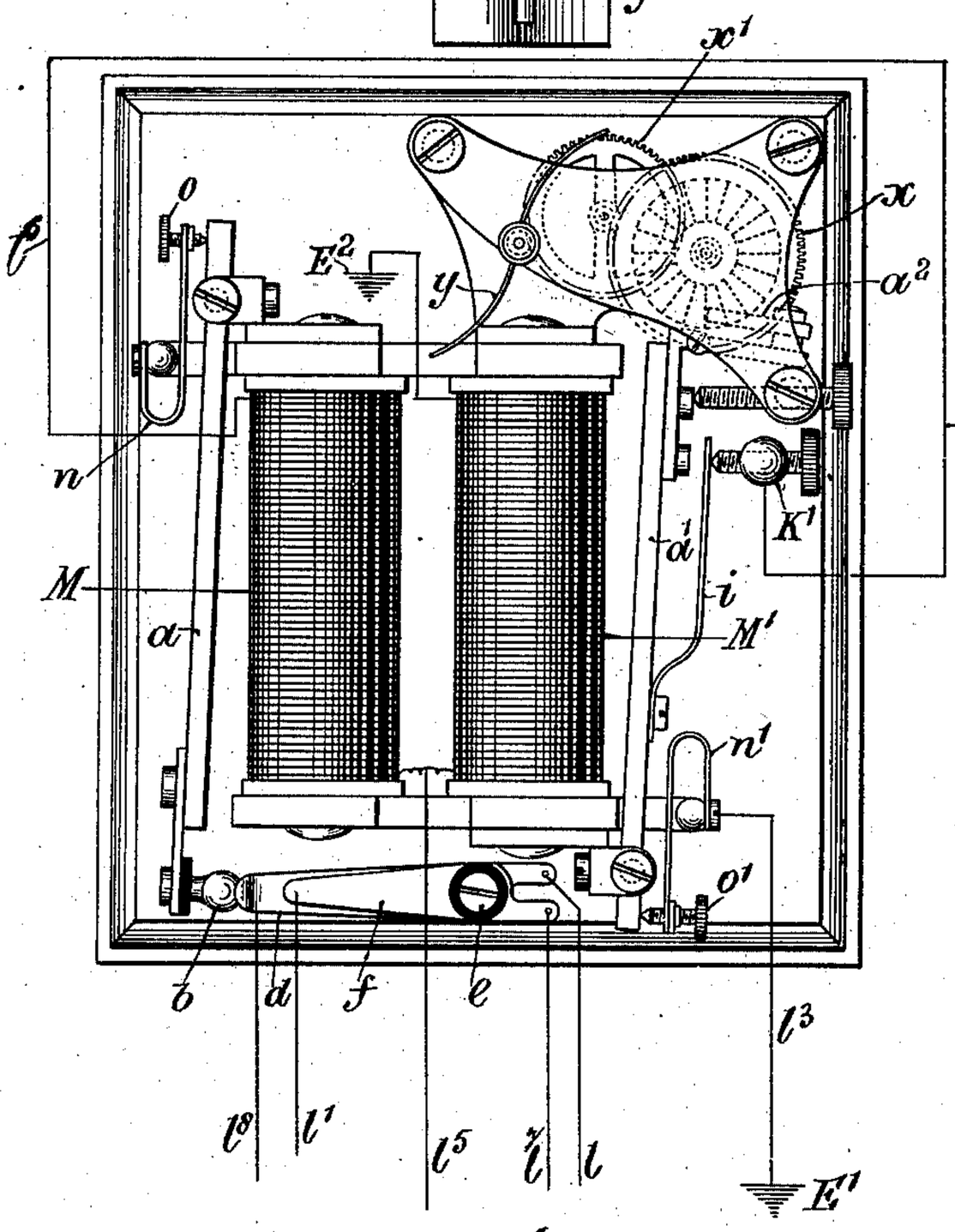

Fig. 2.

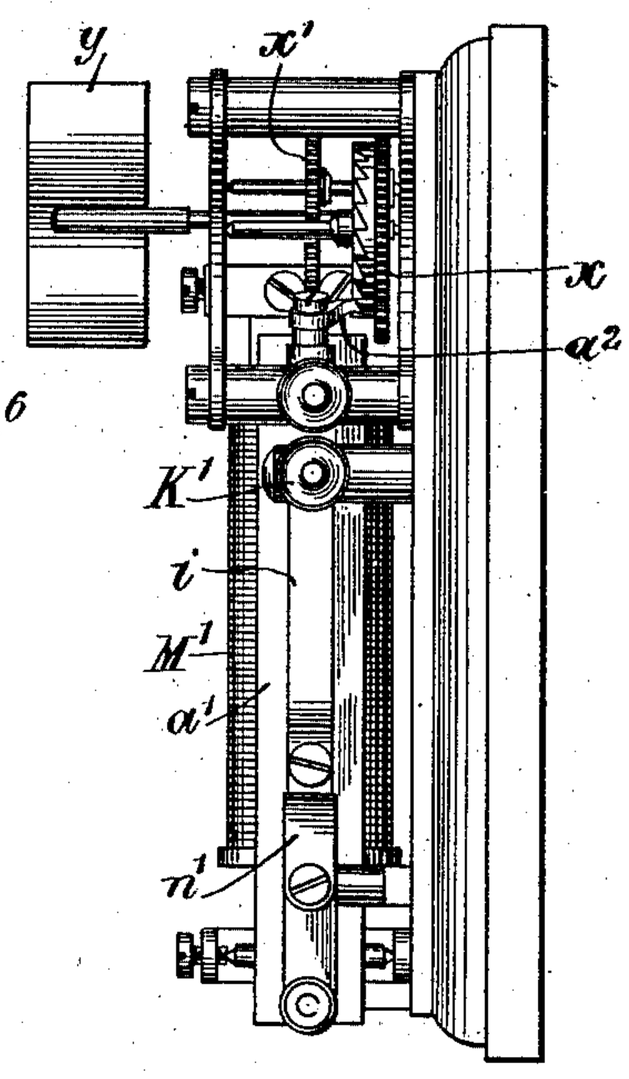

Fig. 4.

Witnesses.
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(Application filed Feb. 4, 1901.)

(No Model.) 3 Sheets—Sheet 3.

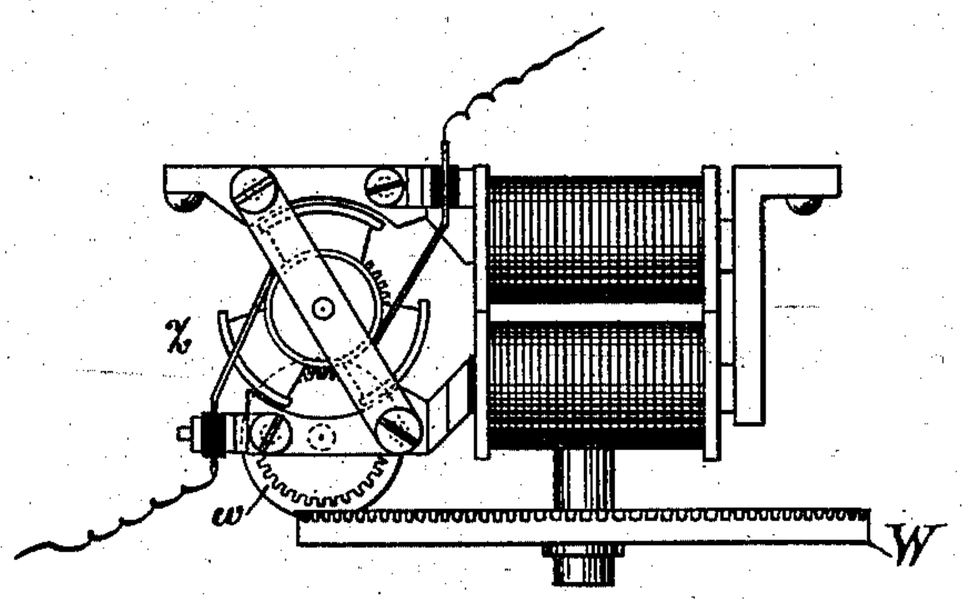

Fig. 6.

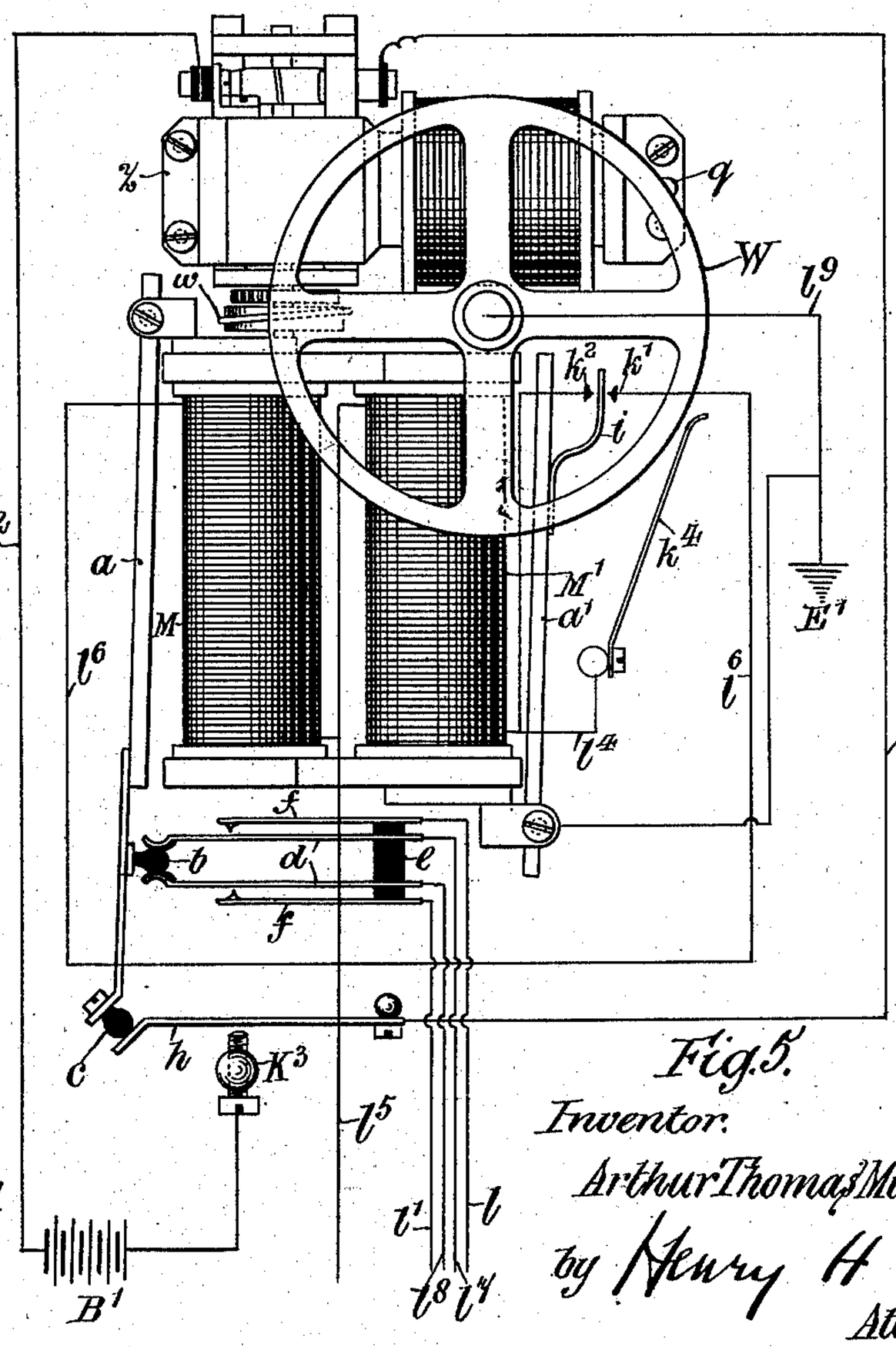

Fig. 5.

Witnesses.
Robt. A. Blake
R. A. Smith.

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UNITED STATES PATENT OFFICE.

ARTHUR THOMAS MILNOR THOMSON, OF THE COUNTY OF MIDDLESEX, ENGLAND.

ELECTRICAL RELAY.

SPECIFICATION forming part of Letters Patent No. 712,619, dated November 4, 1902.

Application filed February 4, 1901. Serial No. 45,980. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR THOMAS MILNOR THOMSON, of No. 10 Vincent Square, in the county of Middlesex, England, have invented certain new and useful Improvements in Electrical Relays; 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.

The object of my invention is to enable by means of a single act an electrical connection either near or at a distance to be established which after a certain lapse of time is automatically interrupted, a second electrical connection being at the same time maintained or established for a certain period.

My invention is especially applicable to telephonic purposes, and in particular where an automatic system of ringing telephone-subscribers' bells is in use, as it is found that the almost instantaneous operation of the automatic signal is of such momentary duration that the bells do not ring long enough and in some cases not at all.

Electromagnets are connected in such a way with a battery or its equivalent that the making of a contact by the attendant or operator at the exchange energizes one of them. This electromagnet when thus energized attracts its armature, and thereby makes certain electric contacts. One of these contacts connects the exchange-generator to the line, causing the subscribers' bells to be rung. The second of these contacts connects the timing device above referred to to a local galvanic battery or other source of electrical power. A current from this local battery then flows through the timing device. The form of this timing device which I prefer to employ consists of a movable and preferably vertical rod or wire of metal, ebonite, or other material expansible by heat fixed at one end, a coil of thin high-resistance wire insulated from the vertical rod or wire by means of asbestos paper, paint, or other suitable equivalent being coiled around the said rod. The vertical brass rod or wire is capable of expansion vertically. When the current from the local battery flows through the thin high-resistance wire, which it does when the second of the above-mentioned electric contacts is closed by the movement of the first of the electromagnets, as above described, the flow of current through the high-resistance wire heats it, and the heat being communicated from it to the vertical rod or wire causes the latter to expand. The upper end of the rod or wire by this expansion is adapted to move a lever, which may be bent or hinged, or a flexible piece of metal or the like equivalent device capable of carrying a third electrical contact, which is made by the movement produced by the expansion of the vertical rod. The heating of this coil of wire and the consequent expansion of the metal rod require time. This period of time may be arranged to suit the requirements of each individual case. When this third contact is made by the action of the heating appliance, it throws a second electromagnet into parallel with the first. This second electromagnet is not energized until the metal rod of the above-described thermostatic timing device by expanding makes a contact and attracts its own movable armature, which on being attracted breaks a contact in series with the first of the electromagnets already mentioned, through which the current which energized it has up to that instant been flowing, and thereby disconnects the said first electromagnet from the circuit, while at the same time it makes a fifth electric contact, which has the effect of permitting the current to continue flowing through the coils of the second electromagnet and to continue energizing it as long as the line is in use. When the first of the electromagnets is thus thrown out of circuit by the operation of the second, it of course releases its armature. This interrupts the connection between the generator and the subscriber's bell (which thereupon stops ringing) and also disconnects the battery from the timing device. The effect therefore is, when the connection is made at the exchange, to cause the subscriber's bell to start and continue ringing until the timing device has heated up and made the contact which the movable portion of it carries. The generator is then cut out, and the bell stops ringing.

In order that the nature of this invention

may be the more readily understood, I hereby refer to the accompanying drawings, which I also at the same time make part of the present specification.

In the drawings, Figure 1 represents diagrammatically the component parts and the electrical connections employed when the time interval during which the calling-bell shall ring is determined by an electric thermostatic device. Figs. 2, 3, and 4 are three views of an alternative construction, in which the requisite time interval is occupied in effecting a definite movement from rest of a clockwork mechanism; and Figs. 5 and 6 show a further alternative timing device, in which the interval is occupied in effecting a definite movement from rest of an electromotor.

In the diagrammatic drawing of Fig. 1, M and M′ are the electromagnets, provided, respectively, with the armatures *a* and *a′*, held in normal position by suitable means, such as the helical springs *n* and *n′*, attached to a fixed arm *p* at one end and to adjustable screws *o* and *o′*, mounted in prolongations of the armatures *a* and *a′*, respectively. A second prolongation of the armature *a* at its other extremity carries a wedge *b* of insulating material, adapted to pass between the curved ends of the flexible metallic springs or arms *d* and *d*, secured in the block of insulating material *e*, to which likewise are attached the contact-springs *f f* in the manner shown. This second prolongation of the armature *a* likewise carries a rounded wedge or roller of insulating material *c*, adapted to slide upon the bent end of the contact-spring *h* and displace it axially. The armature *a′* of the electromagnet M′ carries a contact-spring *i*, which normally makes contact with the contact K′, but is likewise capable of and adapted to make contact with the contact K² at the end of the contact-spring *j*.

g is the fine-wire high-resistance coil of the heating timing device, which is coiled, as seen, on the vertical rod *r*. This vertical rod *r* is fixedly secured to the block *m* and carries at its top the block of insulating material *m′*. The bent rod or spring *q*, secured at *q′*, reposes on *m′*. The heating-coil of this appliance is connected to one pole of the local battery B′ by the lead l^2, the other end of the said coil *g* being connected to the contact-spring *h* by the lead l^3. The other pole of the battery B′ is connected to the adjustable contact K³. G is the generator, which is connected by the leads l^7 and l^8 to the contact-springs *d d*, the contact-springs *f f* being connected by the leads *l* and *l′* to the two sections P*l* and P*l′* of the plug P, the section P*c* of this same plug P is connected to the two electromagnets M and M′ by means of the lead l^5.

The remaining connections of the electromagnets and the other parts, which are shown in the drawings in their positions of repose or the positions they usually occupy when the apparatus is not in use, are as follows: The electromagnet M is connected to the section P*c* of the plug by the lead l^5, as already explained. The other end of the winding of the electromagnet M is connected by the lead l^6 to the adjustable contact K′, the electrical connection extending farther through the spring *i* and the lead l^9 to earth at E′. The lower end of the winding of the electromagnet M′ is connected to the contact-spring *j*. The jack J has two contact-springs *s* and *s′*, connected to the line-wires L and L′, while its bush C is connected to one pole of the station-battery B, the other pole of which is earthed at E.

It will be understood that the connections to the plug P are in part flexible connections to enable it to be inserted into the jack J.

The function of the apparatus is as follows: When the plug P is inserted into the jack J, the section P*c* making contact with the bush C causes the electromagnet M to be energized. The current passes from the unearthed pole of the battery B by way of the lead l^5 to the electromagnet M, thence by way of the lead l^6, the contact K′, the spring *i* and the lead l^9 to the earth at E′, and thus completes the circuit. The electromagnet M thereupon attracts its armature *a*, the movement of which produces two results—first, the wedge *b* by separating the contact-springs *d d* and causing them to make contact with *f f*, puts the generator G into electrical connection with the line-wires L and L′ by way of the leads *l* and *l′*, the sections P*l* and P*l′*, and the springs *s s′*, thereby causing the bell of the subscriber who is being called to ring; secondly, the spring *h* by making contact with the stud K³ completes the circuit of the battery B′ through the thermostatic device above referred to. The current from this battery passes through the high-resistance wire *g*, heating the same, and giving rise to the gradual expansion of the rod *r*, with the result that the displacement of the contact-spring *q* causes it to make contact with K⁴. When contact between *q* and K⁴ is established, the electromagnet M′ becomes energized, the current from the battery B passes from C through the lead l^5, through the electromagnet M′ and the lead l^4 to the contact K³, thence through contact-spring *q* and the lead l^9 to earth at E′. The armature *a′* is consequently attracted, thereby causing the contact-spring *i* to break contact with the stud K′ and to make contact with the stud K² at the end of the contact-spring *j*. This, as will be seen, breaks the circuit of the electromagnet M, which therefore releases its armature *a*, with the result that the connections between the generator G and the line are broken by the withdrawal of the wedge *b* from between the contact-springs *d d*, and the subscriber's bell consequently stops ringing. Contact between K³ and the spring *h* is also broken, interrupting the circuit of the battery B′ at the point K³. The coil *g* being no longer supplied with current cools down, and the rod *r* by contracting causes the spring *q* to gradually revert to its normal position.

It will be understood from the nature of the thermostatic device that contact is not established between q and K^4 until an appreciable time has elapsed since the insertion of the plug into the jack, so that by adjusting this time constant of the device the length of time during which the subscriber's bell continues to ring may be varied at will. As, however, contact has been made between the spring i and the spring j at K^2, the magnet M′ still continues to be energized as long as the plug P is in the jack, its circuit being in that case completed through the spring j, the spring i, and the lead l^9 to the earth at E′. When, however, the plug is finally withdrawn from the jack, the section Pc being no longer in electrical contact with the ring or bush C, the magnet M′ loses its energy, and its armature returns to the position shown in the drawings, in which condition the apparatus is ready to operate again on the insertion of the plug into the jack J.

Instead of the time occupied in ringing being depended on and defined by the necessary interval requisite to heat and expand a given piece of material it may be determined by the interval required by a force derived from the attraction of an armature to generate momentum in a revolving fan through a clockwork mechanism and effect a definite change of position. Figs. 2, 3, and 4 represent three views of this apparatus, the lead of the wires and the connections being shown diagrammatically. Parts which correspond to Fig. 1 are similarly lettered and numbered. In this case the coils of both electromagnets M and M′ are connected to wire l^5, so that both are energized at the same time, the circuit around M′ being connected directly to earth at E^2, while that around M is led to earth at E′ through a spring-contact K′, as in Fig. 1. The wedging of b between the springs d completes the circuit through the generator and bell as before, and the attraction of the armature a' starts a clockwork mechanism into motion in the following manner: At the end of the armature there is a spring-pressed pawl a^2, which engages with the teeth of a crown ratchet-wheel in its movement from right to left. The ratchet-wheel is in one with a toothed wheel x, which gears with a pinion which is a part of a spindle carrying a gear-wheel x', which gears with a second pinion which forms a part of a spindle on which a fan y is mounted. The attraction of the armature starts the fan into motion, permitting the armature to move in obedience to the force. After a certain amount of movement the contact between the spring i and the screw K′ will be broken and the magnet become deënergized. The consequent withdrawal of the wedge b will throw the generator out of circuit with the line-wires, and the signal-bell will cease to ring.

A further alternative method of determining the length of time during which the signal-bell should ring is shown in Figs. 5 and 6, in which an electromotor is started into motion, and after a certain movement a contact is made which stops the ringing of the bell. The operation intimately resembles that of Fig. 1. Corresponding parts are correspondingly lettered, and the lead of the wires and the situation of the contacts are shown diagrammatically. The electromotor z is constructed with three pole-pieces, so as to be self-starting in any position. It is energized by the battery B′ when the circuit is completed by the contact of the spring h with K^3. The motor is, in fact, interposed between the wires l^3 and l^2 instead of the high-resistance helix of Fig. 1. The motor drives a fly-wheel W by a worm w, engaging with teeth formed on the face of W. There is a projection q on the rim of W, which on contact with the spring named K^4 causes the same office to be performed as the like-named parts of Fig. 1—that is to say, the magnet M′ becomes energized and M deënergized—so that the bell which commences to ring when the motor is started ceases ringing when q and K^4 make contact.

I claim—

1. A combination of two combinations of electrical and mechanical devices adapted to effect the object of calling subscribers through telephone-exchanges for an automatically-limited period of time of which one combination consists of a constantly-working generator, a relay-magnet and armature, a battery, a plug, switch-jack, spring-contacts and wire connections to subscriber, these elements being so disposed and adapted that the insertion of the plug in the jack completes a local circuit through the battery and relay-magnet, the armature of the latter being adapted to complete a circuit through the generator and the subscribers' wires: the other combination comprising a second relay-magnet and armature and a time-expending device containing a moving part which is urged by electric energy switched in by the first combination and which is adapted to break the local circuit established by the plug and jack of the first combination.

2. A combination of two combinations of electrical and mechanical devices adapted to effect the object of calling subscribers through telephone-exchanges for an automatically-limited period of time of which one combination consists of a constantly-working generator, a relay-magnet and armature, a battery, a plug, switch-jack, spring-contacts and wire connections to subscriber, these elements being so disposed and adapted that the insertion of the plug in the jack completes a local circuit through the battery and relay-magnet, the armature of the latter being adapted to complete a circuit through the generator and the subscribers' wires: the other combination comprising a second relay-magnet and armature, a second battery, a rod, a high-resistance coil, wire connections and contacts and the armature of the first-mentioned relay-mag-

net the latter being adapted to complete a local circuit through the second battery and high-resistance coil which latter is so disposed as to heat the rod which latter is adapted to complete a circuit through the second relay-magnet whose armature is adapted to break the local circuit established by the plug and jack of the first combination.

3. In combination with a device adapted to effect the object of calling subscribers through telephone-exchanges for an automatically-limited period of time, a further device, adapted to prevent an unintentional repetition of the calling-signal by providing an alternative circuit through the battery and relay-magnet which causes the termination of the period of calling, consisting of a spring contact-plate on the armature of such terminating relay-magnet and a contact-point in electrical connection with the coil surrounding such magnet, these two being adapted to complete an electrical circuit through a battery after such magnet has otherwise become energized and has attracted its armature, substantially as described.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

ARTHUR THOMAS MILNOR THOMSON.

Witnesses:
F. W. LANE,
W. M. HARRIS.