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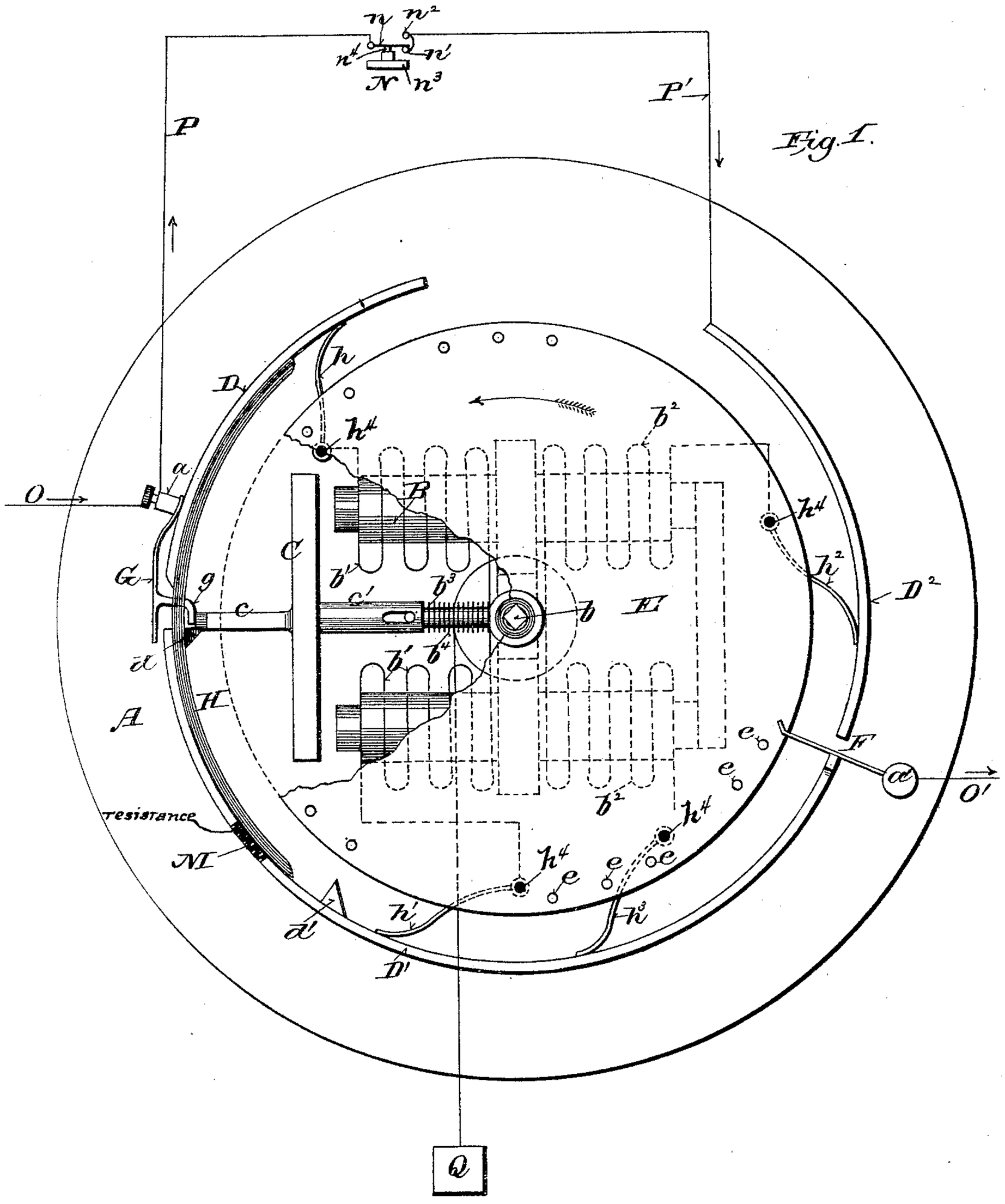
G. KNOWLES, Jr.

ELECTRIC CONTROLLING APPARATUS FOR FIRE ALARMS.

No. 477,214. Patented June 21, 1892.



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(No Model.) 4 Sheets—Sheet 2.

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ELECTRIC CONTROLLING APPARATUS FOR FIRE ALARMS.

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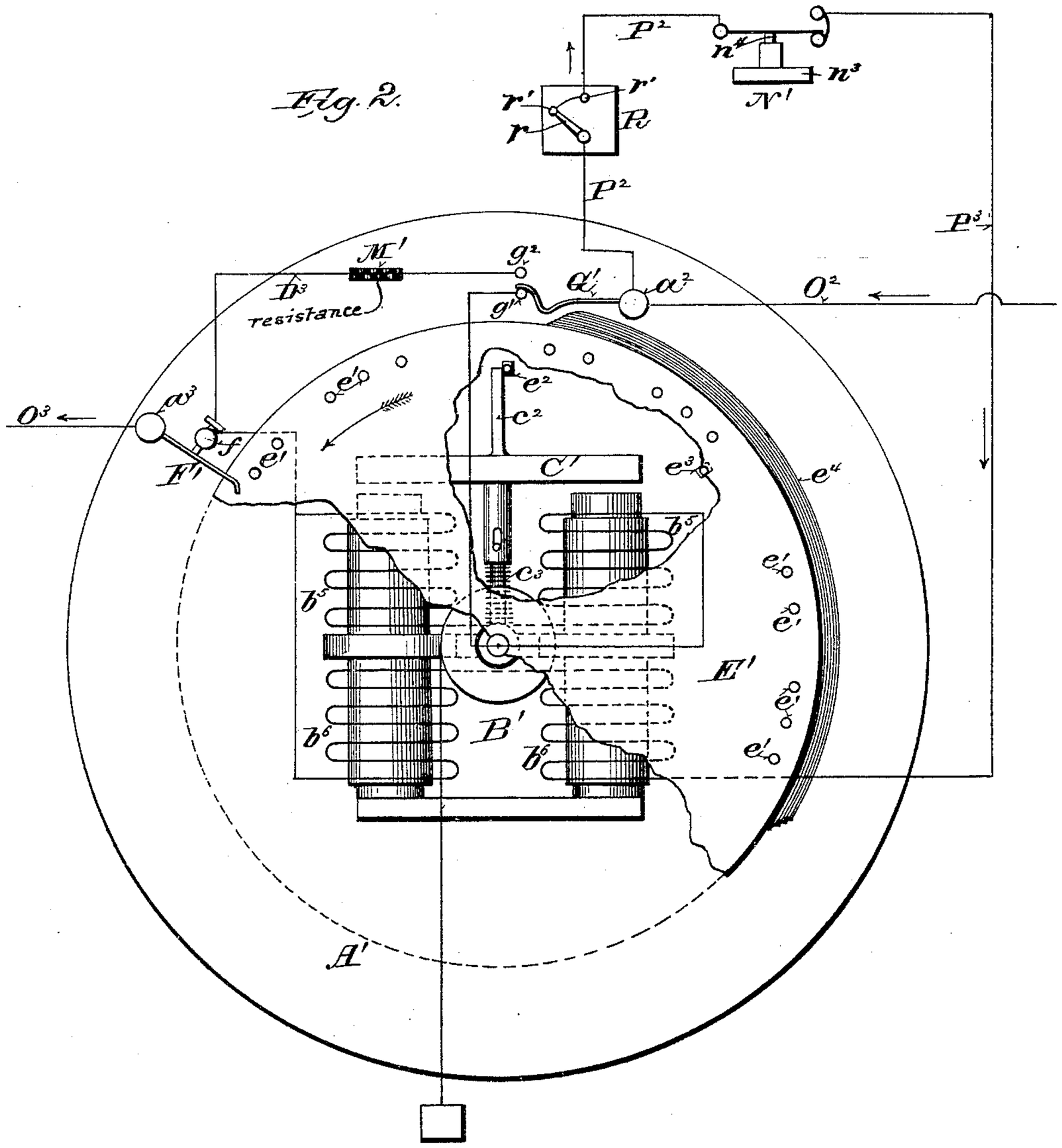
Fig. 2.



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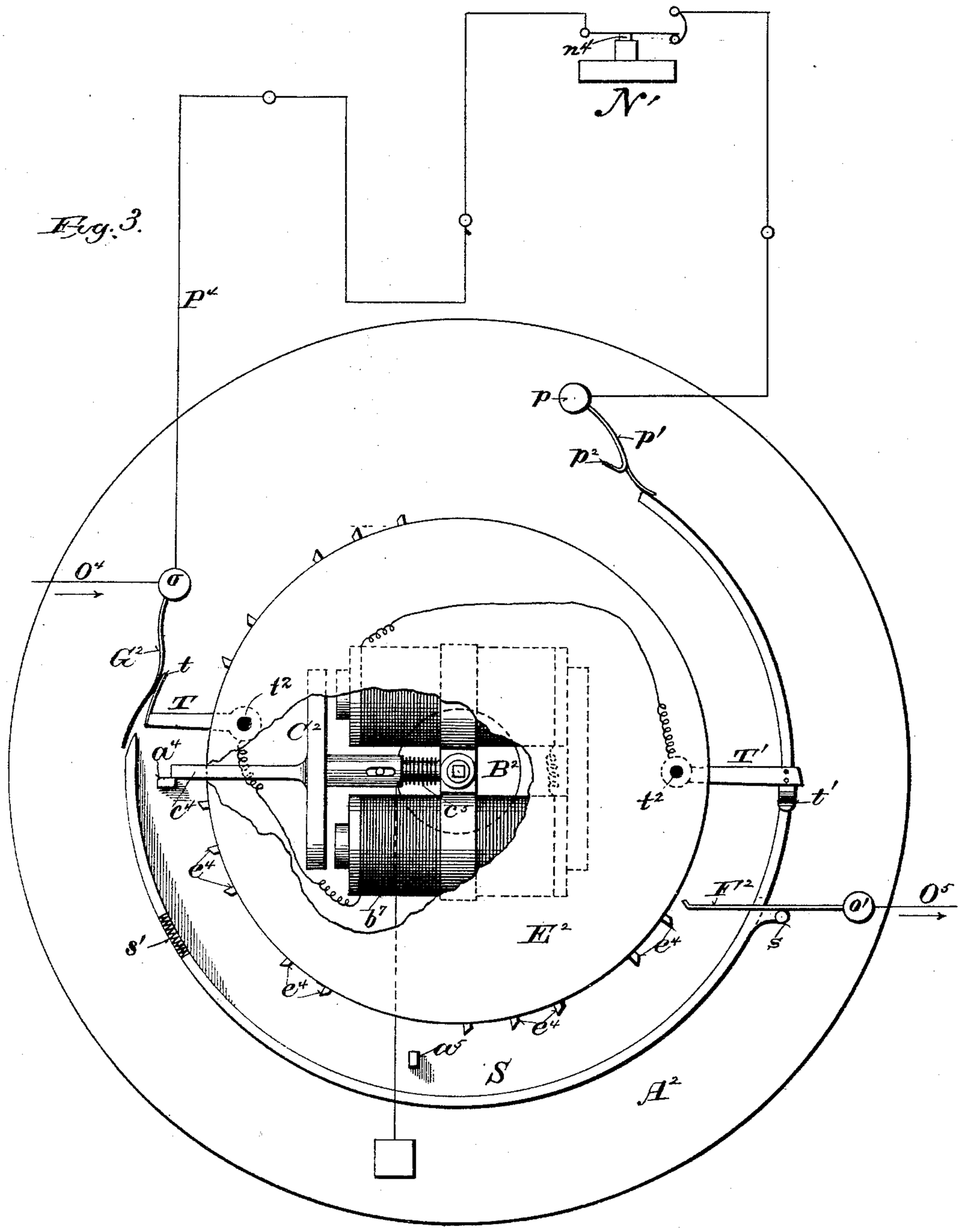
ELECTRIC CONTROLLING APPARATUS FOR FIRE ALARMS.

No. 477,214. Patented June 21, 1892.

Fig. 3.



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(No Model.) 4 Sheets—Sheet 4.

G. KNOWLES, Jr.

ELECTRIC CONTROLLING APPARATUS FOR FIRE ALARMS.

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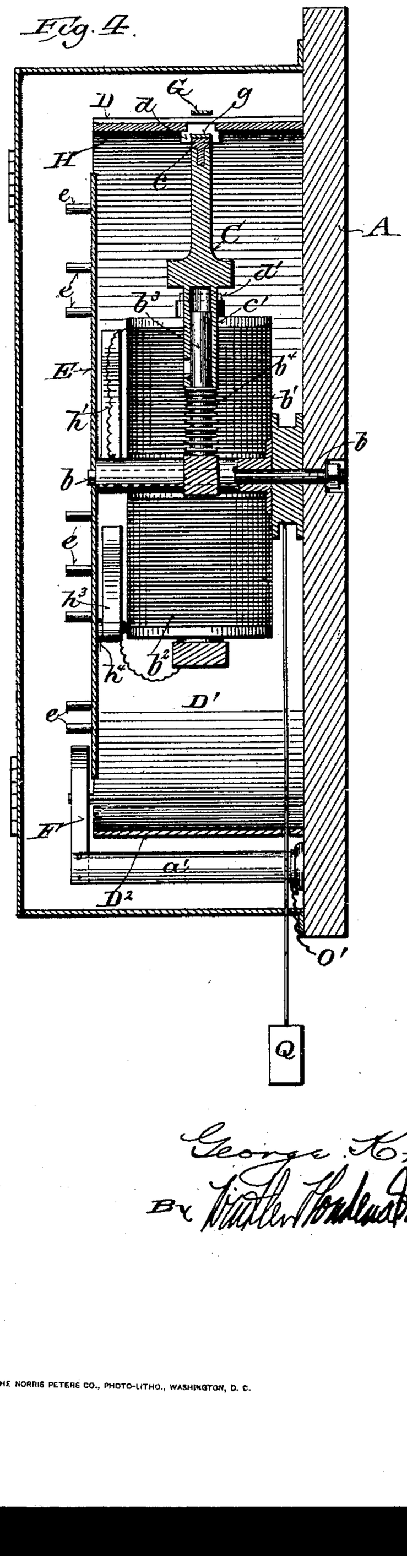
Fig. 4.



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UNITED STATES PATENT OFFICE.

GEORGE KNOWLES, JR., OF MILWAUKEE, WISCONSIN.

ELECTRIC CONTROLLING APPARATUS FOR FIRE-ALARMS.

SPECIFICATION forming part of Letters Patent No. 477,214, dated June 21, 1892.

Application filed December 3, 1889. Serial No. 332,423. (No model.)

To all whom it may concern:

Be it known that I, GEORGE KNOWLES, Jr., of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Electric Controlling Apparatus for Fire-Alarms, &c.; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

The main objects of my invention are to electrically control mechanism for the performance of the desired work without the intervention of a local battery or generator; to supply a main circuit and one or more branch circuits with current from a main or common battery or generator; to start and arrest the mechanism of any branch circuit by the opening or closing of such circuit without affecting mechanism controlled by other branches of same main circuit; to maintain the current in the main circuit when the mechanism of any branch is in operation or abnormal position by diverting the current from one path through another; to provide simple and reliable means for the transmission of electric signals or alarms; to indicate an accidental break or interruption in a branch circuit by a signal distinguishable from signals made for other purposes; to prevent the signal-transmitting mechanism of one station from starting or affecting that of another on the same main circuit or from precluding its operation, &c.

It consists, essentially, of a single main circuit and one or more local or branch circuits supplied with current from the same source—an electro-magnet and a switch controlled by said magnet and arranged to divert the current of the main circuit from one path through another upon the opening or closing of a branch circuit; of suitable circuit-controlling devices in the local or branch circuits; of signal-transmitting mechanism arranged to be set in operation by said circuit-controlling devices; of an electro-magnet arranged to control the operation of the signal-transmitting mechanism; of a stop arranged to arrest the movement of the signal-transmitting mechanism, so as to indicate an accidental break or disturbance in a local or branch circuit by a signal distinguishable from signals for other purposes; of a switch by which the magnet is cut out of the main circuit when the signal-transmitting mechanism is set in operation, whereby disturbance of said mechanism by the opening or closing of said circuit is prevented; of a shunt or branch through which the current is switched around the magnet and the main circuit is maintained for the transmission of signals from other stations, and of certain other peculiarities of construction and arrangement hereinafter particularly described, and pointed out in the claims.

In the accompanying drawings, Figure 1 represents an electric signal-transmitting device and its connections embodying my invention. Figs. 2 and 3 are similar views of modifications of the apparatus, and Fig. 4 is a medial cross-section of the device shown in Fig. 1.

Although I have for the purpose of illustration shown my improvements applied to electric signaling apparatus, they are applicable also to other uses, such as heat regulation, electric lighting, &c.

The devices herein shown and described are arranged for normally-closed main and local or branch circuits, although they may be operated in connection with normally-open circuits.

Referring to Figs. 1 and 4, A represents any suitable base or support upon which the signal-transmitting mechanism is mounted. It may be conveniently formed of non-conducting material, so as to insulate from each other the various parts attached thereto which need to be insulated.

B is an electro-magnet mounted upon an arbor *b*, so as to revolve therewith.

C is the armature of said magnet, provided on the inner side with a sleeve C′, which is supported on an arm b^3, projecting radially from the arbor *b*, and on the outer side with a projection *c*, the purpose of which is hereinafter explained. A spring b^4 holds the armature C normally out of contact with the cores of the magnet B.

E is a break-wheel mounted upon the arbor

b of the magnet, so as to be turned therewith. It is provided with projections *e e*, suitably arranged and grouped to produce, in connection with the spring F, constituting the circuit-breaker, the desired signals.

D D′ D² are arc-shaped metallic strips attached to base A concentrically with the arbor *b* of the magnet and break-wheel and suitably insulated, which may be effected by forming the base A of wood or other non-conducting material or by any other well-known or suitable means.

a a′ are binding-posts, one being connected with the strip D and the other through spring F (in its normal position) with strip D′. The post *a′* is insulated by the base A, to which it is attached, or by other suitable means.

G is a spring attached to the outer side of strip D and projecting over the adjacent end of strip D′. It is formed with a projection *g*, which rests against the outer insulated end of projection *c* of armature C when the magnet is in its normal position, thereby holding said spring out of contact with the strip D′.

P P′ represent wires of a local or branch circuit, which may pass through various apartments in the same or different buildings and be provided at the desired points with either manually or automatically operated circuit-controlling devices by which the signal-transmitting mechanism may be set in operation from such points.

N represents a thermostat constructed and arranged, when subjected to a certain degree of heat, to first break the circuit and by its continued operation to close it. A movable part *n*, connected with the wire P on one side of the thermostat, and two contact-points *n′* *n²*, connected with the wire P′ on the other side, serve for the purpose. The part *n*, against which the thermostat acts, rests normally in contact with the point *n′*. Under the influence of heat the thermostat first moves the part *n* out of contact with the point *n′*, thereby breaking the circuit, and the continued operation of the thermostat moves said part *n* into engagement with the point *n²*, thereby closing the circuit.

The cores of magnet B are wound differentially by wires *b′* and *b²*, the ends of which are connected, respectively, with springs *h h′* and *h² h³*. These springs are attached to the back of the break-wheel E, so as to be moved with the magnet B as it is turned on its arbor and to engage the inner surface of the strips D D′ D². The springs *h h′* and *h² h³* are fastened to the break-wheel E by pins *h⁴ h⁴* of non-conducting material or are otherwise suitably insulated therefrom.

d d′ are fixed projections or stops arranged to be engaged by the projection *c* of armature C, and thereby arrest the movement of the magnet at the desired points for the purpose hereinafter explained.

H is a strip of insulating material attached to the inner sides of the metallic strips D D′ in the path traversed by the spring *h*, so as to hold said spring out of contact with the strips D D′, and thereby cut the winding *b′* of magnet B out of circuit after the spring G is released and the current is diverted through the strip D′.

Suitable mechanism is provided for rotating the magnet B and break-wheel E in the direction indicated by the arrow, and provision is made for winding or resetting said mechanism.

For the foregoing purpose a weight Q is shown attached to a cord which is wound around a spool on the arbor *b*, the end of the arbor being squared to receive a key for winding.

Suitable resistance M is placed in the strip D′ to compel sufficient current to pass through the local or branch circuit P P′ and the winding *b²* of the magnet to properly energize said magnet when said branch circuit is closed and the current is switched from the winding *b′* of said magnet through the strip D′.

It will be understood that the usual or any suitable signal-receiving mechanism and battery or other electric generator are provided in connection with the main circuit O O′ and that any desired number of local or branch circuits with signal-transmitting mechanism like that shown may be operated on said main circuit. The magnet signal-transmitting mechanism and their immediate connections may be inclosed by the usual break-wheel box or by any suitable casing, as shown in Fig. 4. Various other calls or alarms may be transmitted over the same circuit O O′ without disturbing or interfering with the operation of the apparatus herein described.

My improved apparatus operates as follows: Suppose, for instance, that a break or accidental interruption occurs in the branch circuit P P′, which may be conveniently designated as the "building-circuit." The winding *b²* being thus deprived of current, the magnet B will be energized by its winding *b′* and the armature C will be attracted. The attraction of armature C thus withdraws the projection *c* from engagement with the stop *d*, thereby releasing the break-wheel and magnet, which will be turned, as previously described, in the direction indicated by the arrow. At the same time this spring G, being released, will engage with strip D′, thereby switching the current through the spring G, strip D′, and spring F between the connections of the wires O O′ of the main circuit. As the magnet begins to turn, the spring *h* rides upon the insulating-strip H, thereby cutting the winding *b′* out of circuit. Both windings *b′* *b²* being now deprived of current, the magnet B is de-energized and the armature C is forced outward by spring *b⁴* and the projection *c* engages the stop *d′* when it reaches that point, thereby arresting the further movement of the magnet and break-wheel. In turning the distance between the stops *d d′* one group of projections *e e* passes the circuit-breaker F, sending in one round of the box, thereby giving at the

central station a "trouble-signal," indicating the number of the box, and, if no farther movement of the break-wheel follows, an accidental break or interruption of the building-circuit in connection with that box. If now the building-circuit is again closed through the continued action of a thermostat N or by any other circuit-controlling device, the spring h^2 being still in contact with strip D^2, the spring d^3 in contact with D′, and the spring h in contact with the insulating-strip H, the current will pass through the winding b^2 and energize the magnet B, causing it to attract armature C and withdraw its projection c from engagement with stop d', thereby releasing the magnet and break-wheel, which will then complete one revolution, sending in a full round of the box constituting an alarm of fire or other predetermined signal as distinguished from the trouble-signal indicating an accidental break or interruption in the building-circuit. While the projection c is in engagement with the stop d' by which a trouble-signal is made the current of the main circuit is cut out of the winding b' of the magnet by the spring h resting on the insulating-strip H. Therefore any break or interruption of the main circuit cannot affect the magnet or its armature so as to release the signal-transmitting mechanism and allow a complete alarm or other signal as distinguished from a trouble-signal to be sent in. At the same time the current of the main circuit passes through spring G and strip D′. Therefore when the signal-transmitting mechanism is in the position last mentioned signals can be sent through the main circuit from other points thereon either by transmitting mechanism like that described or by any other device suitable for the purpose of transmitting police-calls, burglar-alarms, or other signals. When a complete revolution of the magnet and break-wheel is made, the projection c of the armature engages with the stop d, arrests the further action of the signal-transmitting mechanism, and moves the spring G out of engagement with strip D′. Springs h h' are brought again into contact with the strips D and D′, respectively, thereby directing the current through the winding b', which is balanced by the current passing through the other winding b^2 being brought again into circuit with the building-wire P P′ by the springs h^2 and h^3 engaging, as at the outset, with the strips D^2 and D′, respectively.

Referring to Fig. 2, illustrating a modification of the apparatus, the magnet B′ is stationarily mounted upon the frame or base A′ and the break-wheel E′ is made to revolve, any suitable actuating mechanism being provided to impart the required movement thereto. C′ is the armature, provided on the outer side with a projection c^2 and held normally out of contact with the cores of magnet B′ by a spring c^3. The break-wheel E′ is provided in the usual manner with a series of projections e' e', arranged to produce, in connection with the circuit-breaker F′, the desired signals. It is also provided with lugs e^2 and e^3, adapted to engage with the projection c^2 of the armature when the latter is in its normal position, and thereby arrest the movement of the break-wheel at the proper points. O^2 O^3 are the wires of the main circuit, attached to the binding-posts a^2 a^3, respectively. The spring F′, serving as a circuit-breaker, is attached to or connected with the binding-post a^3, and a spring G′ is attached to or connected with the other binding-post a^2. The free end of said spring G′ projects between two contact-pieces g' g^2, and a wire D^3 or other suitable conductor connects the contact-piece g^2 with a contact-piece f, against which the circuit-breaking spring F′ bears in its normal position. Suitable resistance M′ is placed in the conductor D^3, so as not to deprive the building-circuit of sufficient current when it is closed to energize the magnet. P^2 P^3 represent the wires of the building-circuit, which is supplied with current from the main circuit, of which it constitutes a branch. It is provided at any desired point or points therein with circuit-controlling devices, such as the thermostat N′ and switch R, arranged to break and close the circuit either automatically under the influence of abnormal heat or manually. The switch R consists of a pivoted arm r, connected with one part of the wire P^2, and of contact-pieces r' r', which are connected with the other part of wire P^2 and with each other. The circuit is closed through the switch when the arm r engages with either contact-piece r', but is opened while said arm is passing from one to the other. The magnet B′ is wound differentially with the wires b^5 and b^6, the ends of the winding b^5 being connected, respectively, with the contact-pieces f and g' and the ends of the winding b^6 being connected, respectively, with the wire P^3 of the building-circuit and with the contact-piece f. The other wire P^2 or end of the building-circuit is joined to the binding-post a^2. The binding-posts a^2 and a^3 and the contact-pieces f, g', and g^2 are mounted upon a base A′ of non-conducting material, or may be otherwise suitably insulated. This form of the apparatus operates essentially like that previously described.

When a break or interruption occurs in the building-circuit, the current is cut out of the winding b^6 and the unbalanced effect of the other winding b^5 energizes the magnet, which attracts its armature C and draws the projection c^2 out of engagement with the projection e^2 on the break-wheel, permitting the latter to turn in the direction indicated by the arrow. When the break-wheel begins to turn, the spring G rides upon the insulating-strip e^4 and is moved out of contact with the piece g' and into contact with the piece g^2, thereby switching the current of the main circuit out of the winding b^5 of the magnet through the branch D^3. The current being thus cut out of both windings b^5 and b^6, the magnet becomes inert

and its armature C′ is forced outward by spring c^3, causing the projection c^2 to engage with the stop e^3 and arrest the further movement of the break-wheel until it is again released. In turning from one stop e^2 to the other stop e^3 one group of projections e' e' will pass the circuit-breaker F′ and send in one round of the box to denote if further movement of the break-wheel does not follow an accidental break or interruption of the building-circuit. The winding b^5 being cut out of the main circuit, no break or interruption therein can affect the magnet so as to release the break-wheel, and the current of the main circuit, being switched through the conductor D^3, establishes a connection around and independent of the magnet, through which signals from other boxes or points in the main line may be transmitted when the signal-transmitting mechanism in question is in the position last described. If now the building-circuit is again closed either by the continued action of the thermostat N′, by the switch R, or by any other circuit-controlling device, the current will pass through the winding b^6, energize the magnet, draw the projection c^2 out of engagement with the stop e^3, thereby releasing the break-wheel and allowing it to complete a revolution and send in an alarm or signal distinguishable from the trouble-signal made by a partial revolution of the break-wheel. Before the stop e^2 returns to a point adjacent to the projection c^2 of the armature C′, after the stop e^3 has been released thereby, the insulating-strip e^4 clears the spring G′, which thereupon makes contact with the point g' and again diverts the current from the conductor D^3 and directs it through the winding b^5 of the magnet. Both windings of the magnet being now supplied with current and balanced in effect, the armature C′ is released and spring c^3 forces the projection c^2 outward into engagement with the stop e^2, thereby arresting the further movement of the break-wheel until it is again released by the opening of the building-circuit P^2 P^3, as previously described.

It should be observed that a thermostat for opening and closing the building-circuit in the apparatus herein described should be such that the movable part will not recede after breaking the circuit and close it again, but will remain wherever it is left until it is reset. Otherwise a thermostat subjected temporarily to a degree of heat sufficient to affect it slightly and break the circuit but not sufficient to close the circuit again by causing the continued advance of the movable part would when it cooled release the signal-transmitting mechanism after a trouble-signal had been made, and thus cause a false alarm of fire to be sent in.

The thermostats N and N′, which are shown in the drawings as suitable for the purpose specified, each embrace a chamber n^3, containing a material which is solid, or nearly so, under ordinary temperatures, but softens and expands when subjected to abnormal heat, and a movable part or piston n^4, adapted to be advanced by the expansion of such material, which in cooling solidifies behind the piston and does not permit it to readily recede. It is obvious that various mechanical devices may be arranged to prevent the retrogression of said movable part until it is manually reset.

The spring G′ may be arranged to switch the current through the conductor D^3 before the winding b^6 of the magnet is cut out of circuit, as is done by the arrangement shown in Fig. 1. Such arrangement is desirable to avoid a temporary interruption of the current through the main circuit, and thereby precluding the transmission of signals from other stations or transmitting a single signal, which would in connection with regular signals produce confusion.

In place of the differentially-wound magnets shown in Figs. 1 and 2 a plain-wound magnet may be employed with slightly-modified connections.

Referring to Fig. 3, B^2 is a plain-wound magnet revoluble on a suitable axis. C^2 is the armature of the magnet, suitably connected so as to turn therewith. It is provided with a projection c^4, which is arranged to engage with stops a^4 and a^5, by which the movement of the magnet and of the parts movable therewith is arrested at the desired points. E represents a break-wheel revoluble with the magnet and provided with teeth or projection e^4 e^4, suitably grouped and arranged to work with the circuit-breaker F^2. o and o' are binding-posts to which the wires O^4 and O^5 are attached. P^4 is the wire of the building-circuit, provided, as previously described, with suitable circuit-controlling devices arranged to be manually or automatically operated, or both. It is attached at one end to the binding-post o and at the other to the binding-post p. S is an arc-shaped metallic strip attached to the base A^2, of insulating material, or to any suitable support, from which it is suitably insulated concentrically with the axis on which the magnet and break-wheel turn. It is provided with a shoulder or projection s, against which the circuit-breaker F^2 rests in its normal position. Suitable resistance s' is interposed in the strip S, so as not to deprive the building-circuit of the necessary current when the circuit is closed through both the building-circuit and the strip S. G^2 is a spring-switch attached to or otherwise suitably connected with the binding-post o so as to bear normally against one end of the strip S. p' is a similar spring-switch attached to or otherwise connected with the binding-post p, so as to bear normally against the other end of the strip S. It is provided with a projection p^2 in the path of the outer end of arm T′, which, engaging with it when the break-wheel stands on the trouble-stop, breaks connection between said spring p' and strip S and establishes connection

through the winding b^7 of the magnet and the arms T′ and T between said spring p' and the strip S. Two arms T and T′, attached to the break-wheel E^2 and insulated therefrom by pivot-pins t^2 t^2, of insulating material, or to any other suitable part or parts movable with the magnet, are provided with springs or yielding contact-pieces t and t', arranged to ride over the strip S when the magnet and break-wheel are turned on their axis. To these arms T and T′ are attached the terminals of the winding b^7 of magnet B^2, which winding is of sufficiently high resistance to cause most of the current to pass through the building circuit P^4 without affecting the armature C^2 when the circuit is closed through both the wire P^4 and the winding b^7. The armature C^2 is held normally out of contact with the cores of the magnet and in position to engage with the lugs a^4 a^5 by a spring c^5, and suitable means is provided for turning the magnet and break-wheel—such, for instance, as that hereinbefore referred to. This modified arrangement of my apparatus operates as follows:

While the magnet remains in its normal position (shown in Fig. 3) the spring t rests against the switch-spring G^2, holding it out of contact with the strip S and establishing connection between one terminal of the winding b^7 and the wire O^4 of the main circuit. The spring t', resting on the strip S, establishes connection between the other terminal of the winding b^7 and the other wire O^5 of the main circuit. If now the building-circuit P^4 is broken by any of the devices hereinbefore mentioned or otherwise, the current is compelled to pass through the winding b^7, energizing the magnet B^2, which attracts its armature C^2 and withdraws the projection c^4 from the stop a^4. The magnet and break-wheel thus released are turned on their axis by a weight or other actuating mechanism in the direction indicated by the arrow. As the magnet begins to turn the spring t moves out of engagement with spring G^2, which immediately moves into contact with the strip S, establishing a connection through it between the wires O^4 and O^5 of the main circuit. By reason of the high resistance of the winding b^7 the current, or the greater part thereof, now passes through the strip S, the magnet is de-energized, and the armature forced by spring c^5 outwardly, bringing the projection c^4 into range with the stop a^5, with which it engages, thereby arresting the further movement of the magnet and break-wheel. In turning the distance from one stop a^4 to the other a^5 one group of projections e^4 passes the circuit-breaker F^2 and sends in a trouble-signal to the central station, indicating, if no further movement of the break-wheel follows, an accidental break or interruption of the building-circuit, as well as the number of the associated box. When the projection c^4 engages the stop a^5, the arm T′ passes under the projection p^2 on spring p' and moves and holds it out of contact with the strip S, thereby establishing connection through the winding b^7 between the binding-posts p and o, the spring t bearing against the strip S. If under these conditions the building-circuit is again closed in the manner previously described, the current will pass through the coil b^7 of the magnet B^2, the resistance s' being sufficiently greater than the resistance of the building-circuit and coil b^7 to compel the current to flow through the latter and energize the magnet, which attracts its armature C^2 and withdraws the projection c^4 from the stop a^5, thereby releasing the magnet and break-wheel. When thus released, the break-wheel completes a revolution, sending in a complete round of the box constituting an alarm of fire or other predetermined signals. Having completed a revolution, the parts assume the relative positions in which they are shown in Fig. 3, and the movement of the magnet and break-wheel is arrested by the projection c^4 engaging with the stop a^4, connection being established through the strip S between the building-circuit P^4 and the wire O^5 of the main circuit and the magnet de-energized when the spring p' is released by arm T′.

Various changes may obviously be made in the details of the apparatus herein described and shown without departure from the principle of its operation or the spirit of my invention, and the mechanism controlled in its operation by the electro-magnet may be connected and arranged so as to perform other work than actuating a circuit-breaker by which signals are transmitted—as, for instance, the opening and closing of a valve in a temperature-regulating system.

A fixed plain-wound magnet may be employed instead of the movable plain-wound magnet or the fixed or movable differentially-wound magnets hereinbefore described by providing it with connections like or similar to those shown in Fig. 2.

I claim—

1. The combination, with a main and a branch circuit supplied with current from the same source, of signal-transmitting mechanism and an electro-magnet having its winding normally in connection with the main and the branch circuits and arranged to control said signal-transmitting mechanism in its operation, and a shunt around the winding of said magnet, having sufficient resistance to force current through the branch when it is closed and both shunt and branch are in circuit, substantially as and for the purposes set forth.

2. The combination, with a main and branch circuits supplied with current from the same source and circuit-controlling devices in said branch circuits, of an electro-magnet wound differentially with the wires of the main and branch circuits, suitable mechanism for the performance of the desired work controlled by said magnet, a shunt around the windings of said magnet, and a switch controlled by said magnet to divert the current of the main

circuit through said shunt when the branch circuit is broken, substantially as and for the purposes set forth.

3. The combination of a main circuit and a branch circuit supplied with current from the same source, an electro-magnet the windings of which are normally connected with said main and branch circuits, a shunt around the windings of said magnet provided with resistance, and a switch controlled in operation by said magnet and arranged to automatically divert the current of the main circuit from the windings of said magnet through said shunt upon the opening of the adjacent branch circuit, substantially as and for the purposes set forth.

4. The combination of a main circuit and branch circuits, all supplied with current from said main circuit, each branch circuit including suitable mechanism for the performance of the desired work, an electro-magnet controlling the operation of said mechanism and having its windings normally connected with said main and the corresponding branch circuit, a shunt around the windings of said magnet provided with resistance, and a switch which is controlled by said magnet and constructed and arranged when the branch circuit is broken to connect said shunt with the main circuit and cut the windings of said magnet out of the main circuit, thereby maintaining the main circuit for other branches and preventing the transmission of signals through the main line from other points from affecting said magnet, substantially as and for the purposes set forth.

5. The combination a main circuit and a branch circuit provided with one or more circuit-controlling devices and supplied with current from said main circuit, an electro-magnet the winding of which has connections with the main and branch circuits, a shunt provided with resistance around said magnet, a switch by which the current is diverted from the winding of said magnet through said shunt and the main circuit is maintained closed for operation with other branches, and mechanism controlled in operation by said magnet, substantially as and for the purposes set forth.

6. The combination, with a main circuit and a branch circuit supplied with current therefrom and provided with a suitable circuit-controlling device, of a movable magnet having its windings connected with contact-pieces movable therewith, by which said windings are connected normally with the main and branch circuits, a shunt provided with resistance around the windings of said magnet, and a switch controlled in operation by said magnet, arranged to divert the current of the main line from the winding of said magnet through said shunt, and thereby maintain a closed main circuit for other branches when the branch with which said magnet is normally connected is temporarily broken, substantially as and for the purposes set forth.

7. The combination of a main and a branch circuit supplied with current therefrom and provided with one or more circuit-controlling devices, a differentially-wound electro-magnet, one winding of which is connected normally with the main circuit and the other winding with the branch circuit, a shunt around said magnet, and a switch arranged to divert the current around said magnet through the shunt, and thereby maintain the main circuit for other stations on the main line, substantially as and for the purposes set forth.

8. The combination, with a main circuit and one or more branch circuits provided with suitable circuit-controlling devices, of an electro-magnet for each branch circuit, having its winding normally connected therewith and with the main circuit, signal-transmitting mechanism for each branch circuit, controlled in operation by its magnet, and a switch by which the current of the main line is automatically shunted around said magnet upon the opening of the corresponding branch circuit and the main line is maintained for the transmission of signals from other stations, substantially as and for the purposes set forth.

9. The combination, with a main circuit and one or more branch circuits provided with circuit-controlling devices, of an electro-magnet for each branch circuit having its winding normally connected therewith, signal-transmitting mechanism controlled in operation by said magnet, a home-stop to arrest and hold said mechanism in its normal position, and a trouble-stop arranged to arrest said mechanism when the corresponding branch circuit remains open after being broken, so as to indicate an accidental break or interruption of said branch circuit by a signal distinguishable from signals for other purposes, both stops being controlled by said magnet, substantially as and for the purposes set forth.

10. The combination, with a main circuit and a number of branch circuits supplied with current from the same source and provided with suitable circuit-controlling devices, of a differentially-wound magnet for each branch circuit, one winding of which is normally in circuit with a branch circuit and the other in circuit with the main circuit, signal-transmitting mechanism controlled in operation by said magnet, a locking device arranged to be operated by the opening and closing of said branch circuit through said magnet, a home-stop with which the locking device engages to arrest and hold the signal-transmitting mechanism in its normal position when the branch is closed, and a trouble-stop arranged to arrest its movement when the branch circuit remains open, so as to indicate by a predetermined signal an accidental break or interruption in said branch circuit, the magnet being arranged to disengage the locking device from the trouble-stop when the branch circuit is re-established, substantially as and for the purposes set forth.

11. The combination, with a main circuit and branch circuits supplied with current

from the same source and provided with circuit-controlling devices, of a differentially-wound magnet for each branch circuit, having one of its windings normally connected in a branch circuit and the other in the main circuit, signal-transmitting mechanism controlled in operation by said magnet, a locking device operated by the opening and closing of the branch circuit, a stop with which the locking device engages to hold said mechanism in its normal position, another stop arranged to arrest the movement of said mechanism when the corresponding branch circuit remains open, so as to indicate an accidental break or interruption of said branch circuit by a signal distinguishable from signals for other purposes, a shunt, and a switch operated by said mechanism, set in motion by the breaking of the branch circuit to divert the current of the main circuit around the winding of said magnet, substantially as and for the purposes set forth.

12. The combination, with a main circuit and a branch circuit supplied with current from the same source and provided with suitable circuit-controlling devices, of signal-transmitting mechanism arranged to send signals through said main circuit and to be set in operation by the opening or closing of said branch circuit, a movable electro-magnet controlling the operation of said signal-transmitting mechanism and arranged to automatically cut its winding out of the main line when the branch circuit is broken, and a shunt through which the current of the main line is automatically diverted and maintained when the magnet is cut out, substantially as and for the purposes set forth.

13. The combination of a main and a branch circuit supplied with current from the same source, signal-transmitting mechanism, a single electro-magnet controlling the operation of said mechanism and having its winding normally in connection with the main and branch circuits, a shunt-circuit around said magnet provided with resistance to compel sufficient current to flow through the branch circuit when the same is closed for energizing said magnet, and an automatic switch arranged to divert the current through the said shunt when the branch circuit is broken, substantially as and for the purposes set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

GEORGE KNOWLES, JR.

Witnesses:
CHAS. L. GOSS,
JOHN HURLEY.