No. 751,571. PATENTED FEB. 9, 1904.

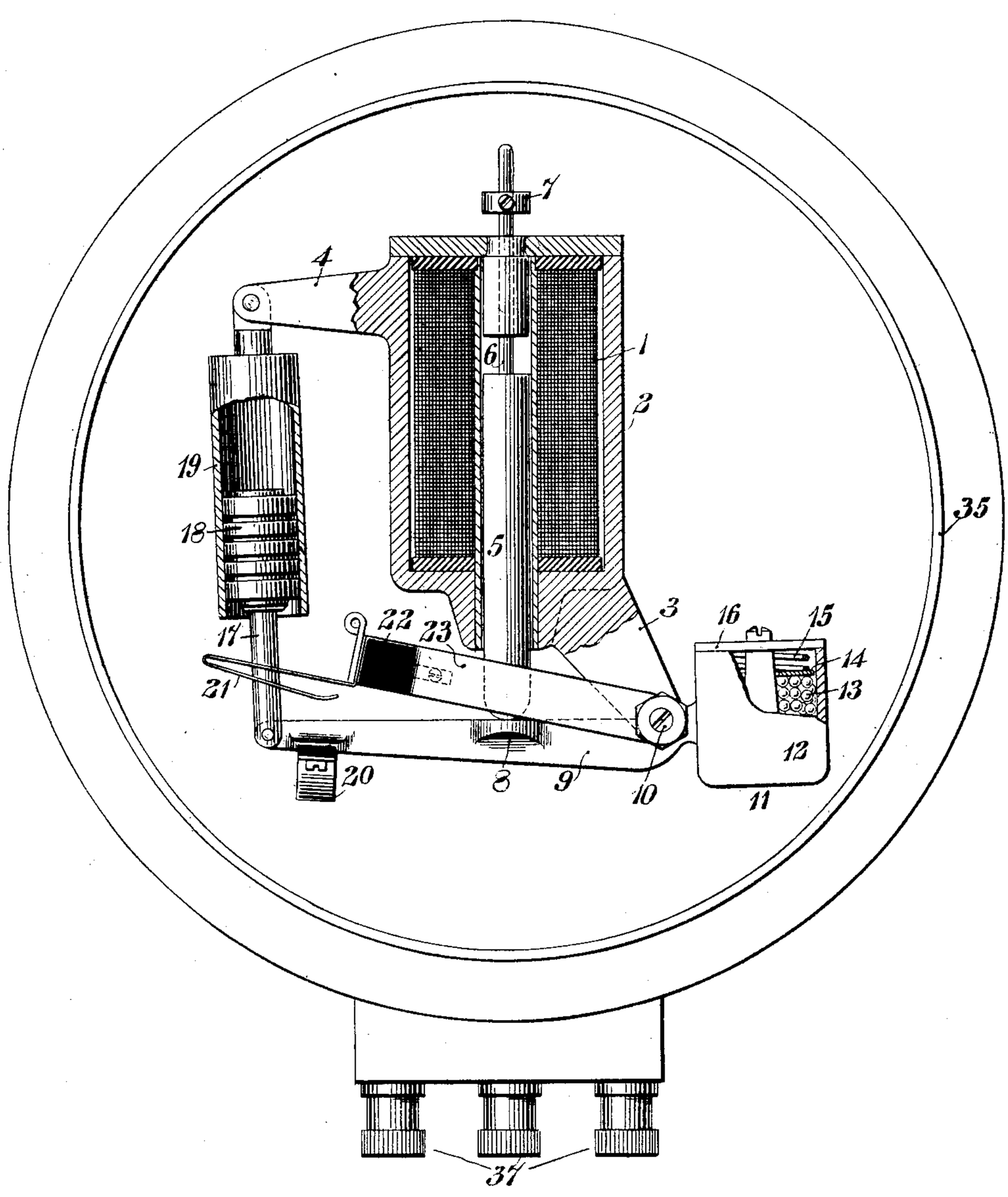
H. R. STUART & A. B. REYNDERS.

TIME LIMIT RELAY FOR ELECTRIC CIRCUITS.

APPLICATION FILED APR. 11, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

C. L. Belcher

Birney Hines

INVENTORS

Harry R. Stuart

& Arthur B. Reynders

BY

Hartley Sloan

ATTORNEY.

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

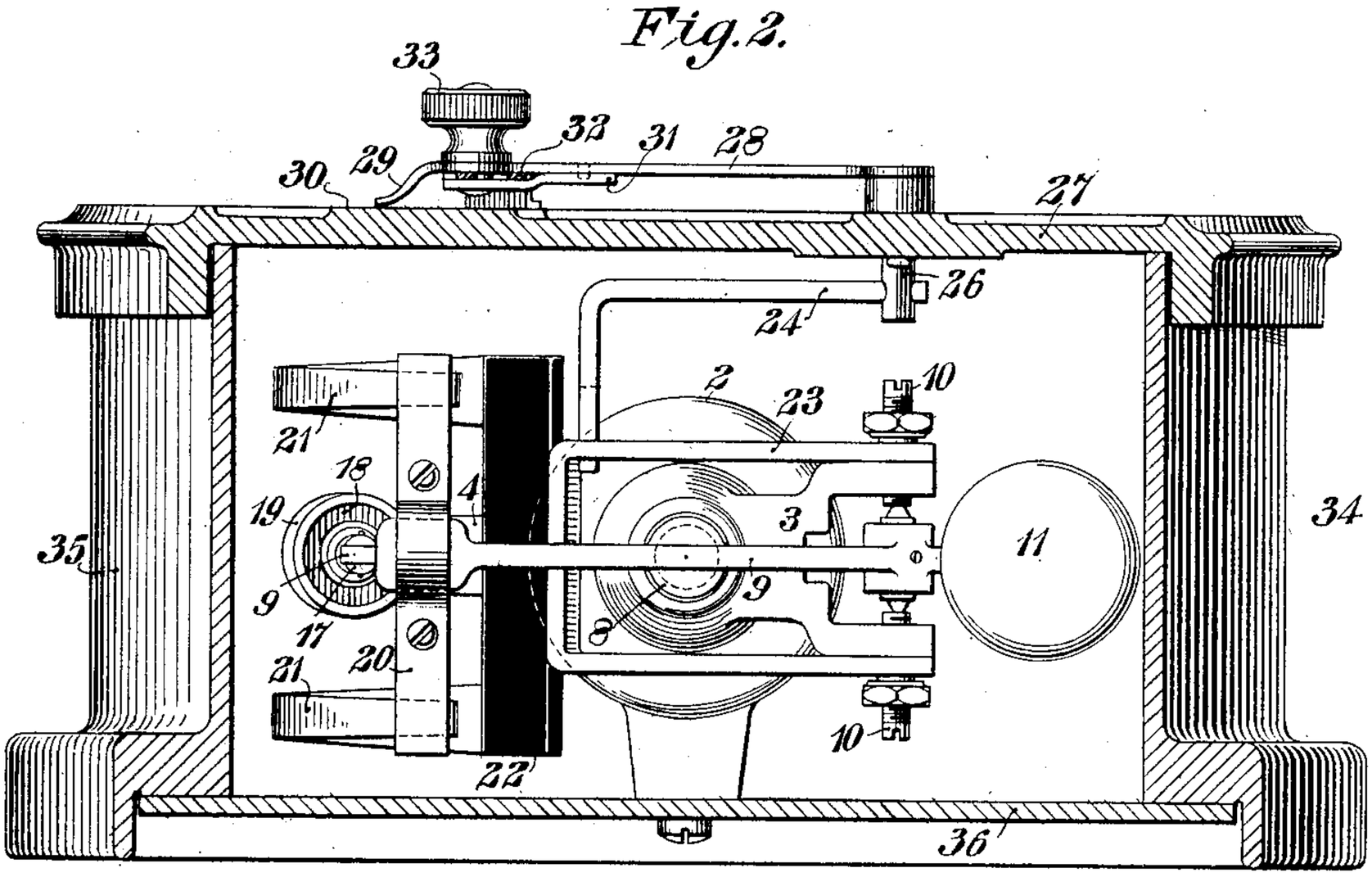
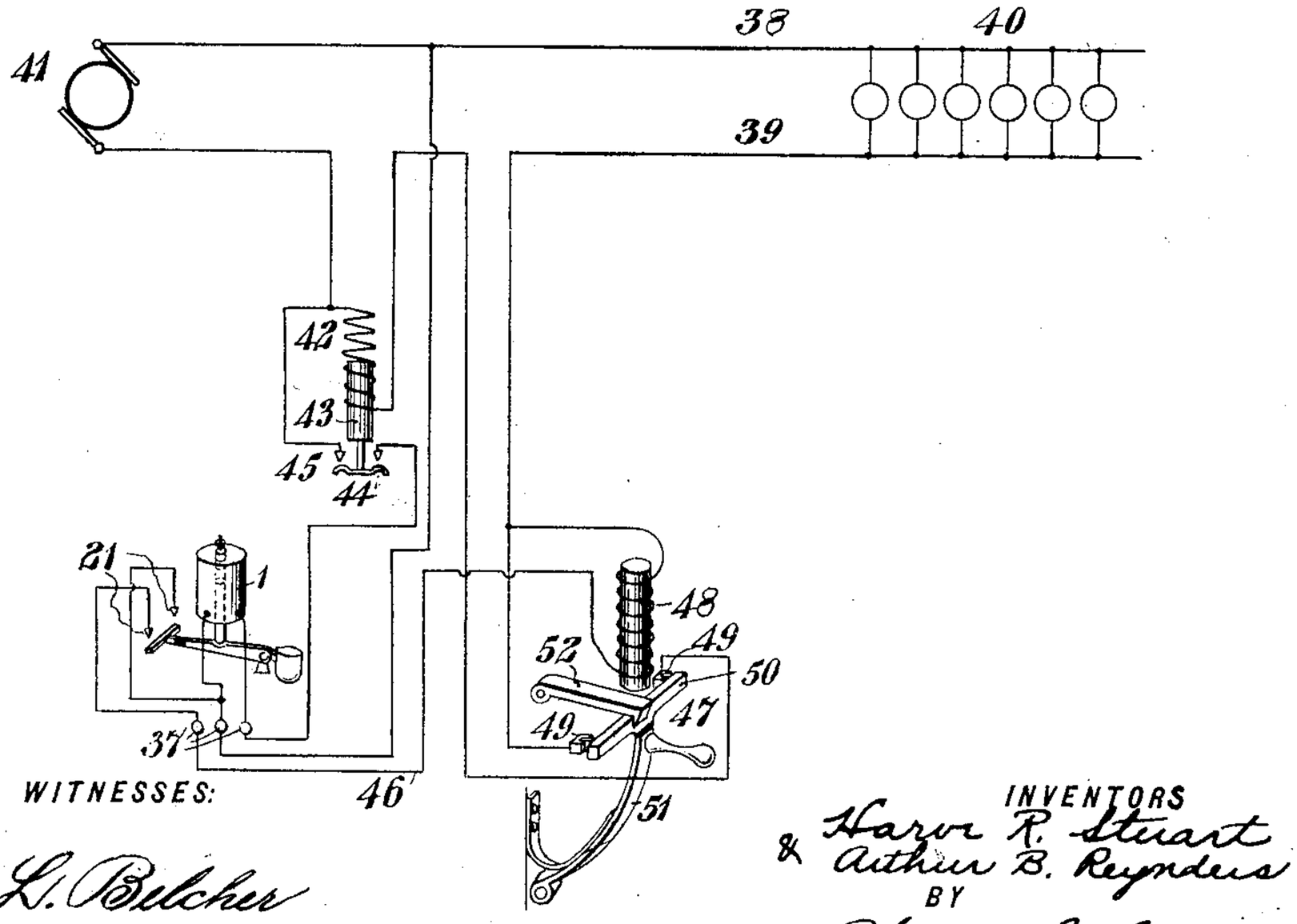


Fig. 3.



WITNESSES:

C. L. Belcher

Birney Hines

INVENTORS

Harvey R. Stuart

& Arthur B. Reynders

BY

Hartley & Carr

ATTORNEY.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 4.

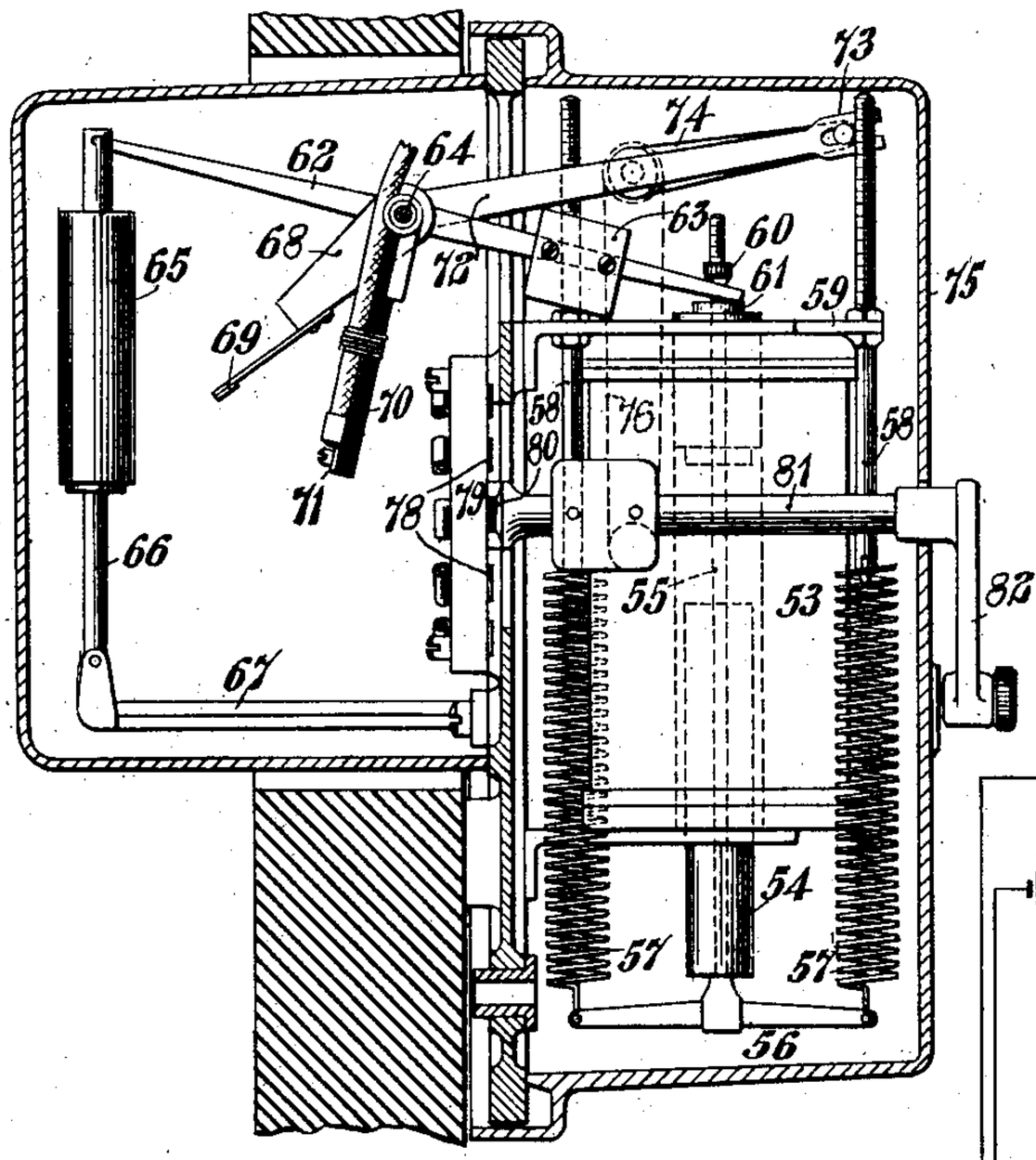


Fig. 6.

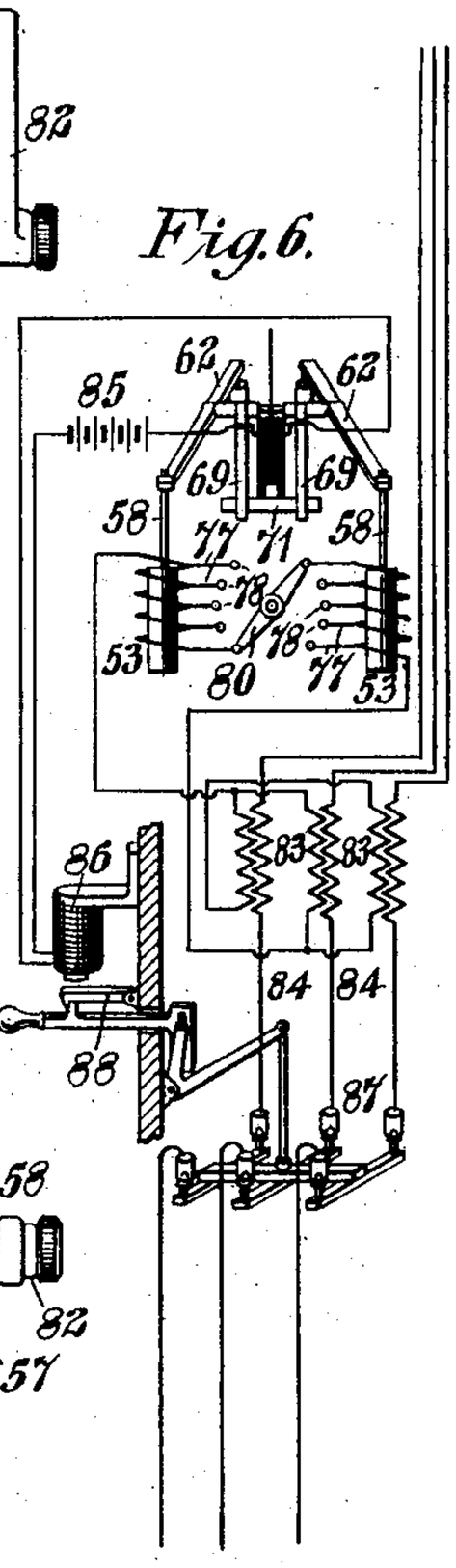
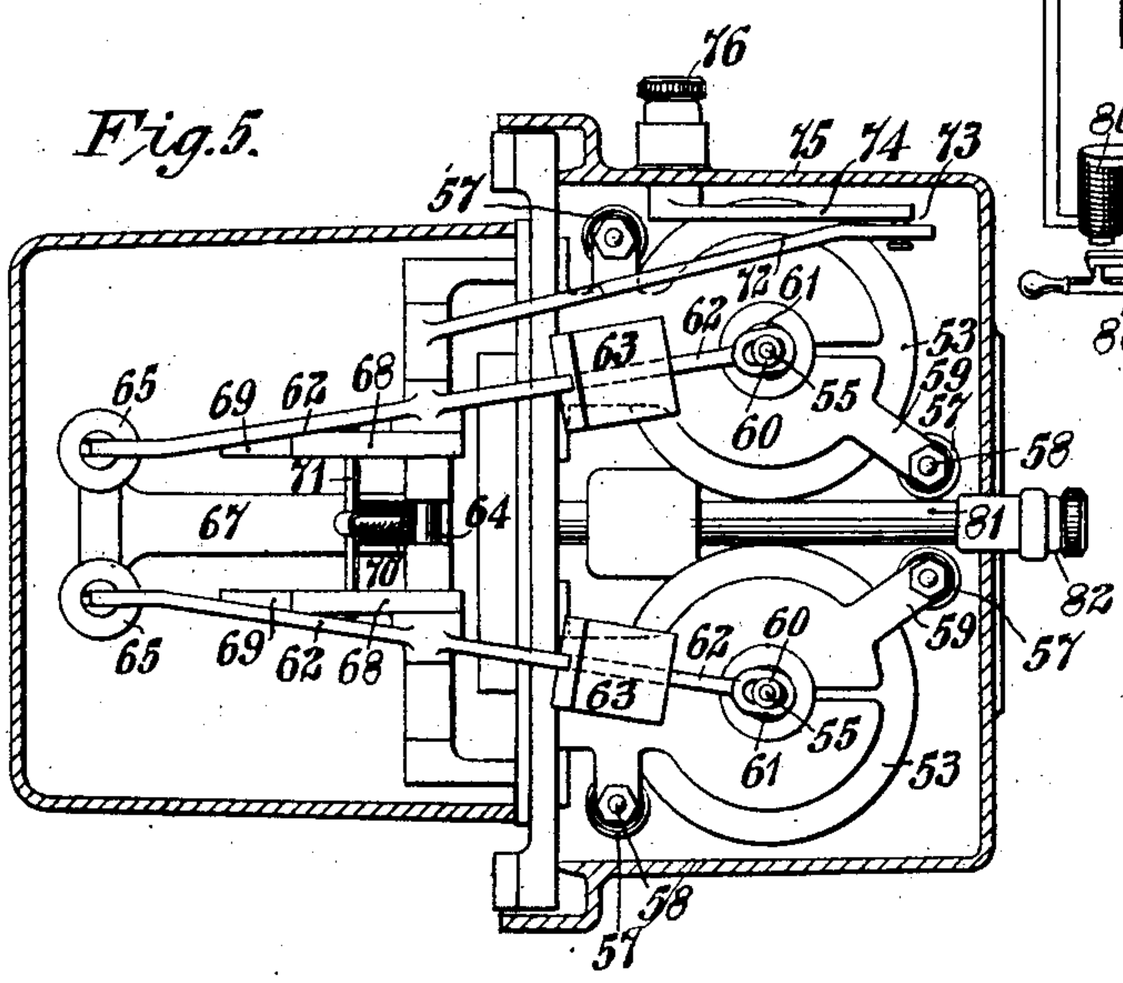


Fig. 5.



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C. L. Belcher

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& Arthur B. Reynders

BY

Wesley G. Carr

ATTORNEY.

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UNITED STATES PATENT OFFICE.

HARVE R. STUART AND ARTHUR B. REYNDERS, OF WILKINSBURG, PENNSYLVANIA, ASSIGNORS TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

TIME-LIMIT RELAY FOR ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 751,571, dated February 9, 1904.

Application filed April 11, 1903. Serial No. 152,277. (No model.)

To all whom it may concern:

Be it known that we, HARVE R. STUART and ARTHUR B. REYNDERS, citizens of the United States, and residents of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Time-Limit Relays for Electric Circuits, of which the following is a specification.

Our invention relates to apparatus used in connection with circuit-interrupting devices and responsive to excessive currents due to short circuits or overloads, and particularly to apparatus of this character which becomes effective to energize the tripping coil or coils of the circuit-breaking devices in connection with which it is used only a predetermined interval of time after the beginning of flow of the excessive currents in the circuit to be protected.

The object of our invention is to provide apparatus of the character above indicated which shall be comparatively simple and inexpensive in construction and reliable in operation and which shall reset itself automatically and require no attention except to adjust it for a new time limit or for a different degree of overload-current.

Our invention is illustrated in the accompanying drawings, in which—

Figure 1 is a view, partially in section and partially in front elevation, of one embodiment of the invention. Fig. 2 is a view, partially in section and partially in plan, looking upward, of the instrument shown in Fig. 1. Fig. 3 is a diagram of apparatus and circuits illustrating one operative arrangement of the apparatus for practical service. Fig. 4 is a vertical sectional view of a relay of modified construction. Fig. 5 is a plan view of the apparatus shown in Fig. 4, the casing being shown in section. Fig. 6 is a diagram illustrating the use of the relay shown in Figs. 4 and 5 in connection with a three-phase alternating-current circuit and a circuit-breaker therefor.

Referring first to Figs. 1, 2, and 3, a solenoid 1 is mounted in a cylindrical casing 2, which is provided with a downwardly and laterally projecting two-armed bracket 3 at its lower end and with a laterally-projecting arm 4 at the opposite side of its upper end. The solenoid 1 is provided with a freely-movable core 5, from the upper end of which projects a pin 6, having at or near its outer end an adjustable stop-collar 7. When the solenoid is deënergized, the lower end of the core 5 rests upon an enlarged portion 8 of a lever 9, which is pivotally mounted between the ends of two set-screws 10, that are adjustably supported in the ends of the arms of the bracket 3. The end of the lever 9 beyond its pivotal support is provided with a counterweight 11, which, as here shown, consists of a cup 12, filled or partially filled with shot 13, upon which rests a follower 14, a coil-spring 15 being provided between the follower and the cap-plate 16 in order to prevent any variation in the application of the counterweight by means of the movement of the shot. The weight is obviously susceptible of variation and adjustment by removing some of the shot or adding others, as may be desired. This form of counterweight has been found convenient in practice, but of course is not essential, since any other form that is readily adjustable may be employed. The free end of the lever 9, opposite that provided with the counterweight 11, is pivotally attached to the lower end of the piston-rod 17 of a dash-pot piston 18, the cylinder 19 of which is pivotally supported from the bracket-arm 4, above referred to. The end of the lever 9 adjacent to the dash-pot piston-rod 17 is provided with a laterally-projecting contact bar or plate 20, the ends of which are so arranged as to respectively make engagement with spring-contact-terminals 21, which are mounted upon an insulating-bar 22, the said bar being fastened to a U-shaped frame 23, which is pivotally supported upon the trunnions 10. In order to adjust the spring-contact pieces 21 to such position as may be desired in accordance with the time limit required and hold them in the adjusted position, we provide a rod 24, one end of which is bent substantially at right angles to the body portion and either projects be-

neath the bar 22 or one arm of the frame 23 or projects through an opening in the latter, as indicated in Fig. 1. The other end of the rod 24 projects through a stud 26, which in turn projects through and has a suitable bearing in the front plate 27 of the instrument and is provided with an adjusting-arm 28, the free end of which is in the form of a pointer 29, moving over a suitable scale 30. The adjusting-arm 28 is provided also with a piece 31, between which and the main portion of the arm is a slotted segment 32, and the parts 28 and 31 are connected together and are clamped to the segment in any position to which the arm may be moved by means of a nut 33. The casing 34, of which the front plate 27 constitutes a part, may have a cylindrical body part 35 and a back plate 36 of metal. The front plate 27 may be made of metal or glass or of metal having a glass-covered opening, the glass being provided when desired in order to permit of inspection of the inclosed mechanism. The casing is also provided with three binding-posts 37, with which connection may be made to an external circuit and with which internal connections are made to the solenoid 1 and the spring-contact pieces 21, as indicated diagrammatically in Fig. 3, which will now be referred to in describing the operation of the device. This relay device may be operated from a given circuit to open and close a separate circuit supplied with current from a different source in order to effect the tripping of a circuit-breaker to open the first-named circuit, or it may be utilized in the manner indicated in Fig. 3, the special arrangement of circuits and the type of circuit-breaker employed being susceptible of wide variation and in no way restricting the scope of use of our invention. As here indicated, the main circuit 38 39 supplies translating devices 40 and is in turn supplied by a suitable generator 41. Connected in series in the circuit 38 39 is a solenoid-coil 42, the core 43 of which carries the movable bridging member 44 of a circuit-closer 45, one of the stationary terminals of which is connected to the conductor 39 of the main circuit and the other stationary terminal of which is connected, through one of the binding-posts 37, to one terminal of the relay-solenoid 1. The other terminal of the relay-solenoid is connected to one of the binding-posts 37 and thence to the conductor 38. This same binding-post is connected to one of the spring-contact pieces 21. The other spring-contact piece 21 is connected to the third binding-post 37 and by a conductor 46, through the circuit-breaker tripping-coil 48, to the conductor 39 of the main circuit. The circuit-breaker 47 may be of any approved construction, that indicated being merely a simple form of device, somewhat diagrammatic in character, comprising, in addition to the tripping-magnet 48, two stationary contact-terminals 49, a bridging member 50 therefor, a supporting-arm 51 for the bridging member, and a latch 52, which serves to normally hold the contact-terminals of the breaker in engagement and is withdrawn to permit the breaker to open by spring action when sufficient current flows through the coil of the magnet 48 to attract the latch, which constitutes its armature. When the current in the main circuit 38 39 exceeds a predetermined safe limit, it serves to close the device 45, and thus energizes the solenoid 1 of the relay. The core 5 is thereupon lifted and the counterweight 11 caused to move the lever 9 to bring the ends of the contact-piece 20 into engagement with the spring-contacts 21, the movement being retarded by reason of the dash-pot 18 19. The length of time which is required to bring the contacts 20 and 21 into engagement obviously is predetermined by adjusting the frame 23 by means of the adjusting-arm 28 and the parts coöperating therewith. In case the excessive current is momentary or does not obtain a sufficient length of time to permit the contacts 20 and 21 to come into engagement the core 5 will be released, and its weight will be sufficient to restore the arm 9 to its original position, as indicated in Fig. 1. If, however, the excessive current obtains a sufficient length of time to permit the contact-terminals 20 and 21 to come into engagement, the circuit will be completed through the tripping-magnet 48 of the circuit-breaker and the breaker will be released and instantly open the main circuit. When the circuit-breaker 47 is again closed, if the current in the circuit is not above the allowable limit the parts will assume and maintain the relative positions shown in Fig. 1, the weight of the solenoid-core 5, as above stated, being sufficient to overcome the weight of the counterbalance 11, and thus the contacts 20 and 21 are separated until the current in the main circuit again becomes sufficient to raise the solenoid-core.

Referring now to Figs. 4, 5, and 6, the relay is shown as constructed and arranged for use in connection with either a polyphase circuit or with two independent circuits, the specific arrangement shown in Fig. 6 being for a three-phase circuit. Substantially one half the apparatus shown in Figs. 4 and 5 is a duplicate of the other half and only one portion would of course be used in a single circuit, whether direct or alternating. The solenoids 53 are provided with cores 54, which are loosely mounted upon rods 55, the latter being provided with horizontal arms 56, which are connected at their respective ends to the lower ends of coil-springs 57, the upper ends of the springs being fastened to rods 58, extending through a supporting-frame 59 and having their upper ends screw-threaded in order that the springs may be adjusted in accordance with any variations in their lengths

or their tensile strengths. The upper end of each rod 55 is also screw-threaded and provided with a nut 60 and also with a collar or stop-piece 61. Loosely connected to the upper end of each rod 55, between its nut 60 and collar 61, is one end of a lever 62, having an adjustable counterweight 63 and journaled approximately midway of its ends upon a shaft or rod 64, the latter being suitably supported by the framework of the apparatus. The other end of the lever 62 is pivotally attached to the upper end of a dash-pot cylinder 65, the piston of which (not shown) may be like that shown in Fig. 1 and may have its stem 66 pivotally supported upon a bracket-arm 67. Rigidly attached to the hub or portion of the lever 62 which surrounds the shaft 64 is an arm 68, having a downwardly-projecting spring-contact piece 69. Supported also upon the shaft 64 is a downwardly-projecting arm 70, which is provided at its lower end with a laterally-projecting contact-piece 71 in position to engage the spring-contact pieces 69 when the latter are moved a sufficient distance inward. This arm 70 is rigidly connected to a rearwardly-extending arm or lever 72, the free end of which is connected by means of a slot-and-pin connection 73 to the free end of an adjusting-arm 74, the other end of which is supported in a suitable bearing in the casing 75 of the instrument and is provided with an operating-handle 76, the turning of which serves to adjust the position of the arm 70 and its contact-piece 71, as will be readily seen, and thus vary the time which takes place between the occurrence of an excessive current in the circuit to be protected and the time when the relay-contacts are brought into engagement to effect the opening of the circuit-breaker. In order to vary the degree of pull of each of the solenoids in accordance with the amount of current for which it is desired to set the relay, we provide a number of leads 77 from the different points in the solenoid to contact-pieces 78, mounted upon a suitable base 79, and provide a contact-arm 80 for successive engagement with these contact-terminal pieces 78. This arm is mounted upon the inner end of a shaft 81, the outer end of which projects through the casing 75 and is provided with a suitable operating-handle 82.

As indicated in Fig. 4 and more clearly in Fig. 6, the movement of the arm 80 will serve to vary the active lengths of both solenoids simultaneously, and thus vary the degree of pull of each to the extent desired.

As indicated in Fig. 6, the solenoids are interconnected to the secondary windings of series transformers 83 in a three-phase circuit 84, so that if the current corresponding to any one of the three phases exceeds the predetermined amount for which the relay is designed and calibrated the solenoid-cores, or one of them, will be raised, and thus relieve the lever or levers 62 of such weight, and the counterweights 63 are so adjusted on the lever-arms that the dash-pot cylinder will slowly descend and the contact 69 will be moved toward the contact-arms 71. If the excessive current continues for the length of time for which the relay is set, the circuit to which these terminals 69 and 71 belong will be closed. In the present instance this is the circuit of a battery 85 and the tripping-coil 86 of a three-phase circuit-breaker 87, the latch 88 of which constitutes the armature of the tripping-magnet 86. When the circuit-breaker is again closed, if the current in the main circuit does not exceed the critical amount the parts of the relay will assume the positions indicated in Fig. 4 and will remain in that position until the current becomes excessive, when the movement above described will be repeated.

The details of construction may obviously be varied from what we have shown without substantial change in the mode of operation, and we desire it to be understood, therefore, that the invention is not to be limited except as limitations may be imposed by the prior art.

We claim as our invention—

1. A time-limit relay for electric circuits comprising contact-terminal members, mechanical means for moving one of said members to circuit-closing position, an electromagnet, an armature therefor the weight of which normally holds said member in open-circuit position and a retarding device for the movable member of the circuit-closer.

2. A time-limit relay for electric circuits comprising contact-terminal members, an electromagnet, an armature therefor the weight of which normally holds said members out of engagement, mechanical means for moving one of said members into engagement with the other when the magnet withdraws its armature, a retarding device for the movable member of the circuit-closer and means for adjusting the time of the circuit-closing movement.

3. A time-limit relay for electric circuits comprising two contact members, mechanical means for operating one of said members to close the relay-circuit, electromagnetic means for releasing said member, a retarding device and means for varying the length of the path through which the movable member travels.

4. A time-limit relay for electric circuits comprising two contact members, mechanical means for operating one of said members to close the relay-circuit, an electromagnetic releasing means for said member, a retarding device and means for setting the stationary member in different positions to vary the length of time of the closing movement.

5. A time-limit relay for electric circuits comprising a solenoid, a stationary switch member, a movable switch member, a retarding device therefor, a solenoid-core that normally holds said movable switch member in

open-circuit position, and mechanical means for actuating the movable member when the solenoid raises its core therefrom.

6. In a time-limit relay for electric circuits, the combination with a solenoid and a core therefor, of a stationary switch member, a movable switch member that is normally held in open position by the weight of the solenoid-core, means for actuating the movable member when relieved from the weight of said core, and means for retarding the movement of said member.

7. In a time-limit relay for electric circuits, the combination with a solenoid and a core therefor, of a stationary switch member, a counterweighted movable switch member that is normally held in open-circuit position by the weight of the solenoid-core and is mechanically moved to closed-circuit position when the weight of the core is removed, and means for retarding the movement of said member when relieved from the weight of the solenoid-core.

8. In a time-limit relay for electric circuits, the combination with a solenoid and a core therefor, of an adjustable stationary switch member, a counterweighted movable switch member that is normally held in open position by the weight of the solenoid-core and is mechanically moved to closed-circuit position when the weight of the core is removed and means for retarding the movement of said member when it is relieved from the weight of the solenoid-core.

9. In a time-limit relay for electric circuits, the combination with a solenoid and a core therefor, of an adjustable stationary switch member, a movable switch member having a variable counterweight and normally held in open position by the weight of the solenoid-core and means for retarding the closing movement of said member when relieved from the weight of the solenoid-core.

10. The combination with an adjustable stationary switch member and a coöperating movable member having a variable counterweight, of a solenoid having a core the weight of which is normally imposed upon said movable member in opposition to the counterweight and a dash-pot for retarding the closing movement of said member when the weight of the core is withdrawn by the solenoid.

11. A time-limit relay for electric circuits comprising an adjustable stationary contact member, a movable contact member, a gravity-actuated solenoid-core normally resting upon said movable member, a solenoid for withdrawing said core, a weight for actuating said movable member when released and a retarding device for said member.

12. A time-limit relay for electric circuits comprising an unattached, gravity-actuated means for maintaining a normally open relay-circuit, an independent, gravity-actuated means for closing said circuit, an electromagnet for withdrawing the circuit-opening means and a retarding device for the movable member of the circuit-closer.

13. A time-limit relay for electric circuits comprising a solenoid and a core therefor, a movable switch member that is normally held in open position by the weight of said core, a variable counterweight for moving said member when relieved from the weight of said core, a dash-pot acting in opposition to said counterweight, a stationary switch member and means for varying its position in accordance with the time limit desired.

In testimony whereof we have hereunto subscribed our names this 6th day of April, 1903.

HARVE R. STUART.
ARTHUR B. REYNDERS.

Witnesses:
W. M. REED,
JAMES B. YOUNG.