J. P. BUCHANAN & F. B. WIEGAND.

RELAY.

APPLICATION FILED JULY 18, 1907.

909,146.

Patented Jan. 12, 1909.

3 SHEETS—SHEET 1.

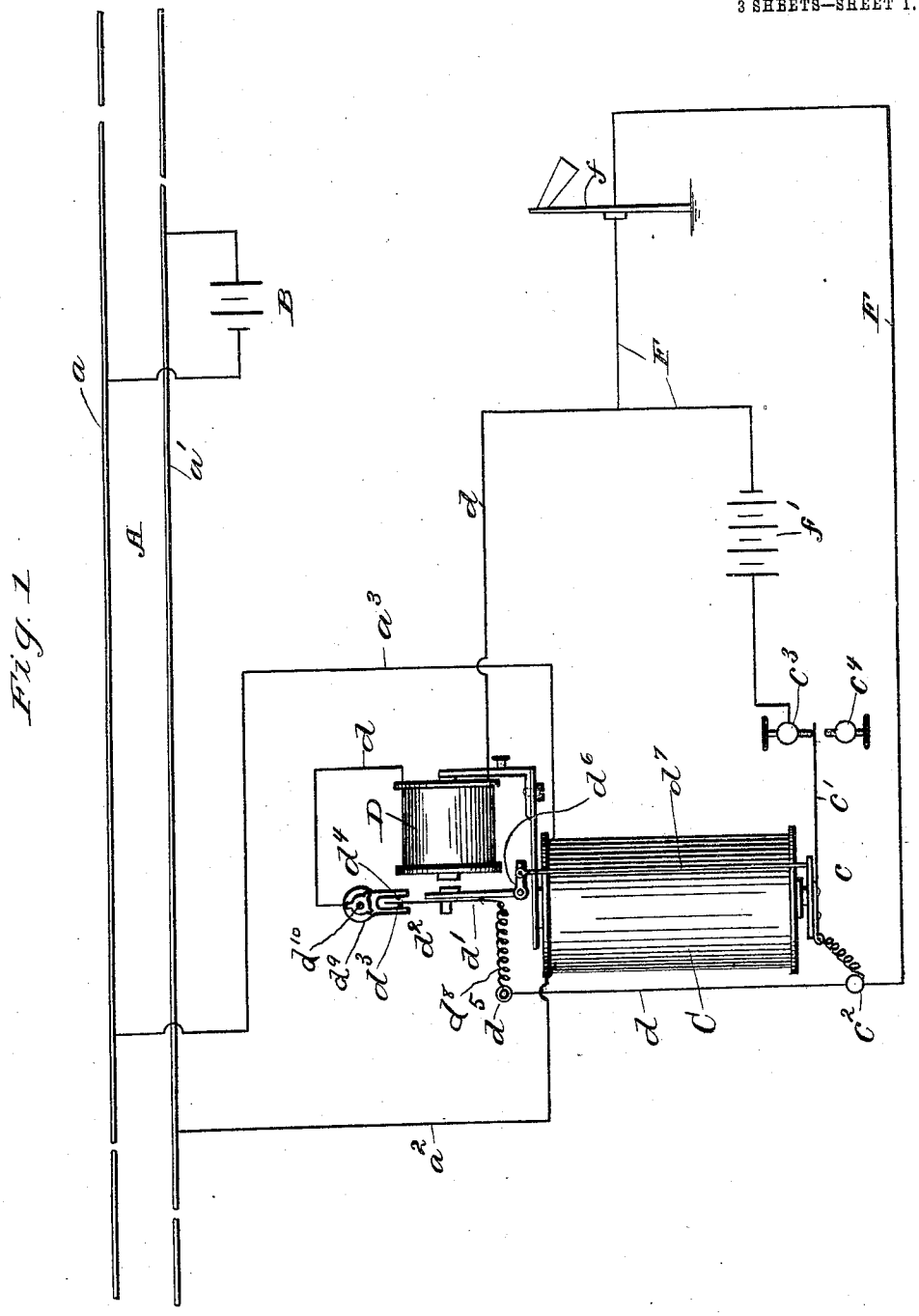


Fig. 1.

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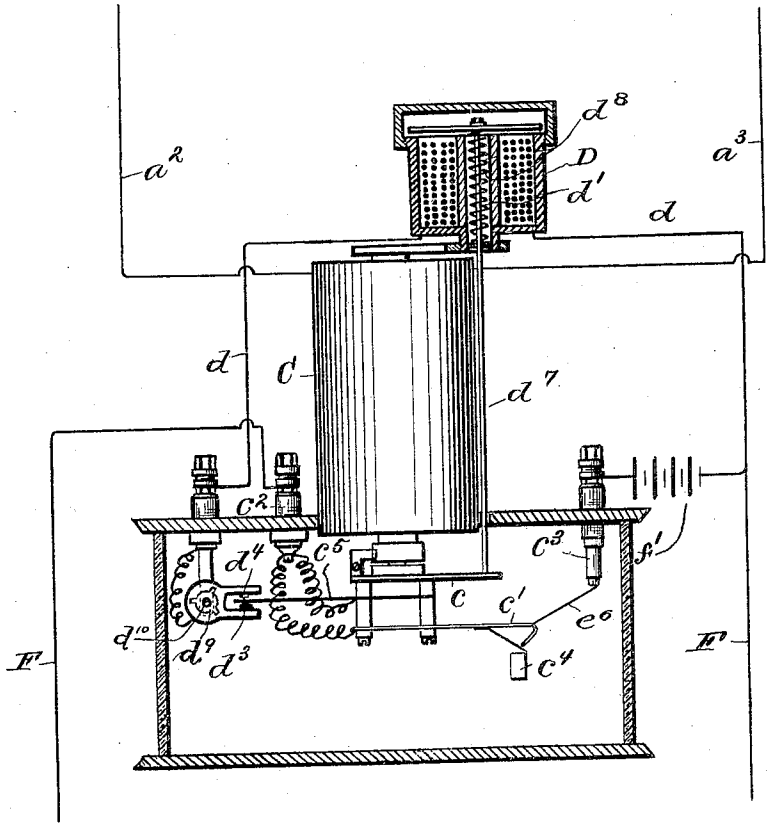
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3 SHEETS—SHEET 2.

Fig. 2



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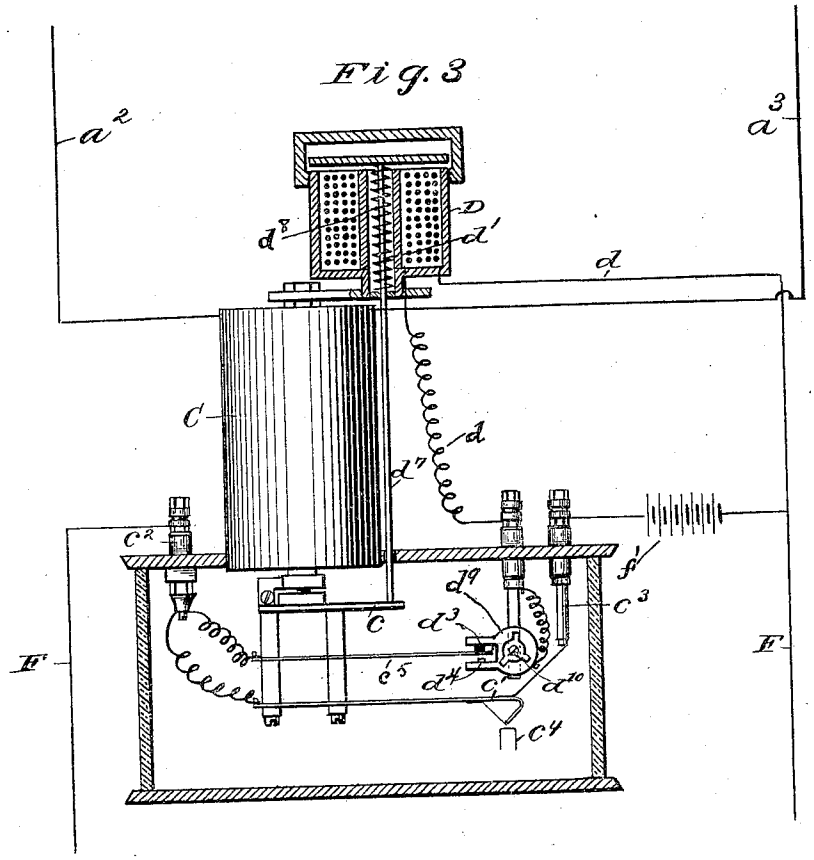
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3 SHEETS—SHEET 3.

Fig. 3



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UNITED STATES PATENT OFFICE.

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RELAY.

No. 909,146. Specification of Letters Patent. Patented Jan. 12, 1909.

Application filed July 18, 1907. Serial No. 384,359.

To all whom it may concern:

Be it known that we, JOHN P. BUCHANAN and FREDERICK B. WIEGAND, citizens of the United States, residents of Cleveland, county of Cuyahoga, State of Ohio, have jointly invented a new and useful Improvement in Relays, of which the following is a specification, the principle of the invention being herein explained and the best mode in which we have contemplated applying that principle, so as to distinguish it from other inventions.

Our invention relates to relays, particularly to relays for use in railway block signal systems of the automatically electrically operated type.

The particular object of our invention is the provision, in connection with automatic electric signal systems, of means for eliminating the harmful effects that frequently arise in such systems owing to the leakage of the current rendered possible by the poor insulation of the rails which form the greater portion of the conductors of the system.

To the accomplishment of the above and related objects, such invention consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings: Figure 1 represents, partly in diagrammatic fashion, a section of block signal apparatus with our improved form of relay incorporated therein; Fig. 2 shows a modification in the construction of such relay: and Fig. 3 shows still a third constructional form.

An approved and quite generally adopted method of equipping a road with an automatic electric signal system is to divide the track up into blocks of the desired length, a signal of the pattern adopted being placed at the entrance of each block. The rails of each block are then made into a track circuit by insulating the rails of one from those of the next block by means of fiber end-pieces of the same size as the rail, and by using wooden or fiber splices in connection with the iron fish-plates ordinarily employed in joining the ends of the rails together, each rail within a block being joined to the next one by suitable bond wire. At one end generally that farthest removed from the signal, a battery, usually of two cells, is located, the two poles of which are respectively joined by wire to the two lines of rail. In practice it should be stated it has been found impossible to make the length of a circuit supplied from one battery equal to that of a whole block owing to the increase in leakage; consequently a block often includes several sub-circuits or sections which, however, are so connected as to be in effect a single circuit. In Fig. 1 of the drawings hence but a single circuit is represented. Such track circuit is merely a control circuit and includes a relay, usually placed at the signal end of the section, the armature of which controls the more powerful signal actuating circuit as will appear. So far as this invention is concerned, the pattern of signal employed is a matter of indifference and may be a pneumatic Westinghouse semaphore, the electrically operated disk signal of Hall, or any other type of signal, whether operated directly, or indirectly, by the current in the signal circuit.

It has been stated that the particular object of our present invention is the elimination of the harmful effects frequently arising from the leakage above referred to as incidental to the character of the relay circuit; for as will be obvious the insulation of one line of rail from the other, in spite of the low voltage of the current in the relay circuit, is by no means perfect. Leakage from one line of rail to the other under ordinary circumstances entails no more serious disadvantage than that incidental to the waste of current involved and the consequent increase in cost of maintenance in the way of battery supplies. A much more serious disadvantage, however, is apt to arise when one of the lines of rail is broken, as by removal from the line of a rail in the course of repair operations or the like. Under such circumstances leakage across the break in the line is just as likely to occur as across from one line of rail to the other, particularly in wet weather conditions. The result here, even though the current is much reduced in power, is not infrequently the retention of the armature of the track relay in its closed position whereby the signal is held "safe"

in spite of the possibility of serious accident on the road. By the improved form of relay, which we shall now proceed to describe, it is proposed to break such signal circuit whenever the amount of current in the track circuit is materially weakened, as by the causes above described, so that, even in spite of a slight leakage across a broken rail, or the like, the signal will be moved to "danger" as it should.

Referring, then, particularly to the drawings, A will be seen to designate a section of track constituting a block of the signal system, the respective rail sections a a' of which constitute the major portion of the track, or control, circuit, such circuit being completed by the battery B connected with the rails at one end of the block as shown, and two leads a^2 a^3 that connect the opposite ends of the rail with the coil of a track relay C. The pivotal armature c of such track relay bears a spring contact member c' that is connected with a binding post c^2 and vibrates between two contact posts c^3 c^4, posts c^2 and c^3 being included in the signal circuit F. Such contact spring, it will be accordingly seen, is adapted, upon energization of the magnet, and consequent inward actuation of the armature, to close the signal circuit F whereby the signal f is actuated, such circuit being energized by a battery f'.

Suitably mounted adjacent to track relay C, is a secondary magnet D, that, in the first form of the device shown in Fig. 1, is mounted at the outer end of the relay, being disposed with its axis extending transversely to that of the main, or relay, magnet C. This magnet D is adapted to be connected in a circuit d in shunt with signal actuating circuit F. Such connection is controlled by the magnet's own armature d', which is pivotally mounted and bears a spring contact member d^2 adapted to vibrate between an insulated contact d^3 and a contact d^4 forming one terminal of such circuit d, the spring contact member in question being connected with a binding post d^5 that constitutes the other terminal of such circuit. Contacts d^3 and d^4 are mounted upon the respective arms of a bifurcated support d^9 preferably oscillatory about a pivotal axis as shown. This support is in effect free to oscillate as may be necessary in order to permit armature d' its full range of movement, but by tightening the screw d^{10}, constituting such axis, sufficient frictional resistance to its movement may be provided to prevent movement thereof at any other time. The distance between the contacts d^3 and d^4 is made such that a very slight movement, indeed, of the armature bearing the contact spring d^2 will suffice to close the shunt circuit. When the return movement of the armature takes place, the contact spring will obviously press against the insulated or "dead" contact d^3 and so there is no possibility of the circuit being prematurely, or inadvertently, closed.

Pivotal armature d' has a lever connection with the armature c of the track relay such connection being had, in the form illustrated, through a lever arm d^6 fixedly mounted upon said first armature and joined at its free end to a connecting rod d^7 that bears against relay armature c. The arrangement and adjustment of said connection are such that, when relay armature c is closed, armature d' is forced away from magnet D and the shunt circuit d through such magnet thereby broken as has just been explained. This will obviously be the normal condition of the apparatus when the current is regularly flowing in the track circuit. Should, however, such current cease to flow, or be materially decreased in amount, there will be an easing up in the attraction of the relay magnet on the armature c, that while not necessarily sufficient in the prevailing construction always to break the contact, will nevertheless produce a sufficient movement, through the magnifying effect of its lever connection with armature d', to close the shunt circuit d controlled through such last armature. The moment this circuit is closed, the magnet D becomes magnetized and the armature is drawn sharply to it, thus giving a sharp thrust, or "kick", to connecting rod d^7 that will suffice to dislodge the armature c in spite of any residual magnetism in the relay magnet.

To overcome friction or other resistance to the movement of the several parts involved in the above operation, it may be desirable or necessary to employ a spring d^8, or the like, that is preferably connected, as shown, to the armature d' of secondary magnet D.

The form of device, illustrated in the modified structure of Fig. 2, differs but slightly from that above described, the track relay C and its connections being of course the same as before. For this reason the latter are shown in part only. In place, however, of a pivotal armature d', a simple reciprocating armature is here employed in connection with the secondary magnet D, the connecting rod d^7 of the previous structure being replaced by a prolongation of such armature, which latter rests, as before, loosely in contact with the armature c of the relay magnet. Closing of the shunt circuit d, in which is included the secondary magnet, is effected by means of a back contact spring c^5 borne by armature c of the relay itself. The result of a very slight movement of such armature will obviously, as before, suffice to close this circuit, and thereupon, owing to the actuation of the armature plunger of such secondary magnet, a

movement of much greater amplitude will be imparted to the relay armature than would otherwise be the case and the actuating circuit be broken beyond all peradventure. The spring corresponding to the spring d^8 of the previous structure is in this case conveniently incased in the core of the secondary magnet, its function here being primarily to support the weight of the movable parts, thus rendering the armature more sensitive in its action. A variation in the form of contact spring c' borne by armature c of the relay and adapted to make and break the signal actuating circuit F is also here shown. This contact member, instead of being flexible throughout its whole length, as in the first described type of relay, is made relatively rigid except for its extreme terminal portion c^6. Such tip consists of a short highly flexible strip, preferably of German silver or the like, that as the armature is drawn up close readily bends or buckles so as to allow its end to slide upon the face of the contact post c^3.

The character of the differences in structure distinguishing the relay shown in Fig. 3 from the one appearing in the figure last described is so obvious as not to require further description than to point out that the forward disposition of the contact spring c^5 for controlling the shunt circuit is preferred, both because it permits of a more compact arrangement of the device, and also because accidental downward movement of the support d^9 due to jarring or the like cannot effect a closure of the shunt circuit.

Further description of the operation of our improved relay is thought unnecessary. Attention may merely be called, by way of conclusion, to the fact that the employment of the second or auxiliary magnet D in no wise affects the closure of the relay armature when its magnet is again properly excited; for since the magnet circuit d is a shunt circuit of circuit F, the breaking of the latter at once serves to cut out magnet D also. The temporary, instantaneous, flow of current, however, that is sent through such magnet while armature c is wavering as the current through the relay magnet C weakens, is sufficient to effect the purpose desired, that or "sending armature c about its business." If the current in the relay increases there is nothing to hinder the return of the armature immediately thereupon to its closed position. By proper initial adjustment of the several contact posts, and particularly of the distance between posts d^3 and d^4, any desired degree of sensitiveness within the resilient, or buckling, limit of contact spring c' may obviously be secured.

It is of course without any implication of limitation of usefulness that our improved relay has been described in connection with railway signal apparatus. It should also be stated that the auxiliary magnet is equally effective preventing any improper cleaving of the spring contact borne by the relay armature, thereby closing the signal circuit, whether such cleaving be due to the causes hereinbefore referred to, such as current leakage in the track circuit, or whether it be due to a slight fusing of the contacts such as might be incident to a static discharge or unusually heavy flow of current.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any one of the following claims or the equivalent of such stated means be employed.

We therefore particularly point out and distinctly claim as our invention:—

1. The combination with an actuating circuit and a relay controlling the same, of a magnet adapted to break said circuit, energization of said magnet being controlled by movement of the armature of said relay.

2. The combination with an actuating circuit and a relay controlling the same, of a magnet adapted to positively actuate the armature of said relay to break said circuit, energization of said magnet being controlled by movement of said armature.

3. The combination with an actuating circuit and a relay controlling the same, of a magnet adapted to positively actuate the armature of said relay to break said circuit, energization of said magnet being controlled by slight initial movement of said armature.

4. The combination with an actuating circuit and a relay controlling the same, the armature of said relay being provided with a spring contact for closing said circuit, of a magnet adapted to positively actuate the armature of said relay to break said circuit, energization of said magnet being controlled by movement of said armature within the buckling limit of such spring contact.

5. The combination with an actuating circuit and a relay controlling the same, of a magnet in shunt with said circuit and adapted to break the same, energization of said magnet being controlled by movement of the armature of said relay.

6. The combination with an actuating circuit and a relay controlling the same, of a circuit in shunt with said actuating circuit, the armature of said relay being adapted to control said shunt circuit also, and a magnet in said shunt circuit adapted, when, energized, to positively actuate said armature to break said actuating circuit.

7. The combination with an actuating circuit and a relay controlling the same, of a circuit in shunt with said actuating circuit, slight initial movement of the armature of

said relay being effective to close said shunt circuit, and a magnet in said shunt circuit adapted, when the latter is thus closed, to positively actuate said armature to break said actuating circuit.

8. The combination with an actuating circuit and a relay controlling the same, the armature of said relay being provided with a spring contact for closing said circuit, of a circuit in shunt with said actuating circuit, movement of such armature within the buckling limit of its spring contact being effective to close said shunt circuit, and a magnet in said shunt circuit adapted when the latter is thus closed to positively actuate said armature to break said actuating circuit.

9. The combination of an actuating circuit, a relay controlling the same, said relay having a pivoted armature, a fixed contact forming one terminal of said circuit, a spring contact borne by such armature and constituting the other terminal of said circuit, a circuit in shunt with said actuating circuit, means for making and breaking said shunt circuit, said means being operatively connected with such armature so as to close said circuit upon slight outward movement of the same, and a magnet in said shunt circuit, the armature of said magnet being connected to actuate said relay armature outwardly when said magnet is energized.

10. The combination of an actuating circuit, a relay controlling the same, said relay having a pivoted armature, a fixed contact forming one terminal of said circuit, a spring contact borne by such armature and constituting the other terminal of said circuit, a circuit in shunt with said actuating circuit, means for making and breaking said shunt circuit, said means being operatively connected with such armature so as to close said circuit upon outward movement of such armature within the buckling limit of its spring contact, and a magnet in said shunt circuit, the armature of said magnet being connected to actuate said relay armature outwardly when said magnet is energized.

11. The combination of an actuating circuit, a relay controlling the same, said relay having a pivoted armature, a fixed contact forming one terminal of said circuit, a spring contact borne by said armature and constituting the other terminal of said circuit, a circuit in shunt with said actuating circuit, a magnet in said shunt circuit, a pivoted armature adapted to be actuated by said magnet, said armature being adapted to make and break said shunt circuit and means connecting said armature with said relay armature whereby slight initial movement of the latter is effective to close said shunt circuit and whereby energization of said magnet is effective to further move said relay armature to break said actuating circuit.

12. In apparatus of the class described, the combination of a track circuit, an actuating circuit, a relay interposed in said track circuit and adapted to control said actuating circuit, and a magnet adapted to break said actuating circuit, energization of said magnet being controlled by movement of the armature of said relay.

13. In apparatus of the class described, the combination of a track circuit, an actuating circuit, a relay interposed in said track circuit and adapted to control said actuating circuit the armature of said relay being provided with a spring contact for closing such circuit and a magnet adapted to positively actuate the armature of said relay to break said actuating circuit, energization of said magnet being controlled by movement of said armature within the buckling limit of such spring contact.

14. In apparatus of the class described, the combination of a track circuit, an actuating circuit, a relay interposed in said track circuit and adapted to control said actuating circuit, the armature of said relay being provided with a spring contact for closing said circuit, a circuit in shunt with said actuating circuit, movement of said armature within the buckling limit of its spring contact being effective to close said shunt circuit, and a magnet in such shunt circuit adapted when the latter is thus closed to positively actuate said armature to break said actuating circuit.

15. In apparatus of the class described, the combination of a track circuit, an actuating circuit, a relay interposed in said track circuit and adapted to control said actuating circuit, said relay having a pivoted armature, a fixed contact forming one terminal of said track circuit, a spring contact borne by such armature and forming the other terminal of said circuit, a circuit in shunt with said actuating circuit, means for making and breaking such shunt circuit, said means being operatively connected with such armature so as to close said circuit upon slight outward movement of the same, and a magnet in said shunt circuit, the armature of said magnet being connected to actuate said relay armature outwardly when said magnet is energized.

16. The combination of an actuating circuit, a relay controlling the same; a fixed contact forming one terminal of said circuit; a spring contact borne by the relay armature and constituting the other terminal of said circuit; a circuit in shunt with said actuating circuit; means for making and breaking said shunt circuit, said means including a movable support provided with an insulated contact and a contact forming one terminal of said shunt circuit, and a movable contact member lying between the contacts of said support and forming the other terminal of the circuit said movable member being

operatively connected with such relay armature; and a magnet in said shunt circuit, the armature of said magnet being connected to actuate such relay armature outwardly when said magnet is energized.

17. The combination of an actuating circuit, a relay controlling the same; a fixed contact forming one terminal of said circuit; a spring contact borne by the relay armature and constituting the other terminal of said circuit; a circuit in shunt with said actuating circuit; a magnet in said shunt circuit, the armature of said magnet being connected to actuate such relay armature outwardly when said magnet is energized; and means for making and breaking said shunt circuit, said means including a movable support provided with an insulated contact and a contact forming one terminal of said shunt circuit, and a contact member borne by said magnet armature and lying between the contacts of said support, said member forming the other terminal of said circuit.

18. In apparatus of the class described, circuit making and breaking means comprising a movable support provided with an insulated contact and a contact forming one terminal of the circuit, means adapted to retain said support in whatever position it may be left, and a movable contact member lying between the contacts of said support and forming the other terminal of the circuit.

19. In apparatus of the class described, circuit making and breaking means comprising a positively moving contact member forming one terminal of the circuit, a second movable contact member, movement of the former being effective to move the latter, and means adapted to retain the latter in whatever position it may be thus left.

20. In apparatus of the class described, circuit-making and breaking means comprising a positively moving contact member forming one terminal of the circuit, a second movable contact member, movement of the former being effective to move the latter, and frictional means adapted to retain the latter in whatever position it may be thus left.

Signed by us this 15th day of July, 1907.

JOHN P. BUCHANAN.
FREDERICK B. WIEGAND.

Attested by—
E. R. RODD,
JNO. F. OBERLIN.