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W. GRUNOW, JR.

ELECTRICAL SWITCH OPERATED BY ELECTROMAGNETS.

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NO MODEL.

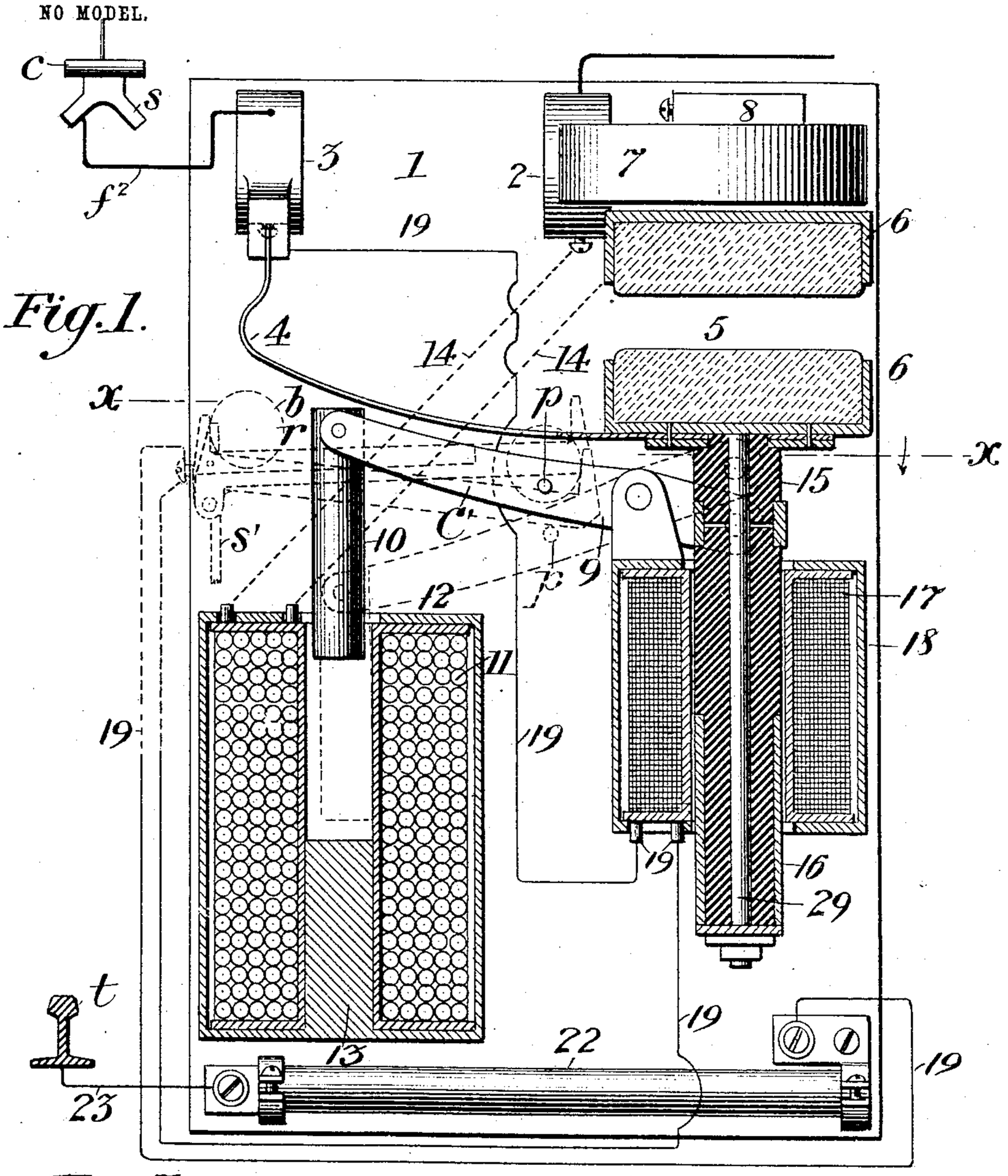

Fig. 1.

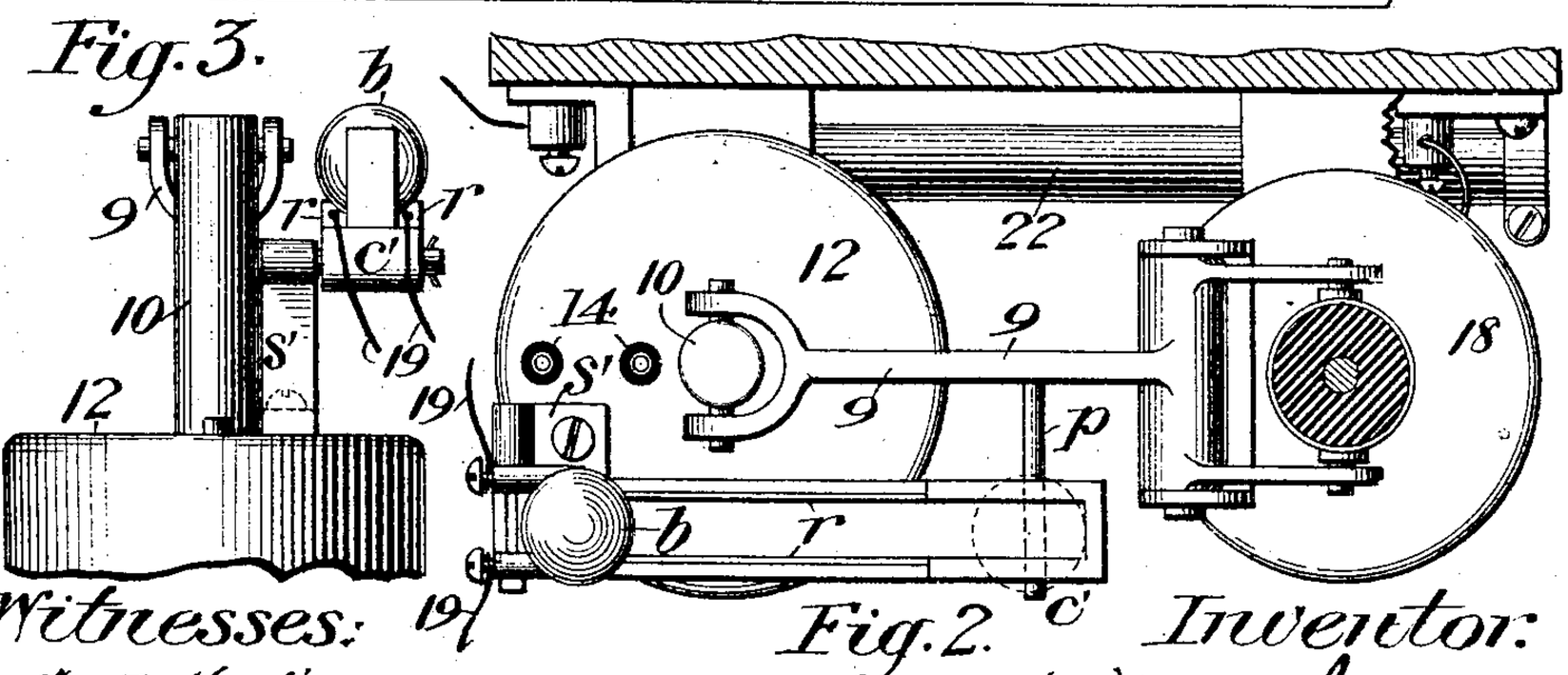

Fig. 3.

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ELECTRICAL SWITCH OPERATED BY ELECTROMAGNETS.

SPECIFICATION forming part of Letters Patent No. 765,655, dated July 19, 1904.

Original application filed August 2, 1902, Serial No. 118,239. Divided and this application filed May 17, 1904. Serial No. 208,477. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM GRUNOW, Jr., a citizen of the United States, residing at Bridgeport, county of Fairfield, and State of Connecticut, have made a new and useful Invention in Electrical Switches Operated by Electromagnets, of which the following is a specification.

My invention is directed particularly to improvements in electrical switches for effecting the manipulation of currents of great quantity and high potential difference—such, for instance, as are used in connection with electric railways and power systems generally; and it has for its objects, first, to effectually close and interrupt an electrical circuit without damaging arcing and also without "chattering" at the terminals of the switch; second, to effect the closure of an electrical circuit by or through the agency of a ground-circuit which is interrupted a definite time after the working circuit has been closed by the application of a retarded force and in such manner that the working current is not interfered with in its functions or permitted in any way to damage the apparatus; third, to combine such a switch with a sectional third-rail system of electric railways.

Referring now to the drawings for a full and clear understanding of the invention, such as will enable others skilled in the art to construct the apparatus hereinafter described, Figure 1 is a side elevational view of my novel switch as combined with a sectional third-rail system of electric railways, the working terminals, the operating-solenoids, and certain of the interconnected parts being shown in sectional view and the circuits in diagrammatic view. Fig. 2 is a sectional view taken through Fig. 1 on the broken line X X and as seen looking thereat from the top toward the bottom of the drawings. Fig. 3 is a detail side elevational view of the upper portion of the switch illustrated in Fig. 2.

With electromagnetically-controlled switches for sectional systems of electric railways such have heretofore been devised much annoyance has resulted from damaging arcing at the working contacts or terminals, and from what is known in the art as "chattering" between said contacts or terminals, owing to the fact that as a rule such switches are operated by electromagnets or solenoids of the double-coil type—that is to say, a primary or high-resistance coil is utilized to cause a solenoid-core carrying the movable terminal to primarily effect the closure of the circuit, after which the terminals are held in permanent contact with each other by the working current flowing directly through a low-resistance coil which acts upon the same solenoid-core, the ampere-turns of the coil being in series relation with the working current to the motor or other translating device designed to utilize such current.

My invention is designed to overcome this objectionable feature, and to this end I provide a solenoid or electromagnet which primarily acts upon a solenoid-core operatively connected with the movable terminal in such manner that the working circuit is first closed by the action of this solenoid, and when thus closed a multiple arc or branch circuit from the working circuit is closed through a low-resistance solenoid acting upon a balanced lever connected with the movable terminal, which lever is proportionately so fulcrumed as to effectually hold the terminals in working contact with each other, after which the first-named circuit is broken by a retarded device, a definite time interval occurring between the time that the working circuit is first closed and the circuit-closing circuit is interrupted, thus causing the operation of the apparatus to be effected through a series of successive steps which avoid or prevent both arcing and chattering.

Referring now to the drawings in detail, in all of which like letters and numerals of reference represent like parts wherever used, *s* is a sectional third rail, and f^2 a branch feeder running to a metallic terminal 3 in the switch-box.

c is a current-collector or trolley-shoe carried by a moving car, one of the wheels of which (not shown) rests upon a tram-rail *t*, constituting the return conductor to the power-house generator, (not shown,) but hav-

ing its positive pole connected to the feeder-circuit.

5 5 represent the carbon terminals, both of which are secured in conducting-cups 6, the upper one being the fixed terminal electrically connected with a metallic terminal 2 by an angle-iron 8 and conductor 7 of relatively low resistance.

1 is an insulating base-board to which the two metallic terminals 2 and 3 and all of the operative parts of the switch are secured.

4 is a flexible conductor connected to the metallic terminal 3 and to the lower surface of the metallic cup 6, which holds or secures the lower movable carbon terminal 5, said cup and carbon terminal being supported by an insulating sleeve or pin 15, to the lower end of which is secured a solenoid-core 16, all of said parts being held together by a rod 29 and pivotally supported by a proportional lever 9, fulcrumed, as shown, above an iron-clad operating-solenoid 17, 18 being the iron-clad structure. The short end of the proportional lever is pivotally connected to the insulating sleeve or pin 15 by a metallic band which surrounds the same, the arrangement being such that vertical adjustment may be effected for the lower carbon terminal through the agency of the rod 29, which connects the two parts of the insulating sleeve or pin 15. To the free end of the proportional lever 9 is secured a solenoid-core 10, adapted to move vertically into the magnetic field of a second iron-clad solenoid 11 and core 13, 12 representing the iron-clad portion thereof. 14 is a branch or shunt circuit of relatively large current-carrying capacity operatively connected to the coils of the solenoid 11, which coils, it will be understood, are of relatively low resistance and bear a definite or fixed proportion to the low-resistance conductor 7. In other words, the low-resistance coil 11 is in shunt-circuit to the conductor 7 and adapted to utilize a part of the working current for holding the carbon terminals 5 5 in working relation with each other.

19 is a conductor running from the metallic terminal 3 to the relatively high resistance coils of the solenoids 17 and thence to the pivoted end of a lever c', fulcrumed at one end upon a standard s', secured to the iron-clad casing 12 of the solenoid 11, the free end of said lever resting upon a pin p, carried by the long arm of the proportional lever 9. (See Fig. 2.) This lever c' is made, preferably, of insulating material and carries upon its upper surface two good conducting-rails r r, preferably of copper, the ends of which are connected directly in circuit with the conductor 19 and to a resistance-bar 22, preferably of carbon.

b is a metal ball of good conductivity, such as copper, adapted to have good surface contact with the inner faces of the rails r, and thus complete the circuit through the conductor 19. The free ends of the rails r r terminate a short distance from the free end of the lever c', and the latter is constructed with a turned-up or hook-like portion, as shown, which acts as a stop for the ball b when the free end of the lever is in its lower position, as shown in dotted lines in Fig. 1, the arrangement being such that when the ball is in this position it is entirely out of metallic contact with the rails r r. Under normal conditions when the sectional third rail or conductor s is disconnected from the feeder the operative parts of the switch are located as disclosed in Fig. 1, with the carbon electrodes 5 5 separated, the free end of the lever c' in its upper position, and the conducting-ball b resting upon the rails r r near the pivoted end of the lever.

The operation is as follows: As the current-collector or trolley-shoe c passes from the sectional third rail s, upon which it is resting, the front end thereof makes metallic contact with the next sectional third rail in advance, thereby closing the current from the sectional conductor s in advance by the corresponding branch conductor f^2, terminal 3, conductor 19, coils of the solenoid 17, conductor 19, metal rails r r, carried by the lever c', ball b, resistance 22, conductor 23 to the tram-rail t, and thence back to the starting-point, the negative pole of the power-house generator. (Not shown.) This causes the solenoid-core 16 to be lifted until the carbon contacts 5 close the working circuit. Consequently the free end of the proportional lever 9 is moved downward with the solenoid-core 10, passing into the solenoid 11. The pin p, carried by the long arm of the proportional lever, is correspondingly depressed, and consequently the several parts assume the positions shown in fine dotted lines in Fig. 1. The ball b therefore commences to roll down the inclined plane, and after a predetermined length of time, dependent upon the inclination of this plane, the circuit is interrupted at the outer or right-hand ends of the rails r r, (see Fig. 2,) the ball ultimately resting in the position shown in dotted lines in that figure against a hooked stop at the free end of the insulated lever. Hence the working circuit is closed and the current now flows through the low-resistance coils of the solenoid 11, maintaining the circuit closed and without chattering or damaging arcing. With such a device the time interval may be increased or diminished, as desired, by changing the inclination of the lever c', which may be effected by adjusting the pin p at different points upon the long arm of the proportional lever 9 or by raising or lowering the pivoted end of the lever in a manner which will be obvious to those skilled in the art.

By the expression "proportional" or "proportioned" lever (indicated by the numeral 9 in the drawings and referred to in the speci-

fication) I wish to be understood as meaning a lever having a long and a short arm so proportioned that a delicacy of operation is effected whereby the terminals are held together by the action of the solenoid 11 upon its core 10 with the greatest nicety, such an arrangement making it possible to secure a certainty of action whereby the terminals are always maintained in contact with each other when working current is flowing through the branch feeder f^2, running to its corresponding sectional conductor or third rail *s*.

Although I have described my invention hereinbefore as applicable to a sectional third-rail system of electric railways, obviously the same may be used in connection with systems of electrical energy generally and with various types of electrical translating devices wherein currents of high potential and large quantity are utilized—such, for instance, as electric motors, electric lamps, and kindred apparatus—and my claims hereinafter made are designed to be of such scope as to include, generically, the use of a retarded circuit-interrupting device which interrupts the circuit-closing circuit of an electromagnetically-controlled switch a definite time after the working circuit is closed.

I make no claim hereinafter to the method of effecting circuit connection between a source of electrical energy and a translating device without damaging arcing, consisting in utilizing a part of the current to primarily close the working circuit, then utilizing the working current to maintain the working circuit firmly closed, and finally interrupting the flow of the first-named current after a definite time interval by the application of a retarded force, as the same is claimed in a prior application, bearing Serial No. 118,239, filed by me in the United States Patent Office on the 2d day of August, 1902, and of which the present application is a division.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. An electromagnetically-controlled switch provided with two operating-electromagnets, circuits and circuit connections, and a retarded-circuit-interrupting device adapted to interrupt the circuit to one of said magnets a predetermined length of time after the circuit has been closed through the other.

2. In a switch a circuit-closing electromagnet and a main-circuit electromagnet made operative successively; in combination with a retarded-circuit-interrupting device adapted to interrupt the circuit to the first-named electromagnet after the circuit has been closed for a predetermined time through the other.

3. A switch provided with two operating solenoids having their cores operatively connected to a proportional lever; in combination with circuits and circuit connections for connecting a translating device to a source of electrical energy and a retarded-circuit-interrupting device adapted to interrupt the circuit to one of said solenoids a definite time after it has been closed through the other.

4. A switch consisting of a pair of terminals one of which is operatively connected to the core of a solenoid included in a circuit normally disconnected from a source of electrical energy; in combination with a second solenoid having the coils connected to the working circuit and through the aforesaid terminals; together with a retarded gravity-controlled circuit-interrupting device adapted to interrupt the first-named circuit a predetermined time after the second circuit is closed.

5. In an electromagnetically-controlled switch, a pair of switch-terminals, two solenoids having their cores connected through a proportional lever to one of the terminals; circuits and circuit connections for both coils and a circuit-interrupting device for the coils of one of the solenoids, consisting of a pivoted lever and a rolling ball carried thereby and adapted to interrupt the circuit only after a predetermined time after the circuit has been closed through the coils of the other solenoid.

6. A switch for connecting a sectional conductor or third rail to and disconnecting it from a current-feeder, consisting of a pair of terminals one of which is operatively connected with a pivoted lever connected in turn to the cores of two solenoids, the coils of one of said solenoids being included in circuit with a retarded-circuit-interrupting device and of the other in a shunt or derived circuit with one of the terminals, the arrangement being such that when the circuit is closed through the first-named coils the working circuit will be closed through the shunt-coils and the terminals, and the first-named circuit interrupted after a predetermined time.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM GRUNOW, JR.

Witnesses:
C. J. KINTNER,
M. F. KEATING.