No. 706,012. Patented Aug. 5, 1902.

# F. BOURNE.

## ELECTROMAGNETIC SWITCH.

(Application filed Nov. 8, 1901.)

(No Model.)

Fig. 1.

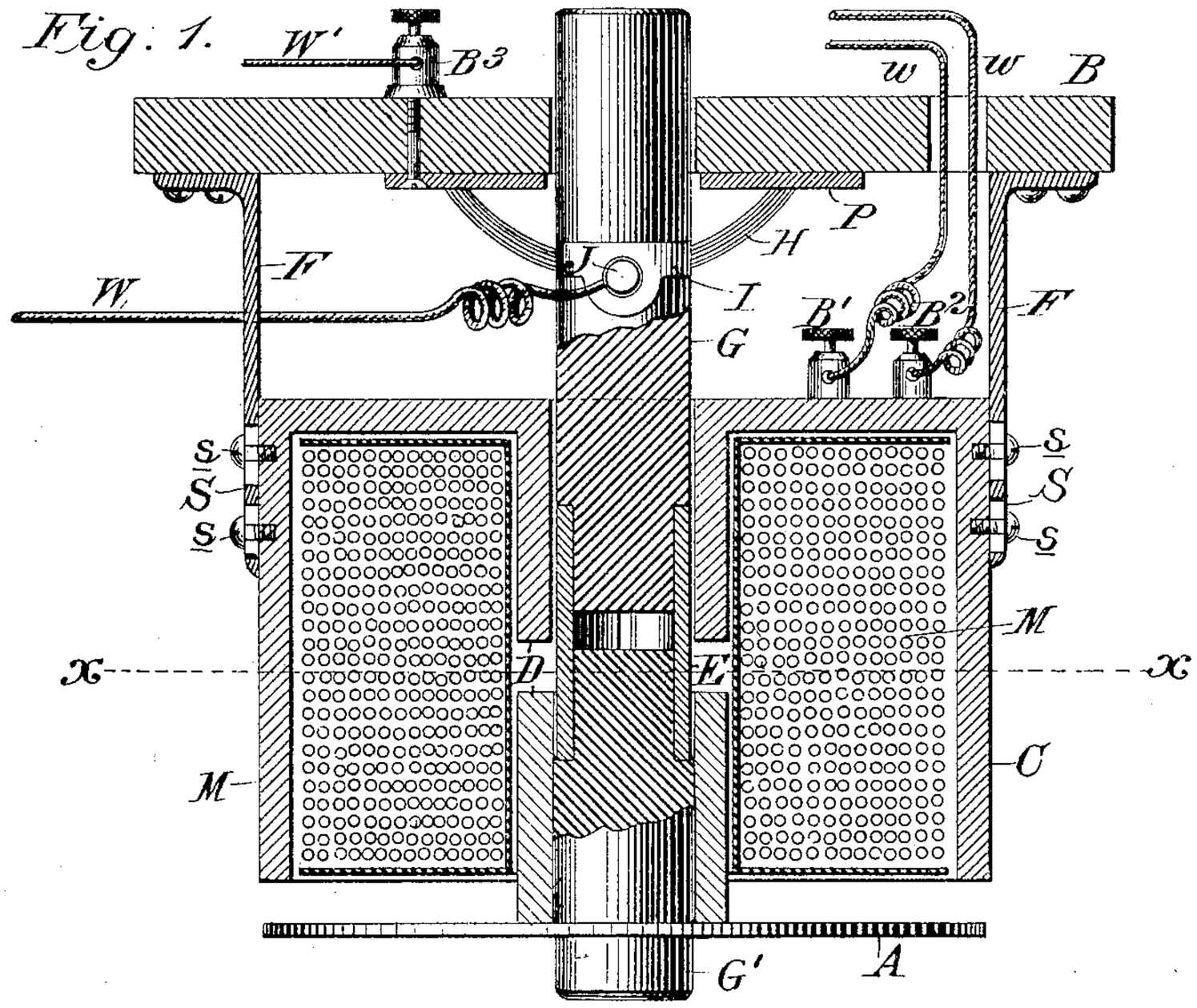
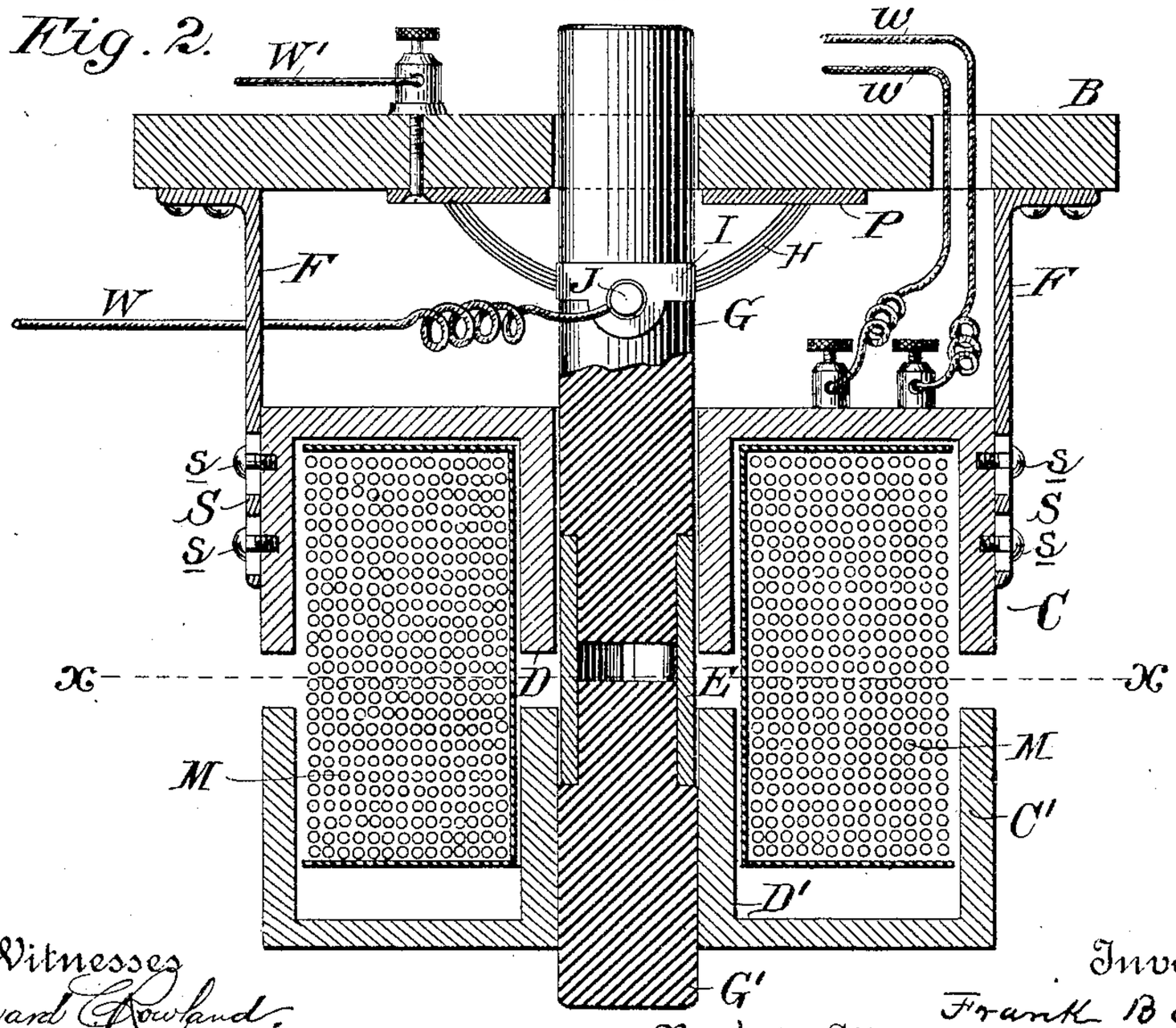



Fig. 2.

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# UNITED STATES PATENT OFFICE.

FRANK BOURNE, OF MOUNT VERNON, NEW YORK, ASSIGNOR TO McELROY-GRUNOW ELECTRIC RAILWAY SYSTEM, OF BRIDGEPORT, CONNECTICUT, A CORPORATION OF NEW JERSEY.

## ELECTROMAGNETIC SWITCH.

SPECIFICATION forming part of Letters Patent No. 706,012, dated August 5, 1902.

Application filed November 8, 1901. Serial No. 81,589. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK BOURNE, a citizen of the United States, residing at Mount Vernon, county of Westchester, and State of New York, have made a new and useful Invention in Electromagnetic Switches, of which the following is a specification.

My invention has for its objects, first, to provide an electromagnetic switch so constructed that when the controlling-circuit thereof is either ruptured or the current-flow therethrough materially less than that which is intended to maintain the movable part of the switch in closed position it will assume its open position; second, to provide an electromagnetic switch which is free from the effects of residual magnetism and in which an air-gap exists between the poles of the controlling-magnet and the armature when the switch is in its closed position; third, to provide an electromagnetic switch so constructed that it is controlled by two magnetic forces, both of which act initially to close the switch and ultimately in opposite directions to such an extent as to make the switch very sensitive in its operation. These objects are accomplished by the devices hereinafter described, for a full and clear understanding of the operation of which reference is had to the accompanying drawings and to the following specification, the features of novelty being particularly pointed out in the claims at the end of the specification.

The drawings, embracing Figures 1 and 2, are sectional views illustrating modified forms of my improved apparatus, certain parts thereof being shown in elevational view.

Referring first to Fig. 1, B represents an insulating base or board, to which are secured two downwardly-depending metallic arms F F, slotted at their lower ends, as shown at S S, S S. C and D represent the exterior and interior concentric poles of a magnet of the bell type, between which poles is located the energizing-coil M, connected at its opposite ends to binding-posts B′ B², *w w* being a conductor connecting the same with a source of current-supply (not shown) and also with any preferred means for opening and closing the circuit thereto. A represents the armature of the magnet, having an upwardly-extending pole of substantially the same contour and proportions as the pole D, the disk portion of this armature being of substantially the same diameter as the exterior pole C. G and G′ represent non-magnetic supports, preferably of insulating material, as wood, and E a tubular solenoid-core, preferably slitted, as shown, and adapted to receive adjustably the shouldered ends of said supports. This solenoid-core may be varied in length and thickness, or it may be solid, if preferred, the essential feature in connection with this part of the invention being that when the circuit is closed the major portion of the core shall be located above the median line of the magnet, as shown by the line *x x*, so as to exert a counteracting force against that of the armature proper. I is a metallic band tightly secured around the upper end of the insulating-support G and provided with a binding-post J, to which is secured a branch conductor W, running to a working source of current-supply. (Not shown.) H is a movable terminal or yielding contact-spring made, preferably, of laminated plates of copper and so arranged that when the circuit is closed the upper or free end thereof makes firm frictional contact with a fixed terminal, preferably a disk-like copper plate P, secured directly to the under face of the insulating-base B. This copper plate P is in turn connected to a binding-post B³ and to a branch conductor W′, running to the point where the working current is to be used. The armature A is attached directly to the support G′ in any preferred manner, and the support G is adapted to move vertically through an opening in the base B. In the construction of the apparatus the magnet is secured to the depending arms F F by screws *s s*, extending through the slots S S, the supports G and G′ are inserted within the opposite ends of the slitted core E, and the relative adjustment of all of the parts so effected that when the switch is closed and the contact-springs H resting firmly against the under face of the plate P the major portion of the solenoid-core will be located above the median line *x x* of the switch-operating magnet and the armature out of contact with the

pole C, leaving a relatively large air-gap between the two, as clearly shown in both figures of the drawings.

Fig. 2 of the drawings illustrates a slightly-modified form of the invention which differs from that shown in Fig. 1 only in that instead of providing a disk armature A, I substitute therefor a bell-armature having concentric poles C′ D′, which are substantially similar in all respects to the corresponding parts C D of the magnet.

In the operation of both forms of the apparatus the circuit is closed first through the conductor *w w*. At this stage of the proceeding the armature and the solenoid-core E, together with their attached parts constituting the movable part of the switch, are in the lowest position, so that the contact-springs H are widely separated from the contact-plate P. Consequently there is a double magnetic effect upon the movable part—that is to say, two magnetic forces are acting—one due to the action of the poles C D and the armature A, Fig. 1, or its equivalent concentric poles C′ D′, Fig. 2, and the other to the split solenoid-core E, which is now in its lowest position, the tendency being at this time to draw the solenoid-core up toward the center of the magnet. As the movable part advances, therefore, there ultimately comes a time when the solenoid-core assumes the position shown in both figures of the drawings, owing to the fact that the magnetic pull of the coil upon the armature is greater than that upon the core, the pull upon the core being practically *nil* when the median line thereof passes the median line of the magnet. Consequently the solenoid-core is advanced to the position shown, and there results a counteracting force due to the action of the magnet upon it, so that now the two magnetic forces are acting in opposite directions and the switch is controlled by the resultant of these two forces, leaving the movable part delicately balanced. When the circuit is interrupted through the conductor *w w*, the working circuit from the conductor W will be surely interrupted, as the air-gap between the armature and magnetic poles is such that residual magnetism can produce no appreciable effect. If, however, there should still remain a small flow of current through the conductor *w w*, which would under normal conditions without the core E hold the armature A in its upper position, it will be apparent that, owing to the counteracting force of the core in my novel switch, the circuit will be surely interrupted. This novel apparatus is especially adapted for use in connection with electric railways, where it may be used to effect the connection between the current-feeder or main and sectional third rails or conductors now well known in the art, and has an especial utility in this respect in that magnetic circuit-closers as now constructed and used may retain the circuit closed from the current feeder or main after a car has passed over the sectional conductor either by leakage or residual magnetism, while with the apparatus hereinbefore described I am enabled to overcome these objectionable features.

Although my invention is especially applicable to this particular use, I desire it understood that my claims hereinafter made are to be construed as of such scope as to include all uses in connection with electromagnetic circuit-closers to which the same may be applied.

I make no claim hereinafter to the method of operation which may be practiced in connection with the use of this apparatus, as this method constitutes the subject-matter of a separate application for a patent filed by me in the United States Patent Office of even date herewith and bearing Serial No. 81,588.

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

1. In an electromagnetic switch a fixed and a movable terminal; a movable part carrying the movable terminal provided with two magnetizable parts, together with a magnet-coil adapted to magnetize both of said parts in such manner as to act conjointly to close the switch and ultimately to oppose each other, substantially as described.

2. An electromagnetic switch provided with a terminal operatively connected to a movable part carrying a solenoid-core and an armature; in combination with a fixed terminal and a magnetizing-coil, all relatively so located that when the circuit is closed the core and armature act conjointly to move the terminals into contact with each other and ultimately oppose each other in their pulling effect, substantially as described.

3. In an electromagnetic switch a fixed and a movable terminal and two magnetizable parts carried by the movable part of the switch; a magnetizing-coil adapted to act upon both of said magnetizable parts; in combination with adjustable means for varying the relative effect of the magnetizable parts in such manner that the delicacy of operation of the switch may be varied at will, substantially as described.

4. An electromagnetic switch embracing a magnet adjustably secured to a base carrying a fixed terminal; a movable part carrying a movable terminal and two magnetizable parts all adapted to be relatively so adjusted with relation to each other and the fixed terminal that on closing the operating-circuit through the coil of the magnet the two magnetizable parts first act conjointly to close the working circuit and afterward oppose each other in their pull upon the movable part, substantially as described.

5. An electromagnetic switch having a movable terminal and two magnetizable parts, all carried by an insulating-support; in combination with a fixed terminal and a magnetizing-coil, all adjustably secured together and in such manner that on closing the switch-op-

erating circuit both magnetizable parts act first to close the circuit and then oppose each other until the circuit is again broken, substantially as described.

6. An electromagnetic switch having an armature, a solenoid-core and a yielding conducting-terminal all carried by a movable part; in combination with a fixed terminal and an energizing-coil, the arrangement being such that when the circuit is closed through the coil the armature is out of contact with the poles of the magnet and the solenoid-core located with its median line above the median line of the coil, substantially as described.

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

FRANK BOURNE.

Witnesses:
C. J. KINTNER,
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