No. 670,425. Patented Mar. 26, 1901.

G. T. HANCHETT & J. McL. MURPHY.

SWITCH MECHANISM FOR SURFACE CONTACT RAILWAYS.

(Application filed July 27, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

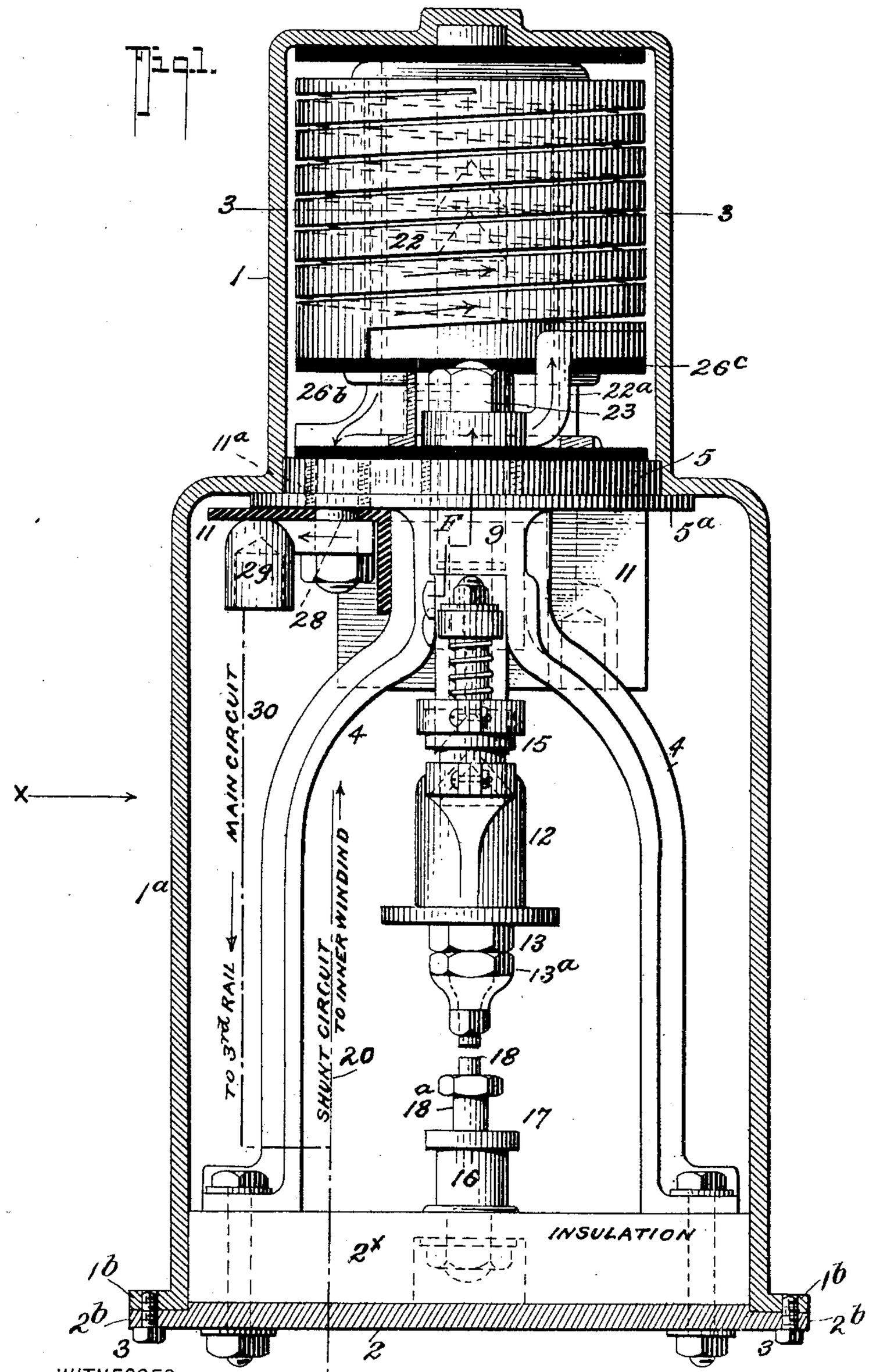

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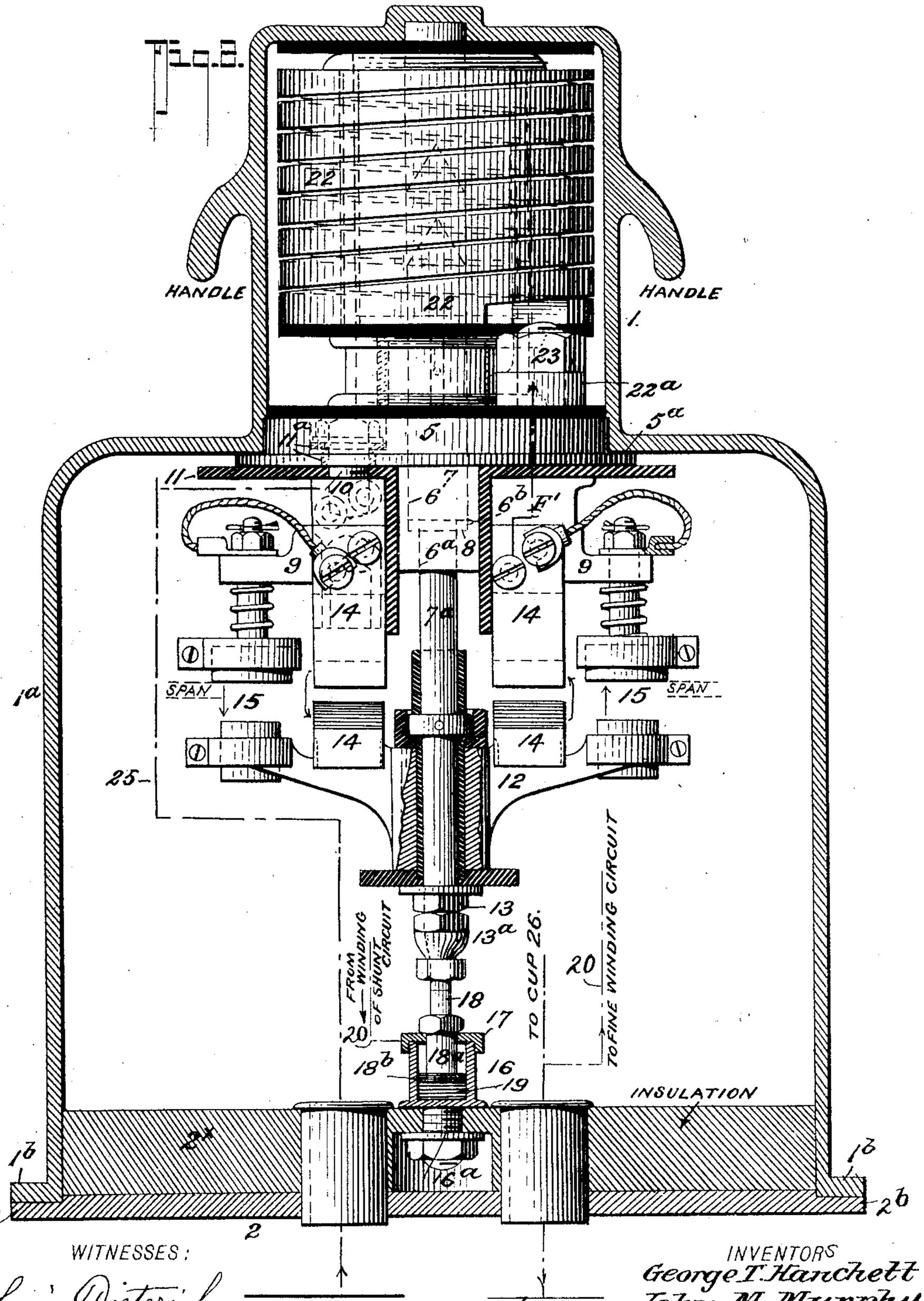
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

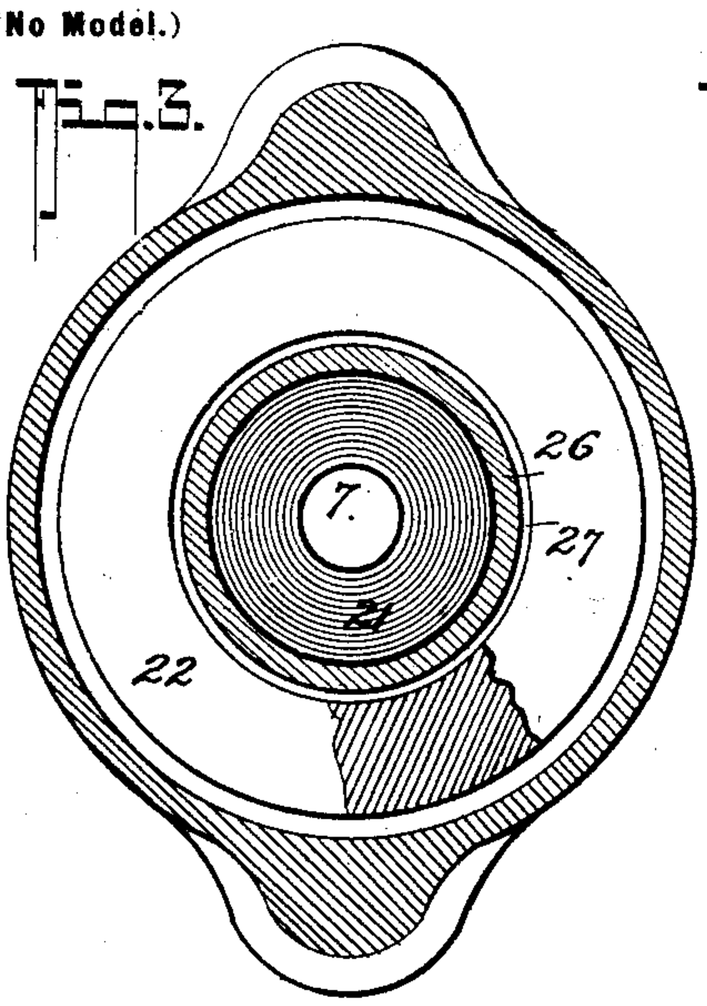


Fig. 5.

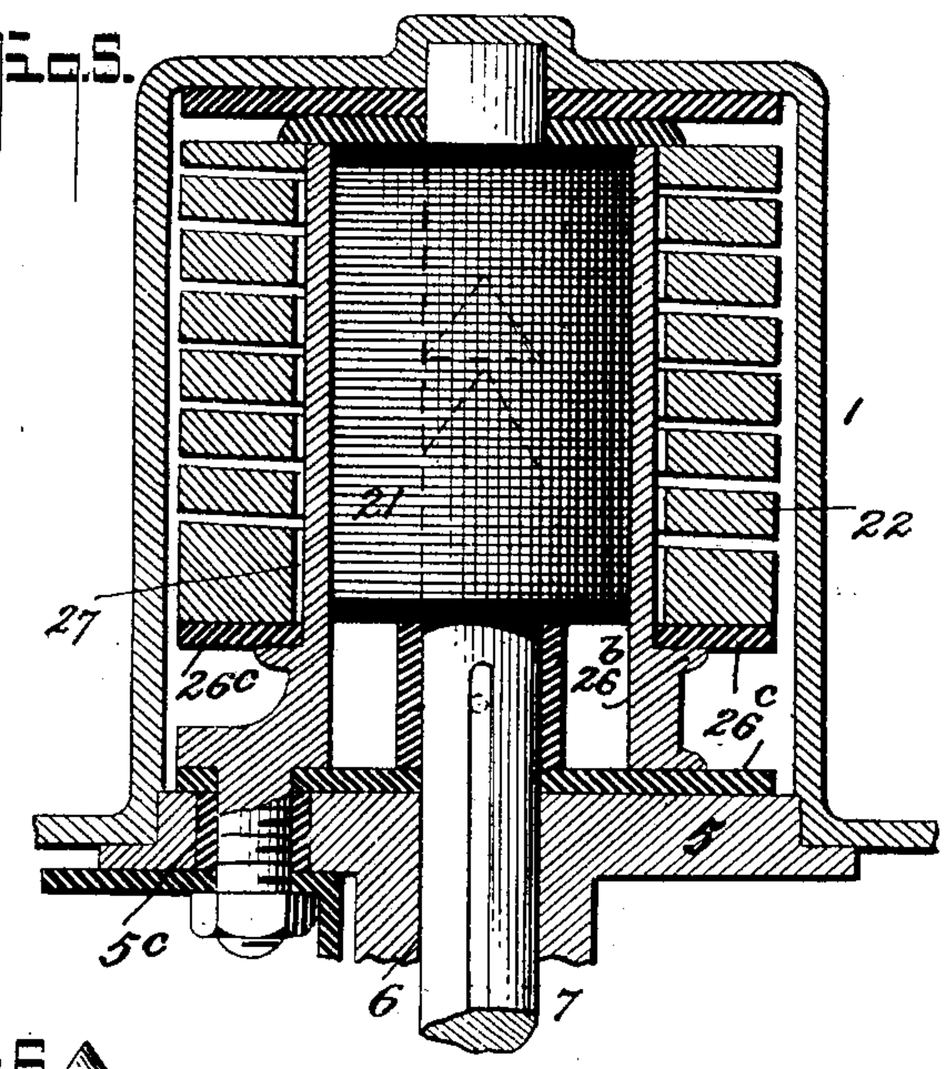


Fig. 6.

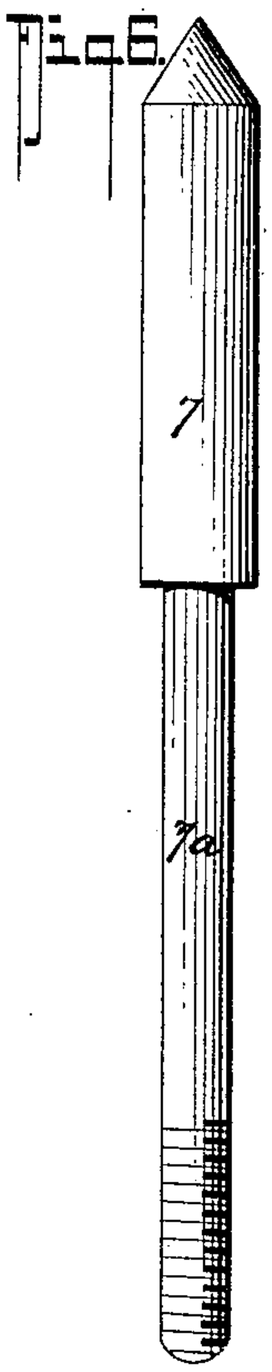


Fig. 4.

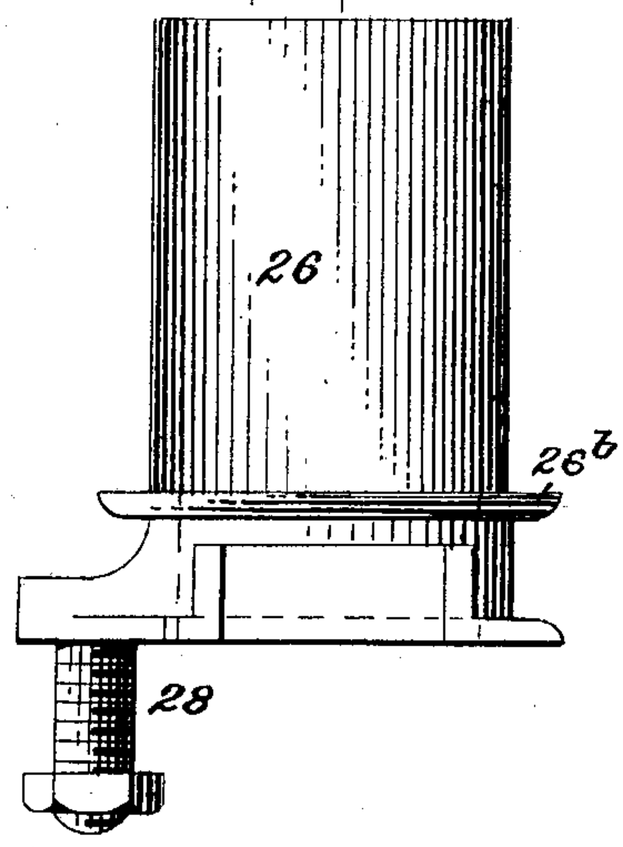
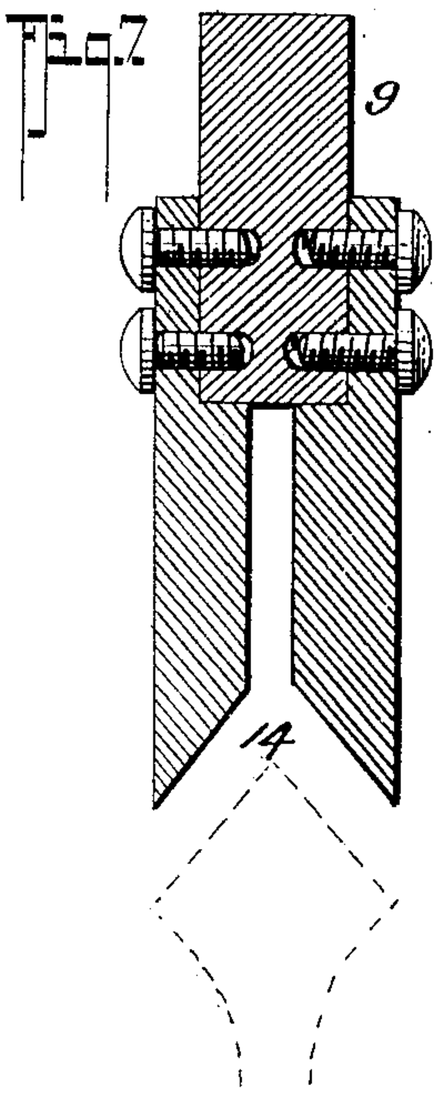


Fig. 7.



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UNITED STATES PATENT OFFICE.

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SWITCH MECHANISM FOR SURFACE-CONTACT RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 670,425, dated March 26, 1901.

Application filed July 27, 1900. Serial No. 25,036. (No model.)

To all whom it may concern:

Be it known that we, GEORGE T. HANCHETT, of Hackensack, in the county of Bergen and State of New Jersey, and JOHN McLEOD MURPHY, of Torrington, in the county of Litchfield and State of Connecticut, have invented a new and Improved Switch Mechanism for Surface-Contact Railways, of which the following is a specification.

This invention relates generally to improvements in that type of switch mechanisms employed in surface-contact electric-railway systems having sectional conductors connected by laterals with the feeder-wire and adapted to be initially moved to a closing position by a pick-up current created by a source of local energy stored upon the car or other moving vehicle.

In its more specific nature our present invention seeks to improve the switch mechanism disclosed in Patents No. 599,344, dated February 22, 1898, and No. 641,879, dated January 23, 1900, granted to John M. Murphy, and has for one of its purposes to simplify the construction and arrangement of the several parts constituting the switch mechanism aforesaid, whereby their action will be rendered the more positive and danger of any of the parts thereof becoming disarranged from ordinary use reduced to the minimum.

Another feature of our present invention lies in the novel and compact manner of assembling the several parts constituting the switch and coöperatively joining them so the entire switch mechanism can be conveniently held in a housing or shell of small area and having such shape as to admit of its being practically buried between the track-rails and in close relation with the conductor or feed rail.

In the practical operation of solenoid-switch mechanisms of the Murphy type aforesaid we have found that through imperfect contact of the trolley or current-collecting shoe the switches frequently vibrate—that is, the bridge member carrying the movable contacts is by reason of such imperfect trolley-contact subjected to a hammering action, which provides an unnecessary waste of energy and wear and a tendency to create arcing and frequently cutting out the feeder-circuit.

The prime object of our present invention is to provide a switch mechanism so constructed that the objectionable features above mentioned will be eliminated and in which the momentary imperfect drag action of the trolley or current-collector under ordinary circumstances cannot affect the switch mechanism sufficient to cause it to hammer or vibrate or break the feeder-circuit.

Another and essential object of this invention is to provide means—a secondary in the nature of a copper tube surrounding the magnet—which gives persistence of magnetic action sufficient to enable the plunger to continue on its upward course even after the shunt-circuit is broken and before the series circuit is made, whereby the use of a complicated following contact mechanism is rendered unnecessary.

Our invention, therefore, in its generic nature comprehends an improved correlation of the inner and outer switch-windings and a current-governing means for controlling the alternate flowing of the current in such manner as to arrest a quick action thereof, whereby to maintain the switch to its closed position during the momentary breaks or irregular contacting of the trolley or current-collector with the conductor-rail.

In its complete make-up our invention includes, in connection with the high and low resistance windings of the switch, means for creating an eddy-current against the switch-governing current in either direction of movement, whereby to cause the shifting of the current to be effected so slowly that before the switch-contacts can separate the current will again assume its proper condition and cause the contacts to remain at their closed position—in other words, to hold the switch closed during the space of time that the current, momentarily broken, is again restored to its normal condition.

Again, our invention numbers among its characteristic features certain improvements relating to the detailed arrangement of the bridge member and the carbon and metallic contacts, whereby the cost of construction is economized and the several parts so arranged that all danger of arcing or the current jumping from the carbon contacts to the suction-plunger is avoided.

Subordinately this invention consists in

certain details of construction and novel arrangement of parts hereinafter fully described, and particularly pointed out in the appended claims, reference being had to the accompanying drawings, in which—

Figure 1 is a combined vertical section and end elevation of our improved switch. Fig. 2 is a combined side elevation and section as viewed in the direction of the arrow X in Fig. 1. Fig. 3 is a horizontal section taken on the line 3 3 of Fig. 1. Fig. 4 is a detail view of the closed secondary or cup forming a part of the outer or low-resistance winding. Fig. 5 is a detail vertical section showing the correlation of the combined wire or high-resistance bobbin, the induction cup or shell, and the outer or low-resistance winding. Fig. 6 is a detail view of the solenoid-plunger or magnet. Fig. 7 is a transverse section taken on the line 7 7 of Fig. 1.

In its practical construction the switch mechanism proper is mounted and preferably hermetically sealed within a metallic casing having an upper circular head or bell 1 and an oblong lower section 1^a, fastened integrally with the head or upper section 1, the said lower portion 1^a being open at the bottom to permit the ready insertion of the switch mechanism, the bottom edge of the oblong portion 1^a having suitable flanges or ears 1^b to receive similar flanges or ears 2^b on the base 2, upon which the switch mechanism proper is mounted, the said ears 1^b 2^b being provided to receive the fastener-bolts 3. The housing 1 1^a is made solid throughout—that is, without any openings excepting at the bottom—whereby when the base 2 is properly fitted within the bottom the entire switch mechanism will be held hermetically sealed. Fixedly mounted upon the base 2 and projected upwardly therefrom is a pair of legs 4, having an arched arrangement at the top, and upon the top of the said legs is made fast a horizontal metal disk 5, adapted to fit snugly into the mouth of the bell portion 1, said disk 5 having an annular flange 5^a to form a stable bearing. The plate 5 and the top or arched portion of the legs 4 are formed with a central socket 6, the lower end of which is contracted, as at 6^a, to provide a guide for the reduced end 7^a of the plunger or solenoid armature 7, the upper or large part of which is projected through the socket 6, the drop movement of said member 7 being cushioned by reason of its shoulder 6^b engaging a leather or other soft washer 8, held in the bottom of the socket 6, as clearly shown in the drawings. A pair of brackets 9 9, diametrically oppositely disposed, are hung pendent from the disk 5 and secured thereto by bolts 10, which bolts, as also the brackets 9, are insulated from the disk 5 and the solenoid-plunger by insulated members 11 11^a.

Upon the lower end of the solenoid-plunger bar is fitted a metallic bridge 12, which is suitably insulated from the plunger in a manner clearly shown in Fig. 2, and on the extreme lower end the plunger-section 7^a carries a clamp-nut 13 and a jam-nut 13^a, the lower extremity of said portion 7^a terminating in an impacting-surface that opposes a cushion or dash-pot device, the construction of which and its multiple functions will be hereinafter explained.

In the Murphy patent, No. 641,879, referred to, the metallic contact-plates, which break circuit prior to the separation of the carbon contacts, are disposed outside of the carbon contacts which are nearest the solenoid or plunger bar.

In our present invention the positions of the metallic and carbon contacts are reversed. The metallic plates 14 are adjacent the plunger-receiving part of the bridge 12, the carbon contacts 15 being mounted on the outer edge of the said bridge 12. The make-and-break correlation and the operation of the metallic and carbon contacts 14 15 in the present invention being precisely similar to the like parts in the Murphy patent, No. 641,879, a detailed description of the said parts is not here deemed necessary. It should be stated, however, that the present way of arranging the two contacts 14 15 has material advantages. First, it provides for making a bridge-piece of less weight and metallic surface, whereby to enable the work of lifting to be done with a smaller and more inexpensive magnetic coil, and, second, as the carbon contacts break last—that is, after the metallic contacts are broken—danger of current leakage or arc jumping from the carbon contacts to the solenoid-plunger is reduced to the minimum.

Centrally mounted upon the insulated block $2^\times$ of the base 2 is a shallow cup or pot 16, made fast by the bolt-shank and nut devices 16^a. The upper end of the pot 16 is externally threaded to receive a gland 17, through which moves vertically an upwardly-extending socket 18^a, which receives a contact-block 18, said socket 18^a having a head 18^b, which plays in the pots 16 and rests on a stout spring 19. The devices 17 18 form the double function of acting as a circuit-breaker for cutting out the shunt or primary circuit and also as a dash-pot cushion for relieving the plunger-bar of too great a jar or shock as it drops back to its normal position.

The dash-pot contact device referred to has the additional advantage in that the same supports the entire weight of the plunger at the lower part of the stroke, and by reason of this the actual effective weight on the plunger is much reduced when the latter member is in the weaker portion of the magnetic field, where the pull is small. Furthermore, as the plunger rises the gravity effect upon it increases by reason of the lesser tension of the dash-pot spring as the weight of the plunger is lifted therefrom; but by this time the plunger will have ascended into a stronger magnetic field amply able to lift it. The said device therefore provides for a longer stroke

of the plunger and a wider separation of the contacts than would otherwise be possible.

20 designates the shunt or primary circuit from the local energy on the car, which passes up through an insulated bushing in the base 2 and up to the inner or fine-wire bobbin 21, from whence it passes down again and joins to the cup or pot 16 and grounds through the contact 18^a, the plunger-bar, the disk 5, and the housing. Normally—that is, when the switch is open—the plunger and bridge members are upon the contact end of the plunger, resting upon the contact 18^a, the spring 19 being at this time compressed. (See Fig. 1.) Now when in this position if the pick-up or shunt circuit 20 is energized current will flow through the fine or high-resistance winding 21 into the contact 18 and ground through the plunger and plate 5. The plunger then, by reason of the magnetism of the bobbin 21, is sucked up, and in consequence the carbon contacts 15 will close in the main or feeder circuit to the switch. The initial upward movement of the plunger is aided by the expansion of the spring 19.

In the practical operation of our switch the contact 18^a is open a considerable time before the contacts 15 take hold, this being a resultant by reason of the plunger by its momentum being carried over the interval and by the persistance of magnetic energy in its iron parts due to the eddy-currents circulating in the closed secondary or cup 26. (Shown in Fig. 4.) By providing the cup member or secondary 26 and arranging the same as shown it will not be necessary that the current circulate in either the series or shunt bobbin in order to magnetize the cores during the shifting of the plunger, for the reason that if the core is once magnetized by either the series or the shunt coil and the current is allowed to suddenly cease in either or both of these members the magnetism will remain and persist in the cores, a resultant of the eddy-current circulating in the closed secondary or cup 26, it being understood the eddy-currents are caused by the dying away of the magnetic lines and the tendency to prevent this dying away according to the law of Lenz. This persistence of magnetism, produced as stated, acts in the case of flow of current in the series coils to prevent the switch from immediately pulling open, and in case of the cessation of current in the shunt-circuit coils it acts to prevent the magnetism and pull on the plunger from immediately dying away, and thereby, in combination and with the momentum of the plunger, assists the latter to continue its motion and close the contacts 15, thereby switching in the series coil and completing the closing stroke of the switch.

22 designates the outer low-resistance main-current-receiving winding, which surrounds the fine-wire bobbin, but snugly fits within the bell portion 1 of the shell or housing. The winding 22 has an integral leg 22^a, which properly supports it in position, and the said leg is made fast on or insulated from the disk or bearing-plate 5, the securing-bolt 23 also forming the binder for one feed-wire section F′, that extends from one of the bracket members 9, as clearly illustrated in the drawings.

25 designates the feeder-wire, which passes up through an insulated bushing and connects with one of the brackets 9.

26 indicates a secondary fitted between the inner and outer windings 21 22, the upper end of which is in circuit with the upper end of the outer winding, while the remaining portion is out of touch with the said winding to produce an intervening annular space 27. The lower end of the secondary 26 has a base formed with an annular flange 26^b, carrying an insulated disk 26^c, upon which the bottom edge of the outer winding 25 may also be supported, and the said base (indicated by 26^b) has a pendent bolt 28, that passes through an insulated aperture 5^c in the disk 5 and carries in its lower end a terminal socket 29, insulated from all but the bolt 28, in which the wire lead 30 to the third rail is fastened. The said lead may be a separate wire from the third rail or may also serve as the feeder from the third rail to the shunt-winding bobbin.

Assuming the switch to be open, its normal position, to close it the local energy on the car is brought into circuit with the inner winding of the switch, which magnetizes and starts to lift the plunger, which as it rises separates from the contact 18 and breaks the local or shunt circuit before the contacts 15 engage; but the lifting magnetism of the shunt-coil does not disappear by reason of the eddy-currents which are at this time circulating in the secondary—*i. e.*, the copper tube 26—and therefore the lifting action of the plunger does not suddenly cease with the breaking of the shunt-circuit at this time, but by its momentum, together with the continued magnetizing force in the shunt-coil, the plunger will be carried up to span the gap indicated by the word "span" in Fig. 2, through which the plunger passes when there is not current in either the shunt or series coils. Current now flows from the feeder through the contacts 15 15 into the outer or low-resistance winding, and the contacts 15 being yielding (spring-held, as shown) the plunger will be continued in its upward throw by the magnetizing force now created by the outer winding until its metallic contacts 14 engage, which contacts then relieve the carbon contact 15. The switch is now held closed by the main-line energy. Now, assuming the switch to be operating and an imperfect contact is made by the current-collector, which now forms the return to the current passing through the switch, the current is practically or at least materially weakened and its power is momentarily broken. Under ordinary circumstances, and especially when switches are used having the ordinary type of low-resistance winding, the switch is caused to vibrate or to break its

connection. Now by reason of the secondary 26 an induced or eddy current is produced at each shifting of the current making or breaking, which creates a slow magnetizing or demagnetizing action, which sufficiently retards the changing of the magnetizing force of the outer or low-resistance winding to prevent its becoming instantaneously negative in case of a slight momentary interruption of the feeder-current, causing it, as it were, to remain sufficiently interrupted to hold up the switch and prevent it vibrating or breaking its contacts. It will thus be apparent that by reason of creating an eddy-current at the shifting of the current that passes under a direct head through the lower-resistance winding we are enabled to automatically maintain a sufficient magnetizing force to bridge over the momentary weakened or broken contacts made by the shoe.

Another advantage of our invention is that by arranging the parts as described the two windings can be compactly arranged, and by mounting all of the switch mechanism in a base capable of being removed bodily with the switch mechanism from the shell or housing easy access can always be had to the said switch mechanism and said mechanism can be the more readily manufactured or repaired.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. A solenoid-switch of the character described, having a high and a low resistance winding, said low-resistance winding including means for creating eddy-currents when the main current flowing through the low-resistance winding fluctuates.

2. A solenoid-switch of the character described having a high and a low resistance winding, said low-resistance winding including means for producing eddy-currents to retard the magnetic effect in said low-resistance winding.

3. A solenoid-switch mechanism of the character stated, having a high and a low resistance winding, and means for creating counteracting currents, whereby the solenoid becomes a slow-acting magnet.

4. A solenoid-switch mechanism of the character described having a high-resistance winding and a low-resistance winding including an external spiral winding and an internal core, one terminal of the circuit connecting to the spiral winding and the other to the core.

5. In a solenoid-switch of the character described, the combination with the inner or fine-wire winding and the outer spiral winding, of a cup-shaped core disposed between the inner and outer windings, the upper end of the said core being in contact with one terminal of the low-resistance winding, the other terminal of said low-resistance winding being in circuit with the feeder-wire, and the other terminal of the core being in circuit with the third rail.

6. In a solenoid-switch of the character described, the combination with the high and low resistance windings, the plunger, the shunt-circuit in line with the high-resistance winding, and having a ground return through the plunger, said plunger being governed by the magnetic influence of either the high or low windings, circuit-closers in the low-resistance or feed-wire circuit, closed by the up or suction movement of the plunger, and a follower-contact in the shunt-circuit engaging the plunger and arranged to become disengaged from the plunger to break the shunt-circuit as the main or feed line is picked up.

7. In a solenoid-switch mechanism of the character described, the combination with the high and low resistance windings, the plunger, the shunt-circuit in line with the high-resistance winding and having a ground return through the plunger, circuit-closers in the main or low-resistance circuit closed by the suction movement of the plunger, of a follower-contact in the shunt-circuit engaging the plunger and adapted to separate therefrom when the main or feeder circuit is picked up to cut out the shunt-circuit, said follower-contact having a dash-pot resistance and adapted to serve as a means for cushioning the drop of the plunger when the switch resumes its normal or open position as specified.

8. The combination of the housing having an upper bell-like top and an oblong lower part, the base 2 adapted to hermetically seal the housing, the legs 4 having a central socket, the bearing-plate 5, mounted in the legs, the high and low resistance winding devices mounted on the plate 5, and insulated therefrom, the plunger 7, carrying a contact-maker at the lower end, said plunger being grounded, contact-makers in the main or feeder circuit governed by the suction action of the plunger, a shunt-circuit in line with the high-resistance winding and having a terminal contact adapted to engage the contact end of the plunger, said terminal contact having a yielding support and adapted to follow the plunger in its up movement to a predetermined point and then separate therefrom for the purposes specified.

9. A solenoid-switch having high and low resistance windings, the high-resistance winding including a means for counteracting the magnetic effect of the low-resistance winding, whereby to maintain sufficient magnetic influence in the plunger to hold it to its contact-closing position during fluctuations in the main-line current for the purposes described.

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