No. 705,136. Patented July 22, 1902.

W. B. POTTER.

ELECTROMAGNETIC SWITCH FOR SURFACE CONTACT ELECTRIC RAILWAY SYSTEMS.

(Application filed Oct. 11, 1897.)

(No Model.) 2 Sheets—Sheet 1.

FIG. 1.

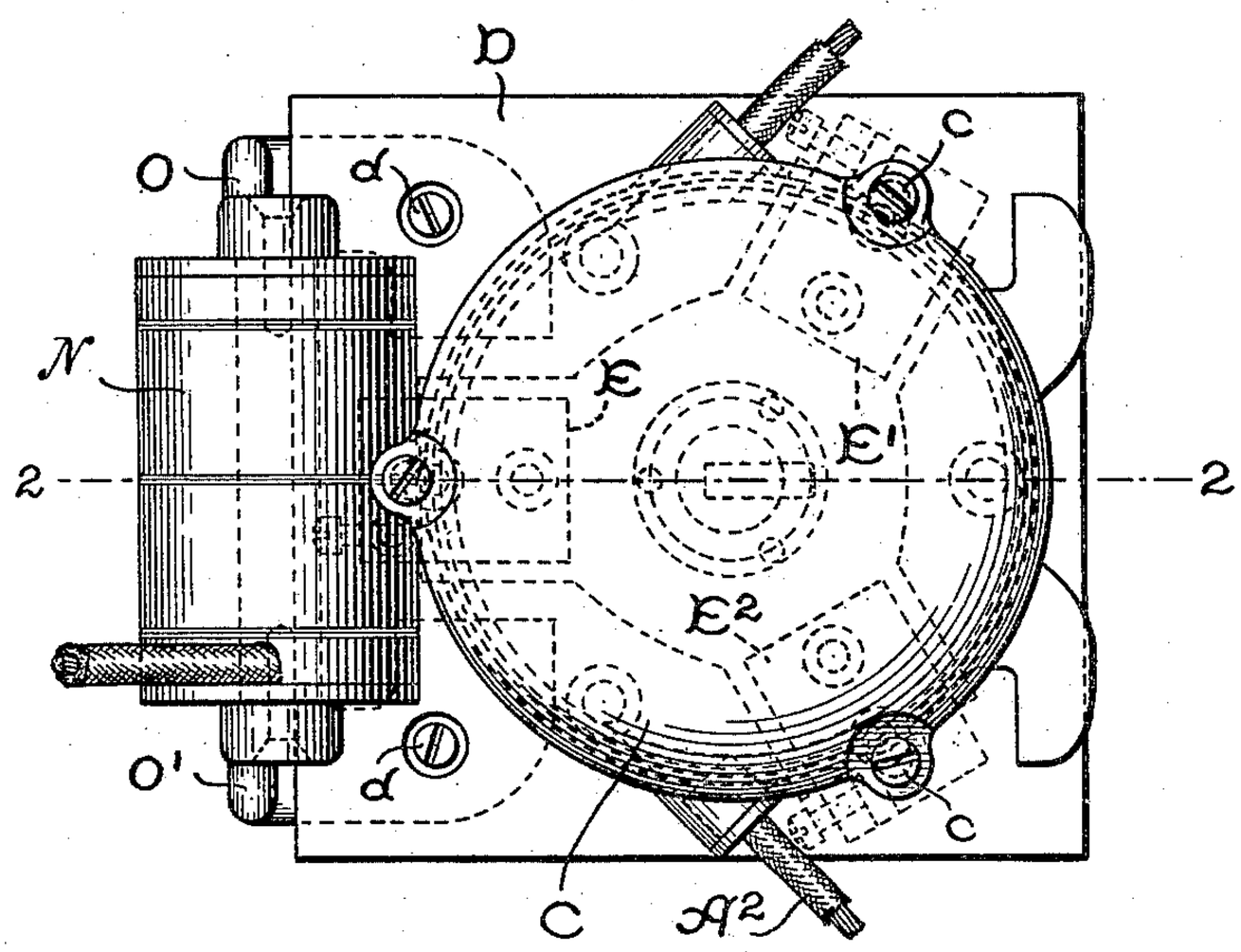
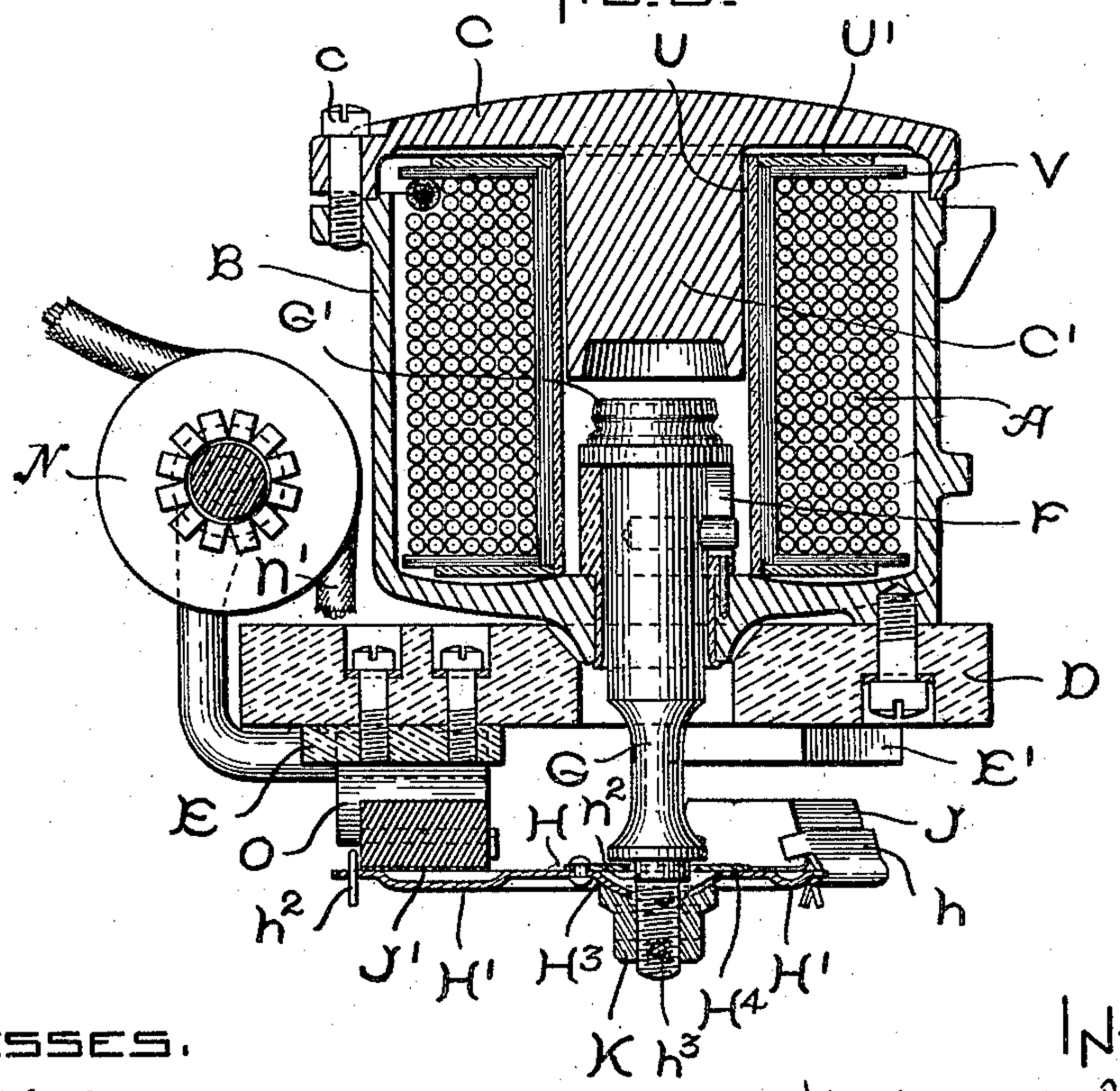


FIG. 2.



WITNESSES.
A. H. Abell.
A. F. Macdonald.

INVENTOR.
William B. Potter
By Geo. R. Bridgett
Atty.

No. 705,136. Patented July 22, 1902.

W. B. POTTER.

ELECTROMAGNETIC SWITCH FOR SURFACE CONTACT ELECTRIC RAILWAY SYSTEMS.

(Application filed Oct. 11, 1897.)

(No Model.) 2 Sheets—Sheet 2.

FIG. 3.

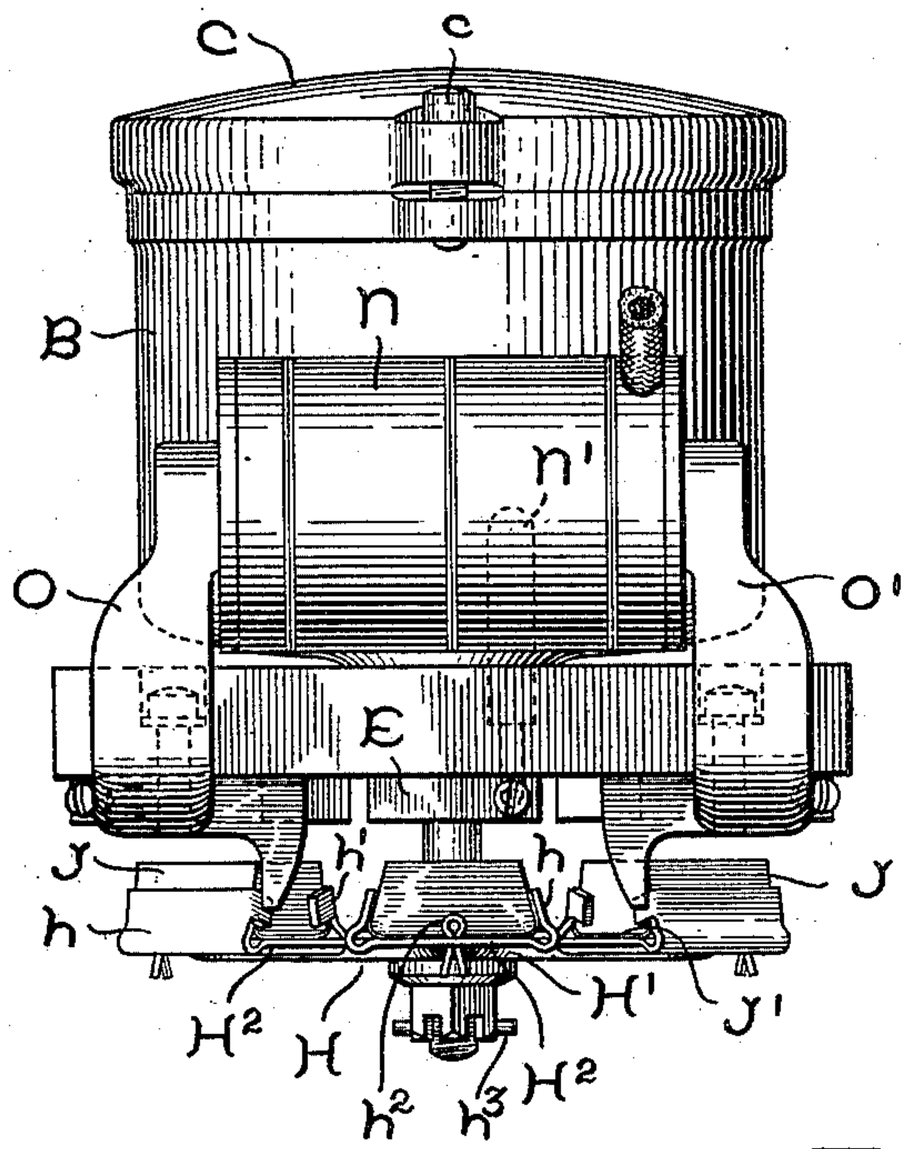


FIG. 4.

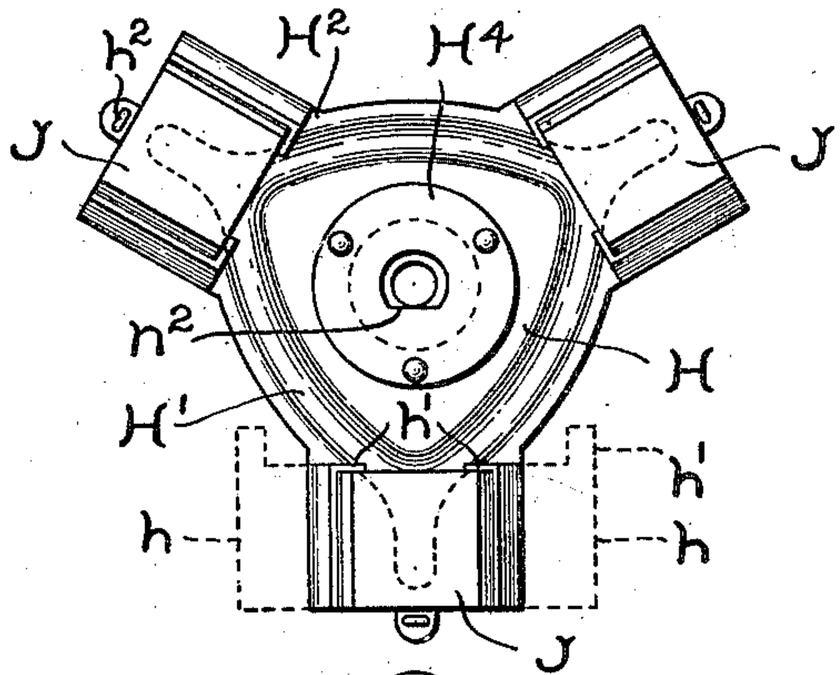


FIG. 5.

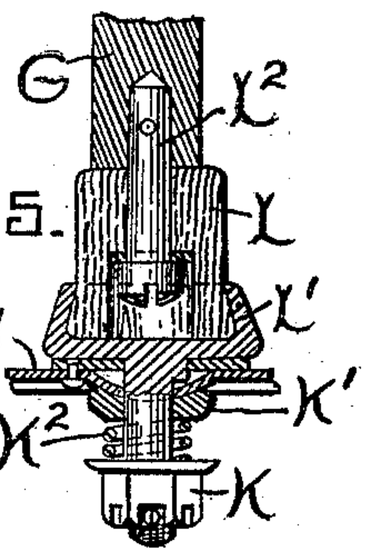
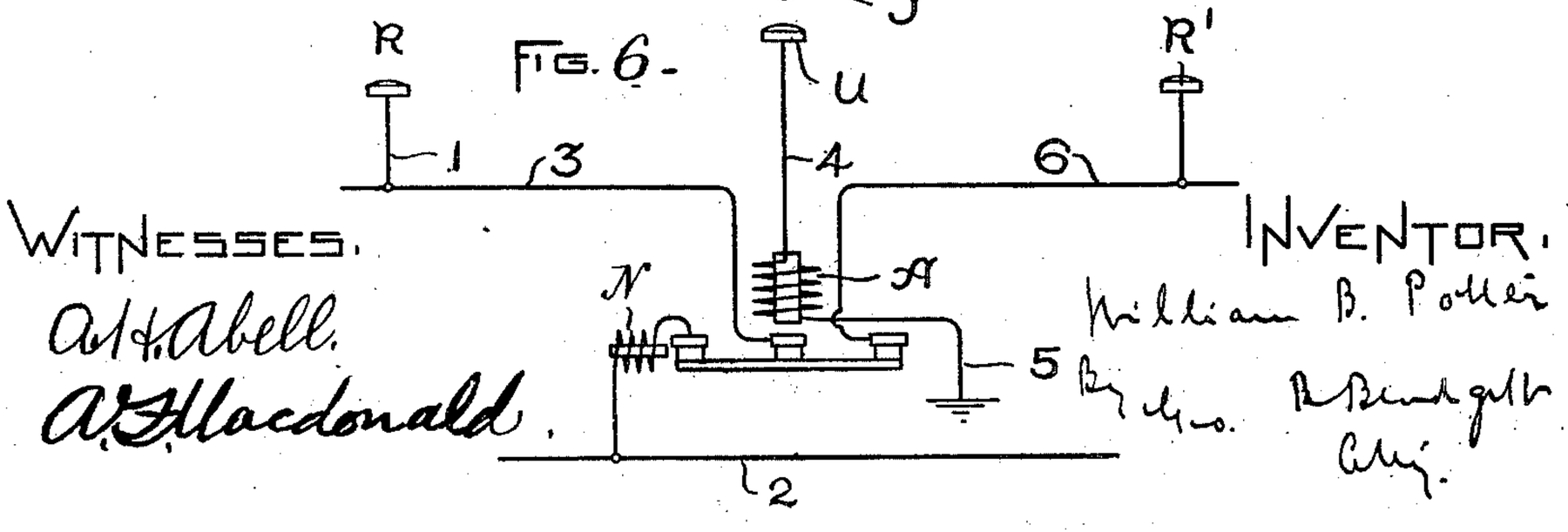


FIG. 6.



WITNESSES.

A. H. Abell.

A. F. Macdonald.

INVENTOR.

William B. Potter

By Chas. B. Burdett

Atty.

UNITED STATES PATENT OFFICE.

WILLIAM B. POTTER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTROMAGNETIC SWITCH FOR SURFACE-CONTACT ELECTRIC-RAILWAY SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 705,136, dated July 22, 1902.

Application filed October 11, 1897. Serial No. 654,793. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM B. POTTER, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electromagnetic Switches for Surface-Contact Electric-Railway Systems, (Case No. 655,) of which the following is a specification.

The present invention relates particularly to surface-contact electric-railway systems in which contacts normally disconnected from the source of supply are located on the surface of the roadway either near or between the tracks and rendered active by suitable mechanism controlled by an approaching vehicle; but in some of its features it has a broader application.

In my Patent No. 589,786, dated September 7, 1897, I have shown and described a system in which two sets of contact-studs are employed, one of high, the other of low, potential. In circuit with the low-potential studs are the energizing-coils of a series of magnets which close the circuit between the source of supply and the high-potential studs as the vehicle progresses, the circuits being so arranged that two high-potential studs are simultaneously energized from each switch, necessitating the use of a three-contact switch.

The present invention has for its object to provide an improved electromagnetically-operated switch of general application, particularly to improve the construction of the three-point switches employed to close the circuit between the contacts located in the roadway and the source of supply in a surface-contact electric-railway system, and to render their operation entirely reliable, both for closing and opening the circuit.

The invention also relates to certain details of construction more fully described and claimed hereinafter.

In the accompanying drawings, Figure 1 is a plan view of my improved switch. Fig. 2 is a section taken on line 2 2 of Fig. 1. Fig. 3 is a front elevation. Fig. 4 is a plan view of the moving portion of the switch. Fig. 5 is a slight modification in which the core is insulated from the switch-contacts and a spring employed to lessen the shock between fixed and moving parts, and Fig. 6 is a diagram of connections.

The coil A of the magnet is mounted within a cup-shaped inclosing case B of magnetic material, which is fixed to a support. The coil has terminals A^2, extending through the casing. A cover C is secured to the upper end of the case by screws *c* and is provided with a central projection C′, which extends downward within coil A and is slightly hollowed out or recessed on the lower end to receive the upper end of core G and forms the fixed core of the magnet. In the lower part of the casing is located a sleeve F, of non-magnetic material, and mounted for vertical movement within this sleeve is a core G. A non-magnetic cap G′ is secured to the upper end of the core to prevent it from sticking to the stationary core C′ when moved upward by energizing coil A. Surrounding the downwardly-extending stationary core C′ is a closed conductor comprising a copper cylinder U, having copper flanges U′ at each end. Between the coil A and the copper conductor is a spool V, of insulating material. I have found by experiment that such a conductor or equivalent arrangement is of great practical value in reducing the arcing at the street-surface between the contact-studs and collector-shoes.

In surface-contact railway systems there is a certain amount of arcing between the stationary contacts and traveling contact-shoes. This is particularly noticeable at the contacts that are connected to the switch-closing magnet-coils and is caused by the inductive discharge of the coils at the time the circuit is interrupted. In all previous systems with which I am familiar this arcing has been objectionable to a greater or less extent, depending upon the magnets employed. By surrounding the core of the switch-magnet with a closed copper conductor I am enabled to reduce to a minimum the arcing at the surface contacts due to the inductive discharge of the magnet-coils. For example, I have fitted up a switch in the usual manner without the copper band and connected a galvanometer in circuit in such a manner that it would indicate by its deflection the kick of the coil. The circuit through the coil was then made

and broken in the customary manner and the deflection of the galvanometer-needle was thirty-three. The same switch was then fitted up with a closed copper conductor surrounding the core of the magnet, and the circuit made and broken as before, resulting in a deflection of the galvanometer-needle of eight. In a comparative test at night between switches constructed with and without copper bands a pronounced decrease in arcing was noticed at the switches having the bands.

On the lower end of movable core G is a support H for the three-point switch. (Best shown in outline in Fig. 4.) This support is preferably a punching and is provided with strengthening-ribs H′. The radial arms H^2 of the support are provided with portions *h*, (shown in dotted lines,) which are bent upward to form clamping-supports for carbon contact-blocks J. Each carbon block is provided with two beveled surfaces, and bearing on these surfaces are the upturned portions *h* of punching H. Lips *h′* prevent the blocks from moving toward the center, and cotter-pins h^2 hold them from coming out. To increase the conductivity, a thin strip of copper or other good conducting material J′ is inserted between each carbon block and its support. Support H being made of spring metal has a certain amount of resiliency. This decreases the shock between the fixed and moving parts at the time coil A is energized and core G attracted. I have shown the arms H^2 of the support angularly displaced by one hundred and twenty degrees. This I have found a satisfactory arrangement; but other arrangements may be employed so long as one of the contacts is displaced angularly with respect to the others. On account of the unequal burning away of the material forming the contacts I have constructed the switch so that it is self-centering and can always make good contact at each of the three contact-points. For this purpose a ball-and-socket joint is located between core G and support H. The under side of support H is depressed at H^3, as shown in section in Fig. 2, and covering it is a circular plate H^4, against which a shoulder on core G abuts. To prevent the support from turning on the core in an angular direction, plate H^4 is slightly flattened at n^2, and a similar flat portion is provided on core G. The lower end of the core is screw-threaded, and mounted thereon is a nut K, having a hollowed-out portion in which is seated the rounded depression H^3. To prevent the nut from turning on the core, it is slotted on its lower face and a pin h^3 passed through one of the slots.

In the constructions described thus far contact-support H has been electrically connected to the movable core of the magnet. In Fig. 5 is shown a slight modification in which the core and support are insulated from each other. Secured to the lower end of the core G by pin L^2 is a piece of insulating material L, which is slightly enlarged at its lower end to form a head. Socket L′ is preferably secured to the head by spinning, as this insures a good mechanical connection. Projecting downward from the socket is a screw-threaded bolt, and mounted thereon is nut K. Support H is provided with a rounded depression, the same as before described, which is seated in a hollowed-out washer K′, and between the washer and nut K is a stiff spiral spring K^2, which reduces the shock between fixed and moving parts. This spring may or may not be used in connection with a spring-support H. It depends upon the pulling effect of the magnet. To the under side of the magnet-casing is secured an insulating-base D, and mounted on the base are three fixed terminals E, E′, and E^2, adapted to be engaged by the carbon-contacts carried by the magnet-core. Terminals E E′ E^2 are made of any suitable metal and are somewhat larger than the carbon-blocks. Each terminal is provided with a set-screw for securing it to a lead. Terminal E is connected in series by lead N′ with coil N of the blow-out magnet.

I have discovered in connection with switches of the character described that the blow-out magnet should have considerable permanency in order that it may be operative at a time when little current is flowing through its energizing-coil. For example, assume that the moving vehicle has left the negative or switch-controlling stud and that for some reason current is leaking through one of the positive studs supplied from the switch. Thus it often happens that an arc forms at the switch as it opens, and the current flowing through the blow-out magnet being only the leakage-current and usually of small amperage will not be sufficient to extinguish the arc promptly. To overcome this difficulty, I make the magnet so that it has permanent magnetism sufficient to form an initial field and assist the arc-rupturing action. Such a blow-out magnet I have found especially well adapted for the conditions present with switches and systems of the character described and quite contrary to prior practice, which has been to make the magnets as free from permanent magnetism as possible. As the safety of any conduit system depends upon the complete interruption of the current after the vehicle progresses, it will be seen that this forms an important feature of the invention.

The blow-out-magnet core over which the coil N is wound comprises a cylindrical piece of metal located in front of the magnet-casing. Extending downwardly from the core are pole-pieces O O′, which are enlarged at their lower ends and secured to base D by screws *d*. In switches already built and tested I have used steel for the core of the blow-out magnet and case-hardened cast-iron for the pole-pieces. The pole-pieces are insulated from the core and the contacts and are arranged one on each side of contact E, this being the contact which is permanently con-

nected to the source of supply through the coil of the blow-out magnet, and current flowing from the switch must necessarily energize the magnet. With the magnet-coil located in circuit with either of the other leads it would only be operative when the vehicle was traveling in one direction, or it might be possible for the switch by tilting and sticking to close the circuit of a high-potential stud without including the blow-out.

In Fig. 6 is shown a diagram of the circuits in which R represents a high-potential stud or power-conductor section, connected to feeder 2 by means of wires 1 and 3 and switch H. The adjacent high-potential stud R′ is connected to feeder 2 by wire 6 and switch H. Low-potential stud or switch-energizing conductor-section U is connected by wire 4 to coil A of the magnet, which is grounded by wire 5.

I do not claim herein the blow-out magnet or surface-contact stud described above, as they have been claimed in divisional cases.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination in a surface-contact electric-railway system, of electromagnetic switches for completing the circuit from the feeder to different surface contacts, consisting of three stationary and three moving contacts arranged at three corresponding points around a central core supporting the moving contacts, the moving and stationary contacts being free to adjust themselves and compensate for wear, and a magnet for lifting the moving contacts into engagement with the fixed contacts.

2. The combination in a surface-contact electric-railway system, of a feeder and surface contacts with electromagnetic switches for making the circuit connections between the feeder and surface contacts, comprising three fixed and three moving contacts angularly spaced around a center and free to adjust themselves so as to compensate for wear at the contact-points.

3. In an electric switch, the combination of a plurality of stationary contacts angularly displaced, a magnet, moving contacts for engagement with the stationary contacts, and a self-adjusting support for the moving contacts, which is actuated by the magnet.

4. In a surface-contact electric-railway system, the combination of stationary switch-contacts angularly displaced and connected to contacts located in the roadway and the source of supply, moving contacts also angularly displaced and adapted to complete the circuit through the stationary contacts, a self-adjusting support for the moving contacts, and a solenoid-magnet for moving the support.

5. In an electromagnetically-operated electric switch, the combination of a plurality of stationary contacts angularly displaced, a solenoid-magnet, moving contacts controlled by the solenoid, and a self-adjusting spring-support for the moving contacts.

6. In an electric switch, the combination of three stationary contacts angularly displaced, three moving contacts similarly displaced, a solenoid-magnet for actuating the moving contacts, a spring-support to which the moving contacts are secured, and a ball-and-socket joint between the support and the magnet-core.

7. In an electric switch, the combination of a base, contacts angularly displaced mounted thereon, an iron-clad solenoid-magnet also mounted on the base, a core for the solenoid, a spring-support carried by the core, and angularly-displaced contacts secured to the moving support for completing the circuit of the fixed contacts.

8. In an electric switch, the combination of a base, stationary contacts mounted on the base and angularly displaced, a solenoid-magnet, a sheet-metal support carried by the core, insulation between the core and the support, and contacts on the support adapted to engage with the stationary contacts.

9. As an article of manufacture, a support for a three-point switch, comprising a punching having three radially-extending arms with contact-clamps located at their outer ends.

10. As an article of manufacture, a support for a three-point switch, comprising a punching having strengthening-ribs, three radially-extending arms formed with contact-clamps at their outer ends, and a central rounded depression forming a portion of a ball-and-socket joint.

11. In a surface-contact electric railway, the combination of contacts located along the line of travel, a source of supply, electromagnetically-operated switches for closing and opening the circuit between the contacts and the source of supply, and a closed conductor surrounding the core of each switch-magnet to decrease the arcing at the surface contacts.

12. In a surface-contact electric-railway system, the combination of contacts located in the surface of the roadway, a source of supply, fixed and moving contacts for making and breaking the circuit between the surface contacts and the source of supply, an iron-clad magnet for actuating the moving contacts, and a closed copper band surrounding the core of the magnet to decrease the arcing at the surface contact when its circuit is interrupted.

13. In an electric railway, the combination with the feeder, of power-conductor sections, switches for connecting the latter with the former, electromagnets for actuating the switch-energizing conductor-sections, the coils of the magnets being connected with the latter sections, a contact-shoe carried by the car for engaging the latter sections to close the circuit through the coils, and a closed conductor in inductive relation to the electromagnet for decreasing the arcing between the switch-energizing sections and the contact-shoe.

14. In combination with a magnet-coil, a magnetic casing for the coil, a cover for the casing and formed integral with a fixed core, a movable core, and a cap of non-magnetic material interposed between said fixed and movable cores.

15. In combination with a magnet-coil, a magnetic casing for the coil, including an integral fixed core having a recessed end, a movable core having its end shaped to fit into said recess, and a cap of non-magnetic material interposed between said fixed and movable cores.

16. In combination, a fixed core, a movable core, an energizing-coil surrounding said cores, a casing of magnetic material inclosing said coil, a bushing of non-magnetic material surrounding said movable core, and a cap of non-magnetic material interposed between said fixed and movable cores.

17. In an electric switch, the combination with an insulating-base, of terminals secured to one side thereof, an electromagnet mounted on the opposite side of the base, a perforation in the base through which the movable member of the magnet extends, and switch-contacts carried by the movable member of the magnet, which engage the terminals mounted on the base when the movable member is caused to be moved by the energizing of the magnet.

18. In an electromagnet, the combination with a central hollow support, of a coil mounted thereon, a cup-shaped case of magnetic material for the coil consisting of a single casting, a cover therefor of magnetic material which has an integral portion forming a stationary core extending within the hollow support, and a movable core extending within the hollow support and through a perforation in the bottom of the case.

19. In an electromagnetic switch, the combination with the electromagnet, of a magnetic casing surrounding said magnet, an insulating-base to which said casing is secured, fixed contacts secured to the opposite side of said base, a movable magnet member operating through said magnet-casing, movable contacts, and a resilient sheet-metal support which carries said contacts and is mounted on the movable magnet member, whereby the support will yield when the electromagnet draws the movable contacts against the fixed contacts.

20. In an electromagnetic switch, the combination with a perforated stationary support, of an electromagnet-coil mounted on one side of the support, contacts fixed on the other side of the support, a movable magnet-core which extends through the support and movable contacts, a resilient sheet-metal support which carries said contacts and is mounted on said core, whereby the support will yield when the electromagnet draws the movable contacts against the fixed contacts.

21. In an electromagnetic switch, the combination with the electromagnet, of fixed contacts, a movable magnet member, movable contacts, and a resilient sheet-metal punching provided with strengthening-ribs which carries said contacts and is mounted on said magnet member, whereby the resilient punching will yield when the electromagnet draws the movable contacts against the fixed contacts.

22. In an electromagnetic switch, the combination with the electromagnet, of fixed contacts, a movable magnet member, movable contacts, and a resilient punching provided with radial arms which carry said contacts, said punching being mounted on said movable magnet member, whereby the punching will yield when the electromagnet draws the movable contacts against the fixed contacts.

23. In combination, a fixed magnet-core, a movable magnet-core, an energizing-coil surrounding said cores, a casing of magnetic material surrounding said coil, and a bushing of non-magnetic material separating said movable core from said casing.

24. In an electromagnetic switch, the combination with the electromagnet, of fixed contacts, a movable magnet member, movable contacts, and a resilient punching having upturned portions for retaining said contacts and mounted on said movable magnet member, whereby the punching will yield when the electromagnet draws the movable contacts against the fixed contacts.

25. In an electromagnetic switch, the combination with the electromagnet, of one or more fixed metallic contacts, a movable magnet member, one or more movable contacts consisting of small blocks of carbon, and corresponding arms of resilient material suitably supported by the movable magnet member, said movable contacts being directly mounted on said resilient arms.

26. In an electromagnetic switch, the combination with a magnet-spool, of a magnet-coil wound thereon, a perforated cup-shaped magnetic casing, a cover therefor formed integral with a stationary core which extends inside the spool, fixed switch-contacts, a movable core which extends inside the spool through the perforation in the casing, and which carries the switch-contacts, and a non-magnetic bushing separating the movable core from the walls of the perforation in the magnetic casing, and extending inside the core to serve as a support for the movable core when the coil is not energized.

27. In an electromagnetic switch, the combination with a magnet-coil, of a magnetic casing therefor, a movable core extending into the coil through the casing, switch-contacts carried by the movable core, and a bushing of non-magnetic material for separating said core from the magnetic casing.

28. In an electromagnetic switch, the combination with the magnet-coil, of a plurality of fixed switch-contacts, a movable magnet member, a plurality of radial resilient arms supported directly upon said movable mag-

net member, and a plurality of switch-contacts mounted on said resilient arms to engage said fixed switch-contacts, whereby the resilient arms will yield to reduce the hammer-blow.

29. In an electromagnetic switch, the combination with the magnet-coil, of a fixed switch-contact, a movable magnet member, a resilient arm supported directly on said movable member, and a switch-contact mounted on said resilient arm to engage said fixed switch-contact, whereby the resilient arm will yield to reduce the hammer-blow.

30. In an electromagnetic switch, the combination with the electromagnet, of a suitably-supported switch-contact, a contact-support secured to the movable member of the magnet so as to have no independent longitudinal movement, a second switch-contact carried by said support and adapted to engage the first switch-contact, and means whereby a contact can yield when the contacts are caused to mutually engage.

31. In an electromagnetic switch, the combination with the electromagnet, of a suitably-supported switch-contact, a contact-support supported directly upon the movable member of the magnet, a second switch-contact carried by said support, and means between the second contact and the point of attachment of its support to the movable magnet member, whereby the second contact can yield when it engages the first.

32. In an electromagnetic switch, the combination with the electromagnet, of a suitably-supported switch-contact, a contact-support supported directly upon the movable magnet member, a second switch-contact carried by said support, and means between the second contact and the point where its support is mounted, whereby the second contact can yield when it engages the first.

In witness whereof I have hereunto set my hand this 6th day of October, 1897.

WILLIAM B. POTTER.

Witnesses:

B. B. HULL,

E. W. CADY.