June 10, 1930. C. D. AINSWORTH 1,762,604

ELECTRIC SWITCH AND CONTACT STRUCTURE THEREFOR

Filed Dec. 27, 1927 2 Sheets-Sheet 1

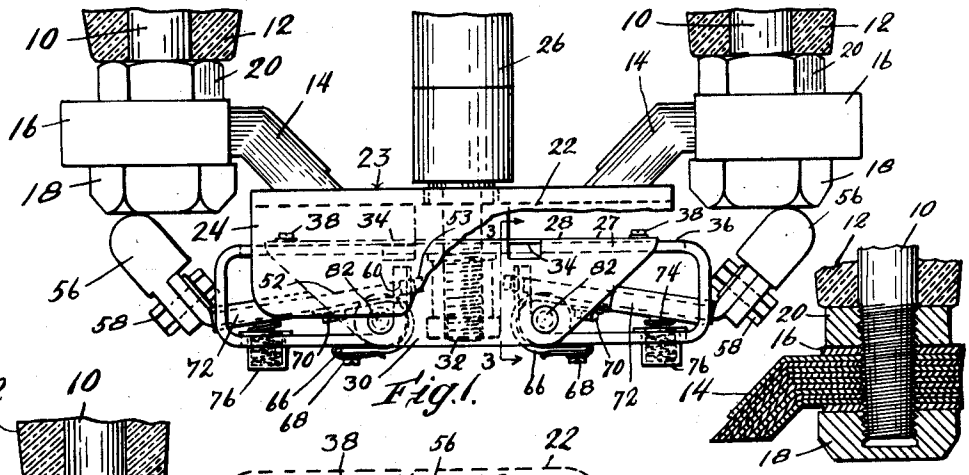

Fig. 1.

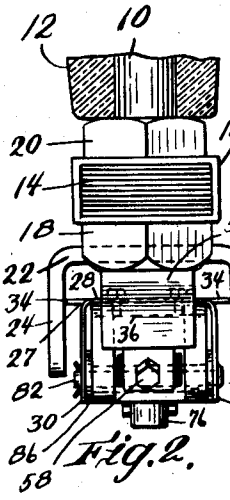

Fig. 2.

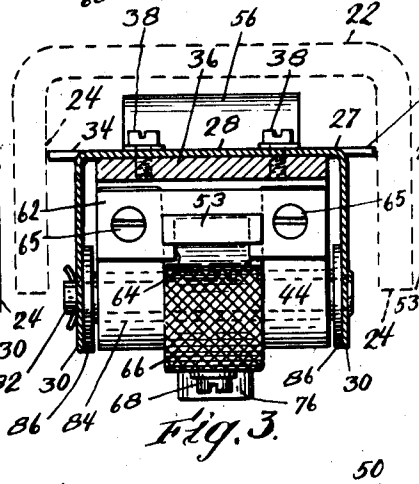

Fig. 3.

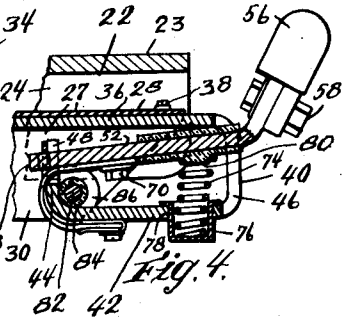

Fig. 4.

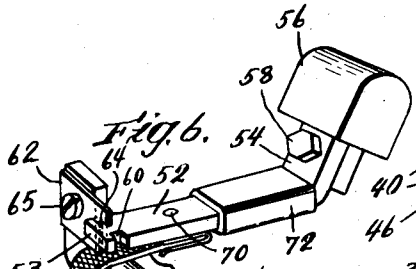

Fig. 6.

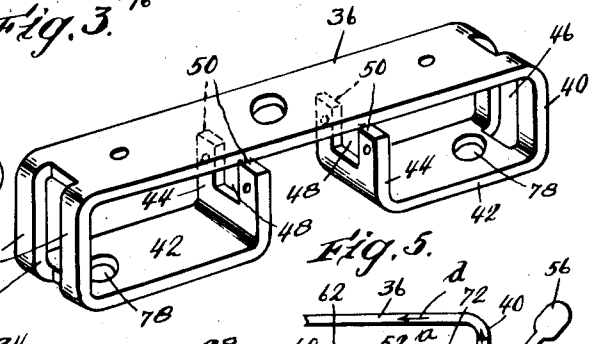

Fig. 5.

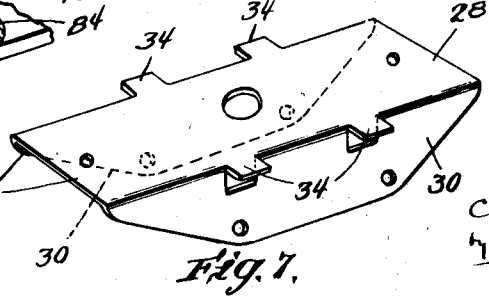

Fig. 7.

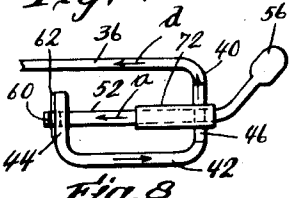

Fig. 8.

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June 10, 1930. C. D. AINSWORTH 1,762,604

ELECTRIC SWITCH AND CONTACT STRUCTURE THEREFOR

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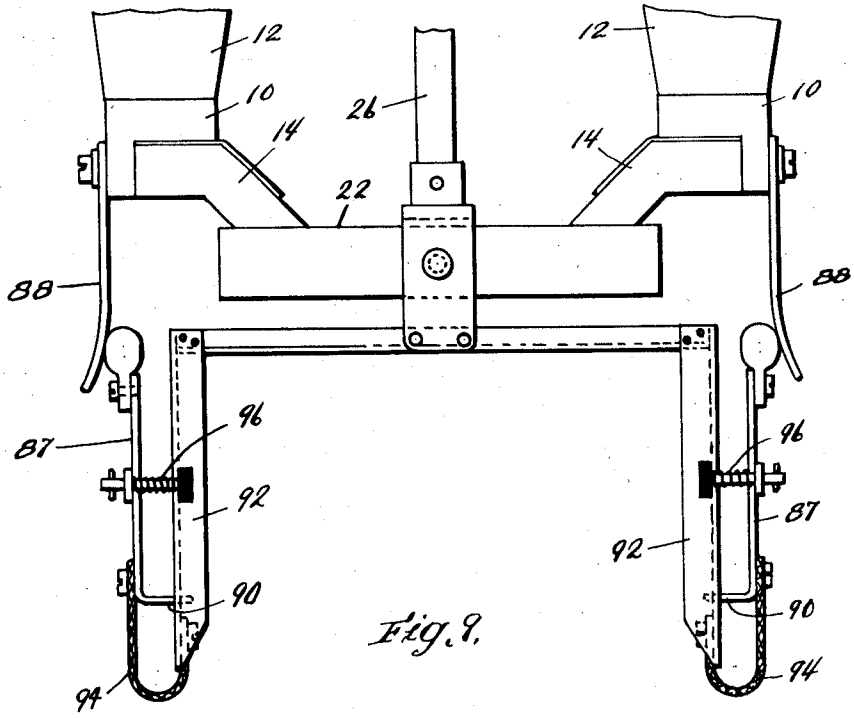

Fig. 9.

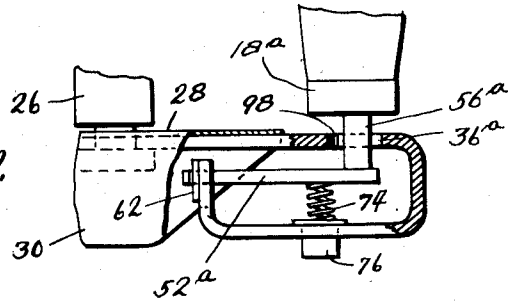

Fig. 10.

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Patented June 10, 1930

1,762,604

UNITED STATES PATENT OFFICE

CHESTER D. AINSWORTH, OF WOLLASTON, MASSACHUSETTS, ASSIGNOR TO CONDIT ELECTRICAL MANUFACTURING CORPORATION, OF SOUTH BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

ELECTRIC SWITCH AND CONTACT STRUCTURE THEREFOR

Application filed December 27, 1927. Serial No. 242,666.

This invention relates to electric switches and contact structures therefor.

In the usual electric switch, consisting of a pair of vertical insulated studs adapted to be connected at the bottom by a vertically movable bridging member, the magnetic flux surrounding the studs and bridging member, when the switch is traversed by heavy current, tends to force apart the cooperating contact members of both or at least tends to reduce the contact pressure therebetween and thus to cause heating and burning of the contacts. It is an object of this invention to provide an arrangement of contact members and associated conducting components by which the conducting components are caused to react magnetically and to apply a force on the contact members to urge them together when the switch is traversed by a heavy current, thus to oppose the oppositely acting magnetic reactions of the current in the general switch circuit on the contact members.

A further object of the invention is the provision of a movably supported contact member and conducting means associated therewith arranged to set up magnetic forces acting on the contact member in a direction to urge it against its cooperating contact member.

A further object of the invention is the provision of a movably supported contact member and a conducting component forming a conducting loop of which said contact member is a part, the magnetic forces in the loop reacting on the contact member to urge it in a circuit closing direction.

A further object is generally to improve the construction and operation of electric switches.

Fig. 1 is a side elevation of the contact structure of an electric switch embodying the invention.

Fig. 2 is an end view of the structure of Fig. 1.

Fig. 3 is a section along line 3—3 of Fig. 1.

Fig. 4 is a vertical sectional detail through one of the movably supported arcing members.

Fig. 5 is a perspective view of the conducting support of the arcing members.

Fig. 6 is a perspective sectional detail illustrating the manner of pivotally securing a contact member to the conducting support.

Fig. 7 is a perspective view of the supporting bracket for the conducting support.

Fig. 8 is a view similar to Fig. 4 and shows the relative directions of the current in the parts.

Fig. 9 is a vertical elevation of a modified arrangement of contact members embodying this invention.

Fig. 10 is a view similar to Fig. 4 but illustrating the modified form of contact member.

The switch here shown includes a pair of vertical conducting rods or studs 10 supported in insulators 12. The studs at their lower end each carry brushes 14 made up of a series of superimposed laminations the shanks of each of which is surrounded by a metal jacket 16. The stud is passed through the shank and has nuts 18 and 20 screw threaded thereon which serve to clamp the brush fixedly to the stud. The lower nut 18 has a flat bottom contact face and comprises a stationary arcing member of the switch. The movable switch member includes a bridging member 22 which comprises a conducting member of channel shape having a top flat contact face 23 and depending webs 24 and is adapted to be moved into bridging engagement with the brushes 14 to complete the main current-carrying path through the switch in the usual manner.

Said bridging member is carried loosely on the lower end of an insulated lifting or switch rod 26. An inverted channel sup-

porting frame 27 having the flat top wall 28 and the depending legs 30 is clamped to the screw threaded lower end 32 of the lifting rod under said loosely supported bridging member 22 and between its depending webs 24 thereof and has laterally-extended struck-out tabs 34 which are adapted to lie close to the inner faces of said depending webs to hold said bridging member from undue lateral or angular displacement on the lifting rod. A rigid conducting support 36 is disposed within said channel supporting frame 27 and comprises a flat bar which is received against the under face of the top wall 28 of the supporting frame and is secured thereto by screws 38. Said bar is extended outwardly in both directions beyond said frame and has downwardly extended end sections 40 and inwardly directed lower sections 42 which are parallel with and are spaced below the top section and has upwardly extended end sections 44 which are terminated beneath and out of contact with the horizontal top section. The end sections 40 have vertical slots or openings 46 therein. The vertical rear sections have notches 48 therein which provide upstanding projections 50 at the sides of the notches. The auxiliary contact members each comprise a stiff bar 52 of conducting material having an upturned outer end 54 to which an arcing member 56 is secured detachably by means of a bolt 58; and said arcing member is arranged to bear against the under face of the stationary arcing member or nut 18 when the switch is closed. The rear or inner section or shank 53 of the bar 52 is extended through one of the openings 46 in the conducting support 36 and has opposed notches 60 in its side edges at its inner end which are received loosely in the upstanding projections 50 of the vertical and inner end 44 of the conducting support with the end of the shank lying loosely in the notch 48. A thin plate 62 has a notch 64 in its lower face in which the shank is received and said plate is secured to said upstanding projections 50 by screws 65 whereby to secure the contact member in pivotal engagement with the inner section 44 of the conducting support against accidental displacement therefrom. Said contact member is maintained in good electrical connection with said conducting support by means of a flexible braid 66 which is disposed beneath and is connected with the shank 53 by a screw 70 adjacent the fulcrum support of the shank. The braid extends through the slot 48 and down around the under side of the horizontal section 42 of the conducting support and is secured thereto by a screw 68. An insulating bushing 72 surrounds the shank 53 and overlies that portion extended through the opening 46 of the conducting support and thus serves to insulate the shank from electrical contact with said support thereat.

A compression spring 74 is seated in a cup 76 received in an opening 78 in the lower horizontal section 42 of the conducting support and encircles a depending insulating projection 80 carried by said insulating sleeve and serves to urge the contact member upwardly. When the switch is closed the spring is adapted to be compressed as shown in Fig. 1 and the contact member is adapted to float upon the spring.

The arrangement of the conducting support 36 and the contact member forms a conducting loop which causes the movable contact member to be forced against the cooperating stationary contact member independently of the spring 74 when current flows through the auxiliary current conducting path. Fig. 8 illustrates the instantaneous direction of the current through the auxiliary current-conducting structure wherein the current is in the direction of the arrow *a*, inwardly or from the contact member through the shank thereof to the inner end of the bottom horizontal section 42 and in the opposite direction in said section outwardly toward the vertical section 40 and upwardly through said vertical section to the end of the top section 36 and inwardly toward the left in said section as indicated by the arrow *d* to the similar contact member on the other side thereof. As thus arranged, it will be seen that the current flows in opposite directions in the shank 53 of the contact member and in the lower horizontal section 42 of the conducting support. The magnetic reaction therebetween thus tends to urge the movable contact member upwardly. The current is in the same direction in the shank 53 and in the upper horizontal section 36 and the reaction therebetween thus tends to draw the contact member upwardly so that both the upper and lower sections 36 and 42 respectively act on said contact member in a direction to force it upwardly and against the cooperating stationary contact or arcing member 18. Since the sections 36 and 42 are close to the contact member their magnetic reactions on the contact member can be made great enough to offset the oppositely-directed reaction between the contact member and the studs.

A pin 82 is extended through the webs 30 of the supporting frame 27 and lies within and close to the angle between each lower horizontal section 42 and the inner upstanding end 44 of the conducting support and is insulated therefrom by the insulating sleeve 84 and the washers 86 Fig. 2 and serves to support the lower horizontal section against upward displacement due to the fulcruming of the contact member on the spring 74 when the switch is in closed

position and also to prevent the lower horizontal section from being displaced in a downward direction by the magnetic reaction of abnormal currents. Said section, if displaced downwardly, brings the shank 53 of the contact member against the insulating sleeve of said pin 82 and thus forces the arcing member 56 thereof with increased effect upwardly against the cooperating stationary arcing member.

In the modification shown in Fig. 9, the movable contact member 87 is vertically disposed and has it upper end in contact with the depending stationary arcing member 88 and has its lower end 90 pivotally connected with a vertically extended rigid conducting member 92 and electrically connected therewith by a loop of flexible braid 94. The contact member 87 and the conductor 92 cooperate to form the legs of a U-shaped conducting path, the current in the legs being in opposite directions, so that the contact member 87 is forced outwardly into pressure contact with its arcing member 88 with a force greater than that resulting from the compression spring 96 alone. In this modification, the magnetic reaction of the current in the switch studs complements the magnetic reaction in the U-shaped conducting path.

The modification shown in Fig. 10 is similar to that shown in Figs. 1 through 6, with the exception that the arcing member 56^a carried by the shank 52^a extends freely through a hole 98 in the upper horizontal section 36^a of the conducting support for engagement with the cooperating stationary contact 18^a. In this case, the opening 98 is the equivalent of the opening 46 of the previous figures. The current reactions in the modification shown in Fig. 10 are the same as described in connection with Fig. 8.

I claim:

1. In an electric switch, the combination of fixed switch terminals having contact members at their ends, movable contact members cooperating with said fixed contact members so arranged that the current traversing the general switch circuit tends to separate said contact members, and relatively movable conducting elements included in said switch circuit which react independently and in opposition to the general switch circuit to hold said contact members together.

2. In an electric switch, a contact member, a cooperating movable contact member, and a looped conducting member connected with said movable contact member and having relative movable parts disposed in position to react magnetically in a direction to urge said contact members together.

3. In an electric switch, a contact member, a cooperating movable contact member having an extended current-carrying arm, and a conductor connected electrically with the end of said arm and disposed close thereto and in a position to react magnetically thereon in a direction to urge said movable contact member against said first named contact member.

4. In an electric switch, a contact member, a cooperating movable contact member, and conducting means providing a current path which is parallel and close to said contact member and reacts magnetically thereon in a direction to urge it toward the aforesaid contact member.

5. In an electric switch, means providing a conducting loop terminated in a movably supported contact member, and a second contact member cooperating therewith, the magnetic reactions of the current in said loop acting to force said movably supported contact member against said other contact member.

6. In an electric switch, a contact member, a conducting member, and a second contact member extended generally parallel and lying close to said conducting member and having a connection at one end therewith by which said contact member is movable toward and away from said conducting member, the magnetic reactions of the current traversing said movable contact member and conducting member being in a direction to urge said movable contact member toward said other contact member.

7. In an electric switch, a rigid conducting member, a contact member overlying and disposed close to said conducting member and having a flexible connection at one end therewith by which current traverses said contact and conducting members in opposite directions, and a second contact member cooperating with said first contact member.

8. In an electric switch a contact member, a cooperating contact member disposed beneath said first contact member having an angularly-extended conducting and supporting arm, and a conducting member disposed beneath and close to and generally parallel with the angularly extended arm of said contact member and having an electrical connection therewith at the end of said arm opposite said contact member.

9. In an electric switch a contact member, a cooperating contact member disposed beneath said first contact member, and a conducting member disposed beneath and close to and generally parallel with said contact member and having a connection at the end of said contact member and forming a magnetic loop therewith, and a spring urging said second contact member towards said first contact member.

10. In an electric switch a contact member, a cooperating contact member disposed beneath said first contact member, and a conducting member disposed beneath and close

to and generally parallel with said second contact member and having a connection at the end of said contact member and forming a magnetic loop therewith, and an insulated spring bearing against said conducting member and said second contact member.

11. In an electric switch, a movable contact member, means providing a current path on opposite sides of and close to said contact member, and a cooperating contact member disposed in position to be engaged forcibly by said movable contact member due to the current reactions between it and said conducting path.

12. In an electric switch a movable contact member, means overlying and close to and in series with said contact member providing a current path in the same direction as in said contact member, and a cooperating contact member disposed in position to be pressed against by said movable contact member due to the magnetic reactions between it and said current path.

13. In an electric switch, a conducting member having closely spaced upper and lower parallel conducting sections through which current is adapted to pass in opposite directions, and a movable contact member extended in the length of and disposed between said conducting sections and adapted to be traversed by current in a path generally parallel to said sections.

14. In an electric switch, a rigid conducting member having upper and lower closely spaced parallel sections connected at their outer ends, a contact member disposed between and extended in the direction of the length of said upper and lower section and having a flexible connection with the inner end of said lower section.

15. In an electric switch, a contact structure comprising a rigid conducting support having upper and lower parallel and closely spaced conducting sections connected at their outer ends, an arcing member extended through said support between said sections and in the direction of the length thereof, and having an electrical connection therewith at the inner end of said lower horizontal section.

16. In an electric switch, a rigid conducting support having upper and lower closely spaced parallel conducting sections having a connection at their outer ends, said lower section having an up-standing lower end, a contact member extended freely through said connection and insulated therefrom and extended into the space between said upper and lower sections and having a flexible connection with said upturned inner end, and an insulating spring carried by said lower section and bearing against said contact member.

17. In an electric switch, a rigid conducting support having upper and lower closely spaced parallel conducting sections having a connection at their outer ends and an opening in said connection, a contact member passed freely through said opening into the space between said sections and extended in the direction of the length thereof, and an insulating sleeve surrounding said contact member in said opening, the inner end of said lower conducting section being upstanding and the inner end of said contact member having a pivotal connection therewith.

18. In an electric switch, a conducting support having upper and lower closely spaced parallel conducting sections having a connection at their outer ends with an opening in said connection, a contact member passed freely through said opening into the space between said sections and extended in the direction of the length thereof, an insulating sleeve surrounding said contact member in said opening, the inner end of said lower conducting section being upstanding and the inner end of said contact member having a pivotal connection therewith, and a compression spring carried by said lower section bearing against said insulating sleeve.

19. In an electric switch, a conducting support comprising a horizontal bar reflexed to provide upper and lower closely spaced horizontal sections and an outer vertical end connection section and an upstanding inner free end at said lower section, a contact member extended into the space between said sections in the direction of the lengths thereof and having a pivotal connection with said upstanding end, and means to restrain the free inner end of said lower section against undue displacement.

20. In an electric switch, a conducting support comprising a horizontal bar reflexed to provide upper and lower closely spaced horizontal sections and an outer vertical end connection section and an upstanding inner free end at said lower section, a contact member extended into the space between said sections in the direction of the lengths thereof and having a pivotal connection with said upstanding end, and a fixedly-supported insulated bar disposed below said contact member and above said lower section at the free end thereof.

21. In an electric switch, a movable switch member comprising a lifting rod, a horizontal conducting member carried by said rod at the bottom thereof, a supporting frame comprising an inverted channel member carried by said rod beneath said conducting member, a conducting support comprising a horizontal bar fixed in the channel of said channel member and having oppositely extended ends providing upper and lower horizontal closely spaced sections connected at their outer ends, the inner ends of said lower sections being free, and arcing

members disposed beyond the ends of said conducting support and extended into the space between said upper and lower sections and along the lengths thereof and having flexible connections with the free inner ends of said lower section.

22. In an electric switch, a movable switch member comprising a lifting rod, a horizontal conducting member carried by said rod at the bottom thereof, a supporting frame comprising an inverted channel member carried by said rod beneath said conducting member, a horizontal conducting bar fixed in the channel of said channel member and having oppositely extended ends providing upper and lower horizontal closely spaced sections connected at their outer ends, the inner ends of said lower sections being free, and contact members disposed beyond the ends of said conducting support and extended into the space between said upper and lower sections and along the lengths thereof and having flexible connections with the free inner ends of said lower section, and insulated pins extended between the webs of said channel member over the free inner ends of said lower sections and under said contact members.

23. In an electric switch, a movable switch member comprising a lifting rod, a horizontal conducting member carried by said rod at the bottom thereof, a supporting frame comprising an inverted channel member carried by said rod beneath said conducting member, a horizontal conducting bar fixed in the channel of said channel member and having oppositely extended ends providing upper and lower horizontal closely spaced sections connected at their outer ends, the inner ends of said lower sections being free and upstanding, and outstanding contact members located beyond the ends of said conducting support and extended into the space between said upper and lower sections and having pivotal connections at their inner ends with the upstanding ends of said lower sections, and insulated pins carried by and extended between the webs of said channel member and over the free ends of said lower sections and under the inner ends of said contact members.

24. In an electric switch, a movable switch member comprising a lifting rod, a main bridging member comprising an inverted channel member carried loosely on said rod at its lower end, and a supporting frame for the auxiliary contact members comprising an inverted channel member disposed within and laterally spaced from the webs of the aforesaid channel member and fixed to said lifting rod and having laterally extended frame-spacing projections which are disposed close to the inner faces of the webs of said main bridging member.

25. In an electric switch, a stationary contact member, a movable contact member cooperating therewith, and a solenoid having relatively movable conducting elements connected with said movable contact member disposed to react magnetically by the current traversing them in a direction to urge said movable contact member against said stationary contact member.

In testimony whereof, I have signed my name to this specification.

CHESTER D. AINSWORTH.