

United States Patent

[11] 3,597,562

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[21]	Appl. No.	844,151
[22]	Filed	July 23, 1969
[45]	Patented	Aug. 3, 1971
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[54] MOVABLE CONTACT STRUCTURE FOR AN ELECTRIC SWITCH
10 Claims, 6 Drawing Figs.

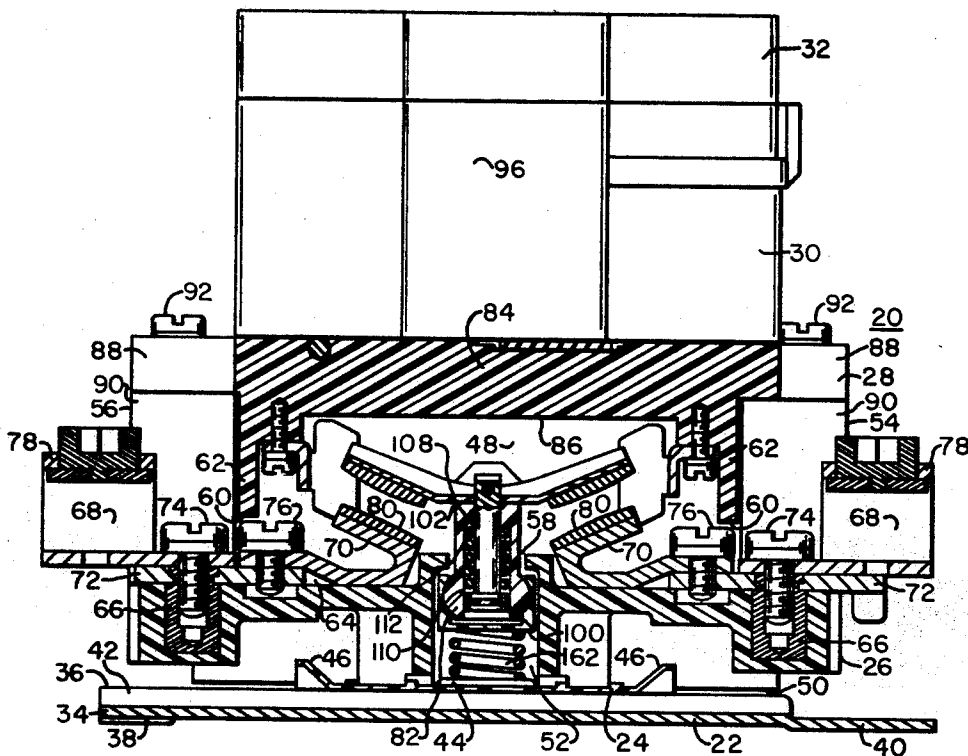
[52] U.S. Cl. 200/166 BC,
200/165
[51] Int. Cl. H01h 3/02
[50] Field of Search..... 200/165,
166 B, 166 H; 335/132, 196, 197

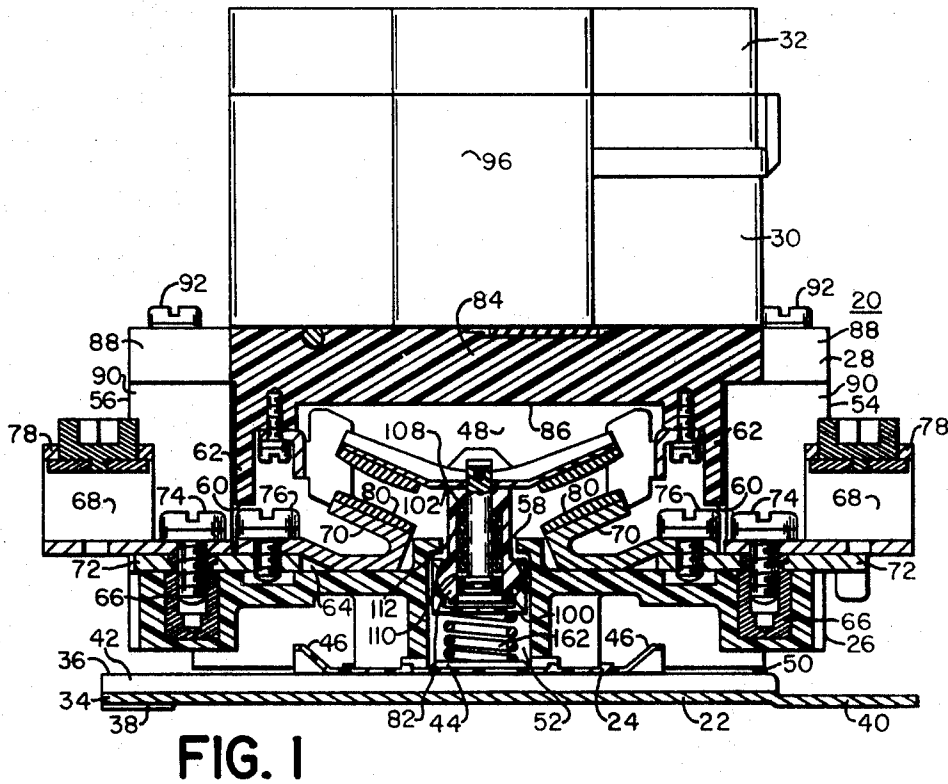
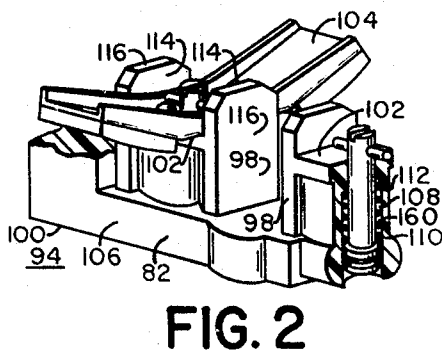
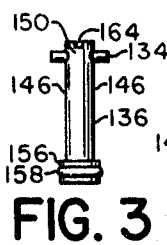
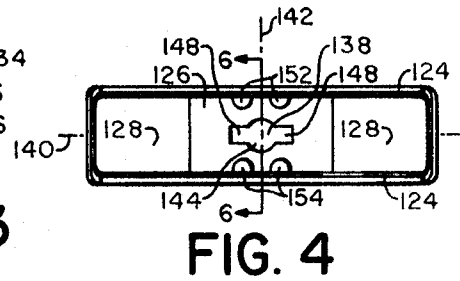
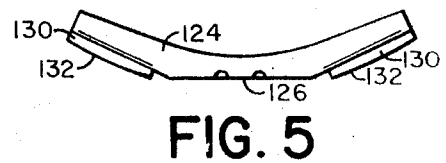
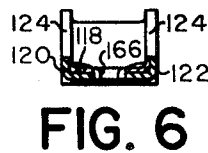
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ABSTRACT: A movable contact structure having a movable contact member carried on a movable contact carrier by a spring biased rotatable plunger. The contact member has a channellike cross section and is formed of at least two laminated metals each having different deflection and conductive characteristics so that the weight of the contact member may be reduced and provide a maximum conductive ability commensurate with its resistance to bending. An end of the plunger extends through a notched opening in the contact member so that when the plunger is rotated to one position the contact member may be separated from the carrier and when the plunger is rotated to a second position, a pin on the end of the plunger engages the material of the contact member to maintain the contact member on the end of the plunger. The plunger also includes a portion that acts as a piston in a bore of the contact carrier to reduce the bounce which occurs when the movable contact surfaces on the contact member initially engage the stationary contacts.





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MOVABLE CONTACT STRUCTURE FOR AN ELECTRIC SWITCH

The present invention relates to switching devices and more particularly to the details of construction of a movable contact structure and support therefor in an electric switch.

The contact structure of the type with which the present invention is concerned is particularly suited for use in electromagnetic switching devices commonly known as contactors which are furnished as devices of varying sizes having ratings in accordance with the standards promulgated by the National Electrical Manufacturers Association, commonly known as NEMA. An example of a contactor construction which is particularly suited to control electrical loads of 50 amperes or less, which corresponds to a NEMA Size 2 device, is disclosed in U.S. Pat. No. 3,354,415, which was granted to the inventors Joseph J. Gribble, Kenneth J. Marien and Harold E. Whiting.

While the proportions of the device shown in the Gribble et al. patent may be increased to control amperes greater than 50 amperes, economic and physical size limitations dictate that additional features should be incorporated therein if currents having a magnitude two or three times 50 amperes are to be controlled by the device. It is well known that any conductor is heated by the current passing therethrough and therefore it follows that an increase in the current controlling capability of a device requires a corresponding increase in the cross-sectional mass of the current carrying metal parts of the device. Inherently, any electrical switch which relies on an abutting engagement between two metal parts to complete an electric circuit will operate with a phenomenon known as contact bounce, which is generated when the movable contacts initially are in effect slammed into engagement with the stationary contacts. Contact bounce is a well-known cause of wear, and thus is objectionable. One possible solution which may be used to reduce contact bounce is to employ extremely strong springs in the movable contact structure. However, this solution is impractical for a number of reasons, including the necessity of requiring an operating magnet structure which would have to be excessively large in physical size. The presence of contact bounce is particularly objectionable in switches of larger sizes and becomes more difficult to control because of the weight of the movable contacts which is required to enable the switch to control the large currents. As any conductor is heated by the current passing therethrough, common practices which have been heretofore followed dictated that each current carrying part in a switch be designed to operate independently of the remaining components in the switch and act as its own radiator for the heat generated therein. However, in any electric switch, the components carrying current must be in firm physical contact with each other if overheating of the switch is to be avoided. In the contact structure according to the present invention, the stationary contact structures which have a large mass in relation to the current passing therethrough are engaged by the movable contact which has a small mass in relation to the current passing therethrough so that the heat generated within the movable contact will be conducted and dissipated by the stationary contact structures. This philosophy of design is incorporated into the movable contact structure according to the present invention wherein the cross-sectional mass of the movable contact is reduced to thereby reduce the problems of contact bounce. Further, as occasionally contacts of the switching devices may require replacement, the movable contact is carried on a rotatable pin which when rotated to one position, will permit removal of the movable contact and when rotated to a second position will position the movable contact for engagement with the stationary contacts.

It is an object of the present invention to provide a movable contact structure which will operate with a low degree of contact bounce and can be readily serviced.

Another object is to provide an electric switch with a movable contact structure that includes a contact carrier having a portion movable in a slot in an insulating base and portions ex-

tending through openings in the base to a front surface of the base to provide a surface on the carrier whereon the movable contact is positioned, and to connect the movable contact to the contact carrier by a spring biased rotatable plunger that extends through a centrally located opening in the movable contact so that when the plunger is rotated to one position the movable contact may be separated from the contact carrier and when the plunger is rotated to a second position, the plunger will be held against rotation by surface portions on the movable contact and constantly urge the movable contact toward the contact positioning surface on the carrier.

Another object is to provide an electric switch with a movable contact structure that includes a contact carrier having a portion movable in a slot in an insulating base and portions extending through openings in the base to a front surface of the base to provide a surface on the carrier whereon the movable contact is positioned, and to connect the movable contact to the contact carrier by a spring biased rotatable plunger that extends through a centrally located opening in the movable contact so that when the plunger is rotated to one position the movable contact may be separated from the contact carrier and when the plunger is rotated to a second position, the plunger will be held against rotation by surface portions on the movable contact and constantly urge the movable contact toward the contact positioning surface on the carrier and to form the movable contact from two laminated metal parts having a U-shaped cross section and different conducting and resistance to deflection characteristics so that the movable contact will have a maximum conductive ability commensurate with its resistance to bending.

Another object is to provide an electric switch with a movable contact structure that includes a contact carrier having a portion movable in a slot in an insulating base and portions extending through openings in the base to the front surface of the base to provide a surface on the carrier whereon the movable contact is positioned, and to connect the movable contact to the contact carrier by a spring biased rotatable plunger that extends through a centrally located opening in the movable contact so that when the plunger is rotated to one position the movable contact may be separated from the contact carrier and when the plunger is rotated to a second position the plunger will be held against rotation by surface portions on the movable contact and constantly urge the movable contact toward the contact positioning surface on the carrier and to form the movable contact from two laminated metal parts having a U-shaped cross section and different conducting and resistance to deflection characteristics so that the movable contact will have a maximum conductive ability commensurate with its resistance to bending and to provide the movable contact carrier with a bore wherein a portion of the plunger acts as an air piston to reduce the contact bounce when the movable contacts engage stationary contacts that are mounted on the front surface of the base.

Further objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawing illustrating a preferred embodiment in which:

FIG. 1 is a view partly in cross section illustrating an electric switch incorporating the movable contact structure according to the present invention.

FIG. 2 is a perspective view of a portion of a movable contact carrier and a movable contact as used in the switch in FIG. 1 with certain portions of the carrier broken away.

FIG. 3 is a side view of a plunger used in the movable contact structure in FIGS. 1 and 2.

FIGS. 4 and 5 are top and side views of the movable contact structure used in the switch in FIG. 1.

FIG. 6 is a cross-sectional view taken along line 6-6 in FIG. 4.

Referring to the drawing, and particularly to FIG. 1, there is shown an electromagnetic switch assembly 20 having a plurality of components that are stacked one upon the other. The components of the assembly include a metal mounting plate

22, an insulating sheetlike member 24, an insulating base 26, an insulation barrier 28, a metal housing 30, and a cover 32, each of which is disclosed and described in an application for U.S. Pat., Ser. No. 844,148, filed July 23, 1969.

The metal mounting plate 22 is formed of a stamped metal part and provides a means to secure the switch assembly 20 to a vertical panel and the like, not shown. When the plate 22 is secured to a panel, an edge 34 becomes a bottom edge of the plate 22 and a surface 36 the front surface of the plate 22. The plate 22 has a pair of rearwardly extending indentations 38 along its bottom edge 34 providing a pair of spaced mounting feet having openings therein. The plate 22 also has an indentation 40 extending across its top edge which provides an elongated mounting foot having an opening, not shown, therein. The mounting feet 38 and 40 with the openings therein are provided for the purpose of securing the plate 22 to a vertical panel. The plate 22 also includes an indentation 42 which extends from the bottom edge 34 rearwardly in the front surface 36 to the indentation 40. The indentation 42 is provided to permit passage of control wires, not shown, from the upper to the lower ends of the switch 20 in the space provided by the indentation. The control wires may be connected in circuit with the switching contacts of a device known as an overload relay, in a manner well known to those skilled in the art. The plate 22 also is provided with suitably located threaded openings which act as mounting holes which are used to secure the insulating sheetlike member 24 and base 26 to the plate 22.

The sheet 24 is preferably formed as a molded insulating part having a relatively thin cross section having a flat rear surface engaging the front surface 36 to cover a central portion of the indentation 42 so as to act as a cover for the wire trough. The sheet 24 is provided with a pair of circular ribs 44 which are raised on the front surface of the sheet 24 on opposite sides of a vertical center of the plate 22. The ribs 44 act as spring seats, as will be later described. The sheet 24 also is provided with portions 46 which are formed along the top and bottom edges of the sheet 24 in alignment with the indentation 42. The portions 46 act as scoops and aid in directing the wires in the portion of the wire trough disposed between the sheet 24 and the plate 22.

As disclosed in the application for U.S. Pat., Ser. No. 844,148, supra, the base 26 and the barrier 28 are formed of a molded insulating material having arc suppressing capabilities and cooperate with each other to provide a cavity which is divided into three compartments 48 having equal widths. The base 26 has a rear surface 50 positioned on the insulating sheet 24 and the plate 22 in a secured position by suitable screws which pass through openings in the base 26 and the sheet 24 and are threadedly received in the housing holes in the plate 22. Extending into the material of the base 26 forwardly of the rear surface 50 and through the sidewalls of the base 26 is a slot 52. The slot 52 is centered on a centerline equidistant between a top wall 54 and a bottom wall 56 of the base 26 and is exposed to each of the compartments 48 by an opening 58. The compartments 48 extend to provide openings 60 between a rib 62 on the barrier 28 and a front surface 64 of the base 26 at the top 54 and the bottom walls 56 of the base 26. Embedded within the material of the base 26 adjacent the bottom and the top walls 54 and 56 of each compartment 48 is a threaded insert 66 which is used to secure the terminal and stationary contact assemblies in the compartments 48.

Each of the compartments 48 has a pair of stationary contact assemblies positioned so that contact assemblies of each pair are spaced equidistantly on opposite sides of the respective openings 58 and face in opposite directions. Each of the contact assemblies includes a terminal member 68, a contact member 70 and a conducting bar member 72. The bar member 72 has a threaded opening adjacent one of its ends and an unthreaded opening adjacent its other end. The terminal member 68 and the bar member 72 are secured adjacent an open end of the compartment by a screw 74. The screw 74 passes through an opening in the terminal member

68 and the unthreaded opening in the bar member 72 and is threaded into the insert 66. The contact member 70 in turn is secured to the bar member 72 by a screw 76 which passes through an opening in the contact member 70 and is threaded into the threaded opening in the bar member 72. As shown in FIG. 1, when the contact assemblies are secured at the opposite ends of the compartments 48, the terminal member 68 will have a wire connecting portion 78 extending external of the top wall 54 and the bottom wall 56 and the contact member 70 will have an inclined stationary contact surface 80 positioned adjacent one of the openings 58.

As disclosed in an application for U.S. Pat., Ser. No. 844,148, supra, the barrier 28, the metal housing 30 and cover 32 define an internal closed cavity wherein an electromagnet, not shown, is included. The electromagnet operates a bellcrank lever which has a pair of arms connected to a movable U-shaped contact carrier that has a bight portion indicated by the numeral 82 in the drawings. The bight portion 82 is movable forwardly and rearwardly in the slot 52. The movable contact carrier including the bight portion 82 is most clearly disclosed in an application for U.S. Pat., Ser. No. 844,100, filed July 23, 1969, which has been assigned by the inventors Merlin Y. Turnbull and Harold E. Whiting to the assignee of the present invention. The barrier 28 has a body portion 84 which provides a front wall 86 for the compartments 48 and suitable ribs, not shown, which provide sidewalls for the compartments and the ribs 62. Extending from the body portion 84 are ears 88 that are arranged to seat upon the forward ends of a pair of posts 90 at the top and bottom walls 54 and 56. The posts 90 each have a threaded insert molded therein and each of the ears 88 has an opening therein which permits the barrier 28 to be removably secured to the front surface of the base 26 by screws 92 which pass through the openings in the ears 88 into the threaded inserts in the posts 90. It is readily apparent that the removal of the screws 92 will permit the assembly, including the barrier 28, the housing 30 and the cover 32, to be detached from the base 26 to permit access to the stationary and the movable contacts within the compartments 48 in event the contacts require inspection or replacement.

A movable contact carrier 94 which is partly shown in FIG. 2, is preferably formed as a U-shaped molded part that includes the bight portion 82. The bight portion 82 is received in the slot 52 while arms, not shown, which extend from opposite ends of the bight portion 82 extend externally of the side walls of the base 26 have free ends received in channels in the housing 30 defined by portions 96 on the housing 30. The free ends of the arms receive arm portions of a bellcrank lever, not shown, within the housing 30. Extending forwardly of the bight portion 82 are a plurality of spaced projections 98 each of which extends through one of the openings 58 into one of the compartments 48. The bight portion 82 has a rear surface 100 and each of the projections 98 has a front surface whereon a movable contact member 104 is positioned. The bight portion 82 also has a pair of sidewalls 106. Extending between the rear surface 100 and the front surface 102 in each of the projections 98 is a cylindrical bore 108 that has a cylindrically shaped counterbored portion 110 extending from the rear surface partially to the front surface 102 to provide an annular ledge which acts as a spring seat 112 adjacent the front surface 102 end of the projection 98. Spaced equidistantly on opposite sides of the opening in the front surface 102 that is provided by the bore 108 are a pair of parallel spaced walls 114 which extend substantially perpendicular to the front surface 102. The walls 114 are provided by a pair of projections 116 which extend forwardly of the front surface 102.

The movable contact member 104 which is most clearly shown in FIGS. 4-6, has a conducting portion formed of at least two laminated metal parts 118 and 120 which are metallurgically laminated together by methods well known to those skilled in the art so the metal parts 118 and 120 act as a unitary member 122. The member 122 has a U-shaped channel cross section throughout its length with the arm portions 124 imparting strength against bending to the contact member

104. The member 104 has a central portion 126 and a pair of portions 128 extending at an angle from opposite ends of the central portion 126 whereon a pair of members 130 which are formed of a noble metal to provide contact surfaces 132 are secured. The angle of incline of the portions 128 corresponds to the angle of incline of the portions on the contact member 70 carrying the contact surfaces 80 so that contact surfaces 132 will properly engage the contact surfaces 80.

The laminated metal parts 118 and 120 as shown in FIG. 6 are arranged so that the part 120 provides a layer of a material having a good electrical conducting ability, such as copper, silver and the like, and the part 118 provides a layer of a material which will resist bending, such as a layer of steel which also is more abrasion-resistant than copper. The copper part 120 provides the outer surface of the channel member 122 and is located on the side of the member 122 to which the contact members 130 are secured and the steel part 118 extends throughout the entire inner surface of the channel member 122 and is located on the member 122 on the side of the member 122 which is engaged by a pin 134 on a plunger 136 shown in FIG. 3. The central portion 126 is provided with an elongated opening 138 that is centered in the member 122 at the intersection of a centrally located longitudinal and a centrally located transverse axis of the member 122 which are indicated by the numerals 140 and 142. The opening 138 includes a circular central portion 144 having a diameter slightly larger than a stem portion 146 of the plunger 136. Extending in opposite directions from the opening 138 toward the contact carrying portions 128 and centered along the axis 140 are a pair of notches 148 which cause the opening 138 to be elongated and having a width and length which will permit the sides and ends of the pin 134 to pass through the notches 148 with clearance when the plunger 136 is rotated to a first position wherein the longitudinal axis of the pin 134 is axially aligned in a plane that is common to the axis 140 so that the movable contact member 104 may be readily detached from a free end 150 of the stem 146.

The pin 134 has a length less than the spacing between the arm portions 124 so that the plunger 136 may be rotated to a second position wherein the longitudinal axis of the pin 134 extends in a plane that is common with the axis 142 and engage portions of the material of the central portion 126 and thereby positions the contact member 104 on the free end 150. As most clearly shown in FIG. 4, projecting from the forward surface of the central portion on opposite sides of the axis 142 and adjacent the arm portions 124 are two pairs of stops 152 and 154 with the stops of each pair spaced to receive the pin 134 therebetween and thereby prevent rotation of the pin 134 when the pin 134 is in the second position.

The plunger 136, as shown in FIG. 3, includes the stem portion 146 which is received in the cylindrical bore 108 with minimum clearance and a cylindrical portion 156 on an end remote from the free end 150 that has a diameter sized so the cylindrical portion 156 may be received in and guided by the counterbore 110. Additionally, if desired, the cylindrical portion 156 may be provided with an annular groove which receives an O-ring seal 158. The O-ring seal 158 is arranged to slidably engage the walls of the counterbore 110 so that the cylindrical portion 156 will move with an air piston type action in the counterbore 110 during movements of the plunger 136 in the cylindrical bore 108. Surrounding the stem portion 146 and positioned between the spring seat 112 and the cylindrical portion 156 is a spring 160.

The plunger 136 and the spring 160 may be assembled in each of the cylindrical bores 108 in the bight portion 82 by positioning the spring 160 on the stem portion 146 so that one end of the spring rests upon the cylindrical portion 156. The assembled spring 160 and plunger 136 is then inserted into the cylindrical bore 108 so that the free end 150 projects forwardly of the surface 102 and the spring is compressed between the spring seat 112 and the cylindrical portion 156. The pin 134 when inserted through a suitable opening in the free end 150 maintains the plunger 136 and spring 160 within

the cylindrical bore in a condition wherein the spring 160 is under compression, the cylindrical portion 156 is received in the counterbore 110 and the free end 150 and the pin 134 are positioned externally and forwardly of the front surface 102.

The components of the switch assembly 20 may be assembled as follows. Initially the insulating sheet 24 is positioned on the mounting plate 22. The movable contact carrier 94 with plungers 136, springs 160 and pins 134 assembled in each cylindrical bore 108 is then positioned so the bight portion 82 is within the slot 52 and the arm portions extend external of the sidewalls of the base 26. The base 26 and the movable contact carrier 94 are assembled on the insulating sheet 24 and the mounting plate 22 by positioning the rear surface 50 adjacent on the sheet 24 with a pair of springs 162 positioned between the insulating sheet 24 and bight portion 82 and tightening screws, not shown, which extend through suitable openings in the base 26 into the threaded openings in the mounting plate 22. The stationary contact assemblies are then secured to the base 26 by tightening the screws 74 which pass through the unthreaded openings in the terminal member 68 and the bar member 72 into the threaded inserts 66 and tightening the screws 76 which extend through the unthreaded opening in the contact member 70 into the threaded opening in the bar member 72.

The movable contact members 104 are installed on the front surfaces 102 by initially positioning the plungers 136 in the first position wherein the axis of the pin 134 is parallel to the sidewalls 114 and placing the movable contact 104 on the front surface 102 in a position wherein the free end 150 and pin 134 are positioned within the elongated opening 138. When the movable contact 104 is thus positioned, the arm portions 124 will be adjacent to the walls 114 and the contact carrying portions 128 will extend outwardly of the sidewalls 106 in a position to align the contact surfaces 132 with the contact surfaces 80 on the stationary contact members 70. The movable contact 104 is secured to contact carrier 94 by merely rotating the plunger 136 from the first position to a second position as shown in FIG. 2 wherein the axis of the plunger 136 extends perpendicular to the walls 114 and is received between the pairs of stops 152 and 154. The rotation of the plunger 136 from the first position to the second position is facilitated by a screwdriver slot 164 in the free end 150 and the inclined wall portions 166 of the notches 148 which are shown in FIG. 6. The slot 164 permits the plunger to be rotated by a screwdriver and the inclined walls 166 provide a camming movement as the pin 134 moves against the force of the spring 160 out of the notches 148 forwardly to a position wherein it rides over the surface of the central portion 126 and passes over the stops 152 and 154 to the second position.

The assembly of the barrier 28, the housing 30 and the cover 32 in a manner described in the application for U.S. Pat., Ser. No. 844,100, supra, on the base 26 completes the assembly of the switch assembly 20 which also discloses in detail the operation of the switch assembly 20.

The switch assembly 20 in FIG. 1 is shown in a deenergized condition. The energization of the switch assembly 20 causes the contact carrier 94 including the bight portion 82 to move in the slot 52 wherein it is guided by a bearing member 166 toward the plate 22 to a position wherein the contact surfaces 132 engage the contact surfaces 80. The initial movement of the contact carrier 94 is opposed as the springs 162 are compressed. The springs 162 have one end positioned with the spring seats provided by the circular ribs 44 and the other end positioned with a recess, not shown, in the rear surface 100 of the contact carrier 94. The subsequent movement of the contact carrier 94, which occurs after the movable contact surface 132 engage the contact surfaces 80, causes the movable contact members 104 to move out of engagement with the front surfaces 102 along a guided path which is controlled by the walls 114. As previously described, the movable contacts 104 are assembled on the free end 150 of the plunger 136 by the pin 134 which acts as stop surface as it engages the forward facing surface portions of the central portion 126 of the

contact member 104. Thus the movement of the contact members 104 from the front surfaces 102 causes the plungers 136 to move in the bores 108 in a direction wherein the springs 160 are compressed as the cylindrical portion 156 moves toward the spring seat 112 in the counterbore 110 and the air present between the cylindrical portion 156 and the spring seat 112 is compressed and escapes through the space between the stem 146 and the portion of the cylindrical bore 108 that is present between the spring seat 112 and the front surface 102.

The layered metal parts 118 and 120 provide the movable contact member with a maximum current conducting ability and resistance to binding relative to its mass. The arm portions 124 also contribute to the resistance to bending without appreciably increasing the mass of the device in terms of the current conducting ability of the device. The contact members 130 are secured to the copper layer instead of the steel layer so the device will have its maximum conducting ability in terms of the amount of copper included in the contact member 130. The steel layer 118 rather than the copper layer 120 is positioned to be engaged by the pin 134 to provide the connection between the movable contact member 130 and the plunger 136 with the maximum resistance to wear.

It is well known that the frequency and magnitude of the bounce of the contacts is a function of the mass of the movable contact and the velocity of the engagement between the movable contacts and the stationary contacts. The contact structure according to the present invention, by having the maximum resistance to bending and current conducting capacity relative to its mass, thus will operate with a minimum contact bounce when the movable contact surfaces 132 initially engage the stationary contact surfaces 80 while the action provided by the operation of the cylindrical portion 156 in the counterbore 110 acts like a hydraulic shock absorber to further reduce the contact bounce of the switch assembly 20.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What I claim is:

1. In an electric switch the combination comprising: a movable contact carrier having a front surface, a rear surface, and pair of sidewalls, a cylindrical bore having a cylindrical counterbored portion with said bore extending between the front surface and the rear surface and said counterbored portion extending from the rear surface partially to the front surface to provide a spring seat adjacent the front surface end of the bore and a pair of walls spaced equidistantly on opposite sides of the bore and extending forwardly of the front surface, a movable contact member movably positioned between the walls on the front surface, said contact member having an opening at a central portion aligned with the opening in the front surface provided by the bore and portions extending in opposite directions from the central portion beyond the sidewalls carrying contact surfaces, and means for resiliently positioning the contact member for movement between the walls and constantly urging the contact member toward an engaging position with the front surface, said means including an axially extending plunger having a cylindrical portion rotatably received in the counterbored portion, a cylindrical stem portion rotatable with the cylindrical portion, said stem portion extending from the cylindrical portion through the opening in the front wall and through the opening in the central portion of the contact member to provide a free end that is disposed forwardly of the central portion and a stop surface on the free end engaging a forwardly facing surface portion of the central portion of the contact member, and a spring having coils surrounding the stem portion and ends respectively engaging the spring seat and an end of the cylindrical portion for constantly maintaining the engagement between the stop surface and the contact member.

2. The combination as recited in claim 1 wherein the opening in the central portion of the contact member is elongated by a pair of notches extending from opposite sides of the opening along a first axis through the center of the opening, the central portion includes at least one pair of stops spaced on opposite sides of a second axis through the center of the opening that extends at an angle to the first axis and the stop surface on the free end of the stem portion is provided by a pin that extends from opposite sides of the plunger along an axis perpendicular to the axis of the plunger so that when the pin is rotated to a first rotative position wherein the axis of the pin and the first axis extend in a common plane the portions of the pin extending from opposite sides of the stem portion are received in the notches so that the movable contact member may be detached from the free end and when the plunger is rotated to a second rotative position wherein the axis of the pin and second axis extend in a common plane the portions of the pin will engage the central portion and the stops and thereby position the contact member on the free end.

3. The electric switch as recited in claim 1 wherein the combination includes a base having a slot in a rear wall of the base and an opening extending from the slot through a front wall of the base and a pair of stationary contacts mounted on opposite sides of the opening in the base and a portion of the movable contact carrier that provides the rear surface of the movable contact carrier is movable in the slot while a portion of the movable contact carrier providing the front surface extends through the opening in the base forwardly of the front wall of the base so that the contact surfaces on the contact member that is positioned on the front surface of the movable contact carrier engages the stationary contacts when the movable contact carrier is moved along the axis of the plunger.

4. The combination as recited in claim 3 wherein the opening in the central portion of the contact member is elongated by a pair of notches extending from opposite sides of the opening along a first axis through the center of the opening, the central portion includes at least one pair of stops spaced on opposite sides of a second axis through the center of the opening that extends at an angle to the first axis and the stop surface on the free end of the stem portion is provided by a pin that extends from opposite sides of the plunger along an axis perpendicular to the axis of the plunger so that when the pin is rotated to a first rotative position wherein the axis of the pin and the first axis extend in a common plane the portions of the pin extending from opposite sides of the stem portion are received in the notches so that the contact member may be detached from the free end and when the plunger is rotated to a second rotative position wherein the axis of the pin and the second axis extend in a common plane the portions of the pin will engage the central portion and the stops and thereby position the contact member on the free end.

5. The combination as recited in claim 1 wherein the contact member is a U-shaped channel member formed of laminated metals having different electrical conducting capabilities and different resistances to deflection.

6. The combination as recited in claim 2 wherein the edges of the notches are included that the pin may be readily rotated from the first rotative position to the second rotative position and the central portion includes two pairs of spaced stops that are positioned on opposite sides of the opening in the central portion.

7. The electric switch as recited in claim 3 wherein the combination includes a spring that is positioned between the rear surface of the movable contact carrier and a support for the switch to supply a force for constantly urging the contact member to a position wherein the contact surfaces on the contact member are separated from the stationary contacts.

8. The combination as recited in claim 1 wherein the walls on the front surface are provided by a pair of projections extending from the front surface on opposite sides of the bore.

9. The switch assembly as recited in claim 1 wherein the cylindrical portion includes an annular groove and an O-ring seal is positioned in the groove in sealing engagement with the

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cylindrical counterbore to reduce the bounce of the contact member when the contact surfaces of the contact member engage contact surfaces of a pair of stationary contacts.

10. The switch assembly as recited in claim 3 wherein the cylindrical portion includes an annular groove and an O-ring

seal is positioned in the groove in sealing engagement with the cylindrical counterbore to reduce the bounce of the contact member when the contact surfaces of the contact member engage contact surfaces of a pair of stationary contacts.

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