DOUBLE BLADE ROTOR SWITCH WITH BLADES INSERTABLE INTO ROTATABLE SHAFT

Abstract: A multipole, double-break, contact-rotor electrical switch is provided having an elongated rotor carrying a pair of radially extending contact blades at each pole with each blade being biased toward the other and having a single locator positioned between each pair of blades. The locator not only serves to continuously maintain its respective contact blades in spaced parallel relation upon being disengaged from stationary switch contacts, but additionally coats with the blades and the rotor to provide a self-locking assembly and restrains the blades against undesired longitudinal movement.
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FIELD OF THE INVENTION

This invention relates to electrical switching apparatus and particularly concerns multipole contact-rotor switches for bridging a pair of stationary contacts at each pole and providing a "double-break" action in each conductive path wherein the current is interrupted as two serially related points in each path.

BACKGROUND OF THE INVENTION

Contact-rotor-type switches commonly have presented problems in maintaining proper alignment of the movable contacts relative to the stationary contacts to ensure quick and easy switching action without binding, particularly during electrical overload tests, while continuing to provide full contact pressure. In addition, critical alignment and close dimensional tolerances frequently required by such switching apparatus of the known prior art have given rise to increased cost and time requirements in manufacture and assembly. Still further difficulties have been known to occur when the switches in closed circuit position are exposed to high fault levels of current tending to cause the contacts to separate or "pop" due to the electromagnetic forces effected by the current flow, resulting in arcing, melting and erosion of contact parts until the arc is extinguished whereupon the contacts weld.

OBJECTS OF THE INVENTION

A primary object of this invention is to provide a new and improved contact-rotor-type electrical switch exhibiting a high level of contact pressure when in a closed circuit position and which is particularly suited to minimize the commonly encountered problems of contact "popping" and welding under heavy overcurrent conditions.

Another object of the invention is to provide an improved switching apparatus of the type described requiring only minimal force to close the switch even during overcurrent conditions.

A further object of this invention is to provide an improved contact-rotor switch which not only is self-adjusting to accommodate manufacturing variations and tolerances but is also self-locking to maintain the components in assembled relation without any need for separate fasteners or additional parts.

Still another object of this invention is to provide an improved contact-rotor switch having minimal contact resistance wherein the switch is fully closed and which virtually eliminates requirements for critical dimensional relationships between component parts of the rotor assembly.

A still further object of this invention is to provide a contact-rotor switch of the above-described type having a minimum number of different parts in a relatively compact, rugged construction which is quick and easy to manufacture, assemble and disassemble while providing reliable operation over an extended service life.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

SUMMARY OF THE INVENTION

The above and related objects are achieved by the multipole switch construction of this invention which comprises a support having plural pairs of stationary contacts in spaced-apart relation with a rotor mounted therebetween and carrying at each pole a pair of bridging contact blades extending radially of the rotational axis of the rotor. Between each pair of contact blades a locator is trapped relative to the rotor in interposed aligned relation to its respective contact blades. The locator not only serves to capture the contact blades against undesired longitudinal movement radially of the rotor, but additionally serves to continuously maintain the blades spaced apart upon being disengaged from the stationary contacts whereby upon movement of the rotor to a closed circuit position, wherein the stationary contacts are received between the contact blades, only a minimal switch-closing force is required to separate the blades upon riding over the stationary contacts while continuously ensuring full contact pressure of the blades on opposite sides of each stationary contact and effectively neutralizing any tendency of the contact blades to "pop" or separate in closed circuit position.

A better understanding of the objects, advantages, features, properties and relationships of this invention will be obtained from the following detailed description and accompanying drawings which set forth an illustrative embodiment and are indicative of the way in which the principle of this invention is employed.

BRIEF DESCRIPTION OF DRAWINGS

In the drawings:

FIG. 1 is a front elevational view of an electrical switch incorporating this invention wherein its enclosure is shown open and partly broken away.

FIG. 2 is a fragmentary, enlarged side view, partly in section, taken generally along line 2—2 of FIG. 1.

FIG. 3 is an enlarged side view, partly broken away and partly in section, showing the rotor assembly of this invention with its contact blades in open circuit position.

FIG. 4 is a view similar to FIG. 3 showing the contact blades in closed circuit position.

FIG. 5 is an enlarged view, partly broken away and partly in section, taken generally along line 5—5 of FIG. 3.

FIG. 6 is an exploded isometric view of part of the rotor assembly of the switch of FIG. 1.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring in detail to the drawings wherein a contact-rotor electrical switching apparatus is shown incorporating a preferred embodiment of this invention, a generally rectangular enclosure 10 is shown housing the switch. The enclosure 10 includes a backwall 12 on which an insulating base 14 is secured by suitable fasteners 16. The insulating base 14 rotatably supports a left-hand end of a contact rotor 18 in a manner fully described in U.S. Pat. No. 3,114,024 of R. S. Tillson, issued Dec. 10, 1963, entitled "Enclosed Multipole Switch with Removable Contact Carrier" and assigned to the assignee of this invention. The right-hand end of the rotor 18 is drivingly connected to an operating member 20 pivotally supported on a pin in a sidewall 24 of the enclosure 10 and connected by a link 26 to a manually operable handle 28 supported on a pivot pin 30 also mounted in the sidewall 24 of the enclosure 10. Three line terminal contacts 32 are shown screw mounted on the base 14, and a set of fuse terminal contacts 34 corresponding in number to the line terminal contacts 32 are similarly fixed on the base 14 with generally planar main contact portions 35 and 36 of the line and fuse terminal contacts 32 and 34 being in spaced aligned relation on diametrically opposite sides of the rotor 18 and contained in a common vertical plane. Suitably attached to each fuse terminal contact 34 is a suitable clip 37 formed in closely spaced offset relation to its vertical main contact portion 36 for receiving a blade 38 of fuse 40, and suitable arc shields 42 are preferably provided for each pair of stationary contacts 32, 34.

Referring now to the rotor assembly, the contact rotor 18 comprises an elongated insulating member formed, e.g., with a suitable nonconductive plastic body having three longitudinally spaced, aligned transverse openings 44 (only one shown in FIG. 6) axially extending through three enlarged hub portions 46 in perpendicular relation to the rotational axis X—X of the rotor 18. A generally oblong bearing flange 48 formed on an intermediate portion of the rotor 18 bears against projecting blades 50 on the base 14 during normal operation of the rotor 18. The bearing flange 48 and the left-hand hub portion 46 coact with adjacent portions of the base 14 to prevent unintended axial rotor movement while also per-
mitting removal of the rotor 18 upon rotating it a sufficient angular distance to clear the projecting stops 50 after disengaging the rotor 18 from its operating member 20 as fully described in the above-referenced patent.

To provide a self-locking and self-adjusting bridging contact blade arrangement which effectively minimizes the objectionable problems of contact "popping" and welding in a switch requiring only a minimal amount of closing force without having any critical alignment requirements and which is quickly and easily manufactured and assembled, a pair of coextensive contact blades 52, 52 are fitted in each transverse opening 44 for bridging their respective pair of stationary contacts 32, 34, and a spacer member or contact blade locator 54 of any suitable material, either insulating or conducting, is trapped relative to the rotor 18 in accordance with this invention between the contact blades. The single locator 54 not only serves to continuously maintain the adjacent contact blades 52, 52 in spaced parallel relation upon disengagement from the stationary contacts 32, 34, but also restrains the contact blades 52, 52 against any undesired longitudinal displacement laterally, i.e., radially, of the rotor 18. Since each pair of bridging contact blades 52, 52 and their supporting components are identical at each pole of the electrical switch, the rotor assembly will be described in connection with one pair of contact blades.

The contact blades 52, 52 are preferably of identical construction and are formed of a suitable conductive material in a channel-shaped or generally U-shaped section. Each pair of blades 52, 52 are disposed in back-to-back relation with confronting surfaces 56, 56 of the blades 52, 52 each having a pair of projections 58, 58 respectively engaging opposite ends of the locator 54 interposed between the blades 52, 52. Full bearing support accordingly is provided by opposite planar surfaces on the locator 54 for each of the contact blades 52, 52 which are resiliently biased toward one another by a pair of flat leaf contact springs 60, 60. The contact springs 60, 60 each have a bowed intermediate portion engaging the rotor 18 within its opening 44, and opposite free end portions of each spring 60, 60 engage the contact blades 52, 52 in outwardly disposed relation to opposite sides of the rotor 18. The free end portions of the springs 60, 60 are preferably seated as shown within depressions 62, 62 formed in the outer surfaces 64, 64 of the contact blades 52, 52 and are thereby captured against unintended movement.

More specifically, the locator 54 is a flat member having a length less than that of the contact blades 52, 52 but greater than the transverse dimension of the rotor opening 44 and is positioned centrally between the contact blades 52, 52 in assembled position. The ends of the locator 54 each have a pair of shoulders 66, 66 projecting in opposite directions for engaging outside surfaces of the rotor 18 surrounding its transverse opening 44. The transverse rotor opening 44 is dimensioned to register in the locator 54 while the locator is inserted diagonally through its opening 44 to dispose the locator 54 centrally of the rotor 18. Following its insertion, the locator 54 is merely rotated 45° to dispose its shoulders 66, 66 in interfering relation to axial movement of the locator 54 within the rotor 18. The contact blades 52, 52 are then inserted through the opening 44 on opposite planar surfaces of the locator 54, and the flat leaf springs 60, 60 are each slid into position behind their respective contact blades 52, 52 with the free end portions of the springs 60, 60 seated in the blade depressions 62, 62. The components are accordingly automatically locked in stacked assembly relative to the rotor 18 by the engagement of the rotor by the shoulders 66, 66 of the locator 54 which in turn is firmly trapped against movement by the contact blade projections 58, 58. Upon mounting the rotor assembly on the base 14, the rotor openings 44 are generally axially aligned with the common plane of the main contact portions 35, 36 of their respective stationary contacts 32, 34.

Disengagement of the contact blades 52, 52 is accomplished by simply removing the contact biasing springs 60, 60 wherein the contact blades 52, 52 and locator 54 may be readily withdrawn from the rotor 18.

To ensure quick and easy closing of the switch even under overload test conditions, the locator 54 is formed with a thickness less than that of the stationary contacts 32, 34 and is generally located in alignment with the common plane of the stationary contacts 32, 34. Upon rotating the rotor 18 in its contact closing direction from its open circuit position shown in full lines in FIG. 2, to its phantom line closed circuit position, wherein the stationary contacts 32, 34 are received between the contact blades 52, 52, blade spreading or blade separation axially of the rotor 18 against the biasing force of the springs 60, 60 is reduced thereby to correspondingly minimize the contact closing force required by the switch. The biasing forces imposed by the springs 60, 60, together with the interengagement between the fixed locator 54 and the contact blades 52, 52 assures that the components will be continuously maintained against longitudinal displacement.

To ensure dependable contact engagement and positive contact pressure while assisting in minimizing the effects of any contact misalignment, the specific illustrated embodiment of this invention is shown with opposite end portions of each contact blade 52 having partispherical protrusions 68, 68 directed inwardly toward the other contact blade 52 to predetermine the point of contact engagement with its respective stationary contact 32, 34. The channel shape of each contact blade 52 continues throughout the entire length of each blade not only to provide rigidity, but also to effect a desirable entrance angle upon moving the rotor 18 toward closed circuit position. In view of such construction, any undesired burning and pitting of the blades 52, 52 and/or stationary contacts 32, 34 which may occur (typically upon opening a switch under load) will tend to be limited to the arcuate side edge portions of the blades 52, 52 and outer edge portions of the stationary contacts 32, 34, thereby minimizing any undesired contact resistance upon moving the switch into fully closed circuit position.

By virtue of the described double-blade construction incorporated in the rotor assembly of this invention, the blades 52, 52 act to effectively neutralize undesirable effects of electromagnetic forces generated in the blades 52, 52 upon occurrence of abnormally high current or overcurrent conditions, which normally tend to force a movable blade of a single-blade rotor switch away from its stationary contact when the electromagnetic forces exceed the mechanical forces holding the movable contact members in closed circuit position. While the current flow through a first blade 52 of the double-blade rotor switch of this invention may be sufficiently high to produce attractive force which would normally overcome the biasing force of its contact spring, the EMF generated by the current flowing in the second blade 52 will produce a magnetic force attracting the first blade toward its stationary contact to effectively overcome any tendency of the blades 52, 52 to be separated against the biasing forces of their contact springs 60, 60 thereby to significantly preclude any tendency of the disclosed double-blade rotor switch construction to be subjected to the troublesome problems of contact "popping" and welding. Additionally, this problem is precluded by the decreased current density inherent in the double-blade structure.

Since no highly conductive parts are required to be flexed upon closure of the switch, the contact-rotor switch of the above-described construction will be seen to provide dependable contact engagement and full contact pressure which is solely determined by the contact springs. An easily closed switching movement is ensured in addition to minimizing the objectionable problem of contact "popping" and welding so commonly encountered in known prior art apparatus. In addition, manufacture, assembly and disassembly of the rotor assembly of this invention is facilitated by the self-locking feature of the stacked rotor components within the rotor body without requiring any separate fastening or retaining members whatsoever. The self-locking capability further facilitates and enables the ability to resiliently adjust the stationary contacts further minimizing the costs of manufacture and assembly in reducing the normally critical dimensional relationship between parts.
and accommodates variations in the positioning of the rotor relative to the switch base. Moreover, the switching apparatus of this invention is particularly suited for rugged, dependable operation over an extended period of time with minimal service requirements.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electrical switching apparatus comprising:
   a. a support having a pair of spaced-apart stationary contacts thereon,
   b. a rotor mounted on said support and carrying a pair of bridging contact blades extending laterally of the rotational axis of the rotor for angular movement in opposite contact opening and closing directions,
   c. a locator trapped relative to the rotor between the contact blades in interfering relation to longitudinal displacement thereof laterally of the rotor while continuously maintaining the contact blades in spaced parallel relation upon disengagement from the stationary contact,
   d. the contact blades being biased toward one another for intimately engaging each stationary contact upon rotating the rotor in a contact closing direction to a closed circuit position with the stationary contact interposed between the contact blades,
   e. said rotor having a transverse opening therethrough,
   f. said contact blades and said locator extending through said rotor opening,
   g. said locator having a length less than that of said contact blades but greater than the transverse dimension of said rotor opening,
   h. said locator being positioned centrally between said contact blades,
   i. said contact blades each having confronting surfaces having a pair of projections respectively engaging opposite ends of said locator, and
   j. the opposite ends of said locator each having an enlarged portion providing shoulders for engaging said rotor and portions coacting with said contact blade projections to retain said contact blades and said locator in assembled relation against unintended longitudinal displacement relative to said rotor.

2. Electrical switching apparatus comprising:
   a. a support having a pair of spaced-apart stationary contacts thereon,
   b. an elongated rotor mounted on said support and extending longitudinally between said stationary contacts in a direction substantially perpendicular to a line drawn between said contacts,
   c. said rotor having a noncircular opening extending therethrough in a direction at right angles to its longitu-
   dinal axis, said opening having a width dimension in a direction parallel to said longitudinal axis, said opening having a height dimension in a direction at right angles to said width dimension, said opening having a length dimension in a direction extending transversely of said rotor and substantially perpendicular to said longitudinal axis,
   e. a combined spacer-and-locator member in said opening of said rotor, the intermediate portion of said member having a width slightly less than said height of said opening, said member having abutment shoulders at its opposite end portions engaging a wall of said rotor adjacent said opening and preventing substantial longitudinal movement of said member when in operating position in said opening,
   f. a pair of elongated contact blades in said opening on opposite sides of said spacer-locator member, abutment portions carried by each of said contact blades and engaging said spacer-locator member and preventing substantial longitudinal movement of said blades in said hole when in operative position,
   g. biasing means carried by said rotor and acting between a wall of said opening and at least one of said contact blades and urging said contact blade toward the other of said contact blades,
   h. said abutments on said spacer-locator member being spaced and dimensioned so that said member can pass through said opening when tilted in diagonal relation to said generally rectangular opening and then rotated to its operative position,
   i. said contact blades having no transverse dimension greater than said height of said opening, whereby each of said contact blades can be slid endwise into said opening to a position in which said biasing means acts thereon to move said contact blade laterally into operative position in engagement with said spacer-locator member.

3. Electrical switching apparatus as set forth in claim 2 in which said biasing means comprises a pair of spring members, each acting between a wall of said opening and one of said contact blades, said pair of spring members serving to hold said contact blades and said spacer member generally centrally of said opening.

4. Electrical switching apparatus as set forth in claim 2 in which said biasing means comprises a pair of elongated flat strip bowed spring members each having a flat side against a corresponding flat wall of said opening and serving to maintain said contact blade assembly in stable normal position with the major flat planar surfaces of said contact blades parallel to each other and substantially perpendicular to the axis of said rotor.

5. Electrical switching apparatus as set forth in claim 4 in which the elongated contact blades have a generally U-shaped cross section substantially uniformly throughout the length thereof.

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