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ROTARY ELECTRICAL SWITCH

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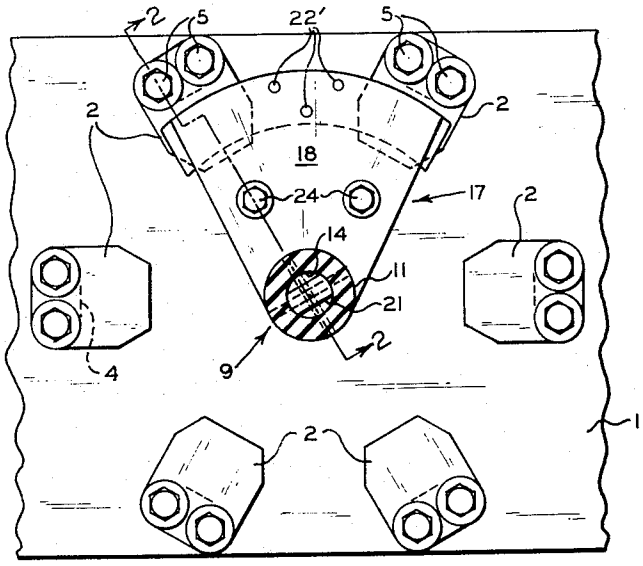

FIG. 1

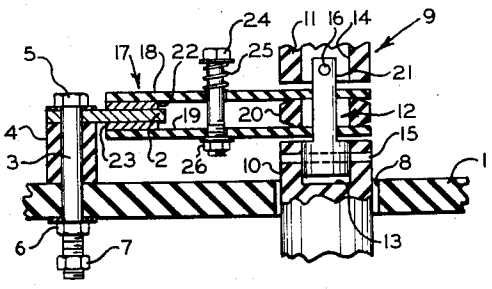

FIG. 2

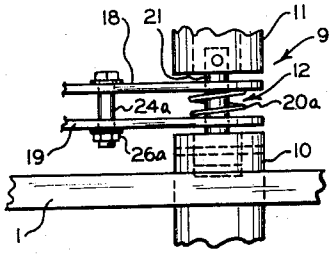

FIG. 3

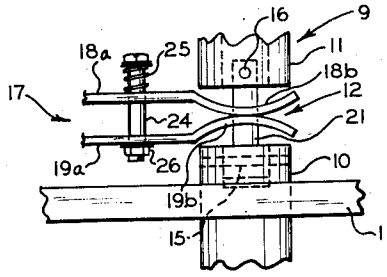

FIG. 4

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ROTARY ELECTRICAL SWITCH

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This invention relates to electrical switches and more particularly to a rotary switch construction especially adapted for use in circuits involving extremely high electric potential such, for example, as would be required of a transformer tap changer.

In the past, high voltage rotary switches have had the majority of their component parts formed of electrically conductive material necessitating the use of insulating means for some of the component parts and requiring the switches to have large overall dimensions to reduce the possibility of arc-over. Aside from the expense of manufacturing large, multiple part rotary switches, the use of multiple parts detracts from the desirability of such switches because of the greater likelihood of failure of a switch composed of many parts as compared to a switch composed of relatively few parts. The resistance to failure of the parts of the rotary switch is especially important when the switch is used as a transformer tap changer because it frequently is necessary for a transformer tap changer to carry heavy, short circuit current which may be as high as twenty-five times the normal current.

An object of this invention is to provide a rotary switch construction which incorporates a minimum number of parts so as to minimize the likelihood of failure of the switch components.

Another object of the invention is to provide a rotary switch construction utilizing a minimum amount of conductive material so as to enable the overall dimensions of the switch to be reduced.

A further object of the invention is to provide a switch of the kind referred to in which the contact pressure of the movable contacts may be adjusted or set manually and in which the contacts thereafter are self-adjustable to compensate for wear.

Still a further object of the invention is to provide an improved rotary switch construction in which magnetic forces add to the mechanical contact pressure acting on the contacts.

Other objects and advantages of the invention will be pointed out specifically or will become apparent from the following description when it is considered in conjunction with the appended claims and the accompanying drawings, in which:

Figure 1 is fragmentary view partly in elevation and partly in section of a mounting panel equipped with a rotary switch constructed in accordance with one embodiment of the invention;

Figure 2 is a transverse sectional view of the apparatus shown in Figure 1;

Figure 3 is a fragmentary, side elevational view of an embodiment of the invention; and

Figure 4 is a fragmentary, side elevational view of another embodiment of the invention.

A rotary switch constructed in accordance with any of the embodiments of the invention is adapted for installation on an insulating panel 1 formed of laminated nylon,

phenolic material such as "Bakelite," or other suitable insulating material and on which is mounted a plurality of stationary contact elements 2 formed of electrically conductive material such as copper. As is best shown in Figure 1, the contact elements 2 are arranged in arcuate or circular form and each of the contact elements is mounted on the panel 1 by means of a pair of metallic bolts 3 which extend through openings in the panel 1 and through corresponding openings in the elements 2. Each of the contact elements is spaced from the panel 1 by means of a spacer 4 formed of insulating material of the kind above referred to and the elements 2 are maintained rigid relative to the panel by the compressive action of the heads 5 of the bolts and nuts 6 threaded on the lower end of the bolts. Each of the bolts may be provided with a second nut 7 by means of which an electrical conductor (not shown) may be connected to the elements 2 through the bolts 3.

At the center of the arc or circle defined by the stationary contacts 2 the panel 1 is provided with an opening 8 in which is rotatably journaled a driving member 9 composed of a pair of adjacent shaft sections 10 and 11 spaced apart and connected by a connecting link or inner shaft element 12 which is received in hollowed out portions 13 and 14 formed in the shaft sections 10 and 11, respectively. The link 12 is fixed at one of its ends to the shaft section 10 by means of a pin 15 and at its other end to the other shaft section 11 by means of a similar pin 16. The driving member 9, i.e., the shaft sections 10, 11 and 12, are formed of non-conducting material of the kind previously referred to, but the pins 15 and 16 may be of metal, if desired.

In the embodiment of the invention disclosed in Figures 1 and 2, the switch includes a bridging device 17 composed of a pair of segment-shaped plates 18 and 19 formed of non-conductive material, such as has been described, and spaced apart from each other. The outer ends of the plates should be of such length as to bridge the space between adjacent pairs of contacts 2, as is shown in Figure 1. The plates 18 and 19 are spaced apart by a spacer element 20 of annular form which surrounds the shaft section 12. As is best shown in Figure 2, the shaft section 12 has a reduced shank 21 which is substantially rectangular in cross section and which extends through correspondingly shaped openings in the radially inner ends of the plates 18 and 19. The openings in the plates preferably are of slightly greater area than the cross-sectional area of the shaft section 21 so that the plates 18 and 19 may slide on the shank 21 for a purpose presently to be explained, but the openings in the plates should not be so large as to prevent turning of the plates by the driver 9. The plates 18 and 19 are provided adjacent to their radially outermost edges with electrically conductive surfaces 22 and 23, respectively, formed of copper or the like, the surfaces 22 and 23 being so arranged as to bear or engage opposite sides of the contact elements 2. The parts 22 and 23 may be fixed on their respective plates by any suitable means such as rivets 22'.

Means for yieldably urging the conductive surfaces 22 and 23 towards each other is provided and comprises, in the Figure 2 embodiment, a pair of bolts 24 headed at corresponding ends and threaded at the opposite ends and extending through openings formed in the plates 18 and 19 intermediate the ends of the latter, each of the bolts 24 being surrounded by a compression spring 25 which reacts between the headed end of its associated bolt and one of the plates of the bridging device to urge the contact surfaces 22 and 23 towards one another. The bolt accommodating openings preferably are of somewhat greater diameter than the diameter of the bolt shanks so as to enable the plates to slide on the bolts with ease.

The mechanical force by which the plates are urged together may be adjusted by manipulation of a nut **26** on the threaded end of each of the bolts **24**. The movements of the plates towards and away from one another is facilitated by the sliding fit of the plates on the reduced shank portion **21** of the shaft section **12** and is further facilitated by the provision of beveled edges at the periphery of the spacer **20**.

In the illustrative embodiment of the invention shown in Figures 1 and 2, the only electrically conductive parts of the switch are the contact surfaces **2**, **22**, and **23**; the metallic bolts **3**, **24** and their associated fittings; the springs **25**; and the pins **15** and **16**. All the other parts are made from insulating material. Accordingly, the overall dimensions of the switch may be materially smaller than the previously known switches and the use of insulating material around such parts as the springs **25** and the bolts **24** is avoided.

The mechanical operation of the apparatus described thus far is similar to the operation of known rotary switches in that manipulation of the rotary driving member **9** will effect rotation of the bridging device **17** so as to cause the distance between two adjacent fixed contacts **2** to be bridged by the current carrying surfaces **22** and **23**. Movement of the bridging device **17** from contact to contact may be characterized as a wiping movement inasmuch as the bias of the springs **25** causes the contact surfaces **22** and **23** to bear against the surfaces of the contact **2** with some degree of force, thereby tending to clean the contact surfaces of any carbon or sludge formations which may be present, especially if the tap changer is used on a transformer of the oil cooled kind. In this connection, it is preferred that the fixed contacts **2** be spaced by the parts **4** from the panel **2** as shown so that any sludge which may form adjacent to the contacts will not interfere with the contacts or the bridging device.

As has been pointed out previously, the plates **18** and **19** are mounted on the driving member with a sliding fit. The sliding fit of the plates, coupled with the provision of the spacer **20** and the yieldable biasing springs **25**, enables the contact surfaces **22** and **23** to be self adjusting to compensate for wear of the parts to assure firm contact between the surfaces **22**, **23** and the contacts **2**. The mechanical biasing of the plates towards one another is assisted, during the flow of currents along the parallel paths of the surfaces **22** and **23**, by the magnetic forces created by the flow of current. Currents of high magnitude sometimes may flow through the bridging device and because of this it is preferred to make the contact **2** and the surfaces **22** and **23** flat so as to minimize the possibility of arcing during the making and breaking of a circuit.

The embodiment of the invention disclosed in Figure 3 of the drawing is similar to the embodiment previously described, but differs from the latter in that the plates **18** and **19** are spaced apart by a compression spring **20***a* which is interposed between the plates and surrounds the shank **21** of the shaft section **12**. The plates **18** and **19** are apertured to accommodate bolts **24***a* similar to the bolts **24** with the exception that the bolts **24***a* do not have any biasing spring associated therewith. The bolts **24***a* function as fulcrum points about which the plates rock under the influence of the spring **20***a*, and the arrangement is such that the expansive force of the spring **20***a* causes the radially outer ends of the plates to be urged towards one another. Thus, the spring **20***a* not only serves to space the plates apart, but also functions to urge the radially outer ends of the plates towards each other. The force by which the outer ends of the plates are urged towards each other may be regulated by manipulation of a nut **26***a* on the threaded end of each of the bolts **24***a*. The operation of the embodiment shown in Figure 3 is similar to the operation of the Figure 2 embodiment.

In the embodiment illustrated in Figure 4, two plates **18***a* and **19***a* constitute the bridging device and are similar to the plates **18** and **19** with the exception that the radially inner ends are bowed convexly towards one another so as to permit rocking of the plates towards and away from one another under the influence of the springs **25** mounted on the bolts **24**, the latter being arranged in a manner identical to that previously discussed in connection with Figures 1 and 2. The operation of the device shown in Figure 4 again is similar to the operation of the apparatus shown in Figures 2 and 3.

The disclosed embodiments are representative of presently preferred forms of the invention, but are intended to be illustrative rather than definitive thereof. The invention is defined in the claims.

I claim:

1. A rotary switch construction comprising a mounting panel; a number of electrical contact elements; means mounting said contact elements on said panel in spaced apart arcuate form; a bridging device for bridging and electrically connecting any adjacent two of said contact elements, said device comprising spaced apart first and second plate members each formed of non-conducting material and each provided with an electrically conductive surface adapted to conduct electric energy from one contact element to another, said conductive surfaces being so arranged as to engage opposite surfaces of the contact elements; a rotary driving member located at the center of the arc defined by said contact elements and to which the plates of said bridging device are drivingly connected, said plates being mounted on said driving member for movements relative to the latter in directions to increase or decrease the space between said plates; and yieldable means remote from said conductive surfaces reacting on the plates of said bridging device to urge said conductive surfaces of the latter towards one another.

2. The construction set forth in claim 1 wherein said rotary driving member is formed of non-conductive material.

3. The construction set forth in claim 2 wherein said rotary driving member comprises a shaft having a non-circular cross-section extending through correspondingly shaped openings in the plates of said bridging device, said openings being larger than said shaft to permit sliding movements of said plates relative to said shaft.

4. The construction set forth in claim 3 including a spacer element around said shaft and interposed between said plates.

5. The construction set forth in claim 4 wherein said spacer element is annular in configuration and has its peripheral edge beveled.

6. The construction set forth in claim 4 wherein said yieldable means is located intermediate said shaft and said electrically conductive surfaces.

7. The construction set forth in claim 4 wherein said spacer element comprises a spring and wherein said spring also constitutes said yieldable means.

8. The construction set forth in claim 2 wherein each of said plates is bowed convexly towards the other in the region where said shaft passes through it for spacing said plates apart and to provide a fulcrum about which said plates may rock towards and away from each other.

9. The construction set forth in claim 8 wherein said yieldable means is located intermediate the bowed regions of said plates and the electrically conductive surfaces.

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