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 RECIPROCATING CONTACT DEVICE WITH SMOOTHLY
 CONTOURED BRIDGE CONTACTORS
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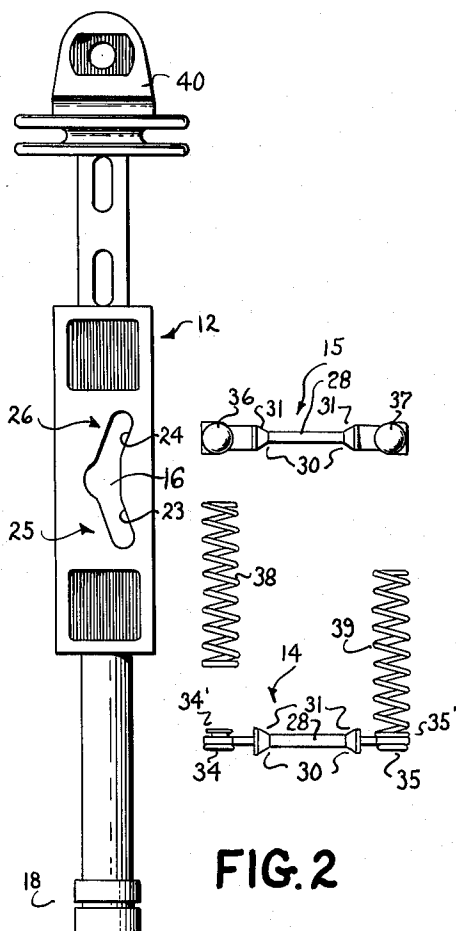


FIG. 2

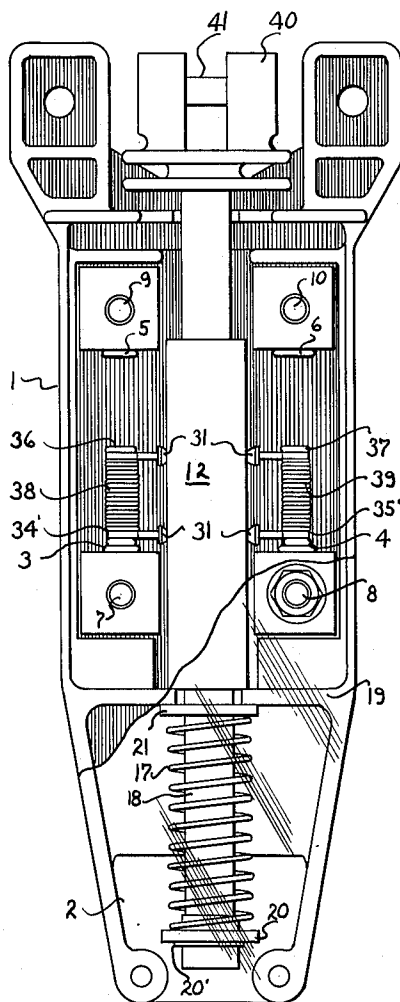


FIG. 1

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1

3,230,322

RECIPROCATING CONTACT DEVICE WITH SMOOTHLY CONTOURED BRIDGE CONTACTORS

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8 Claims. (Cl. 200-16)

This invention relates to improvements in electrical contact devices and more particularly to a new and improved contact mechanism for electrical contact devices of the reciprocating contact type. Although not limited thereto, this invention is especially suited for the construction of auxiliary or control switches such as, for example, switches employed on electromagnetic contactors.

Electrical contact devices for use in dirty atmosphere, heavy duty applications are usually provided with some type of wiping or sliding action which operates to clean the contact surfaces by sliding one contact surface on the other to remove any foreign matter therefrom. This sliding action has heretofore been difficult to achieve in linear movement contact devices without increasing the contact wear excessively, requiring an excessive contact travel, or both. As a result, the prior art devices of the linear movement type have not been satisfactory for dirty atmosphere, heavy duty applications.

With the advent of low cost molding compositions having high mechanical strength, low coefficients of friction and high electrical insulation properties, further attempts were made to provide contact devices of the linear movement type for these dirty atmosphere operating conditions. Although such prior art devices were almost completely sealed from the dirt of the surrounding atmosphere, tended to substantially avoid sticking due to the dirt which could enter the device and had some degree of wiping action, they were still not satisfactory.

We have discovered that although this prior art construction substantially solved the commonly recognized problems associated with the dirty atmosphere operating conditions, new problems were introduced due to the new construction itself. We have discovered, for example, that the sliding of metal parts on the electrical insulating material of the device and the sliding of the contacts on one another produced electrostatically charged particles within the contact mechanism itself. These charged particles tended to fall on the contact surfaces and moreover were even attracted to them due to the electric field of the completed electric circuit. It has been further discovered that the better the insulation properties of the insulating material employed, the more aggravated and serious the problem becomes. This is due, in part at least, to the increased charge on the particles and the insulation properties thereof.

It is an object of this invention therefore, to provide a linear movement type electrical contact device which substantially overcomes one or more of the prior art difficulties and is more reliable.

It is another object of this invention to provide a linear movement type electrical contact device which is capable of providing for a large amount of sliding action between contact surfaces within a minimum amount of linear device movement.

It is still another object of this invention to provide a linear movement type electrical contact device wherein the amount of contact sliding action is independent of the amount or character of the contact wear.

It is a further object of this invention to provide an electrical contact device having extremely long life even in contaminated atmospheres.

2

Briefly stated, in accordance with one aspect of this invention, the improved electrical contact device comprises at least one pair of spaced contacts each adapted to be shunted by engagement with a contact bridge. The contact bridges are carried by a contact carrier of electrically insulating material and are arranged thereon for movement therewith and relative thereto. Movement of the contact carrier causes the contact bridges to be engaged and disengaged from the respective spaced contacts. Cam surface means are provided on the contact carrier operative to produce a positive tangential movement between the spaced contacts and the contact member engaged therewith as the contact bridge is moved relative to the contact carrier in response to the engagement and disengagement of the contact bridge with the pair of spaced contacts.

The novel features believed characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof as well as its organization and method of operation can best be understood by reference to the following description taken in conjunction with the accompanying drawing in which:

FIG. 1 is a plan view of a double pole double throw contact device in accordance with one embodiment of this invention; and,

FIG. 2 is a detail view of the contact carrier member with the contact bridges and springs thereof partially disassembled.

As shown in FIGS. 1 and 2, the invention is incorporated for purposes of illustration in a double pole-double throw electrical contact device comprising a contact mechanism mounted within a housing body 1 having a cover 2 partially removed. The housing body 1 and cover 2 may be made of any suitable electrically insulating material in accordance with known techniques, such as by molding, for example.

Two pairs of spaced stationary contacts 3, 4 and 5, 6 are mounted within the housing body 2 near opposite ends thereof. The contacts are adapted to be connected to suitable external electrical circuits (not shown). To this end, contacts 3, 4 and 5, 6 are provided with suitable circuit connecting means, such as for example, the terminals 7, 8 and 9, 10 respectively. The contacts are selectively opened and closed by movement of a contact carrying member 12 made of suitable electrically insulating material and movably mounted within the housing body 2. Contact carrying member 12 carries a pair of contact bridges 14 and 15 within an opening 16 thereof which are arranged, when in contact with the stationary contacts, to shunt the stationary contacts 3, 4 and 5, 6 respectively.

A spring 17 is provided between the end 18 of contact carrying member 12 and a wall 19 of housing body 2 and is operative to urge the contact carrying member 12 downwardly so that, in the normal position of the contact device shown, the contact bridge 14 shunts the stationary contacts 3, 4. Spring 17 may be retained on the contact member 12 for example by a washer 20 and snap ring 20' which fits into a groove in the end 18. A washer 21 is interposed between spring 17 and wall 19 and provides the normal bias for contact carrier member 12 in the downward direction.

The opening 16 in contact carrying member 12 is shown more clearly in FIG. 2 and comprises a transverse aperture 21 having cam surfaces 23 and 24 associated with and extending from the aperture 21. As shown, the cam surfaces are provided by the slots 25 and 26 extending from the aperture 21 at a preselected angle with the longitudinal axis of contact carrier member 12. The contact bridges 14 and 15 fit within the opening and are guided by the cam surfaces 23 and 24 thereof as

they move toward and away from each other upon making and breaking contact with the respective stationary contact 3, 4, or 5, 6. Thus, movement of the contact bridges 14 and 15 on the respective cam surfaces 23 or 24 is operative to impart a transverse movement to the contact bridges. The cam surface 23 provides for positive sliding action between contact bridge 14 and stationary contacts 3, 4 while the cam surface 24 provides for positive sliding action between contact bridge 15 and stationary contacts 5, 6. Since the amount of sliding is produced by this cam action, it is positive and completely independent of the condition of the contact surfaces. Moreover, by proper selection of the cam angle, a desired amount of sliding action may be provided even though there may be only a very small linear movement.

The contact bridges 14 and 15 are each provided with a smooth cylindrical central portion 28 which blends smoothly at each end 30 thereof into a portion 31 of generally conical configuration. The portions 31 serve to retain the contact bridges within the cam surface portions of the opening 16. To provide for better guiding action, the edges of the aperture 16 may be chamfered preferably at an angle substantially the same as that of the conical end portions 31. The smooth cylindrical central portion of the contact bridges allows for smooth sliding movement along the cam surface of the opening 16 with virtually no wear and no production of insulating particles from the contact carrying member due to such movement thereby contributing greatly to the operating lifetime of the device. In addition, by providing the smooth blending of the cylindrical central portion to the enlarged conical end portions, virtually no wear or production of insulating particles result from the sliding movement of these regions with the edges of the opening 16.

Contact bridges 14 and 15 each have a pair of contact tips 34, 35 and 36, 37 respectively which face away from each other as shown. Bridges 14 and 15 are urged apart and toward the cam surfaced portion of opening 16 by the two interiorly disposed springs 38 and 39 at the respective ends thereof. The inner portions 34', 35' and 36', 37' of contact end portions 38 and 39 are provided with shoulders, shown clearly at 34' in FIG. 2, upon which a coil of each end of the springs 38 and 39 fit and lock. The use of the two spaced apart springs 38 and 39 at the ends of contact bridges 14 and 15 allows for a large sliding action for even a very small movement of the contact carrying member 12. In addition, the two springs operate to reduce fluttering of the contact bridges when the contact carrying member 12 is subjected to rapid, snap-type actuation such as, for example, when the force applied thereto to bring the contact tips 36, 37 of contact bridge 15 into contact with the stationary contacts 5, 6 is suddenly removed and the spring 17 is allowed to rapidly return the contact carrying member 12 to its normal position.

To assure that only one pair of contacts, 3, 4 or 5, 6, will be closed at any one time, the distance between the contact bridges 14 and 15 with the springs 38 and 39 free of compression should be made less than the distance between their related stationary contacts 3, 4 and 5, 6.

The contacts may be opened and closed by application of a suitable force on the end 40 of contact carrying member 12, which extends from one end of housing body 2. Conveniently, the end 40 may form a clevis to which a suitable actuating means, such as for example the linkage from an electromagnetic contactor, may be connected by the pin 41.

There has been described, therefore, a double pole, double throw switch where circuits may be completed through wires attached to the terminals 7, 8 and 9, 10 respectively. A first electric circuit is normally complete through the terminal 7 to the stationary contact 3 across the contact bridge 14 and into the stationary contact 4

and terminal 8 when the contact carrying member 12 is held in the downward direction shown by its return spring 17.

When a suitable force is applied to the end 40 of contact carrying member 12, contact bridge 14 begins to move laterally due to the cam action of the guide wall while the springs 38 and 39 are moving out of compression until eventually contact carrying member 12 has moved sufficiently to cause contact bridge contact tips 34 and 35 to move out of contact with stationary contacts 3, 4. That is, there is a tangential movement between the surfaces of the spaced contacts and the contact tips of the contact bridge due to the relative movement of the contact bridge with respect to the contact carrier as the contact bridge moves both into and out of engagement with the spaced contacts. When this relative movement is produced, the contact bridge is caused to traverse the cam surface of the contact carrier thereby producing a positive movement. Further motion of contact carrying member 12 brings the contact tips 36, 37 of contact bridge 15 into contact with the stationary contacts 5, 6. Again as the central portion of contact bridge 15 traverses the cam surface, it is caused by move laterally with respect to the longitudinal axis of the contact carrier producing a positive sliding action, or tangential movement, between the stationary contacts and the contact tips 36, 37 of contact bridge 15.

When contact tips 36, 37 are in contact with the stationary contacts 5, 6, therefore, the circuit is completed through the terminal 9, stationary contact 5, across contact bridge 15 and into the stationary contact 6 to the terminal 10.

Although the invention has been described in detail with respect to a double pole-double throw contact device, it will be understood that the invention is not limited to such a device. Further, the contact carrier has been indicated as being mounted within the housing for linear sliding movement, however, it will be understood that the contact carrier may be mounted so as to have any desired type of motion operative to engage and disengage the contact bridges and the spaced contacts. Thus, the contact carrier may be suitably pivoted and actuated by any convenient means such as a cam, for example, engaging an extension thereof.

While only preferred features of the invention have been shown by way of illustration, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. An electrical contact device comprising: a housing of electrically insulating material; at least one pair of spaced contacts mounted in said housing; a contact carrier of electrically insulating material arranged for movement in said housing relative to said spaced contacts, said contact carrier having a transverse aperture therethrough defining a cam surface region for each pair of spaced contacts; a contact bridge for each pair of spaced contacts mounted on said contact carrier for movement therewith and relative thereto, said contact bridge having a smoothly contoured central portion having a contact tip at each end thereof adapted to shunt said spaced contacts when engaged therewith; resilient means at the ends of said contact bridge and between a corresponding member carried by said contact carrier opposite said contact bridge for urging said contact bridge toward one end of said cam surface region so that movement of said contact bridge relative to said contact carrier causes a portion of said contact bridge to traverse said cam surface; means for actuating said contact carrier to move said contact bridge into and out of engagement with its associated pair of spaced contacts, said engagement and disengagement being operative to cause said contact bridge to move

5

with respect to said contact carrier and be guided by said cam surface region thereof to produce a positive tangential movement between said contact bridge and the pair of spaced contacts shunted thereby.

2. An electrical contact device comprising: a housing of electrically insulating material; first and second pairs of spaced contacts mounted at opposite ends of said housing respectively; a contact carrier of electrically insulating material movably mounted within said housing, said contact carrier having a transverse aperture there-through defining first and second cam surface regions; first and second contact bridges mounted on said contact carrier each having a smoothly contoured central portion and contact tips at each end thereof adapted to engage said spaced contacts and provide a shunt therefor, the central portion of said contact bridges being disposed within said aperture to allow for movement of said contact bridge relative to said contact carrier; resilient means at the ends of and between said contact bridges arranged to urge said contact bridges apart and toward one end of their associated cam surface region; means for actuating said contact carrier to selectively bring the respective contact bridges into and out of engagement with the associated pair of spaced contacts, said engagement and disengagement being operative to cause the associated contact bridge to move relative to the contact carrier and be guided by its respective cam surface region to produce a positive tangential movement between the contact tips of said contact bridge and the pair of spaced contacts engaged thereby.

3. The electrical contact device of claim 2 wherein the central portion of said contact bridge is of smooth cylindrical configuration blending toward each end into a region of generally conical configuration.

4. The electrical contact device of claim 2 wherein said cam surface regions are provided by first and second oppositely directed slots disposed at a preselected angle with respect to the direction of motion of said contact carrier.

5. A contact mechanism for an electrical contact device including a housing of electrically insulating material having pairs of spaced contacts therein adapted to be selectively shunted by an associated movable contact bridge comprising: a contact carrier of electrically insulating material mounted for movement in said housing relative to said spaced contacts, said contact carrier including a cam surface region; a contact bridge having spaced contact tips and a smoothly contoured central portion therebetween, said contact bridge being mounted on said contact carrier for movement therewith and relative thereto and being arranged so that said cam surface region guides the smoothly contoured central portion of said contact bridge whenever there is relative movement between said contact bridge and said contact carrier; resilient means disposed at the ends of and between said contact bridge and a corresponding member carried by said

6

contact carrier opposite said contact bridge adapted to urge said contact bridge in a direction toward the pair of contacts it is adapted to shunt so that engagement and disengagement of the contact bridge with its associated pair of spaced contacts causes said contact bridge to move relative to said contact carrier and be guided by the cam surface region thereof to produce a positive tangential movement between the contact tips of said contact bridge and said pair of spaced contacts shunted thereby.

6. The contact mechanism of claim 5 wherein the cam surface associated with said contact carrier comprises a slot disposed at a preselected angle with respect to the direction of movement of said contact carrier.

7. The contact mechanism of claim 5 wherein the central portion of said contact bridge has a generally cylindrical configuration blending smoothly at each end into a region of generally conical configuration.

8. An electrical contact device comprising:

- (a) a housing of electrically insulating material;
- (b) at least one pair of spaced contacts mounted in said housing;
- (c) a contact carrier of electrically insulating material movably mounted within said housing and having a transverse aperture therein including a cam surface region for each pair of spaced contacts mounted in said housing;
- (d) a contact bridge for each pair of spaced contacts each having spaced contact tips and a smooth cylindrical portion therebetween blending smoothly at the ends into a region of generally conical configuration, said contact bridge being mounted on said contact carrier with the central portion thereof being received in said aperture and adapted for guided movement therein by said cam surface region;
- (e) and resilient means at each end of said contact bridge and between means disposed opposite said contact bridge and carried by said contact carrier operative to urge said contact bridge in the direction of the pair of spaced contacts it is adapted to shunt so that engagement and disengagement of said contact bridge with said pair of spaced contacts causes said contact bridge to move relative to said contact carrier and to traverse the cam surface region thereof to produce a positive tangential movement of the contact bridge with respect to the pair of spaced contacts shunted thereby.

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