

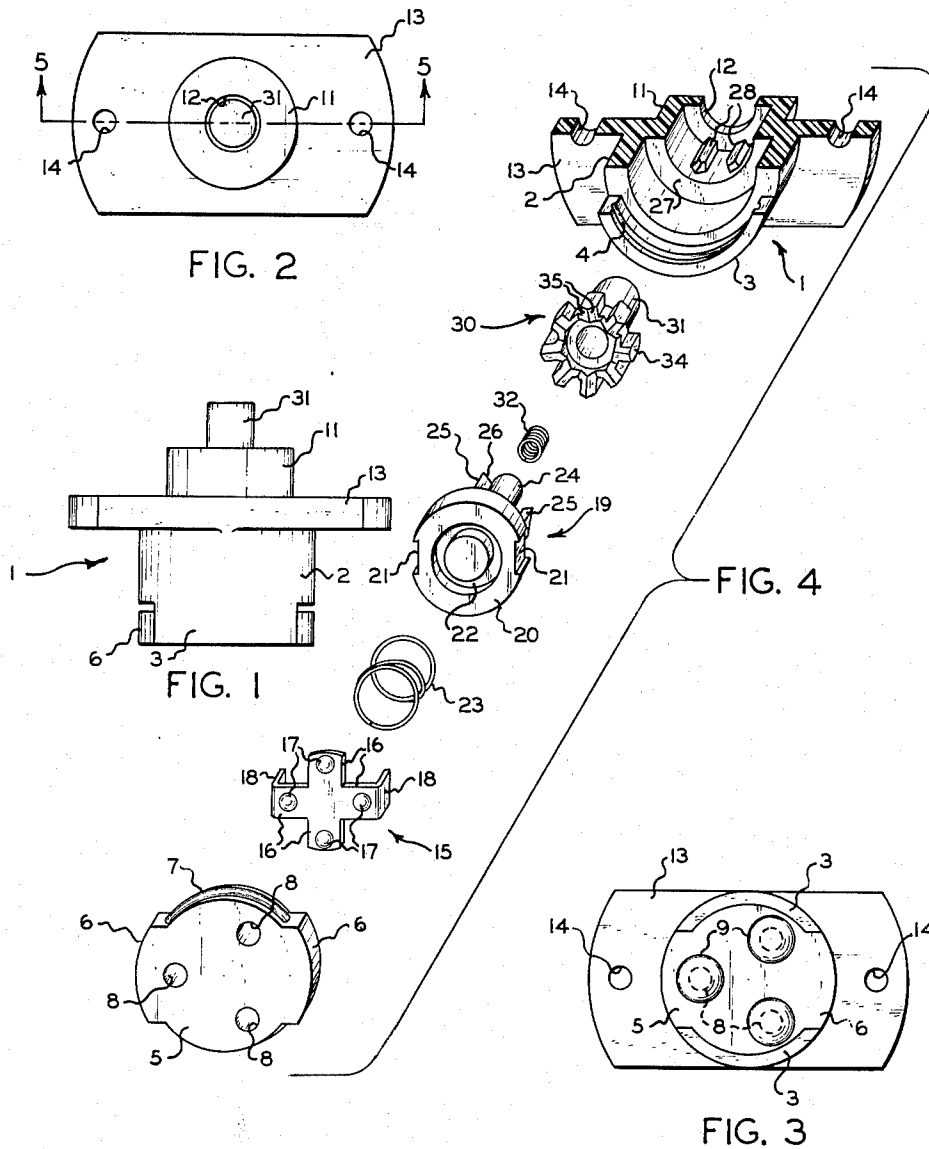
Aug. 31, 1965

W. L. BROWN
PUSH ROTARY SWITCH CONSTRUCTION WITH LOST MOTION
CONTACT COUPLING

3,204,067

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2 Sheets-Sheet 1



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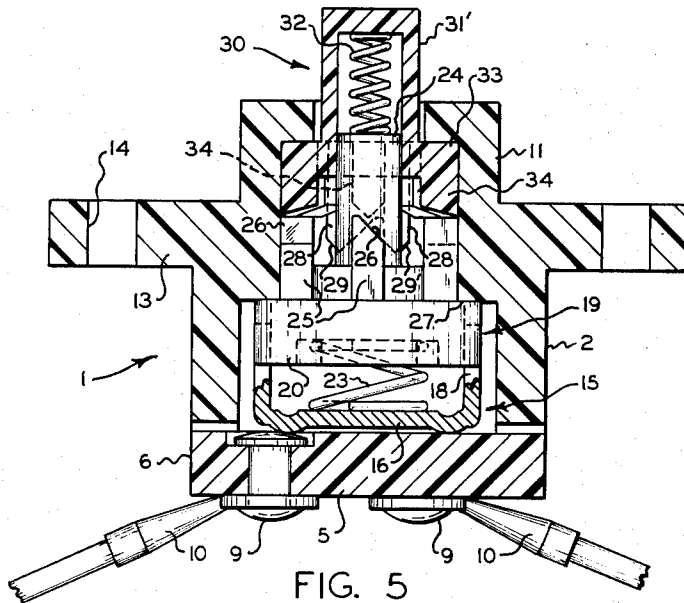


FIG. 5

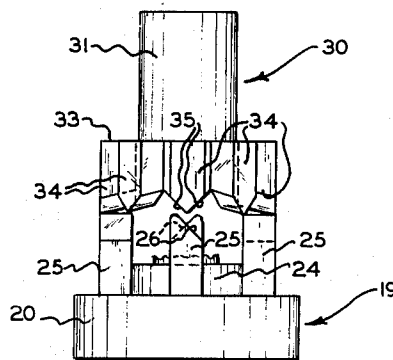


FIG. 6

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This invention relates to rotary switch constructions and more particularly to a plunger operated rotary switch wherein reciprocating motion of the plunger is converted to rotation of a rotary conductor.

Plunger operated rotary switches of the general class to which the invention relates have been proposed heretofore, but most, if not all of them, have been constructed in such manner as to make it possible for the rotary switch part to be indexed or rotated a distance less than is desirable upon movement of the plunger less than its full stroke. With such switches it is possible to move the rotary conductor to an intermediate position where it either makes no contact with other electrical contacts or imperfectly engages the other contacts. In either event, the results are undesirable.

Many of the known plunger actuated rotary switches are so constructed that the conversion of linear motion to rotary motion imposes binding forces on the rotary part, thereby necessitating the application of excessive forces on the plunger to effect rotation of the rotor. As a consequence, such switches have not been utilized in many instances where a more easily operable switch could be used effectively.

Most of the known plunger operated rotary switches are of such size as to prohibit their use in instances where the space in which they must be accommodated is restricted. In such instances, it has been necessary to utilize purely reciprocable or toggle switches which, in many cases, are incapable of functioning properly for extended periods of time.

An object of this invention is to provide a plunger operated rotary switch wherein indexing of the rotary part to or from an operative position is effected only upon and in response to full stroke operation of the plunger.

Another object of the invention is to provide a rotary switch construction in which the rotary part is actuated in response to linear movement of a plunger and wherein the conversion of linear movement to rotary movement is accomplished without the imposition of binding forces on the rotary part.

A further object of the invention is to provide a rotary switch construction of the kind referred to which readily lends itself to miniaturization.

Another object of the invention is to provide a rotary switch construction which provides for excellent wiping characteristics between relatively movable contacts so as to promote long life to the switch.

A further object of the invention is to provide a rotary switch construction that is economical to manufacture and assemble and has wide applicability.

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 a side elevational view of an assembled switch constructed in accordance with the invention;

FIGURE 2 is a top plan view of the switch;

FIGURE 3 is a bottom plan view of the switch;

FIGURE 4 is an exploded perspective view, partly in section, of the component parts of the switch;

FIGURE 5 is an enlarged sectional view taken on the line 5—5 of FIGURE 2; and

FIGURE 6 is an exploded elevational view of certain parts of the switch.

A switch constructed in accordance with the invention comprises a hollow casing 1 which preferably is molded from insulating material such as nylon or any other suitable plastic material having generally similar properties. The casing includes an open end, annular body portion 2 terminating at one end in a pair of opposed, arcuate flanges 3, each of which has an internal groove 4 formed therein. The open end of the body is adapted to be closed by a molded nylon or the like base member 5 having a pair of aligned wings 6 of such size as snugly to fit between the ends of the arcuate flanges 3. Between the wings 6 the sides of the base member are arcuate and are provided with convex ribs 7 which are adapted to be snapped into the grooves 4 so as removably to maintain the base assembled with the body. The base is pierced in a plurality of places to provide openings 8 for the reception of a plurality of electrically conductive, fixed contacts 9 which conveniently may comprise metallic rivets formed of copper, copper alloy, or the like and to which may be connected electrical conductors, two of which are shown at 10 in FIGURE 5, forming parts of electrical circuits (not shown).

At its opposite end the body 2 terminates in a reduced, annular housing 11 having a centrally located opening 12 therein. A mounting flange 13 may be molded integrally with the casing 1 between the members 2 and 11. The flange 13 preferably includes openings 14 for the reception of mounting screws or the like (not shown).

Mounted in the body of the casing 1 is an electrically conductive, metallic switching member 15 of generally cruciform configuration having a plurality of arms 16 adapted to engage selected contacts 9. If desired, the arms 16 may be provided with protuberances 17 for effectively making contact between the conductor 15 and the contacts 9. Two of the arms 16 terminate in upstanding, lost motion coupling flanges 18 for a purpose presently to be explained.

A rotor member 19 molded of nylon or similar material is mounted in the casing for rotation and for linear or axial movements along a path toward and away from the base 5. The rotor comprises a generally cylindrical body 20 having a pair of axially extending grooves 21 provided in its peripheral edge for reception of the coupling flanges 18 of the conductor 15. Coupling of the members 15 and 19 is such that rotation of the rotor 19 is imparted to the conductor 15, but the rotor is capable of reciprocating movement relative to the conductor in directions toward and away from the base. One face of the rotor 19 is provided with an annular groove 22 in which is seated one end of a compression biasing spring 23, the other end of which bears against the conductor 15 so as normally to urge the latter into engagement with the contacts 9 and constantly to exert a force on the rotor 19 tending to move the latter away from the base.

From the face of the rotor body 20 opposite the groove 22 extends a cylindrical post 24 which is surrounded by a number of equally spaced projections or guide fingers 25. In the disclosed embodiment there are four such fingers 25 and each of them is provided with an inclined surface 26 at its free end that slopes in a direction transversely of the path of linear movements of the rotor. The fingers 25 are located radially inwardly from the peripheral edge of the rotor body 20 so as to enable the body to bear against a shoulder 27 provided between the casing portions 2 and 11. The shoulder 27 limits movement of the rotor 19 in a direction away from the base 5.

On the inner periphery of the casing portion 11 is a plurality of spaced apart, parallel guide ribs 28 that extend axially of the body portion 11. The relative lengths of the ribs 28 and the fingers 25 are such that the fingers extend between adjacent guide ribs 28. The distance between the guide ribs 28 corresponds substantially to the thickness of the guide fingers 25, but permits the latter to be slideably received therebetween. In the preferred embodiment of the invention there are two sets of guide ribs 28 that are arranged symmetrically about the longitudinal axis of the casing. Preferably, the ends of the guide ribs 28 adjacent the rotor body 20 are double chamfered to provide oppositely inclined surfaces 29, 29', but only one inclined surface is required.

Operating means for indexing or rotating the rotor comprises a molded nylon operating plunger 30 having a hollow stem 31 which rotatably receives the rotor post 24 and a compression spring 32. One end of the spring 32 seats against the closed end of the stem 31 and the other end seats against the end of the post 24, and constantly exerts a force on the rotor tending to move the latter toward the base 5. The spring 32 is of smaller capacity than the spring 23, however, so that the latter overpowers the spring 32.

The plunger 30 includes an annular flange 33 that is adapted to bear against the end wall of the casing portion 11 so as to limit movement of the plunger in a direction away from the casing base 5. The periphery of the annular flange 33 is provided with a plurality of uniformly spaced apart actuating teeth 34 which are capable of engaging the adjacent, free ends of guide fingers 25 on the rotor 19. The free end of each tooth 34 is double chamfered as at 35 so as to present an inclined surface complementary to the inclined surface 26 on each guide tooth 25. The spacing between adjacent teeth 34 corresponds to the thickness of and the spacing between the guide ribs 28 so as to permit any tooth 34 to be received between a pair of guide ribs. The width of each tooth 34 is such as to fit snugly, but slideably, between adjacent guide ribs 28, thereby restraining rotation of the plunger, but permitting the latter to reciprocate relatively to the casing between extended and retracted positions.

When the component parts of the apparatus are assembled as illustrated in FIGURE 5, the spring 32 will hold the operating plunger 30 in its extended position, the conductor 15 will be forcibly urged into engagement with selected contacts 9 on the base 5 by the spring 23, and the spring 23 also will hold the rotor body 20 against the flange 27. In these positions of the parts, the guide fingers 25 of the rotor 19 will be received between the guide ribs 28 so as to prevent rotation of the rotor. Certain actuating teeth 34 of the plunger 30 also will be received between the guide ribs 28 so as to prevent rotation of the plunger.

The application of an external force on the plunger 30 to retract it into the casing 1 will cause linear movement of the plunger relative to the rotor 19, and compression of the spring 32, until such time as certain teeth 34 on the plunger engage the guide fingers 25 on the rotor. Since certain ones of the guide fingers 25 are trapped between the guide ribs 28, engagement between the inclined surfaces of the teeth 34 and the fingers 25 effects linear movement only of the rotor 19 toward the base 5 until such time as the free ends of the guide fingers 25 have been moved to a level corresponding to the level of the inclined surfaces 29' of the guide ribs. In these positions of the parts, further retraction of the plunger causes the inclined surfaces on the actuating teeth 34 and on the guide fingers 25 to exert a force on the latter tending to rotate the rotor clockwise, as viewed in FIGURE 5, such rotation being permitted by the inclination of the guide surfaces 29'. Rotation of the rotor is accompanied by continued lineal movement of the latter toward the base 5 and such lineal movement continues until the

rotor has been moved toward the base a distance sufficient to enable the free ends of the guide fingers 25 to clear the tips of the guide ribs 28. When the fingers 25 are clear of the ribs 28, further relative lineal movement of the plunger and the rotor, caused either by further retraction of the plunger 30 or by the force exerted by the spring 23, will cause additional rotation of the rotor in a clockwise direction so as to rotate the fingers 25 slightly beyond the tips of the ribs 28.

Upon release of the plunger 30, the force exerted by the spring 32 will restore the plunger to its projected position and the force exerted by the spring 23 will move the rotor 19 linearly in a direction away from the base 5, whereupon the inclined surfaces 29 of the guide ribs 28 will engage the inclined surfaces 26 of the guide fingers 25 and impart further rotation in a clockwise direction to the rotor as the latter moves away from the base. Thus, for each full cycle of operation of the plunger 30, the rotor is rotated or indexed in two increments, the first of which occurs upon retraction of the plunger, and the second of which occurs upon extension of the plunger. The conductive member 15 rotates with the rotor and, due to the construction of its coupling means, the rotor is free to move lineally relatively to the conductor.

As has been pointed out earlier, the conductor 15 constantly is urged by the spring toward the base 5. Consequently the conductor wipes the contacts 9 upon relative movement thereof, maintaining the engaging surfaces clean and bright. Such wiping action assures a long electrical life to the switch.

In the event the plunger 30 is not retracted within the casing a distance sufficient to enable the tips of the fingers 25 to clear the tips of the ribs 28, i.e., less than a full stroke, the release of the plunger will enable the springs 23 and 32 to restore the parts to their first or inactive positions, with the inclined surfaces 29' on the guide ribs 28 causing the rotor 19 to be rotated counterclockwise as it is returned. Consequently, retraction of the plunger an amount less than a full stroke does not effect any permanent change in the position of the conductor 15 relative to the contacts 9. If the guide surfaces 29' are omitted from the guide ribs, retraction of the plunger in an amount less than a full stroke will not effect any rotation of the rotor.

As will be apparent from FIGURE 5, the rotor floats between the springs 23 and 32. As a result, there are no large surfaces of the rotor bearing on the casing to cause frictional resistance to the rotation of the rotor. Consequently, the conversion of linear motion to rotary motion is accomplished upon the application of relatively little force. Inasmuch as the switch is operable upon the application of relatively light forces, the parts can be made quite small, thereby achieving miniaturization of the switch.

Except for the parts hereinbefore referred to as being metallic, all other parts can be molded in large quantities and with great accuracy so as greatly to minimize the cost of manufacture.

The disclosed embodiment is representative of a presently preferred form of the invention, but is intended to be illustrative rather than definitive thereof. The invention is defined in the claims.

I claim:

1. In a rotary switch construction: a hollow casing; electrical contacts fixed to said casing; a rotatable conductor mounted in said casing adjacent said contacts for engagement therewith and disengagement therefrom; a rotor; means mounting said rotor in said casing for rotation and for axial movements along a path from a first position to a second position and return; means coupling said conductor to said rotor for rotation therewith and for axial movements of said rotor independently of said conductor; means for moving said rotor axially; and means for rotating said rotor.

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2. The construction set forth in claim 1 including biasing means interposed between said rotor and said conductor and reacting therebetween for constantly urging said conductor axially.

3. The construction set forth in claim 1 wherein said coupling means comprises arm means slideably engaging said rotor and extending from said conductor along the path of axial movement of said rotor.

4. In a rotary switch construction: a hollow casing having a base; electrical contacts fixed to said base; an electrical conductor rotatably mounted in said casing adjacent said contacts; a rotor; means mounting said rotor in said casing for rotation and for axial movements along a path from a first position to a second position and return; means coupling said conductor to said rotor for rotation therewith and for axial movements of said rotor independently of said conductor; cooperable guide means on said casing and on said rotor engaged with one another when said rotor is in said first position for restraining rotation of the latter; operating means reciprocally mounted in said casing for moving said rotor axially along said path from said first position toward said second position a distance sufficient to disengage said cooperable guide means; and actuating means on said operating means engageable with said rotor and operable to rotate the latter and said conductor upon disengagement of said cooperable guide means.

5. The construction set forth in claim 4 including biasing means interposed between said rotor and said conductor for constantly urging the latter toward said base and for moving said rotor toward its said first position.

6. The construction set forth in claim 5 wherein movement of said rotor from said second position to said first position reengages said cooperable guide means, said cooperable guide means being so shaped that reengagement thereof imparts rotation to said rotor.

7. In a rotary switch construction: a casing; a rotor; means mounting said rotor in said casing for rotation about an axis and for axial movement along a path from a first position to a second position; guide means on said casing engaging said rotor when the latter is in its first position for restraining rotation thereof during initial movement of said rotor toward said second position; operating means for moving said rotor axially from said first position toward said second position a distance sufficient to disengage said rotor and said guide means; actuating means on said operating means acting on said rotor for rotating the latter in response to disengagement of said guide means and said rotor; and means acting on said rotor for returning the latter to said first position following rotation of said rotor.

8. In a rotary switch construction: a casing; a rotor; means mounting said rotor in said casing for rotation about an axis and for axial movement along a path from a first position to a second position; first guide means on said casing; second guide means on said rotor, said first and second guide means being in engagement when the rotor is in its first position for restraining rotation thereof during initial movement of said rotor toward said second position, said second guide means having a surface inclined transversely to the direction of axial movement of said rotor; operating means for moving said rotor axially from said first position toward said second position a distance sufficient to disengage said first and second guide

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means; actuating means on said operating means acting on said inclined surface of said second guide means for rotating the rotor in response to disengagement of said first and second guide means; and biasing means reacting between said casing and said rotor for returning the latter to said first position.

9. The construction set forth in claim 8 wherein said actuating means rotates said rotor such an amount as to locate said inclined surface of said second guide means in a position to engage said first guide means.

10. The construction set forth in claim 9 wherein engagement between said first guide means and said inclined surface effects rotation of said rotor in response to movement of said rotor toward said first position by said biasing means.

11. In a rotary switch construction: a casing; a rotor; means mounting said rotor in said casing for rotation about an axis and for axial movement along a path from a first position to a second position; guide means on said casing engaging said rotor when the latter is in its first position for restraining rotation thereof during initial movement of said rotor toward said second position; operating means for moving said rotor axially from said first position toward said second position a distance sufficient to disengage said rotor and said guide means; actuating means on said operating means acting on said rotor for rotating the latter in one direction in response to disengagement of said guide means and said rotor; and means acting on said rotor for returning the latter from said second position axially to said first position, the return movement of said rotor effecting reengagement of said guide means and said rotor, reengagement of said guide means and said rotor effecting further rotation of the latter in said one direction.

12. In a rotary switch construction: a casing; electrically conductive contacts supported by said casing; a rotor; means mounting said rotor in said casing for rotation about an axis and for axial movement along a path from a first position to a second position; guide means on said casing engaging said rotor when the latter is in its first position for restraining rotation thereof during initial movement of said rotor toward said second position; operating means for moving said rotor axially from said first position toward said second position a distance sufficient to disengage said rotor and said guide means; actuating means on said operating means acting on said rotor for rotating the latter in response to disengagement of said guide means and said rotor; electrically conductive switching means in said casing in a position to engage and disengage said contacts; and lost motion means coupling said rotor and said switching means for conjoint rotation of said switching means and said rotor and for relative axial movement of said rotor and said switching means.

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