Oct. 27, 1959 J. B. LINDGREN 2,910,552

SWITCH

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FIG. 1.

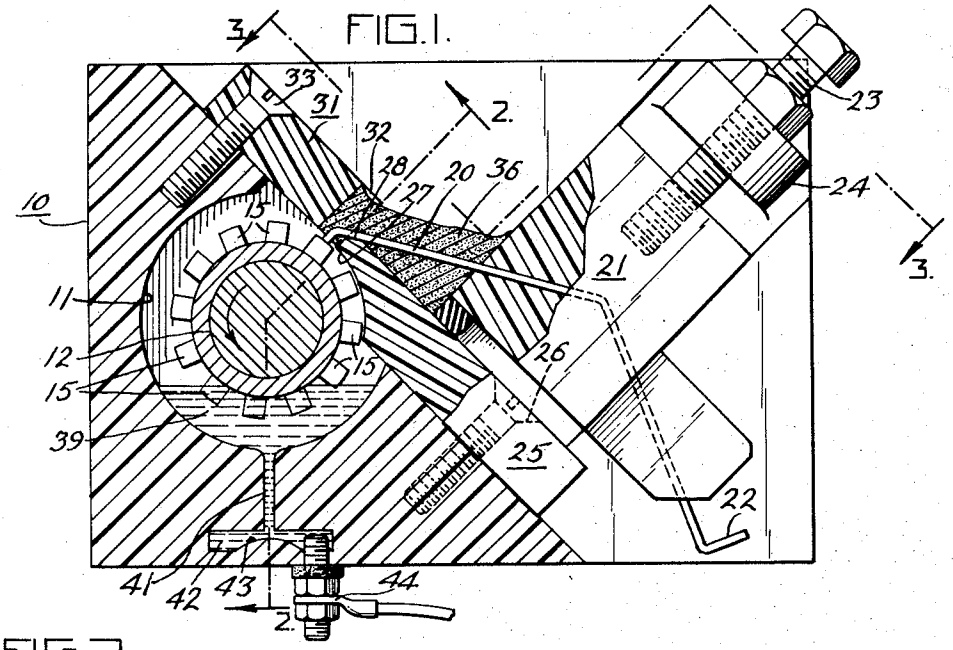

FIG. 2.

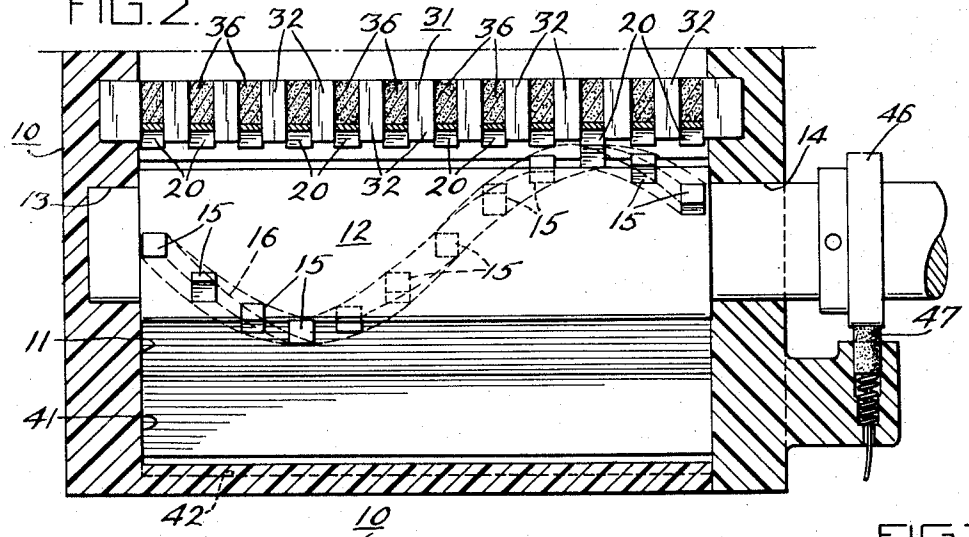

FIG. 3.

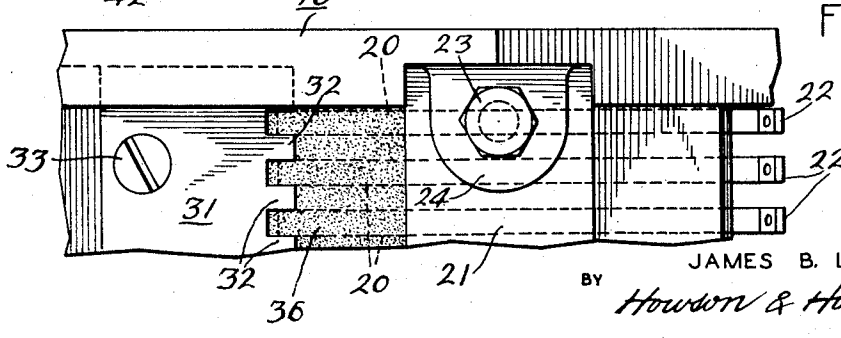

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FIG. 5.

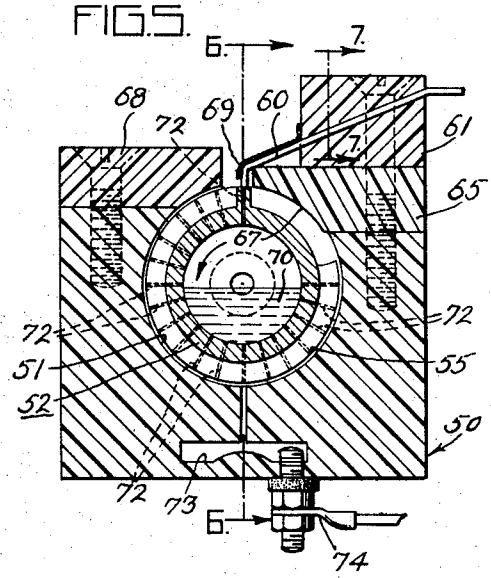


FIG. 4.

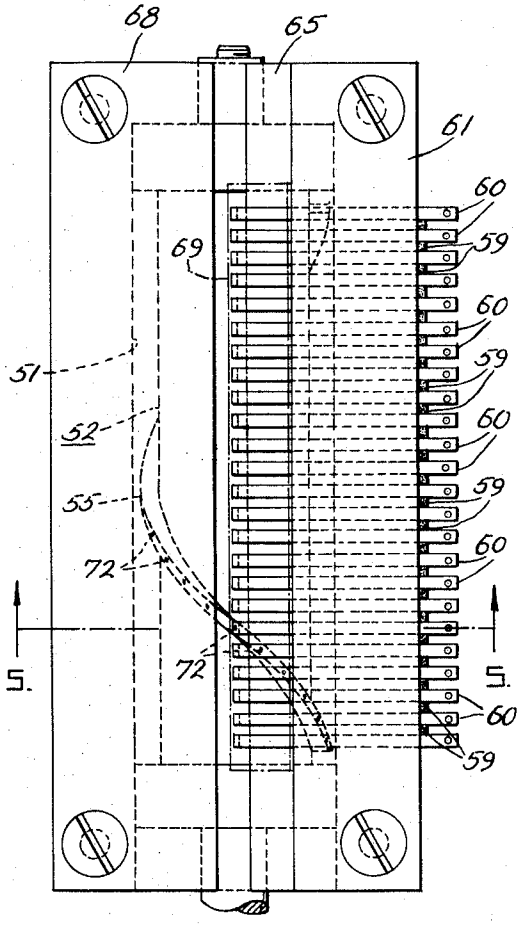


FIG. 7.

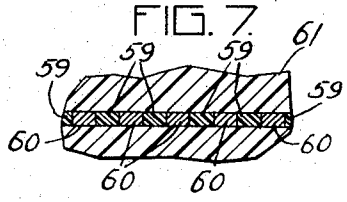
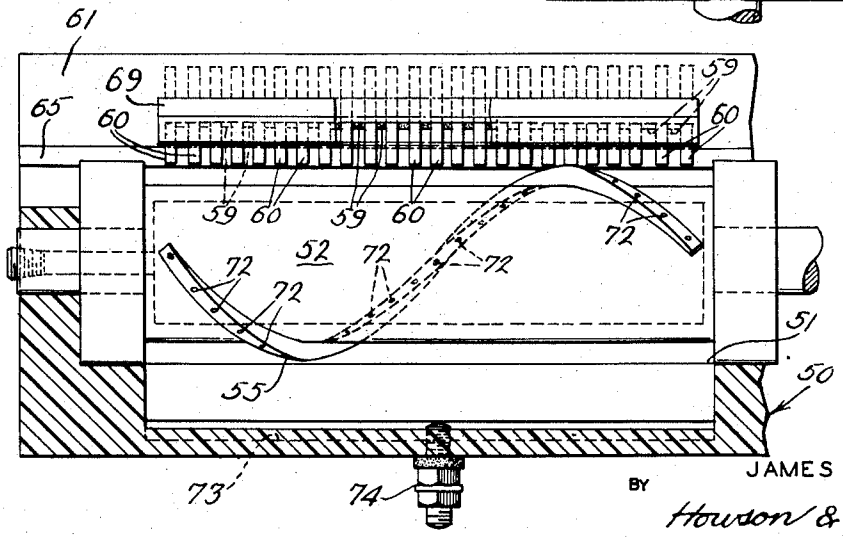


FIG. 6.



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2,910,552

SWITCH

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12 Claims. (Cl. 200—24)

The present invention relates to switches, and more particularly to multiple contact switches operable to control a plurality of circuits in a predetermined sequence.

Prior switches of this character have not been entirely satisfactory because of the problems of wear, and breakdown in use due to leakage between the various circuits controlled by the switch.

With the foregoing in mind, the present invention provides a switch of the stated type having wetted or lubricated contacts which reduces wear to a minimum.

The present invention maintains the contacts of the switch free from foreign particles which might otherwise cause electrical leakage or short circuiting.

The present invention also provides a switch which is readily manufactured with normal mechanical tolerances without danger of electrical leakage or short circuiting in operation.

The invention also provides a switch of simple mechanical design which is fully effective in operation and use.

All of the objects of the present invention and the various features and details of the construction and operation thereof are more fully set forth hereinafter with reference to the accompanying drawing wherein:

Fig. 1 is a transverse sectional view through a switch made in accordance with the present invention;

Fig. 2 is a longitudinal sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a plan view of a modified form of switch made in accordance with the invention;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4; and

Figs. 6 and 7 are sectional views taken on the lines 6—6 and 7—7 respectively of Fig. 5.

Referring now to the drawing, the switch illustrated in Figs. 1 to 3 comprises a housing 10 of a suitable insulation material. The housing is formed with a cylindrical recess 11 therein which houses a rotary contact member 12 journalled for rotation in the housing 11 as indicated at 13 and 14 respectively. The rotary contact member 12 is formed with projecting contact elements 15 arranged in helical array about its periphery. In the present instance, the contact elements are in the form of projecting lugs, for example formed by cutting away a helical fin indicated by the broken lines at 16 in Fig. 2. If desired, the fin 16 need not be cut away and the contact elements 15 may therefore be formed continuously in helical array about the rotary member 12.

In accordance with the invention, a plurality of contact arms 20 are biased into engagement with the contact elements 15 as the latter are rotated past the contact arms 20. As shown in Fig. 2, the contact arms are spaced axially along the length of the rotary member 12. In the illustrated embodiment of the invention, the arms 20 comprise spring strips, although spring wires may be used, if desired, in place of the spring strips.

The arms 20 are supported in a mounting block 21 and extend beyond the block as indicated at 22 to provide for connection to the various circuits controlled by the switch. The mounting block 21 is secured to the housing 10 by means of a bracket 24 and bolt 23.

In order to limit their displacement, the arms 20 are supported adjacent their free ends by an auxiliary support member 25 mounted on the housing as indicated at 26, and having an arcuate surface 27 conforming to the outer periphery of the contact elements 15. The auxiliary support 25 is provided with a bearing surface 28 engaging the contact arms 20 to support them in the path of movement of the contact element 15 but out of engagement with the body of the rotary member 12. The surface 28 of the support member 25 permits the free end of the contact arms 20 to be displaced only a minute fraction of an inch when the contact element 15 passes out of engagement with the arm 20. By reason of this limited displacement of the contact arm, the arm is not subject to substantial flexure and is not subject to deterioration in use. Lateral displacement of the brushes axially of the rotary member 12 is prevented by a comb-like spacer member 31 having teeth 32 projecting intermediate the brushes 20. The spacer member 31 is secured to the housing, for example as indicated at 33 and the teeth 32 bear against the auxiliary support member 25. Thus, the members 31 and 25 cooperate to close the recess 11 to a substantial extent. To preclude entry of dirt or other foreign matter into the recess 11, a packing 36 is provided about the arms 20. The packing 36 fills the spaces between the teeth 32 and is sufficiently flexible or plastic to afford movement of the arms 20 into and out of engagement with the contact members 15.

In accordance with the invention, a liquid bath 39 is contained in the recess 11 and operates to wet the contact member 15 as the member 12 is rotated within the housing. The liquid may be mercury, as shown, which operates to wet the contact elements 15 and provide proper electrical contact between the elements 15 and the arms 20. The mercury also operates to flush any foreign particles from the contact and assist in maintaining trouble-free operation. The mercury also may serve to connect the contacts to the line or other common electrical circuit element. To this end, the recess is provided with a passageway 41 in the form of an elongated slot at the bottom of the recess 11. The passageway 41 enters into an auxiliary reservoir 42, the bottom wall of which has a convex center portion 43 elevated above the level of the remaining portion of the wall. A terminal 44 is connected into the reservoir 42 to provide electrical connection between the mercury and the electric circuit. Instead of mercury, a liquid or other fluent lubricant may be employed in the recess 11. The lubricant may serve to prevent undue friction between the contact elements 15 and the arms 20, and also serve to flush any foreign particles from the brushes. Any heavy particles flushed by the liquid in the reservoir 11 will settle into the passageway 41 and into the reservoir 42. By reason of the convex portion 43 the particles will settle toward the periphery of the bottom wall. Thus, the chance of return of the particles into the body of the fluid in the recess 11 is impeded by the construction shown in Fig. 1.

The auxiliary support 25 at its concave surface 27 serves to sweep or scrape the excess fluid from the contact elements 15 as they rise from the bath 39 so that an excess build-up of liquid on the contact elements is prevented. The scraper surface 27 is spaced sufficiently far from the arms 20 to prevent bridging of the clearance between the arms by the liquid scraped from the contact elements.

When the fluid in the reservoir 11 is not sufficiently conductive, it is necessary to employ a collector ring 46

and brush 47 for connecting the rotary element 12 to the electrical circuit elements.

By reason of construction of the switch illustrated herein, the life of the switch is prolonged by the reduction in wear and by the self-cleaning action of the switch. Furthermore, if any foreign particles do remain on the contact elements 15, the switch arms wipe them circumferentially and deposit the particles on the trailing edge of the element where they will not tend to short-out adjacent brushes or contact elements, or cause leakage therebetween. If a reducing-type lubricant is employed in the reservoir 11, the seal of the packing 36 precludes entering of air and oxygen, precluding oxidation of the parts within the recess 11 and the formation of abrasive oxides.

The packing 36 enables the liquid-wetted switch of the present invention to be used in installations where the switch is subject to extreme vibrations since the packing prevents the leakage of liquid from the recess 11. Because of the support at 28, and since the arm 20 is biased toward the support, the possibility of the arm bouncing or vibrating are substantially reduced.

In the modified form of switch shown in Figs. 4 to 7, the housing 50 is similar to the housing 10 and has a cylindrical recess 51 therein which houses a rotary contact member 52 having a projecting contact element 55 which, in the present instance, comprises a continuous helical fin. In the present instance, the recess encloses the member 52 with limited clearance between the wall of the recess and the fin 55.

Contact arms 60 are biased into engagement with the contact element 55 and are laminated with spacer elements 59 in a mounting block 61. In order to limit their displacement, the arms 60 are supported adjacent their free ends by an auxiliary support member 65 having an arcuate surface 67 conforming to the outer periphery of the fin 55, and operating similarly to the auxiliary support member 25 discussed above.

A cover element is provided at 68 to close the recess to a substantial extent, and a tape 69 overlies the contact arms 60 to serve as a packing to prevent foreign matter from becoming deposited on the extending portions of the arms.

In the modified form of the switch, a liquid bath 70 is contained within the hollow interior of the rotary member 52, and capillary conduits 72 operate to conduct the liquid from the bath 70 to the contact surface of the fin 55. Preferably, the liquid bath is mercury so that the contact between the arms 60 and the fin 55 is mercury-wetted. A reservoir 73 is provided in the housing 50 to collect excess mercury or the like which may be discharged through the capillary openings in the helical fin. An electrical contact 74 is shown connected to the reservoir which operates when the switch is operated similarly to the switch of Fig. 1 with a mercury bath within the recess 51. When operated with the mercury bath within the interior 71 of the element 52, the electrical contact 74 serves simply as a drain plug for the reservoir 73. A collector ring (not shown) similar to the ring 46 is provided to supply electrical energy to the rotary member 52.

The laminated construction of the contact arm assembly affords substantial economy in the manufacture of the unit, and the unit shown in Figs. 5 to 7 inclusive, possesses many of the advantages of the unit shown in Figs. 1 to 3.

While particular embodiments of the present invention have been herein illustrated and described, it is not intended to limit the invention to such disclosure, but changes and modifications may be made therein and therto within the scope of the following claims.

I claim:

1. In a switch having a rotary member with at least one electrical conductive contact element extending radially outward therefrom, and a contact arm operable to engage said contact element when in registry therewith, a housing having a recess therein to receive said rotary member and forming a trough for a bath of liquid through which said contact element passes upon rotation of said rotary member, mercury in said trough operable to wet said contact element to provide a mercury-wetted connection between said arm and said element, a cover member for said recess mounting said contact arm and limiting radially inward displacement thereof relative to said rotary member, said arm being biased radially inward toward said cover member and free for radially outward displacement by said rotary member upon interengagement thereof, means on said arm for connecting the same to an electric circuit, and means for connecting said rotary element to said circuit whereby said circuit is closed upon rotation of said rotary element to register said contact element with said contact arm.

2. In a switch having a rotary member with at least one electrical conductive contact element extending radially outward therefrom, and a contact arm operable to engage said contact element when in registry therewith, a housing having a recess therein to receive said rotary member and forming a trough for a bath of liquid through which said contact element passes upon rotation of said rotary member, a cover member for said recess mounting said contact arm and limiting radially inward displacement thereof relative to said rotary member, said arm being biased radially inward toward said cover member and free for radially outward displacement by said rotary member upon inter-engagement thereof, means on said arm for connecting the same to an electric circuit, a collector ring mounted on said rotary element and electrically connected thereto, and a brush biased into engagement with said collector ring and having means for connecting the same to the electrical circuit to thereby connect said rotary element to said circuit, said circuit being closed upon rotation of said rotary element to register said contact element with said contact arm.

3. In a switch having a rotary member with at least one electrical conductive contact element extending radially outward therefrom, and a contact arm operable to engage said contact element when in registry therewith, a housing having a recess therein to receive said rotary member and forming a trough for a bath of liquid through which said contact element passes upon rotation of said rotary member, a cover member for said recess mounting said contact arm and limiting radially inward displacement thereof relative to said rotary member, said arm being biased radially inward toward said cover member and free for radially outward displacement by said rotary member upon interengagement thereof, means on said arm for connecting the same to an electric circuit, and means for connecting said rotary element to said circuit whereby said circuit is closed upon rotation of said rotary element to register said contact element with said contact arm, said cover member comprising a comb-like member secured to said housing and having teeth projecting on opposite sides of said contact arm, a second member secured to the housing and bearing against the free ends of said teeth and serving to support said contact arm, and packing surrounding said arm and filling the space between said teeth to close said recess against the admission of foreign material, said packing being flexible to afford displacement of said arm into and out of engagement with said contact element upon rotation of said rotary member.

4. In a switch having a rotary member with at least one electrical conductive contact element extending radially outward therefrom, and a contact arm operable to engage said contact element when in registry therewith, a housing having a cylindrical recess therein to receive said rotary member and forming a trough for a bath of liquid through which said contact element passes upon rotation of said rotary member, a supplementary reservoir in said housing underlying said recess, an elongated passageway interconnecting said reservoir with said recess

and opening into said recess at the lowermost point thereof, and a cover member for said recess mounting said contact arm and limiting radially inward displacement thereof relative to said rotary member, said arm being biased radially inwardly toward said cover member and free for radially outward displacement upon engagement thereof with the contact element of said rotary member, means on said arm for connecting the same to an electric circuit, and means for connecting said rotary element to said circuit whereby said circuit is closed upon rotation of said rotary element to register said contact element with said contact arm.

5. In a switch having a rotary member with electrical conductive contact means circumferentially offset along the length thereof and projecting radially outward therefrom, and a plurality of contact arms mounted in spaced sequence axially of said rotary member, each arm operable to engage said contact means when in registry therewith, a housing having a cylindrical recess therein to receive said rotary member and forming a trough for a bath of liquid through which said contact means passes upon rotation of said rotary member, and a cover member for said recess mounting said contact arms in their spaced relation and limiting radially inward displacement thereof relative to said rotary member, each arm being biased radially inward toward said cover member and being free for radially outward displacement upon engagement thereof with the contact means of said rotary member, means on each arm for connecting the same to a separate electric circuit, and means for connecting said rotary element to each of said separate circuits whereby said separate circuits are closed in sequence upon rotation of said rotary element to engage said contact means with the respective contact arms.

6. A switch according to claim 5 including a supplementary reservoir in said housing underlying said recess, and an elongated pasageway interconnecting said reservoir with said recess and opening into said recess at the lowermost point thereof.

7. Apparatus according to claim 6 wherein said means for connecting said rotary element to said circuit comprises a terminal mounted on said housing and projecting into said supplementary reservoir, and conductive liquid filling said trough and supplementary reservoir to establish electrical connection between said rotary elements and said terminal.

8. Apparatus according to claim 7 wherein said conductive liquid comprises mercury operable to wet said contact elements to provide a mercury-wetted connection between said arms and said elements.

9. Apparatus according to claim 5 wherein said electrical connection for said rotary element comprises a collector ring mounted on said rotary element and electrically connected thereto, and a brush biased into engagement with said collector ring having means for connecting the same to the electrical circuits.

10. Apparatus according to claim 5 wherein said cover member comprises a comb-like member secured to said housing and having teeth projecting intermediate said contact arms, a second member secured to the housing and bearing against the free end of the teeth of said comb-like member and serving to limit the inward radial movement of said contact arms, and packing surrounding said arms and filling the space between said teeth to close said recess against the admission of foreign material, said packing being flexible to afford displacement of said arms into and out of engagement with said contact means upon rotation of said rotatary member.

11. A switch according to claim 5 wherein said contact means comprises a plurality of axially-spaced contact elements arranged in helical array about the periphery of said rotary member.

12. A switch according to claim 5 wherein said cover member has a concave cylindrical surface confronting said rotary member in closely-spaced relation to the outer extremity of said projecting contact means to wipe excess liquid therefrom as said means passes out of said bath of liquid.

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