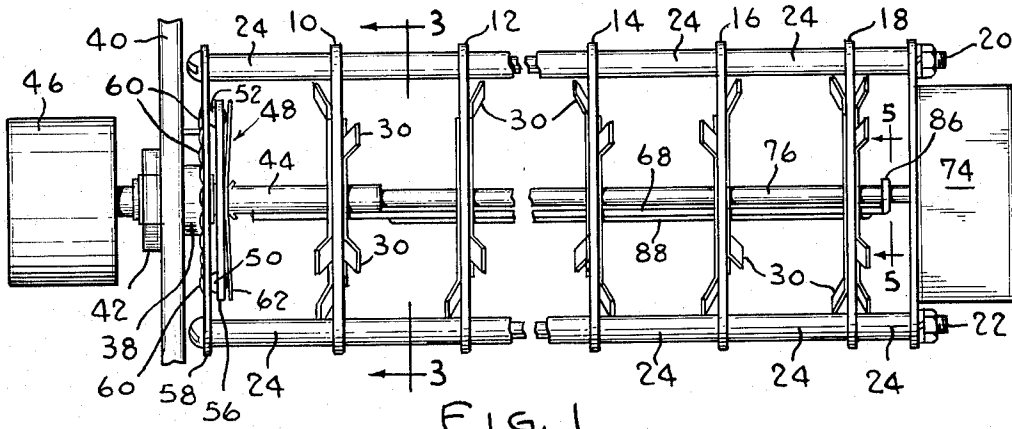
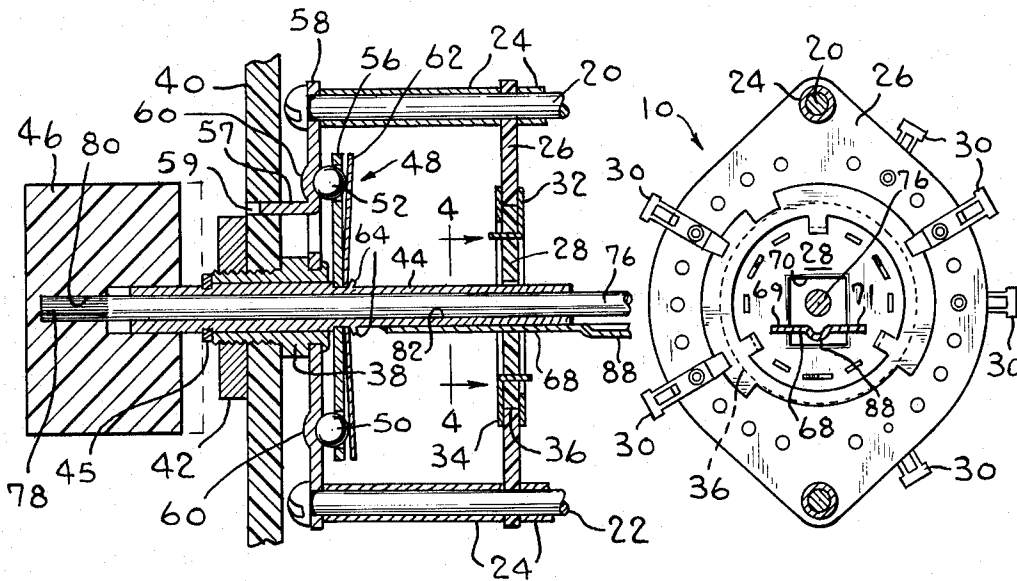
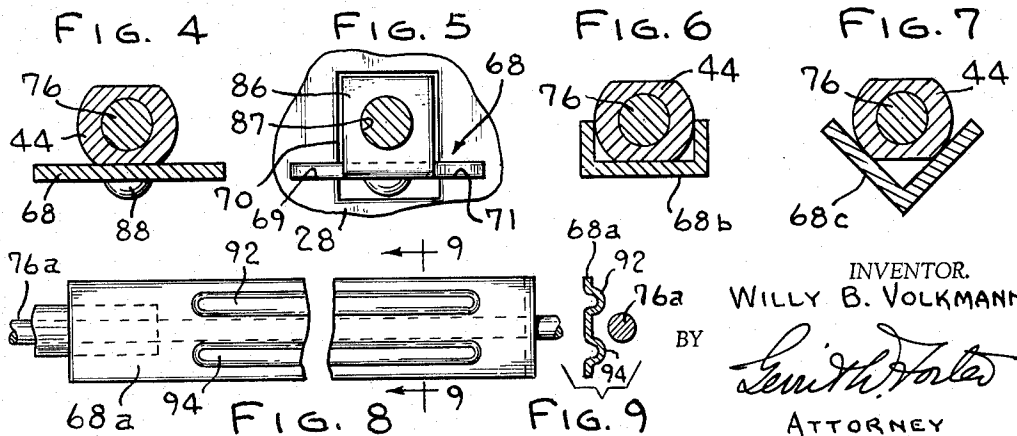


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ROTARY SWITCH ACTUATOR FOR ACTUATING MULTIPLE ROTOR
SECTIONS AND INCLUDING SECONDARY
ELONGATED ROD ACTUATOR
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3,254,165 ROTARY SWITCH ACTUATOR FOR ACTUATING MULTIPLE ROTOR SECTIONS AND INCLUDING SECONDARY ELONGATED ROD ACTUATOR

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This invention relates to rotary electric switches and, more particularly, to an improved actuating mechanism for such switches.

Rotary switches are generally provided with one or more switch sections which are operated by rotation of a control shaft. For use in many applications, it is desirable to make available additional control through the provision of axial as well as rotary control movement. Heretofore, prior art constructions have usually provided this dual control movement with an arrangement of inner and outer concentrically arranged, telescoping shafts, one shaft being rotatable to control the switch sections and the other being movable axially to control a separate operational function, e.g. an on-off switch which could control the circuit to the rotary switch sections. The concentrically arranged, telescoping shafts provide a compact arrangement but also present the problem of binding between the shafts, particularly as the number of switch sections is increased and the axial length of the rotary switch increases accordingly. Avoidance of this problem in prior art constructions requires holding relatively close tolerances on the switch actuator parts and rather involved assembly and close inspection procedures. Moreover, the concentric shaft arrangement does not lend itself well to facile and effective connection to the switch section rotors and is difficult to machine, the most commonly accepted procedure being to provide a flat on the shaft which results in a shaft having a weakened section.

A general object of this invention is to provide an actuating mechanism which retains the compactness of the concentric, telescoping shaft arrangement but eliminates the binding problems normally encountered in such an arrangement.

Another object of this invention is to provide such an actuating mechanism which permits facile and effective connection with the switch section rotors.

A further object of this invention is to provide an effective actuating mechanism which affords at least two independent, selectively operable control movements but which represents an overall simplification of the switch structure as compared to prior art constructions.

For the achievement of these and other objects, this invention proposes a rotary switch control having a first rotary control member and a second member adapted to provide control movement, either axial or rotary, in addition to the control movement of the first member. The rotary switch control is of substantially open construction so that the first and second control members can be positioned adjacent each other to afford a compact arrangement while remaining substantially free for relative movement without binding.

The novel features of this invention are set forth in the appended claims. The invention itself, together with additional objects and advantages thereof, will be more clearly understood from a reading of the following description in connection with the accompanying drawing wherein preferred embodiments of this invention are illustrated and in which:

FIG. 1 is a side elevation of a rotary switch embodying this invention;

FIG. 2 is an axial section through the control portion of the rotary switch actuating mechanism;

FIG. 3 is a section view generally along line 3—3 of FIG. 1;

FIG. 4 is a partial section view generally along line 4—4 of FIG. 2;

FIG. 5 is a view generally along line 5—5 of FIG. 1;

FIG. 6 illustrates an alternative arrangement of the axially movable control rod and rotatable control member taken at a point in a rotary switch similar to FIG. 4;

FIG. 7 illustrates another alternative arrangement of an axially movable control rod and rotatable control member, again taken at a point similar to FIG. 4;

FIG. 8 is a bottom plan view of still another alternative construction; and

FIG. 9 is a section view taken generally along line 9—9 of FIG. 8.

With particular reference to the drawing, a rotary switch is illustrated as including switch sections 10, 12, 14, 16 and 18 mounted on strut bolts 20 and 22 and maintained in relative spaced relationship by spacers 24, it will be appreciated that the number and spacing between switch sections can be varied as desired. Except for variations in terminal clip arrangements as dictated by particular circuit requirements, the switch sections are of identical construction and, for convenience, only one will be described in detail. Switch section 10 comprises a stator 26 and a rotor 28. Contact clips 30 are connected to the opposed faces of the stator and are arranged for selective engagement with rotor contacts 32 and 34. Rotor contacts 32 and 34 are suitably connected to opposite sides of the rotor for engagement with stator 26 to support the rotor for rotation in aperture 36 in the stator.

The control portion of the actuating mechanism of the rotary switch extends through bushing 38 which is adapted to extend through a suitable mounting surface 40 for receipt of mounting nut 42 to connect the rotary switch to the mounting surface. The control includes hollow shaft 44 disposed in the bore of bushing 38 and having a knob 46, of suitable electrical insulating material, suitably connected to its outer end for affording manual control over rotation of the shaft in the bushing.

Detent mechanism 48 is provided to index rotation of control knob 46 and shaft 44. As illustrated, detent mechanism 48 comprises a pair of balls 50 and 52, a stop plate 56 supporting the balls, and indexing plate 58 including depressions 60 arranged around the axis defined by shaft 44 and disposed in the path of rotation of the balls. It will be noted that index plate 58 also provides a point of connection for strut bolts 20 and 22 and includes a locating lug 57 which fits into an opening 59 in the mounting surface to properly locate and hold the switch sections against rotation. The detent mechanism also includes spring 62 arranged to bias the balls toward the depressions and provides an actuator which indexes the rotary switch through its various step positions with a snap action and a positive feel. Shaft 44 is staked, as at 64, to connect stop plate 56, balls 50 and 52 and detent spring 62 for rotation with the control shaft. A suitable fastener such as C-ring 45 completes the connection of the shaft for rotation in bushing 38 and to hold it against axial movement.

It will be noted in FIGS. 1 and 2 that shaft 44 does not extend completely through the rotary switch. As illustrated the shaft extends only through the switch section 10, if desired, the shaft could also terminate short of switch section 10; however, the illustrated construction is preferred as it affords an effective bearing for the left end of rod 76. The driving connection to the remainder of the switch section rotors for effecting rotation thereof is established by an elongated operating member 68. Member 68 is suitably connected to shaft 44, e.g. by spot welding, and extends therefrom through each of the rotors. More particularly, each rotor is provided

with a generally centrally located clearance aperture 70 which includes aligned notch portions 69 and 71 extending generally transversely of the axis of rotation and forming an opening which conforms generally to and for receipt of the edges of member 68. More particularly, operating member 68 is generally planar and its longitudinally disposed edges are engaged in notch portions 69 and 71 to connect the rotors and member 68 for joint rotary movement.

This construction lends itself well to the inclusion of an additional operating member to control an additional control function. In the illustrated embodiment suitable switch mechanism 74, of any well-known construction, is supported at the right end of the rotary switch to control a desired operational function such as to electrically connect the switch sections in a particular circuit. The additional operating member takes the form of rod 76 connected for movement with knob 46 by knurled portion 78 engaged in bore 80 and extending between the knob and switch 74. Movement of rod 76 can be used to control switch 74 and it will be appreciated that either rotation or axial movement of the rod could be used for this purpose, however, for the purpose of the following description the rod will be described as being movable axially. Rod 76 extends through bore 82 of shaft 44 and clearance apertures 70 in each of the rotors into the switch mechanism where it makes engagement with the switch in any suitable, well-known manner. The shaft 44 provides a bearing for one end of rod 76 and a simple and effective bearing for the opposite end of the rod is provided by a formed tab 86 extending upwardly from member 68 and including an aperture 87 for receipt of the rod. A single tab at the end of member 68 has provided a satisfactory bearing, however, if required its position could be varied or additional tabs could be formed from the body of member 68 intermediate its ends. This support arrangement mounts the rod for axial, or rotary, movement while leaving it substantially open. With this construction the rotatable control member, the combination of shaft 44 and member 68, can be positioned adjacent the rod to achieve a compact arrangement and provide the support for the rod but is of substantially open construction to preserve the open condition of the rod and thereby permit relative movement between the rotatable control member and rod without binding. Thus, knob 46 can be rotated to adjust the switch sections and also can be moved axially, as illustrated by the dotted line in FIG. 2 to actuate switch mechanism 74, both control movements being accomplished independently of the other.

To lend rigidity to the operating member 68 a rib 88 is formed generally coextensively therewith. Where a single rib 88 is utilized it is preferably located centrally of the operating member and in general alignment with and opening toward rod 76. An alternative arrangement is illustrated in FIGS. 8 and 9 and in this arrangement a rotatable operating member 68a is provided with a pair of ribs 92 and 94 and, where a pair of ribs are used, they are formed to open away from elongated rod 76a and the rod is located between the two ribs as illustrated in FIG. 9.

With this construction of rotatable and axially movable operating members it can be seen that problems of binding as encountered in prior art constructions are eliminated. The rotatable control member is of substantially open construction with relatively spaced, longitudinally disposed ends for establishing a facile connection with the rotors and leaving the axially movable rod open and free to eliminate the problem of binding during control movement. Although the illustrated two-piece rotatable control member construction is preferred, it is conceivable that a unitary, open control member could be used and it will also be appreciated that connection of the rotatable operating member with the rotors could be accomplished

by other methods than engagement in a conforming opening.

The open construction can be achieved with rotary operating members taking forms other than the generally planar form illustrated. For example, as illustrated in FIG. 6, operating member 68b can be generally channel-shaped in transverse cross section or, as illustrated in FIG. 7, operating member 68c can be in the form of a V. With these alternative forms the rotor sections will be provided with means for receiving and engaging the channel or V-shaped operating member. Both alternative forms permit a simple and effective drive connection with the rotors and are disposed generally to one side of the rod leave it substantially open and free for movement, i.e. to one side in the sense that they do not completely encircle the rod as in prior art constructions and can also be provided with a formed tab to provide a bearing support for the axially movable member. The alternative embodiments have a configuration which themselves lend sufficient rigidity to the rotatable operating members to resist bending without the need for auxiliary stiffening ribs.

Although this invention has been illustrated and described in connection with particularly embodiments thereof, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

What I claim is:

1. A rotary switch comprising, in combination, bushing means connected in said rotary switch adjacent one end thereof, a generally hollow rotatable member disposed in said bushing for rotation about an axis, a plurality of switch sections aligned on said axis in relative spaced relationship and each including a rotor supported for rotation about said axis, each of said rotors including a generally centrally located aperture, said generally hollow rotatable member characterized by a limited axial length so as not to extend completely through all of said switch sections, a first generally elongated operating member connected adjacent one end thereof to and rotatable with said hollow member and extending therefrom through the apertures in said rotors, said first operating member including relatively spaced, longitudinally disposed end portions engaged in said apertures so that said rotors, said first operating member and said hollow rotatable member are connected for joint rotation, and a second generally elongated operating member supported for movement in said hollow member and extending from said hollow member along and intermediate the longitudinal ends of said first operating member whereby said first operating member is of generally open construction and said second operating member is substantially exposed to permit relative movement between said first and second operating members without binding.
2. The combination of claim 1 wherein the opposite end of said first operating member includes a tab extending toward said second operating member and including a bearing surface coaxially arranged with said hollow member for receipt and support of said second operating member.
3. The combination of claim 1 wherein said first operating member has a generally planar configuration and said aperture in each of said rotors include generally aligned notches for receipt of and engagement with said first operating member.
4. The combination of claim 3 wherein said first operating member includes a formed depression extending longitudinally and generally coextensively therewith, and wherein said second operating member has a rod-like

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configuration and said depression is disposed in general alignment with and opens toward said second operating member.

5. The combination of claim 3 wherein said first operating member includes a pair of formed, relatively spaced depressions extending generally longitudinally of and co-extensively therewith, said second operating member characterized by a generally rod-like configuration and disposed intermediate said depressions with said depressions opening away from said second operating member.

6. The combination of claim 1 wherein said first operating member is generally channel-shaped in transverse cross-section and said second operating member is positioned intermediate the longitudinally disposed end portions thereof.

7. The combination of claim 1 wherein said first operating member is generally V-shaped in transverse cross-section and said second operating member is positioned intermediate the longitudinally disposed end portions thereof.

8. A rotary switch comprising, in combination, a plurality of switch sections relatively spaced along a common axis, said switch sections each including a rotor supported for rotation about said common axis and having an aperture therethrough, first generally elongated operating means extending axially through said rotor apertures and connected with said rotors to establish a driving connection between said rotors and said first operating means and characterized by having relatively spaced, longitudinally disposed end portions to be of generally open construction,

second generally elongated operating means extending axially through said rotors, means engaging and supporting said second operating means for movement relative to said switch sections while leaving a substantial portion of said second operating means generally exposed,

said second operating means disposed intermediate the longitudinal ends of and adjacent said first operating means whereby, with said first operating means being of generally open construction, said second operating means is substantially exposed and said first and second operating means are free for relative movement therebetween without binding,

means supporting said first operating means for rotation about said axis,

and said first operating means including a generally hollow member disposed adjacent one end of said rotary switch and connected for rotation about said axis, said first operating means also including a portion disposed in axial spaced relation from said hollow member and extending toward said second operating means to provide a bearing support therefor, said second operating means extending through said hollow member and engaging said portion.

9. The combination of claim 8 wherein said first operating means is generally channel-shaped in transverse cross-section, said second operating means is positioned intermediate the longitudinally disposed end portions of said first operating means, and said rotor apertures include portions for receipt of and engagement with said first operating means.

10. A rotary switch comprising, in combination, a plurality of switch sections relatively spaced along a common axis, said switch sections each including a rotor supported for rotation about said common axis and having an aperture therethrough,

first generally elongated operating means comprising a generally planar strip having relatively spaced, longitudinally disposed end portions and extending axially through said rotor apertures,

said apertures in said rotors including portions arranged for engagement with said planar strip to

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establish a driving connection between said rotors and said first operating means,

second generally elongated operating means extending axially through said rotors,

means engaging and supporting said second operating means for movement relative to said switch sections while leaving a substantial portion of said second operating means generally exposed,

said second operating means disposed intermediate the longitudinal ends of and adjacent said planar strip of said first operating means whereby, with said planar strip providing a generally open construction, said second operating means is substantially exposed and said first and second operating means are free for relative movement therebetween without binding,

and means supporting said first operating means for rotation about said axis.

11. The combination of claim 10 wherein said planar strip includes at least one longitudinal depression in and extending generally coextensively with said strip.

12. A rotary switch comprising, in combination, a plurality of switch sections relatively spaced along a common axis, said switch sections each including a rotor supported for rotation about said common axis and having an aperture therethrough,

first generally elongated operating means extending axially through said rotor apertures and characterized by having relatively spaced, longitudinally disposed end portions and connected with said rotors to establish a driving connection between said rotors and said first operating means,

second generally elongated operating means extending axially through said rotors,

means engaging and supporting said second operating means for movement relative to said switch sections while leaving a substantial portion of said second operating means generally exposed,

said second operating means disposed intermediate the longitudinal ends of and operatively adjacent said first operating means, said first operating means having an open and non-encircling construction and arrangement with respect to said second operating means so that said second operating means is substantially exposed and said first and second operating means are free for relative movement therebetween without binding,

and means supporting said first operating means for rotation about said axis.

13. A rotary switch device comprising, in combination, a plurality of switch sections relatively spaced along a common axis with each switch section including a rotor supported for rotation about said common axis,

first elongated operating means extending through and generally coaxial with said rotors,

means connecting said rotors to said first operating means for rotary motion in response to movement of said first operating means,

second elongated operating means extending generally parallel to said axis,

and means supporting said second operating means for movement in said rotary switch device and engaging said second operating means at axially spaced points thereon to leave said second means substantially exposed,

said first operating means including relatively spaced, longitudinally disposed end portions to be of substantially open construction and said second operating means disposed intermediate the longitudinally disposed end portions of and adjacent to said first operating means and being substantially exposed and free for movement relative to said first operating means without binding.

14. The combination of claim 13 wherein each of said rotors includes an aperture and said first operating means is engaged in said apertures.

15. The combination of claim 13 wherein said first operating means includes a generally hollow elongated portion and a laterally disposed portion extending toward said second operating means at a point spaced from said hollow portion to provide a bearing for said second operating means, and said second operating means extends through said hollow portion and is engaged by said laterally disposed portion.

16. An actuating mechanism for providing rotary control movement of a plurality of relatively spaced switch sections arranged on a common axis and also to provide additional control movement to effect a second, independent control function, said actuating mechanism comprising, in combination,

first generally elongated operating means extending through said switch sections generally parallel to said common axis,

second generally elongated operating means extending generally parallel to said axis,

means supporting said second operating means for movement relative to said switch sections and engaging said second operating means at axially spaced points thereon to leave said second means substantially exposed,

said first generally elongated operating means being disposed adjacent said second operating means and forming at least a portion of the support for said second operating means, said first operating means characterized by having a construction in transverse cross-section which is substantially open and non-encircling with respect to said second operating means so that said second operating means is positioned adjacent said first operating means and remains substantially exposed and free for movement relative to said second operating means without binding,

a control knob,

means connecting said control knob to both said first and second operating means for selective operation of said first and second operating means through a common control knob,

and means connecting said switch sections to said first operating means for rotary control movement of said switch sections in response to movement of said first operating means.

17. A rotary switch device comprising, in combination, a plurality of switch sections relatively spaced along an axis,

first and second generally elongated operating members extending along said axis through said switch sections, said first and second operating means arranged closely adjacent each other and extending generally coaxially with each other and said switch sections,

means connecting said switch sections to said first operating member for rotary control motion of said switch sections in response to movement of said first operating member,

means on said first operating member cooperating to support said second operating member for movement relative to said first operating member and said switch sections,

and one of said first and second operating members characterized by having, with respect to the other of said operating members, a substantially open and non-encircling construction and arrangement in transverse cross-section so that said first and second operating members can be positioned adjacent each other and remain substantially free for relative movement without binding.

18. In a rotary switch device having a plurality of switch sections relatively spaced along a common axis with each switch section including a rotor supported for rotation about said common axis the combination of an actuating mechanism comprising,

first and second generally elongated operating means extending through and generally coaxial with said rotors,

means connecting said rotors to said first operating means for rotary movement in response to movement of said first operating means,

means supporting said second operating means for movement relative to said first operating means and said rotors,

a control knob,

means connecting said control knob to both said first and second operating means for selective actuation of said first and second operating means through a common control knob,

and one of said first and second operating means including relatively spaced, longitudinally disposed end portions and the other of said first and second operating means arranged intermediate the longitudinally disposed ends of and adjacent to said one operating means, said one operating means having, with respect to said other of said operating means, a substantially open and non-encircling construction so that said other operating means is substantially exposed and said first and second operating means are free for relative movement therebetween without binding.

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