United States Patent

O'Malley

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[54] **MINIATURE AXIAL BRIDGING ROTARY SWITCH WITH IMPROVED HOUSING**

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[73] Assignee: **Grayhill, Inc.,** La Grange, Ill.

[22] Filed: **Feb. 1, 1971**

[21] Appl. No.: **111,545**

[52] **U.S. Cl.**.....**200/11 A,** 200/11 D, 200/14

[51] **Int. Cl.**.....**H01h 19/58,** H01h 21/78

[58] **Field of Search**.....200/11 A, 11 D, 14, 17 R, 168 S

[56] **References Cited**

UNITED STATES PATENTS

3,588,392	6/1971	Cartwright	200/11 A
3,525,826	8/1970	Allison	200/11 D
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Primary Examiner—J. R. Scott

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[57] **ABSTRACT**

Multi-position electrical switch including switch sections or decks arranged so that any desired number of sections can be used. Each section includes a rotor for selectively bridging switch contacts which can be arranged in different manners as required in different applications. A large number of switch positions, for example, 24, can be provided in a very small switch structure. The individual contacts for the different positions are embedded in a plastic insulating member to provide a solid insulated support therefor.

11 Claims, 6 Drawing Figures

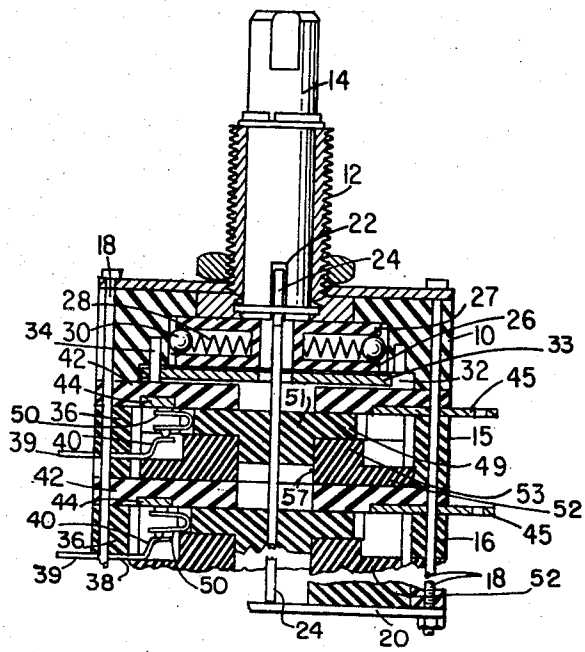


FIG. 3

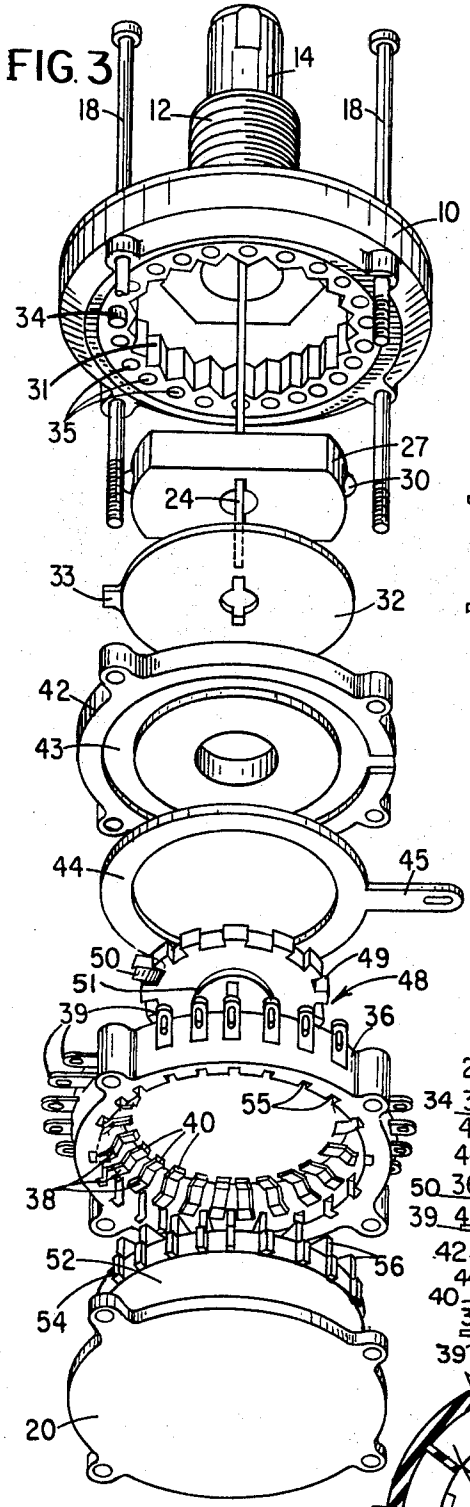


FIG. 1

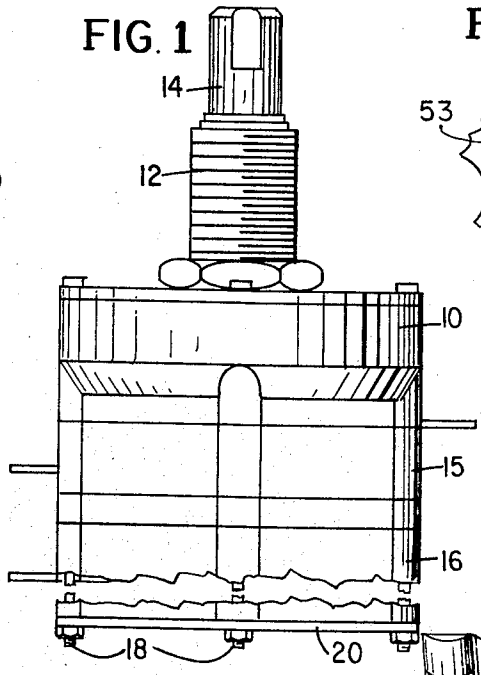
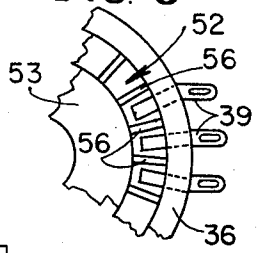


FIG. 5



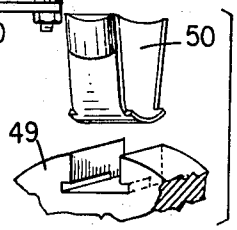
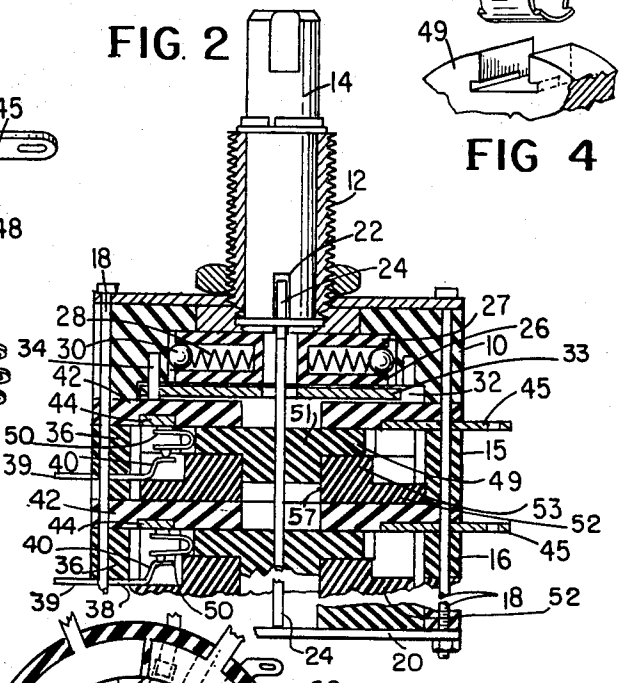


FIG 4

FIG. 2



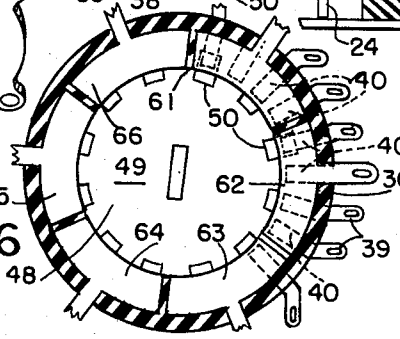


FIG. 6

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MINIATURE AXIAL BRIDGING ROTARY SWITCH WITH IMPROVED HOUSING

BACKGROUND OF THE INVENTION

A miniature multi-position rotary switch structure is described and claimed in my prior U.S. Pat. No. 3,297,836, issued Jan. 10, 1967. This switch has been highly successful in actual use and is being produced in large quantities by Grayhill, Inc., assignee of the invention. As described in the patent, this prior switch structure provides **12** switch positions, and it has also been constructed with **10** switch positions.

There has been a significant demand for miniature rotary switches having more than **12** positions. More specifically, switches are required in various applications which have **16**, **20** and **24** positions. The switches which are available and which have such a large number of positions have been quite large, substantially larger than the switches constructed in accordance with U.S. Pat. No. 3,297,836. Although attempts have been made to provide smaller switches with **16** or more positions, the switches have not been entirely satisfactory in operation and have not been of a construction to provide the contact arrangements which are required in many applications.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a miniature multi-position rotary switch which is of simple construction and which can have as many as **16** or more switch positions.

Another object of the invention is to provide a multi-position rotary switch having a large number of switch positions, with the contacts required for such switch positions being embedded in closely spaced relation in an insulating support housing, and insulated from each other thereby.

A further object of the invention is to provide a miniature multi-position rotary switch which has a plurality of switch sections or decks, with a common operator therefore and independent contact structures, with each deck having a large number of switch positions.

In accordance with the invention, a miniature rotary electrical switch is provided including a base member to which a rotary actuator is connected, and which has a detent structure and a stop structure coupled thereto. One or more switch decks are connected to the base member, with the actuator extending through the switch decks to move the rotors thereof. Each switch deck includes a cylindrical insulating housing section having a plurality of conductors embedded therein at radially spaced positions. The conductors have portions extending outside the housing forming terminals, and portions extending inside the housing forming switch contacts. A rotor within each housing section has one or more contacts therein which selectively engage the contacts of the conductors embedded in the housing, and one or more other contacts provided on a plate which closes one end of the housing section. The other end of the housing section is closed by a disc having ridges extending therefrom into the spaces between the switch contacts. The ridges insure that the contacts are insulated from each other and form recesses or wells for receiving foreign particles, so that such particles are removed from the vicinity of the switch contacts. The ridges may extend into the path of the moving contacts, and serve to clean such contacts as they move from one position to the other.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a miniature rotary multi-position switch in accordance with the invention;

FIG. **2** is a cross-section view of the switch of FIG. **1**;

FIG. **3** is an exploded view of the switch of FIG. **2** showing only one switch deck;

FIG. **4** is a detail view showing the insulating rotor **49** and the U-shaped contact **50**;

FIG. **5** illustrates the construction of the insulating disc of the switch; and

FIG. **6** illustrates a modification of the contact structure.

DETAILED DESCRIPTION

In FIG. **1** there is shown a miniature multi-position rotary switch of the invention which includes a base housing member **10** having a threaded tubular bushing **12** extending therefrom for mounting the same on a panel. A rotary operating shaft **14** extends through the bushing **12** for controlling the position of the switch. A plurality of switch sections or decks **15** and **16** are shown mounted to the base member **10** by a plurality of bolts **18**. A cover plate **20** is provided after the last switch section **16**. It is to be pointed out that any number of switch decks, from **1** to **12** or more, can be used, with the deck **16** being broken away to indicate that additional decks can be used. The switch is shown enlarged in the drawing to better illustrate the structure. A **24** position switch as illustrated may have an outer diameter of about 1¼ inches, and the thickness of each switch deck is about one third of an inch.

FIG. **2** is a cross-section view of the switch of FIG. **1**, and FIG. **3** is an exploded perspective view showing such a switch with a single switch deck. As shown in FIG. **2**, the operating shaft **14** has a slot **22** in the end thereof into which an actuating blade **24** is keyed. The blade **24** is held in position with an end thereof in the slot **22** by the cover plate **20**. The base member **10** of the switch forms a housing in which a detent mechanism **27** is positioned. This mechanism includes an elongated rotor (FIG. **3**) with opposing holes therein in which springs **28** are positioned. The springs **28** force balls **30** outwardly against the wall **31** of the housing recess **26**, and has ribs thereon (FIG. **3**) to form detented positions. The detent mechanism **27** is turned by the blade **24** as the switch operating shaft **14** is rotated.

A stop plate **32** is also provided in the recess **26** in the base member **10**. This plate is also keyed to the blade **24**, and has a projecting stop arm **33** which engages pins **34** in the base **10** to limit the rotary movement of the operating shaft **14**. The pins **34** may be positioned in any desired ones of the openings **35** in the base **10**, to limit the rotary movement of the shaft **14**, as may be required.

Each switch section or deck includes a cylindrical housing member **36** which is molded of insulating material. This member has a plurality of conductors **38** embedded therein which are substantially uniformly radially positioned about the cylindrical housing **36**. The conductors have outwardly extending terminal portions **39** and inwardly extending contact portions **40**. The contact portions **40** may be bent upwardly to facilitate contact therewith by the rotor, as will be further explained. On the top side of the insulator **36** is an insulating cover plate **42**, which has a recess **43** on the bottom side in which a common annular conductor **44** is placed. The conductor **44** has a terminal projection **45** to which electrical connection can be made.

Positioned within the housing **36** is a rotor structure **48** including an insulating member **49** having one or more contacts **50** movable thereby. The member **49** has a slot for receiving the blade **24**, with the operating shaft **14** and the actuating blade **24** cooperating to form a rotary actuator for the rotor structure **48**.

As shown in FIGS. **2** and **4**, the movable contact **50** is U-shaped and has one arm selectively engaging the individual contacts **40** of the conductors **38** and another arm engaging the common conducting ring **44** (FIG. **2**). The movable contact **50** is made of a resilient metal to provide spring biased engagement with the fixed contacts. It will be obvious that a plurality of contacts **50** can be positioned in the recesses provided in rotor **49** to simultaneously bridge a plurality of contacts **38** to the common conductor **44**.

An insulating disc **52** is positioned in the end of the cylindrical housing member **36** opposite to that engaged by the cover plate **42**. This disc may have projections **54** about the periphery thereof which mate with recesses **55** in the member **36** to key the same in position. The disc **52** has a plurality of ridges **56** (FIG. **5**) which extend between the individual con-

tact portions 40 to insure that the contacts are insulated from each other. The ridges also provide a recess or well under each contact into which foreign material which may enter the switch, or which is produced by engagement of the contacts, can fall to eliminate the possibility of such material bridging the contacts. Also, the top of the ridge extending between adjacent contacts 40 may be engaged by the contact 50 as it moves from one contact portion 40 to another, and can be molded of material with abrasive therein so that it cleans the engaging surface of the contact 50. It may be desirable to have a smaller number of interengaging projections 54 and recesses 55 than shown, it being only necessary to hold the disc 52 and the housing section 36 in radial alignment so that the ridges 55 are positioned between the individual contact portions 40. The insulating disc 52 has a center opening 57 to receive a hub 51 on the rotary insulating member 49 of rotor structure 48, to hold the rotor structure in axial alignment.

FIG. 5 shows in more detail the construction of the insulating disc 52 and the ridges 56 thereon. The disc has a central hub portion 53, and the ridges 56 extend from this hub to the edge of the disc to engage the insulator 36. Actually the ridges 56 continue to the projections 54 which fit in the recesses 55 in the insulator 36. The space defined by a pair of adjacent ridges, the hub portion 53 and the inside surface of the insulator 36 forms a well under each contact into which foreign material can drop, so that this is removed from the contacts and does not provide a conducting bridge therebetween. As previously stated, the disc 52 may be molded of material having abrasive in the portion thereof forming the ridges, and this acts to clean the surface of contact 50 as this contact slides thereacross. However, this will produce small conducting particles which could form bridges between the contacts 40. FIG. 5 shows the contact 40 and the insulator 36 to show the relative position of the contacts and wells formed by the ridges.

FIG. 6 shows the contact arrangement in more detail, and shows that a number of contacts 50 may be used on the rotor 48. This figure also shows that the common conductor 44 may be replaced by a plurality of flat conductor segments. In the structure shown, six conductor segments 61, 62, 63, 64, 65 and 66 are used in place of the single conductor 44. In this structure, a 24 position switch is illustrated having 24 fixed contacts 40, so that there are four contacts 40 for each conductor segment 61 to 66. Six movable contacts 50 are provided in the rotor, one for each segment 61 to 66. The switch structure therefore provides six separate switching sections, each having four positions in which a different one of the contacts 40 is connected to one of the contact conductor 61 to 66. For such a switch, the stop pins 34 would be positioned to allow the stop arm 30 to move through an angle of 60°, and the detent structure 27 would clearly define the four positions in the 60° segment.

It will be apparent that various arrangements of the movable contacts and contact segments can be provided to provide desired switching arrangements. Thus each deck can form a plurality of separate switch sections, and a plurality of decks can be used. The switch contact arrangement is extremely flexible and can provide a large number of simultaneously operated switching section in a very small switch structure.

In the switch structure shown, the movable contact 50 engages a ridge 55 as it moves from one contact portion 40 to another, and breaks the one contact before the next contact is made. It will be apparent that the contact 50 can be constructed so that it will simultaneously engage two contact portions, and the first contact is not broken until after the next contact is made. In such case, the ridges 55 are constructed so that the contact 50 does not engage the tops thereof as it moves from one contact portion 40 to the next.

The switch construction of the invention provides a very compact rotary switch having 16 or more rotary positions. One or more switch decks can be provided to thereby provide a large number of switched connections which can be independent of each other or have any one of a large number of different relations as may be required for different applications.

I claim:

1. A rotary multi-position electrical switch structure including in combination,

a molded cylindrical insulating member having a plurality of conductors molded therein, said conductors being substantially uniformly radially spaced about said insulating member and having external terminal portions and internal contact portions,

an insulating plate engaging one end of said cylindrical insulating member, contact means in engagement with said insulating plate,

a rotor structure within said insulating member having a rotary insulating member and at least one conducting contact moved by said member, said contact having portions selectively engaging said contact portions of said conductors and said contact means, and

an insulating disc engaging said cylindrical insulating member at the end thereof opposite to said end engaging said insulating plate, said disc having a portion extending into said cylindrical insulating member and ridges extending between said contact portions, said disc and said cylindrical member having interengaging portions to insure that said disc is in a predetermined radial position with respect to said cylindrical member.

2. A switch structure in accordance with claim 1 wherein said internal contact portions have raised ends, and said contact of said rotor structure is U-shaped and has a first end adapted to selectively engage said contact portions and a second end adapted to engage said contact means.

3. A switch structure in accordance with claim 1 wherein said insulating disc extends within said cylindrical insulating member with one surface thereof flush with said opposite end of said insulating member.

4. A switch structure in accordance with claim 1 wherein said ridges of said insulating disc have heights to be engaged by said contact of said rotary member when said contact moves from one of said contact portions to another, and wherein said ridges are constructed of a material which acts to clean said contact as said contact moves thereacross.

5. A switch structure in accordance with claim 4 wherein said insulating disc has a central hub connected to said ridges and cooperating therewith and with the inside surface of said cylindrical insulating member to form wells under said contact portions.

6. A switch structure in accordance with claim 1 wherein said insulating plate has a plurality of recesses therein and said contact means includes a plurality of flat conductors positioned in said recesses, with each conductor having a radial extent to be aligned with a plurality of said contact portions.

7. A switch structure in accordance with claim 6 wherein said rotor structure has a plurality of conducting contacts equal in number to the number of said flat conductors.

8. A rotary electrical switch structure including in combination,

a base member having an operating shaft supported thereby and means coupled to said shaft providing predetermined switching positions,

a plurality of switch decks mounted on said base member each including a cylindrical insulating housing section having a plurality of conductors molded therein in radially spaced positions, an insulating disc in predetermined positional engagement with said housing section and having a central opening therein, contact means supported in fixed position with respect to said conductors, and a rotor within said housing section including a movable contact selectively bridging said conductors and said contact means, said rotor including a rotary insulating member having a hub extending into said central opening in said insulating disc, and

drive means coupling said operating shaft to said rotor of each of said switch decks for simultaneously rotating the same.

9. A switch structure in accordance with claim 8 wherein said conductors have portions extending outside said cylindri-

cal housing section forming terminals, and portions extending within said housing section forming fixed contacts which are engaged by said movable contact of said rotor.

10. A switch structure in accordance with claim 8 wherein said base member has a plurality of openings therein and including a pair of stop pins adapted to be positioned in said openings, and a stop plate coupled to said operating shaft having a stop arm adapted to engage said stop pins to limit rotation of said operating shaft, with the extent of rotation being determined by the positioning of said stop pins in said openings.

11. A rotary switch structure in accordance with claim 1 wherein said insulating disc has a central opening therein, and said rotary insulating member has a hub extending into said central opening.

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