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ROTARY SWITCH HAVING SELECTIVE ANGULAR CONTROLLING LIMITS MEANS

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FIG. 1

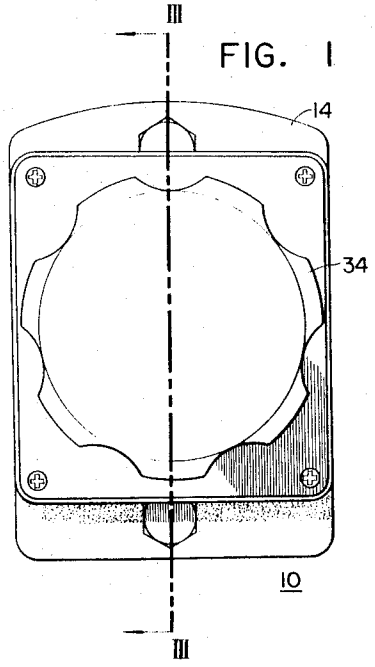
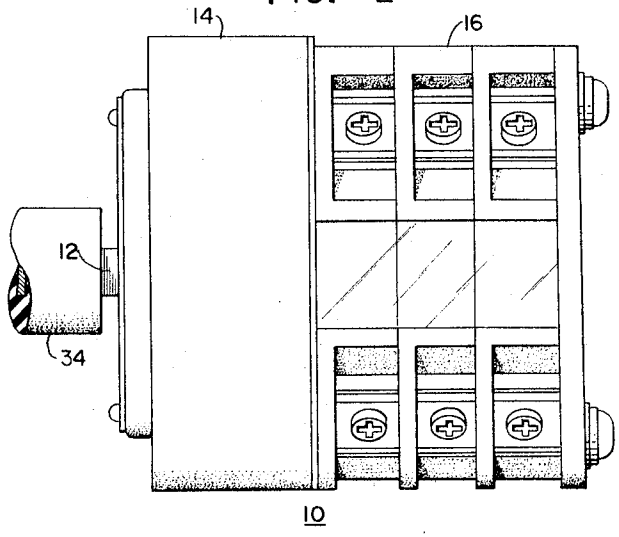


FIG. 2



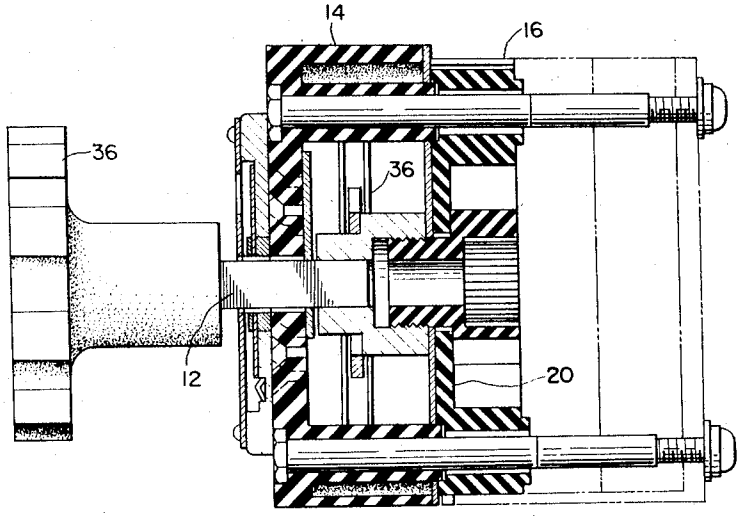


FIG. 3

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FIG. 10

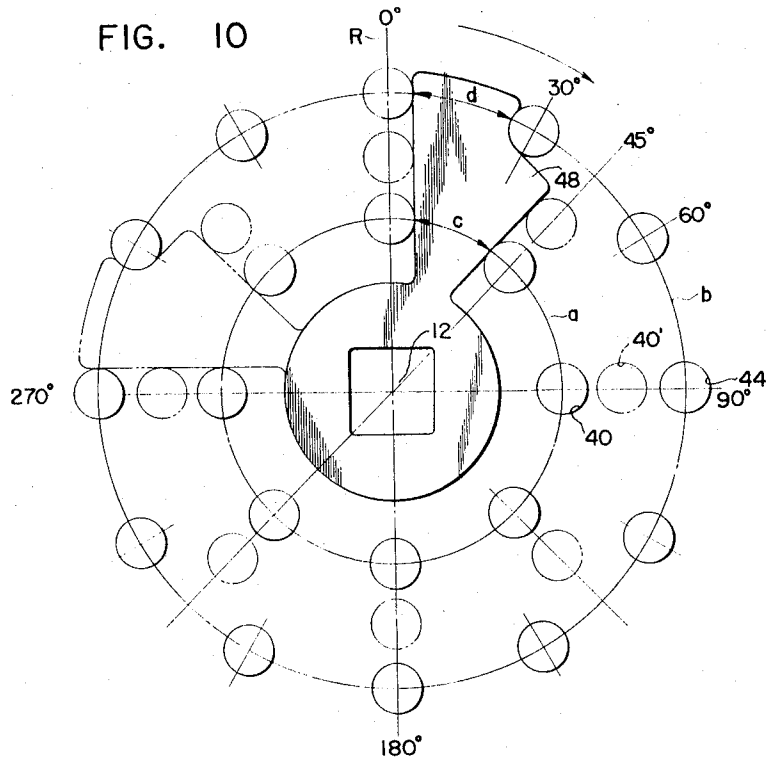

FIG. 4

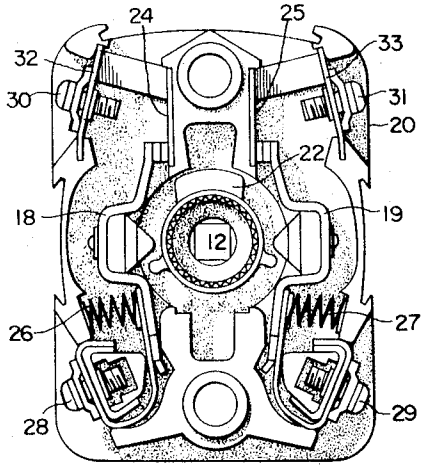

FIG. 9

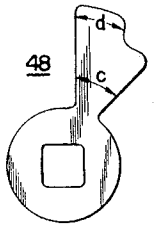

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FIG. 5

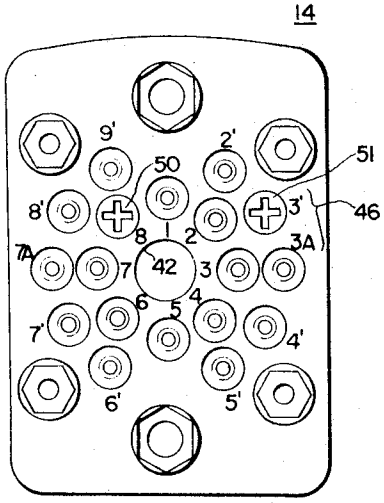
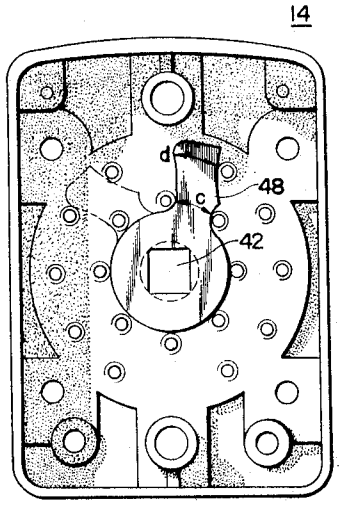


FIG. 6



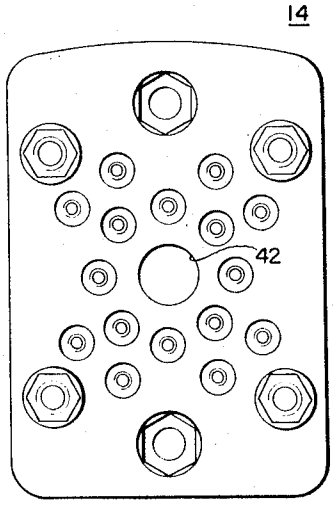
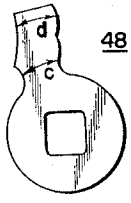


FIG. 7

FIG. 8



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ROTARY SWITCH HAVING SELECTIVE ANGULAR CONTROLLING LIMITS MEANS

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Claims priority, application Japan, Dec. 8, 1964, 39/95,506
1 Claim. (Cl. 200—166)

This invention relates in general to a rotary switch and more particularly to a mechanism for selectively limiting an angular operating region over which an operating shaft for such a switch can be rotated stepwise in either of the forward and rearward directions.

Heretofore it has been commonly practiced to produce preliminarily the several types of the standard parts for limiting angular operating movement of operating shafts for rotary switches, for stock, and to assemble the proper parts selected from the stocked parts in accordance with the particular user's order. However, since such selection and assemblage of the stocked parts can not meet all the requirements of different users, the necessary parts have been designed and produced individually each time an order has been accepted. This measure, however, is disadvantageous in that urgent orders are not only impossible to be accepted but also the products become expensive.

Accordingly, the primary object of the invention is to provide a new and improved rotary switch having a great flexibility of angular operating region over which an operating shaft thereof can be rotated stepwise in either of the forward and reverse directions.

Another object of the invention is to provide an improved and inexpensive mechanism for selectively controlling limits of angular operating region of a rotary switch, which can be mass-produced in accordance with a single predetermined design for storage and which can be adjusted in angular operating region immediately in accordance with the particular requirements of a user for delivery, while the user can vary, at will, the angular operating region.

With the aforesaid objects in view, the invention resides in a mechanism for selectively limiting an angular operating region of an operating shaft for a rotary switch, comprising a set of bores disposed at substantially equal angular intervals substantially equal to 45 degrees on a circle having its center on the axis of the operating shaft on a front wall of a switch box for the rotary switch, a set of bores disposed at substantially equal angular intervals substantially equal to 30 degrees on a circle concentric to and larger in radius than the firstmentioned circle on the front wall, said two sets of bores having a common reference line from which the respective angular intervals are measured, a movement limiter member rigidly secured on said operating shaft adjacent the front wall within the switch box and having a root portion and a free end portion capable of stepping respectively along said two sets of bores as the operating shaft effects stepped rotational movement, said root portion having a width substantially equal to an angular distance between any pair of adjacent inner bores minus twice the radius thereof and said free end portion having a width substantially equal to an angular distance between any pair of adjacent outer bores minus twice the radius thereof, and one stud detachably engaging a selected one of each set of bores and when engaged projecting beyond the associated bore into the interior of the switch box to be engageable by said movement limiter member whereby the operating shaft can step over any desired angular region determined by the pair of studs engaging the selected ones of the inner and outer bores respectively.

The invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a front plan view of a rotary switch embodying the principle of the invention;

FIG. 2 is a side elevational view of the rotary switch illustrated in FIG. 1;

FIG. 3 is a longitudinal sectional view, partly in elevation, of the rotary switch taken along the line III—III of FIG. 1;

FIG. 4 is a rear plan view of the rotary switch illustrated in FIGS. 1 through 3 with a cover omitted for the purpose of illustrating the internal construction of the switch;

FIG. 5 is a front plan view of a switch box illustrated in FIGS. 1 through 3;

FIG. 6 is a plan view of the switch box as viewed from the rear end thereof;

FIG. 7 is a view similar to FIG. 5 but illustrating a modification of the invention;

FIG. 8 is a plan view of a movement limiting arm constructed in accordance with the teachings of the invention;

FIG. 9 is a plan view of a modification of the movement limiting arm; and

FIG. 10 is an enlarged plan view useful in explaining the principle of the invention.

Referring now to FIGS. 1 through 4, there is illustrated a rotary switch embodying the principle of the invention. An arrangement illustrated comprises a switch box of any suitable electrically insulating material generally designated by the reference numeral **10** and an operating shaft **12** centrally disposed within the switch box **10**. As best shown in FIG. 3, the switch box **10** is divided into two portions or a front box portion generally designated by the reference numeral **14** for accommodating the mechanism of the invention and a rear box portion generally designated by the reference numeral **16** for accommodating a switching mechanism.

While the invention is applicable to any desired type of rotary switches, it will now be described as being applied to a rotary switch illustrated in FIG. 4. The rotary switch illustrated comprises a pair of movable contact arms **18** and **19** suitably secured on an electrically insulating plate **20**, a cam member **22** mounted on the operating shaft **12** to serve to move the movable contact arms **18** and **19** away from each other, a pair of stationary contact arms **24** and **25** suitably secured on the insulating plate **20** and a pair of compression springs **26** and **27** for normally biasing the pair of movable contact arms **18** and **19** to engage the pair of stationary contact arms **24** and **25** respectively. Each of the compression spring **26** or **27** has one end attached to the associated movable contact arm **18** or **19** and the other end attached to the insulating plate **20**.

The pair of movable contact arms **18** and **19** are electrically connected to a pair of terminals in the form of fastening screws **28** and **29** disposed on the lower corners of the insulating plate **20** while the pair of the stationary contact arms **24** and **25** are electrically connected to another pair of terminals in the form of fastening screws **30** and **31** disposed on the upper corners of the insulating plate **20** through a pair of connecting elements **32** and **33** respectively.

The operating shaft **12** extends externally of the front box portion **14** and has an operating knob **34** secured at the end of the exposed portion. The operating shaft is adapted to step by the action of a click-stop mechanism **36** of the conventional construction disposed in the front box portion **14**.

With the arrangement illustrated, it will be readily understood that as the operating shaft **12** is rotated stepwise in either of the forward and reverse directions are separation and re-closure of the contact arms is effected through the cam member **22** shown as having three projections in FIG. 4.

If desired, a plurality of contact assemblies such as above described may be disposed one over another in angularly offset relationship with a cam member such as **22** associated with different one of the contact assemblies. FIG. 2 shows, by way of example, three contact assemblies.

The invention contemplates to provide a new and improved mechanism for selectively limiting an angular operating region over which the operating shaft **12** and hence the cam member **22** as previously described in conjunction with FIG. 4 can be rotated stepwies in either of the forward and reverse directions.

Referring now to FIG. 10 the front box portion **14** (see FIGS. 5 and 6) is provided on the front wall with a plurality of bores **40** disposed at substantially equal angular intervals on a cycle *a* having its center on the axis of the operating shaft **12** on center of a central opening **42** (see FIGS. 5 and 6) formed on the front wall of the front box portion **14** and a plurality bores **44** disposed at equal angular intervals different from the first-mentioned angular intervals on a circle *b* concentric and larger in radius than the circle *a* with reference line R from which the angular intervals are measured in the direction of the arrow, being common to both sets of the bores **40** and **44**. The reference line may conveniently be a vertical, upward directed line passing through the center of the circles in FIG. 10 although any other line passing through the center might be the reference line. Preferably the equal angular intervals for the bores **40** on the smaller circle *a* are equal to 45 degress and those for the bores **44** equal to 30 degrees. Also the two sets of the bores **40** and **44** are preferably screw threaded and of a countersink type of the purpose as will be apparent hereinafter.

It is to be noted that all the plurality of outer bores **44** on the larger circle *b* are not necessarily provided on the front wall of the front box portion and that any one or more of such bores may be omitted as desired. For example, FIG. 5 illustrates that two bores **44** positioned at angular intervals equal to 0 and 180 degrees respectively measured from the reference line or the vertical upwardly directed radius. Alternatively four bores **44** positioned at angular intervals equal to 0, 90, 180 and 270 degrees respectively measured from the vertical upwardly directed line may be omitted as shown in FIG. 7. Also the set of bores **40** may be disposed further away from the center of the central opening **42** as shown at dot-and-dash circles **40'** in FIG. 10. Alternatively the set of bores **40** may be disposed nearer the center of the central opening **42** if desired.

FIG. 5 also shows legends **46** such as **2̇, 3̇, 3A, 4̇ . . . 9̇** denoted adjacent the outer bores **44** and **1, 2, 3 . . . 8** denoted adjacent the inner bores **40** which serve to set an angular region over which the operating shaft **12** can be stepwise rotated, with reference to a chart (not shown) annexed with the present device.

In order to limiting rotational movement of the operating shaft **12**, a movement limiter arm **48** (see FIG. 8) is rigidly secured to the shaft adjacent the internal surface of the front wall of the front box portion **14**. As shown in FIGS. 6 and 8, the movement limiter arm **48** includes that portion thereof adapted to step along the circular arrangement of the inner bores **40** and having a width *c* substantially equal to the distance between any pair of adjacent bores **40** minus twice the radius of the bore **40** and the free end portion adapted to step along the circular arrangement of outer bores **44** and having a width *d* substantially equal to the distance between any pair of adjacent bores **44** minus twice the radius of the bore **44**.

The present device is completed by a pair of stopper studs **8** preferably in the form of a countersunk bolt being detachably fitted into a selected one of the inner bores **40** and a selected one of the outer bores **44** as shown in FIGS. 5 and 6. It is to be noted that the stud as fitted into the associated bore should have a length sufficient to project beyond the bottom of the bore to be engageable by the movement limiter arm **48**. Thus it will be appreciated that the studs **50** and **51** serve as stopper for limiting stepwise rotational movement of the limiter arm **48** and hence of the operating shaft **12**. Since the bores **40** and **44** and the studs **50** and **51** are of countersink type, the switch box **10** having the pair of studs **50** and **51** fitted into the selected two respectively of the inner and outer bores **40** and **44** on the front wall has a substantially flat outer surface leading to facilitating mounting of the device.

FIG. 9 shows a modification of the movement limiter arm **48** somewhat different in configuration from that illustrated in FIG. 8. It is, however, to be noted that the movement limiter arm **48** shown in FIG. 9 should have its root and free end portions whose widths are specified as previously described for FIGS. 6 and 8.

With the arrangement thus far described, it is assumed that the stud **50** has been screwed into a selected one of the inner bores **40** positioned at an angle of 45 degrees measured in the counterclockwise direction as viewed in FIG. 5 from the reference line or the vertical upwardly directed radius while at the same time the stud **51** has been screwed into a selected one of the outer bores **44** positioned at an angle of 60 degrees measured in the clockwise direction from the reference line with the movement limiter arm **48** disposed between the studs **50** and **51**. Then the knob **34** and therefore the operating shaft **12** is prevented from being rotated in the counterclockwise direction as viewed in FIG. 5 or in the clockwise direction as viewed in FIG. 6 because the right-hand edge as viewed in FIG. 6 of the movement limiter arm **48** abuts against the stud **50** as shown at solid line in FIG. 6. The operating shaft **12**, however, is allowed to be rotated in the clockwise direction as viewed in FIG. 5 or in the counterclockwise direction as viewed in FIG. 6 through an angle of 60 degrees whereupon the lefthand edge of the limiter arm **48** abuts against the stud **51** as shown at dot-and-dash line in FIG. 6, resulting in prevention of further movement of the limiter arm and hence the operating shaft in the same direction. Thus it will be seen that the operating shaft **12** can step over an angular interval equal to 60 degrees.

If it is assumed that the stud **50** has been screwed into a selected one of the inner bore **40** disposed at an angular interval measured in the counterclockwise direction from the reference line while at the same time the stud **51** has been screwed into a selected one of the outer bore **44** positioned at an angular interval equal to 240 degrees measured in the clockwise direction as viewed in FIG. 5 from the reference line then the operating shaft **12** can step up to 90 degrees in the counter clockwise direction but it is prevented from effecting further movement in the same direction. On the other hand the shaft is allowed to step up to 240 degrees in the clockwise direction but it is prevented from effecting further movement in the same direction. Thus it will be readily appreciated that the operating shaft can step over an angular region equal to 285 degrees.

Further it is assumed that the stud **50** has been screwed into a selected one of the inner bore **40** positioned at an angular interval equal to 45 degrees measured in the clockwise direction as viewed in FIG. 5 from the reference line while at the same time the stud **51** has been screwed into a selected one of the outer bores **44** positioned at an angular interval equal to 60 degrees measured in the counterclockwise direction from the reference line. Then the operating shaft **12** can step up to an angle of 60 degrees in the counterclockwise direction whereupon

it is prevented from effecting further rotational movement in the same direction and will have an operating angular region corresponding to 75 degrees. Therefore it will be appreciated that by engaging the pair of studs **50** and **51** by a selected one of the inner bores **40** and a selected one of the outer bores **44** respectively, there can be set any desired angular region over which the operating shaft **12** can step.

It is, however, to be noted that if the operating shaft **12** steps in the counterclockwise direction as viewed in FIG. 5, the stud should engage one bore **40** or **44** positioned at angular intervals equal to a desired operating angular region of the shaft plus 45 degrees for the inner bore **40** or plus 30 degrees for the outer bore **44** because of the circumferential dimension of the movement limiter arm **48**. More specifically the limiter arm **48** has the root portion whose width is equal to the angular distance between any pair of adjacent inner bores **40** minus twice the radius of the bore **40** and the free end portion whose width is equal to the angular distance between any pair of adjacent outer bores **44** minus twice the radius of the bore **44**. Accordingly the movement limiter arm **48** itself locates an angular interval of from 0 to 45 degrees in the counterclockwise direction for the inner bores and an angular interval extending from 0 to 30 degrees in the counterclockwise direction for the outer bores **44**. Therefore it is to be understood that the rotational movement of the operating shaft **12** can not exceed an angle of 315 degrees for a single stud **50** engaging a selected one of the inner bores **40** and an angle of 330 degrees for a single stud **51** engaging a selected one of the outer bores **44**. Also it will be understood that the operating shaft **12** can effect stepwise rotational movement over any desired angle between a minimum of 15 degrees and a maximum of 330 degrees with a difference between the adjacent two of such angles equal to 15 degrees.

From the foregoing it will be appreciated that the objects of the invention have been accomplished by the provision of means including a plurality of bores disposed at a predetermined equal angular intervals on each of two concentric circles on the front wall of the switch box, a movement limiter arm having a width adapted to be accommodated between any pair of adjacent bores in each plurality of bores and one stud detachably engaging a selected one of each plurality of bores.

While the invention has been illustrated and described in conjunction with certain preferred embodiments thereof it is to be understood that various changes in the detail of construction and the arrangement and combination of parts may be resorted to without departing from the spirit and scope of the invention.

What I claim is:

In a rotary switch comprising a switch box having a front wall and an operating shaft rotatably extending through a central hole on the front wall into the switch box, a mechanism for selectively limiting an angular region over which the operating shaft can be rotated stepwise in either of the forward and reverse directions, including a set of bores disposed at substantially equal angular intervals equal to 45 degrees on a circle having its center on the axis of said operating shaft on said front wall, a set of bores disposed at substantially equal angular intervals equal to 30 degrees on a circle concentric to and larger in radius to the first mentioned circle on the front wall, said two sets of bores having a common reference line from which the respective angular intervals are measured, a movement limiter member rigidly secured on said operating shaft adjacent the front wall within the switch box and having a root portion and a free end portion capable of stepping along said two sets of bores as the operating shaft effects stepped rotational movement, said root portion having a width substantially equal to an angular distance between any pair of adjacent inner bores minus twice the radius thereof and said free end portion having a width substantially equal to an angular distance between any pair of adjacent outer bores minus twice the radius thereof, and one stud detachably engaging a selected one of each set of bores and when engaged projecting beyond the associated bore into the interior of the switch box to be engageable by said movement limiter member.

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