Jan. 31, 1961 W. B. DULL ET AL 2,970,199

ROTARY SWITCH ASSEMBLY

Filed March 25, 1958 2 Sheets-Sheet 1

Fig. 1

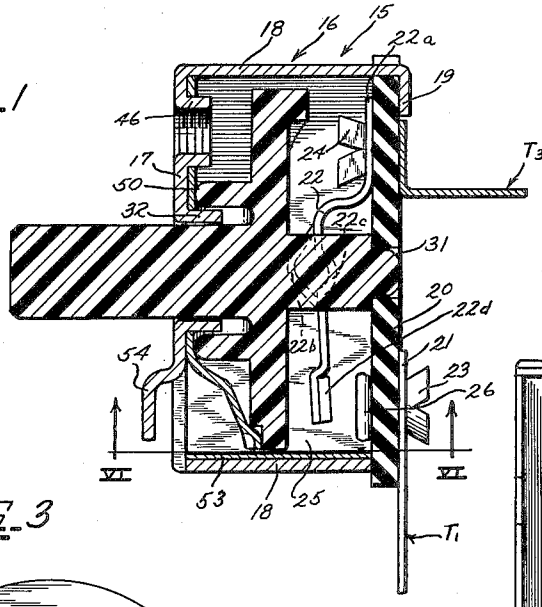


Fig. 2

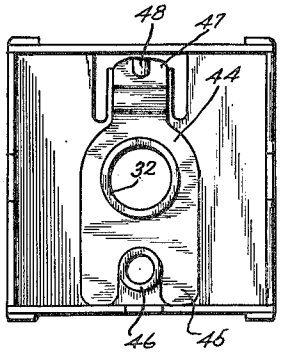


Fig. 3

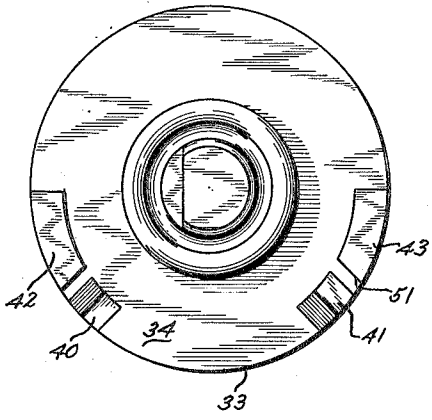


Fig. 4

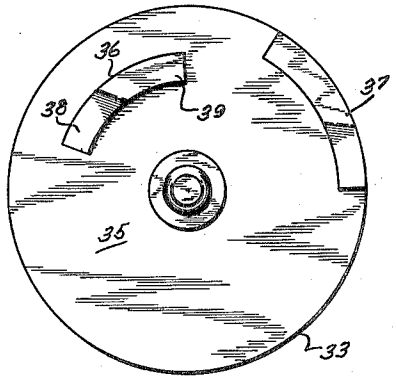
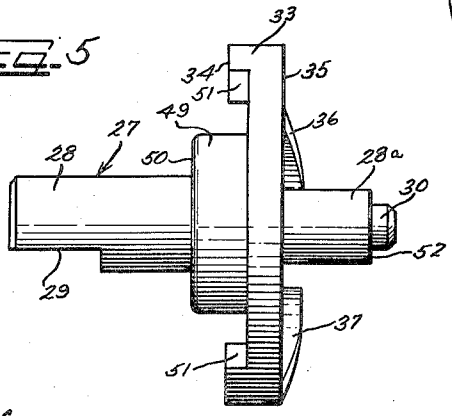


Fig. 5



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ROTARY SWITCH ASSEMBLY

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FIG. 6

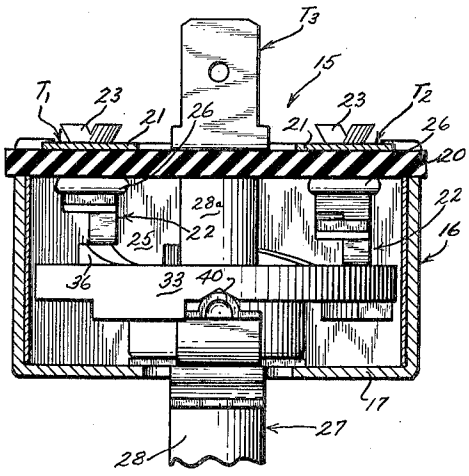


FIG. 7

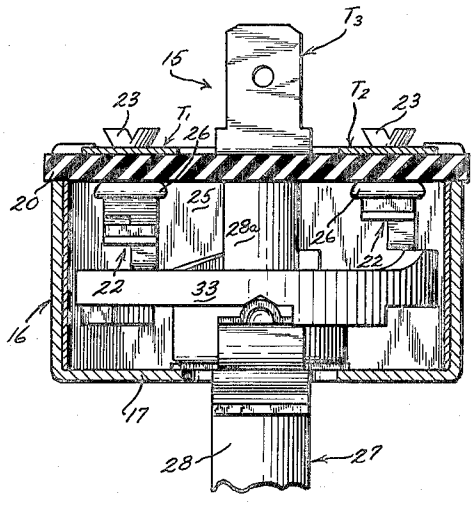


FIG. 9

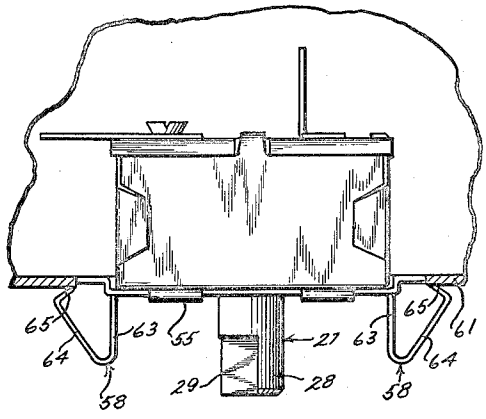


FIG. 8

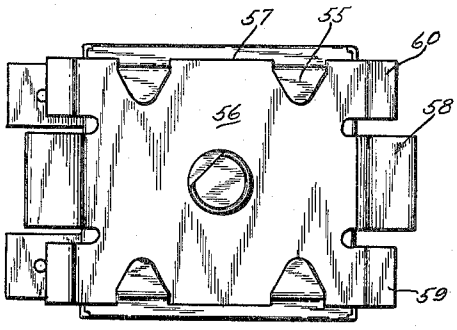
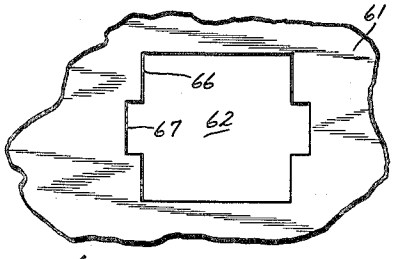


FIG. 10



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ROTARY SWITCH ASSEMBLY

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8 Claims. (Cl. 200—153)

The present invention relates broadly to electrical switch constructions, and is more particularly concerned with a rotary switch wherein an angularly adjustable actuator member takes the form of a unitary stem having a camming flange cooperating with resilient contact arms and resilient positioning means to thereby effect selective actuation of the contact arms and self-indexing of the switch through the positioning means.

This application is a continuation-in-part of our copending patent application, Serial No. 544,739, filed November 3, 1955, and now Patent No. 2,876,313 which is assigned to the assignee of the present application.

According to the general principles of the present invention, a one-piece actuator made of molded nylon or the like and provided with a stem having a flange formed thereon is used to actuate resilient contact arms into selective bridging engagement with contact terminals carried on a base plate. The contact arms and the actuating flange on the stem are enclosed in a switch housing. One side of the flange has camming surfaces formed thereon selectively engaging the contact arms, while the other side of the flange has camming surfaces selectively engaging resilient positioning means preferably supported by an adjoining wall of the housing. Said other side of the flange may further be formed with lugs or equivalent means against which the resilient positioning means may bear to limit the angular adjustability of the actuator member. By provision of camming surfaces on opposite sides of the flange, the resilient contact arms are actuated to perform electrical function and the resilient positioning or stop member engaged to perform the mechanical functions of indexing and angular movement control. Further, by reason of the inherent resilience of the contact arms and stop member, all parts are preloaded and unnecessary looseness therebetween, rattling and other undesirable actions are effectively avoided. Additionally, the preloading gives a good positioning feel in the operation of the switch.

It is accordingly a primary aim of the present invention to provide an improved rotary switch assembly.

Another object of the invention lies in the provision of a rotary switch which has a minimum number of relatively simple components.

A further object of the invention is to provide a one-piece actuator mechanism for a rotary switch which does not require lubrication.

A still further object of the invention is to provide an electric switch of the rotary type incorporating therein a novel actuator member effective to induce the performance of both electrical and mechanical functions.

Other objects and advantages of the invention will become more apparent during the course of the following description, particularly when taken in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same:

Figure 1 is a cross-sectional view, with parts shown in elevation, of a rotary switch provided in accordance with the principles of the present invention;

Figure 2 is a plan view of the interior of the switch housing, with parts removed, and showing the resilient positioning means as located therein;

Figure 3 is a plan view of one side of the rotary actuator showing the indexing and stop surfaces thereon;

Figure 4 is a plan view of the opposite side of the actuator member showing the camming surfaces thereon which engage the resilient contact arms;

Figure 5 is a side view of the actuator member;

Figure 6 is a sectional view taken substantially along the line VI—VI of Figure 1, and illustrating one position of the switch with the flange camming surfaces engaged by a contact arm and the resilient stop member.

Figure 7 is a view similar to Figure 6, and showing another switch position;

Figure 8 is an end view looking toward the base of the switch assembly and showing a mounting means which may be employed to secure the switch to a wall of an appliance or the like;

Figure 9 is a fragmentary plan view of the switch assembly typically mounted with the means of Figure 8; and

Figure 10 is a side view showing the opening normally provided to receive the switch assembly mounting means of Figures 8 and 9.

The switch of the present invention is indicated generally by the reference numeral **15**, and comprises an enclosure or housing **16** which can be conveniently made as a cup-shaped stamping of generally rectangular configuration including a wall **17** and upstanding side walls **18**. At the edges of the side walls **18** there is provided a plurality of tangs or lugs **19** which can be struck over to retain in firm assembly across the open side of the enclosure **16** a base member **20** made of an electrically nonconductive material.

The base member **20** is a rectangularly shaped insulator sheet and has its edges notched to receive the tangs or lugs **19**. Attached in firm assembly to the base member **20** is a plurality of contact terminals. For clarity in description, the designation T_1 and T_2 is applied to the contact terminals visible in Figs. 6 and 7, and T_3 indicates the spade terminal. The switch assembly **15** now to be further described is a two-position switch, and only a pair of contact terminals T_1 and T_2 are required therein. However, it will be appreciated that the principles of this invention apply to switches having more than two positions, and that a greater number of contact terminals may be provided. Variations may further be practiced in the arrangement of camming surfaces later to be described. The number of switch positions to be provided is limited principally by availability of space on the actuator member for the camming surfaces, and the two-position switch herein disclosed should therefore be considered as exemplary only.

Each contact terminal T_1 and T_2 comprises a connecting contact portion **21** on the outside of the switch **15**, and a switch contact portion **22** inside of the enclosure **16**. A contact rivet **23** is generally employed to secure the connecting portion **21** of each terminal to the base member **20**, and in the embodiment shown, the spade terminal T_3 is used to attach the switch portion **22** to said member **20**. This may be done by flaring the terminal T_3 as at **24**. It may be noted at this point that the enclosure casing **16**, being closed by the base member **20**, has a hollow space **25** bounded on opposite side by walls formed by the base member **20** and the wall portion **17** of the enclosure **16**.

Each of the contact arms **22** includes a body portion **22***a* connected to the base member **20** by means of the spade terminal T_3 as noted, and each of said contact arms is disposed inside of the space **25** of the casing **16**. The body portion **22***a* of each contact arm **22** may be slotted to receive the end of the spade terminal T_3. Each contact arm **22** is made of a strip material which is electrically conductive, and preferably has an inherent resilience

or springiness in order to develop the novel functions of the present invention.

The body portion 22*a* of each arm 22 extends toward the contact terminals T_1 and T_2 and includes an angularly bent detent portion indicated at 22*b*, the legs of the detent portion 22*b* being shaped to protrude inwardly into the space 25 of the enclosure 16. The detent portion 22*b* may be struck out of the contact arm 22 generally midway of its length to provide an oppositely bent portion 22*c*. On the other hand, the detent portion 22*b* may comprise the entire width of the contact arm 22 as is often customary in the art.

At the free end of the contact arm 22 is provided a switch contact portion indicated at 20*d* line in registry with a contact cap 26 carried by the rivet 23 attaching the connecting portion 21 of each terminal T_1 and T_2 to the base member 20.

It will be appreciated that during operation of the switch 15, the contact portion 22*d* of either of the arms 22 will engage the contact cap 26 of one of the terminals T_1 or T_2. However, the contact arm 22 is shaped and arranged so that the switch contact portion 22*d* is spaced away from the contact cap of the connecting portion 21 except when pressed into electrical contact by the actuator member now to be described.

According to the principles of the present invention, there is provided a one-piece actuator member which is conveniently fabricated as an integral molded article made of a suitable electrically non-conductive material such as nylon or the like. In this connection, it may be noted that the material selected may include such a representative plastic material as nylon which has the characteristic of being self-lubricating when fitted in bearing engagement with a metallic surface.

The actuating member of the present invention is indicated generally at 27, and comprises a generally cylindrical stem 28 flattened as at 29 to receive a finger manipulable knob (not shown) to facilitate manual actuation of the switch 15.

At the opposite end of the stem 28 is provided a reduced diameter pin 30 which is received and seated in an aperture 31 centrally located in the base member 20 thereby to provide a bearing and journal support for the end of the actuator 27.

The wall portion 17 of the enclosure 16 is also provided with an apertured embossment 32 sized to provide a bearing and journaling engagement for the stem 28 of the actuator 27.

At an intermediate portion of the stem 28, the actuator 27 is provided with a flange 33 which extends radially outwardly from the stem 28 inside the space 25 of the enclosure or casing 16. The flange 33 has front and rear faces 34 and 35, respectively, spaced from the wall 17 and base member 20.

The face 35 of the flange 33 is constructed to include a pair of arc-like camming surfaces 36 and 37 (Fig. 4) shaped and disposed to engage the detent portions 22*b* of the contact arms 22 during rotation of the actuator 27. Each camming surface 36 and 37 is provided with a sloped or inclined portion 38 and a generally flat portion 39, and the camming surfaces 36 and 37 are disposed radially and circumferentially with respect to the flange face 35 and to each other such that only a single surface 36 or 37 is engaged by a detent portion 22*b* of either of the contact arms 22 during rotation of the actuator 27. As mentioned previously, other arrangements of camming surfaces are well within the purview of this invention should it be desired to provide a switch having more than the two electrical positions shown in the drawings and described herein.

The opposite face 34 of the flange 33 is provided with a pair of spaced camming surfaces 40 and 41, as shown in Fig. 3, and these may take the form of the notches or indentations shown. Spaced circumferentially from the camming surfaces 40 and 41 are a pair of lugs or similar stop means 42 and 43. The notches or camming surfaces 40 and 41 provide an indexing of the actuator 27 during its rotation, while lugs 42 and 43 limit the extent of angular movement of said actuator. The novel means of this invention engageable with said surfaces and lugs will now be described.

Viewing now particularly Figure 2, there is carried interiorly of the housing or enclosure 16 upon the apertured embossment 32 in the wall 17 a resilient stop member or positioning spring means 44 which cooperates with the camming surfaces and stop means 40—43 on the flange face 34 to accomplish the desired indexing and stop functions. The positioning means 44 is shaped to include at one end a yoke portion 45 surrounding an apertured embossment 46 in the wall 17 of the enclosure 16 to restrain the positioning means against movement within the housing. The opposite end of the stop member or positioning means is formed to include a raised or tongue portion 47 having a detent 48 thereon. As appears in Fig. 1, the major portion of the length of the resilient positioning means 44 lies flush with the inner surface of the wall 17, with the exception of the raised or tongue portion 47 of said positioning means.

In addition to being restrained against movement within the housing by location on the embossments 32 and 46, the positioning means 44 is held closely against the inner surface of the wall 17 by an annular bearing ring 49 which projects axially from the face 34 of the flange 33 and is spaced concentrically outwardly of the stem 28. The bearing ring 49 is sized to surround the apertured embossment 32, and has an annular bearing edge 50 slidably abutting the resilient positioning means 44 and preventing inward movement of said means within the housing 16.

A predetermined spacing relationship exists between the camming surfaces 40 and 41 on the flange face 34 and the lugs 42 and 43 adjacent thereto, such that when the detent 48 of the positioning means raised portion 47 is received in either of the camming surfaces 40 or 41, a side edge of the raised portion 47 will closely approach or even abut the adjacent end wall 51 of either of the lugs 42 or 43. It may accordingly be seen that the raised portion 47 and the detent 48 thereon substantially simultaneously cooperate with the camming surfaces and lugs on the flange base 34 to index and limit rotative movement of the actuator 27.

Between the pin 30 and the stem 28 there is a radial shoulder 52 which engages against the base 20. Thus, the portion of the stem 28 indicated at 28*a* and lying between the pin 30 and flange 33 operates as a spacer in positioning the flange relative to the base member 20. Likewise, in addition to cooperating in maintaining the positioning spring 44 against the inner surface of the housing wall 17, the bearing ring 49 operates as a spacer positioning the flange 33 relative to said wall 17. The axial dimension between the shoulder 52 and the bearing surface 50 is such that when the actuator 27 is positioned with the flange 33 thereof interiorly of the space 25, the resilient contact arms 22 resiliently engage the camming face 35 of said flange and develop a spring bias detent function upon cooperatively engaging either of the camming surfaces 36 and 37 provided on the flange face 35.

As is generally considered desirable in the art, an insulating medium 53 may be disposed interiorly of the housing 16 in contact with the side walls thereof. This may be the well-known fish paper or an equivalent thereof.

The operation of the switch 15 can most conveniently be understood by referring to Figs. 6 and 7. In Fig. 6 the detent 48 of the resilient positioning means 44 is engaged by the camming surface or notch 40, and the marginal side edge of the positioning means raised portion 47 is against the end wall 51 of the lug 42 on the flange face 34. In this end position, the detent portion 22*b* of one of the contact arms 22 is in engagement with the relatively flat portion 39 of the camming surface 36 on the flange face 35 pressing the switch contact portion 22*d* against

the contact cap 26 of the connecting portion 21 of the contact terminal T_1, and establish an electrical circuit through said terminal to circuitry to be regulated by the switch 15 and electrically connected to the connecting portion 21 of the terminal T_1. In this position, the other contact arm 22, appearing on the right side of Fig. 6, remains spaced from the corresponding contact portion 21 of the terminal T_2.

In the position of adjustment indicated by Fig. 7, the actuator member 27 has been rotated counterclockwise from the position of Fig. 6, and the detent 48 of the resilient positioning means 44 is engaged in the camming notch 41 of the flange face 34. Further, the marginal side edge of the tongue portion 47 of the positioning means 44 is abutted against the end wall 51 of the lug 43 on said flange face 34. The detent portion 22*b* of the contact arm 22 is upon the relatively flat portion 39 of the camming surface 37 on the flange face 35, and thereby the arm contact portion 22*d* is pressed against the contact cap 26 of the connecting portion 21 of the terminal T_2. An electrical circuit through said terminal to circuitry regulated by the switch 15 is thereby completed. And in the position of Fig. 7, the left hand contact arm 22 is spaced from the connecting contact portion 21 of the terminal T_1, and the detent 22*b* of said arm normally rides free on the face 35 of the flange 33.

A switch of the character described finds many applications in the appliance and related industries, and the switch may be conveniently mounted on an appliance cabinet or related structure in a number of different ways. The wall 17 of the enclosure or housing 16 may have an outwardly turned portion 54 receivable in a suitable opening in the supporting structure, and the casing 16 may be rigidly secured thereto by passing a metal screw or bolt or similar means through the apertured embossment 46 in the wall 17 of the enclosure 16 and into said supporting structure.

Another form of mounting means is shown in Figures 8, 9, and 10, and reference is now made thereto. The wall 17 of the casing 16 may be provided with tangs or lugs 55 struck over to retain against the wall 17 a mounting plate 56. The plate 56 may be stamped from a spring metal, and includes a generally rectangular body portion 57 carrying at opposite ends a relatively wide center tab 58 disposed between a pair of relatively narrow marginal tabs 59 and 60.

The mounting plate 56 and attached switch 15 are mounted on structure 61 (Fig. 10) provided with a shaped opening 62 therein. It will be appreciated that the opening 62 shown in Fig. 10 is reduced to approximately half-size, as contrasted to Figs. 8 and 9, to facilitate illustration. Prior to mounting each of the center tabs 58 is bent into generally the configuration shown in plan in Fig. 9. Each tab 58 is thus shaped to include a generally perpendicular leg portion 63 integral with an angularly disposed leg portion 64 and a relatively short angular end portion 65.

The switch 15 is attached to structure 61 by moving the switch and attached mounting plate 56 toward the opening 62 generally parallel to the vertical plane of the structure 61. The plate 56 is of a length measured between the ends of the tabs 59 and 60 such that the ends of said tabs preferably closely abut the end walls 66 of the opening 62 as shown in Fig. 9. With the tabs 58 formed as indicated, said tabs 58 are passed through and between the relatively farther spaced end walls 67 of the opening 62, and since said tabs are of a springable metal, the leg portion 64 and 65 expand outwardly after passing between said end walls 67 and engage the structure 61 surrounding the opening 62 on the back side thereof. The position of the switch and location of the tabs 58, 59, and 60 with respect to structure 61, and the opening 62 therein, is shown in Fig. 9.

Because of the inherent resilience of the spring contact arms 22 and positioning spring means 44, the actuator 27 is in effect preloaded, thereby tending to maintain selected positions of adjustment obtained by rotating the actuator 27 relative to the detent portions 22*b* of the contact arms 22 and relative to the detent 48 of the positioning spring 44. When the actuator 27 is manually operated, good positioning feel is afforded because the detent 48 tends to definitely snap in place when said detent seats in a cam recess 40 or 41 on the flange face 34. The actuator is also securely locked in place, and is not moved out of selected positions of adjustment because of vibration or inadvertent turning of the stem 28.

It is to be understood that various modifications may be effected in the structures herein disclosed without departing from the spirit of the invention or the scope of the subjoined claims.

We claim as our invention:

1. A switch comprising a sheet form member having a first wall portion and side wall portions offset therefrom to form a generally cup-shaped enclosure, tangs on said wall portions, a terminal member having contact means thereon and extending across said side wall portions to close said enclosure and being engaged by said tangs in firm assembly with said sheet form member, said first wall portion having an aperture formed therein with embossed inwardly extending edge portions forming an axially extending bearing surface at said aperture, a one-piece actuator member having a stem extending through said aperture and journalled in said bearing surface and having a flange inside of said enclosure, one side of said flange having cam surfaces thereon engageable with the contact means of the terminal member to press said means toward said member, the opposite side of said flange having at least one lug formed thereon, and stop means removably carried by the first wall portion upon the embossed inwardly extending edge portions thereof and held in position thereon by the actuator stem engageable with the lug and limiting angular rotation of the actuator inside of said enclosure.

2. A rotary switch comprising a substantially rectangular cup-shaped housing open along one wall, a terminal member closing said wall and attached to said housing, resilient contact arms secured to the terminal member and having detent portions extending into the housing interior, an actuator member comprising a stem journalled in the terminal member and a second wall of said housing and a flange extending radially from said stem inwardly of opposite ends thereof, one side of said flange having cam surfaces formed thereon receiving the detent portions of the resilient contact arms during rotation of the actuator member, the other side of the flange being provided with cam surfaces, and resilient positioning means within the housing apertured to receive the stem of the actuator member and having a flat body portion and an offset tongue portion at one end formed with a detent engageable with the camming surfaces on the other side of the flange to index the actuator member, said positioning means being removably supported by the housing second wall and held thereagainst along its body portion by the actuator member.

3. A rotary switch comprising a substantially rectangular cup-shaped housing open along one wall, a terminal member closing said wall and attached to said housing, resilient contact arms secured to the terminal member and having detent portions extending into the housing interior, an actuator member comprising a stem journalled in the terminal member and a second wall of said housing and a flange extending radially from said stem inwardly of opposite ends thereof, one side of said flange having cam surfaces formed thereon receiving the detent portions of the resilient contact arms during rotation of the actuator member, the other side of the flange being provided with cam surfaces and stop means, and resilient positioning means removably supported by the second wall of the housing and apertured to surround the stem of the actuator member and hav-

ing an inwardly directed end portion engageable both with the cam surfaces and stop means on the other side of flange to index and limit rotary movement of the ac tuator member.

4. A rotary switch comprising a substantially rectangular cup-shaped housing open along one wall and having a second wall spaced therefrom provided with an aperture with embossed inwardly extending edge portions forming an axially extending bearing surface at said aperture, a terminal member closing said one wall and attached to said housing, resilient contact arms secured to the terminal member and having detent portions extending into the housing interior, an actuator member comprising a stem journalled in the terminal member and in the bearing surface of the second wall of said housing and a flange extending radially from said stem inwardly of opposite ends thereof, one side of said flange having arc-shaped radially and circumferentially spaced cam surfaces formed thereon receiving in pressing contact the detent portions of the resilient contact arms during rotation of the actuator member, the other side of the flange also being provided with cam surfaces, and an apertured resilient positioning means provided with a generally flat body portion removably supported upon the embossed inwardly extending portions of the second wall of the housing and lying generally flush against said second wall, said means having a detent portion at one end thereof engageable with the cam surfaces on the other side of the flange to index the actuator member.

5. A rotary switch comprising a substantially rectangular cup-shaped housing open along one wall and having a second wall spaced therefrom provided with an aperture with embossed inwardly extending edge portions forming an axially extending bearing surface at said aperture, a terminal member closing said one wall and attached to said housing, resilient contact arms secured to the terminal member and having detent portions extending into the housing interior, an actuator member comprising a stem journalled in the terminal member and in the bearing surface of the second wall of said housing and a flange extending radially from said stem inwardly of opposite ends thereof, one side of said flange having cam surfaces formed thereon receiving the detent portions of the resilient contact arms during rotation of the actuator member, the other side of the flange being provided with cam surfaces and stop means adjacent thereto, and apertured resilient positioning means provided with a generally flat body portion removably supported upon the embossed inwardly extending portions of the second wall of the housing and lying generally flush against said second wall, said means having a raised end portion provided with a detent thereon, said raised end portion contacting stop means on the other side of the flange to limit rotary movement thereof and said detent engaging the cam surfaces on the same flange side to index the actuator member.

6. A rotary switch comprising a substantially rectangular cup-shaped housing open along one wall and having a second wall spaced therefrom provided with an aperture with embossed inwardly extending edge portions forming an axially extending bearing surface at said aperture, a terminal member closing said one wall and attached to said housing, resilient contact arms secured to the terminal member and having detent portions extending into the housing interior, an actuator member comprising a stem journalled in the terminal member and in the hearing surface of the second wall of said housing and a flange extending radially from said stem inwardly of opposite ends thereof, one side of said flange having a plurality of arc-shaped cam surfaces spaced radially and circumferentially from one another and provided with inclined and relatively flat portions receiving the resilient contact arms during rotation of the actuator member, the other side of the flange being provided with a plurality of circumferentially spaced notches and stop means adjacent thereto, and apertured resilient positioning means provided with a generally flat body portion removably supported upon the embossed inwardly extending portions of the second wall of the housing and lying generally flush against said second wall, said means having a raised end portion provided with a detent thereon, said raised end portion contacting the stop means on the other side of the flange to limit rotary movement thereof and said detent engaging the notches on the same flange side to index the actuator member.

7. A rotary switch comprising a substantially rectangular housing having a pair of spaced walls, one of which comprises a terminal member removably secured to said housing, the other of said walls having a pair of apertured embossments thereon, resilient contact arms attached to the terminal member and having detent portions spaced from said walls, an actuator member comprising a stem portion journalled in the terminal member and one of the apertured embossments in the other housing wall and a flange extending radially from said stem portion inwardly of opposite ends thereof, one side of said flange having cam surfaces formed thereon receiving the detent portions of the resilient contact arms during the rotation of the actuator member, the other side of the flange being provided with cam surfaces and stop means, and a resilient positioning member carried by one of the apertured embossments in the other housing wall and having a yoke portion surrounding the other embossment, said positioning member further including a tongue portion having a detent thereon engageable with the cam surfaces on the other side of the flange to index the actuator member, the tongue portion contacting the stop means to limit rotary movement of the actuator member.

8. A rotary switch comprising a substantially rectangular housing having a pair of spaced walls, one of which comprises a terminal member removably secured to said housing, the other of said walls having a pair of apertured embossments thereon, resilient contact arms attached to the terminal member and having detent portions spaced from said walls, an actuator member comprising a stem portion journalled in the terminal member and one of the apertured embossments in the other housing wall and a flange extending radially from said stem portion inwardly of opposite ends thereof, one side of said flange having arc-shaped radially and circumferentially spaced cam surfaces formed thereon receiving in pressing contact the detent portions of the resilient contact arms during rotation of the actuator member, the other side of the flange being provided with cam surfaces and stop means, and a resilient positioning member carried by one of the apertured embossments in the other housing wall and having a yoke portion surrounding the other embossment, said positioning member further including a tongue portion having a detent thereon engageable with the cam surfaces on the other side of the flange to index the actuator member, the tongue portion substantially simultaneously contacting the stop means to limit rotary movement of the actuator member.

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