July 19, 1966 B. J. GOLBECK ETAL 3,261,931

LEVER SWITCH DETENT APPARATUS

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Fig. 1.

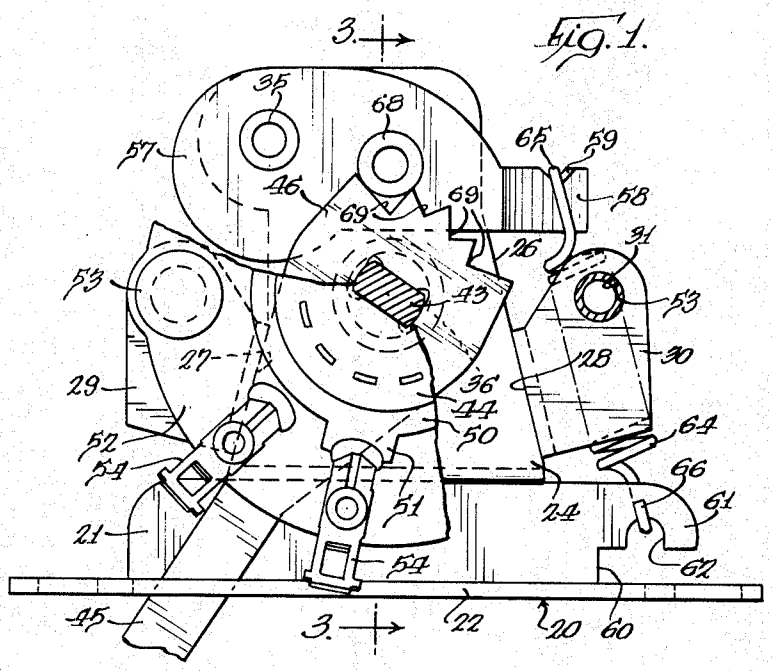


Fig. 3.

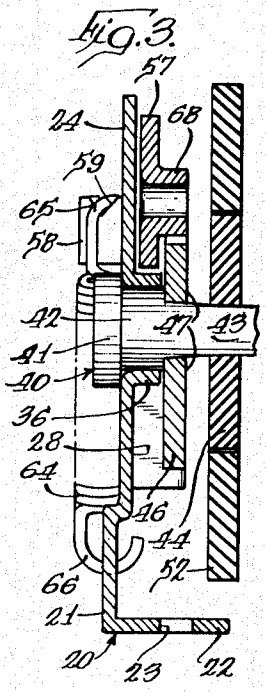


Fig. 2.

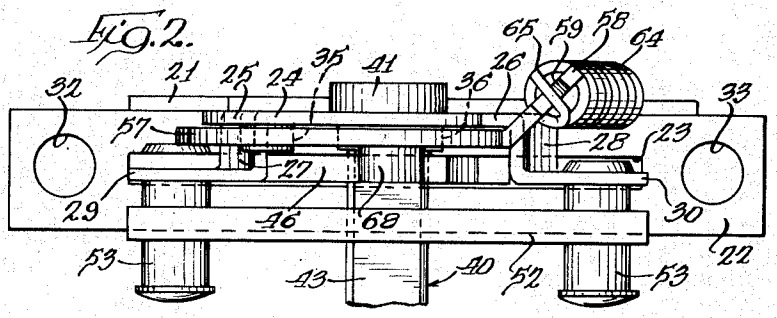
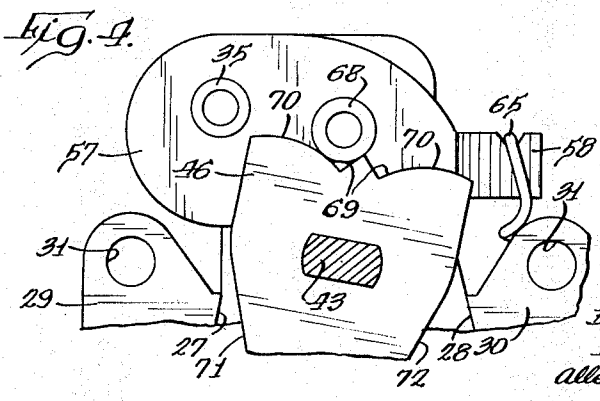


Fig. 4.



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2 Sheets-Sheet 2

Fig. 5.

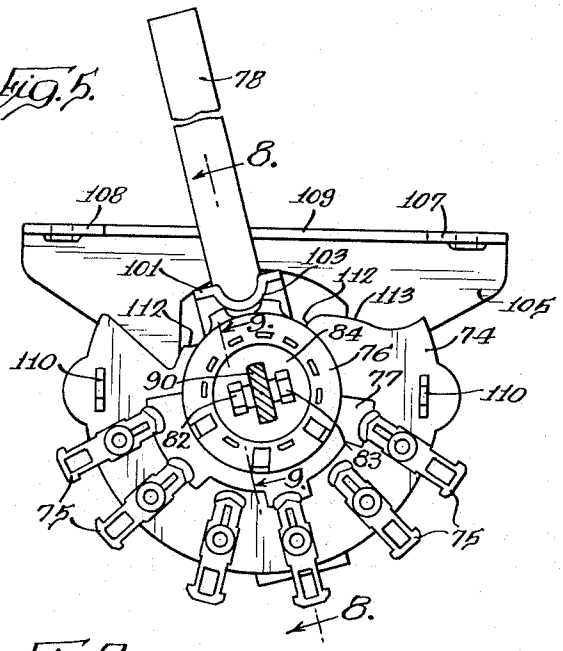


Fig. 6.

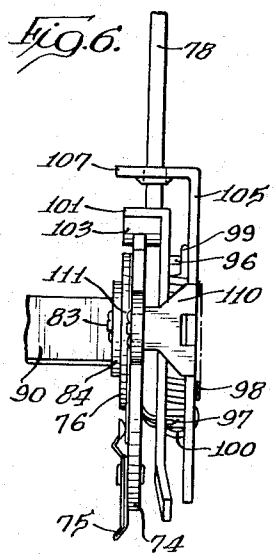


Fig. 7.

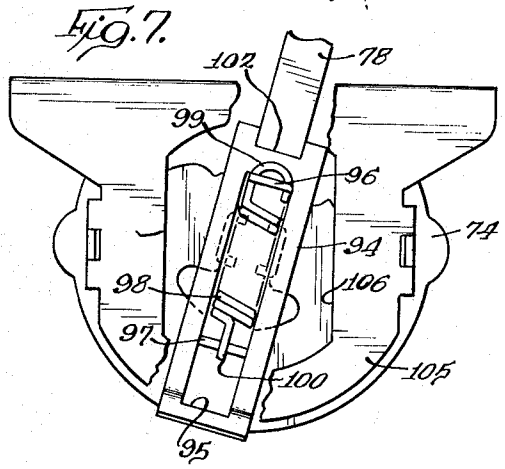


Fig. 8.

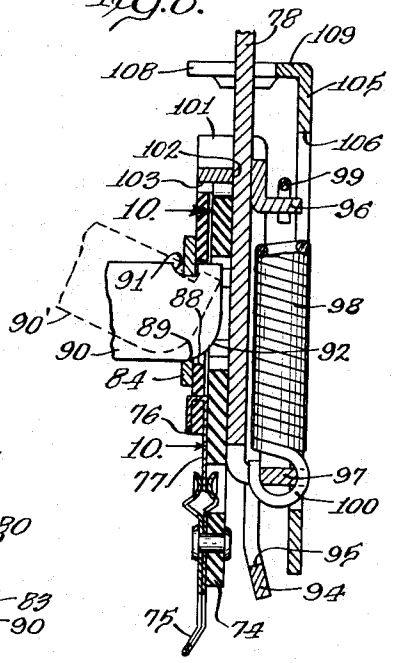


Fig. 9.

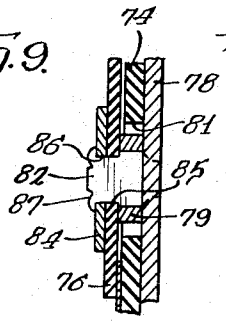
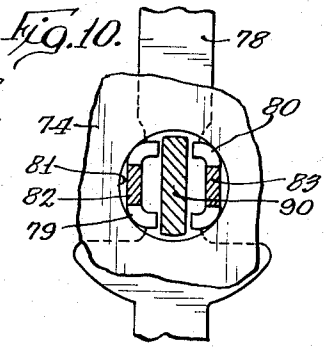


Fig. 10.



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3,261,931

LEVER SWITCH DETENT APPARATUS

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Filed Jan. 21, 1965, Ser. No. 426,809
14 Claims. (Cl. 200—11)

This invention relates in general to electric switches, and more particularly to electric switches wherein a manually operable lever is provided to operate the switch between switching stations.

In the electrical switch art, it is well known to provide a stator having a plurality of stator contacts, a rotor rotatable relative to the stator and having at least one rotor contact movable into and out of engagement with the stator contacts, a manually operable lever for rotating the rotor between the switching stations defined by the stator and rotor contacts, and internal cam means on the manually operable lever for releasably retaining the rotor at certain switching stations, and to provide automatic return of the rotor from other switching stations. Such switches are typified by that shown in the patent to C. E. Nygsen, No. 2,503,885. Such switches have proven to be less than satisfactory in that the internal cam profile on the manually operable lever is relatively expensive to manufacture, and is relatively inaccessible during use of the switch. Accordingly, the general purpose of the present invention is to provide an electric switch as described above which is simple in construction, efficient in operation, well adapted for its intended purposes, and relatively inexpensive to manufacture.

An object of the invention is to provide a lever actuated electric switch with an actuating lever having a cam surface on the external periphery thereof.

Another object of the invention is to provide a lever actuated electric switch as described above with a novel arrangement of switch components, which contribute to the ease of assembly of the switch, and increase the useful life of the switch.

A further object of the invention is to provide a novel lever actuated electric switch having a cam surface formed directly on the switch stator for providing spring return of the switch rotor from a certain switching station, and releasable detenting of the switch rotor at other switching stations.

Still another object is to provide a lever operated electric switch as described in the preceding paragraph with a detent member which is movable longitudinally of the actuating lever.

A still further object of the invention is a provide novel means for coupling a plurality of switch rotors of the type described above together.

A related object is to provide novel means for securing a rotor coupling shaft to the first switch section of a multisection switch.

These and other objects of the invention will hereinafter become more fully apparent from the following description, taken in connection with the annexed drawings, wherein:

FIGURE 1 is a rear elevational view of a switch embodying the invention, with certain parts broken away for clarity of illustration;

FIGURE 2 is a top plan view of the switch illustrated in FIGURE 1;

FIGURE 3 is a sectional view, taken generally along line 3—3 of FIGURE 1;

FIGURE 4 is a fragmentary rear elevational view, similar to FIGURE 1, and showing a modified form of switch actuating lever;

FIGURE 5 is a rear elevational view of a second embodiment of the switch;

FIGURE 6 is a side elevational view of the switch illustrated in FIGURE 5;

FIGURE 7 is a front elevational view of the switch illustrated in FIGURE 5, with certain parts broken away for clarity of illustration;

FIGURE 8 is an enlarged sectional view, taken generally along line 8—8 of FIGURE 5;

FIGURE 9 is an enlarged sectional view, taken generally along line 9—9 of FIGURE 5; and

FIGURE 10 is a sectional view, taken generally along line 10—10 of FIGURE 8.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail two specific embodiments and a modification thereof, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments and modification illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, the switch embodiment illustrated in FIGURES 1 to 4 includes a frame 20 having a generally planar lower front portion 21, and a portion 22 extending rearwardly at right angles with respect to frame portion 21 and having a transverse slot 23. Frame 20 includes an upper portion 24 of reduced width offset slightly rearwardly from the lower frame portion 21, but which cooperates with frame portion 21 to effectively define a generally planar front frame member. The sides of frame portion 24 converge upwardly as at 25 and 26; and walls 27 and 28 extend rearwardly from sides 25 and 26, respectively, to define inclined abutment surfaces engageable with the sides of the switch operating lever to be hereafter described. Mounting tabs 29 and 30 extend laterally outwardly from the rearmost ends of frame portions 27 and 28, respectively; and each of the mounting tabs are apertured as at 31 (FIGURE 1) to provide means by which the switch stator section is secured to the frame. As can be best seen in FIGURE 2, the rearwardly extending lower frame portion 22 is provided with a pair of apertures 32 and 33 at opposite ends thereof, by means of which the frame 20 may be mounted on a suitable support, not shown.

A hollow cylindrical boss 35 extends rearwardly from the frame portion 24 adjacent the upper left hand end thereof, as viewed in FIGURE 1, to define a first pivot axis. A second hollow cylindrical boss 36 extends rearwardly from the frame portion 24, downwardly and to the right of boss 36, as viewed in FIGURE 1, to define a second pivot axis. It will be readily understood from a consideration of FIGURE 1 that the pivot axes defined by bosses 35 and 36 are parallel to one another and perpendicular to the frame portion 24.

A shaft 40 is rotatably mounted in boss 36, and shaft 40 includes an enlarged forward end 41 which is seated against the front face of frame portion 24 surrounding the bore of boss 36. Shaft 40 includes a cylindrical portion 42 adjacent enlarged end 41 which is rotatably mounted in the bore of boss 36. The rearward end 43 of shaft 40 is of noncircular configuration, such as the conventional "double-D" cross sectional configuration, and the switch rotor section is mounted thereon.

A switch actuating lever includes a lower portion 45 extending downwardly through the longitudinal slot 23 in the frame portion 22 into position for manual operation, and an enlarged upper portion 46 having a noncircular aperture which mounts the actuating lever on the noncircular portion 43 of shaft 40. As can be best

seen in FIGURE 3, the upper portion 46 of the actuating lever is held against the shaft step defined by the cylindrical shaft portion 42 and the reduced section shaft portion 43, as by upsetting or deforming the shaft as shown at 47, into engagement with the rearward face of the actuating lever portion 46. Thus, the actuating lever is held against axial movement relative to the shaft 40, and against rotational movement relative thereto, so that pivoting movement of the actuating lever will rotate the shaft 40 and impart corresponding movement to the switch rotor section 44.

A rotor contact 50 having a contacting portion 51 is fixed to the rotor 44, as is well known in the art. A switch stator 51 is fixed to the mounting portions 29 and 30 of the switch frame by suitable connectors 53, such as eyelets, strut screws, or the like. A plurality of stator contacts 54 are fixed to the stator 52 in a conventional manner, and cooperate with the rotor contact 50 to define a plurality of switching stations. Thus, as will be readily understood, pivotal movement of the actuating lever rotates the rotor contacts between the stator contacts to effect the desired switching action.

A detent lever 57 is provided with a suitable opening which is received on boss 35 to pivotally mount the detent lever 57 relative to the switch frame 20. Detent lever 57 includes a forwardly extending portion 58 having an upwardly open generally V-shaped groove 59 positioned in vertical alignment with the frame portion 21. Frame portion 21 is undercut, as shown at 60 in FIGURE 1 to create an overhanging portion 61 having an arcuate groove 62 in the lower portion thereof. A coil spring 64 is connected between the detent lever 57 and the switch frame 20 by having its opposite hooked ends 65 and 66 engaging notches 59 and 62, respectively. Spring 64 functions to bias detent lever 57 in a clockwise direction about the pivot axis defined by boss 35.

A cam follower is provided on the detent lever 57, and, as illustrated, the cam follower is defined by a hollow cylindrical boss 68 extending rearwardly from the detent lever 57 and positioned in vertical alignment with the actuating lever. A cam surface is provided on the upper end of the actuating lever, and co-operates with the cam follower 68 to provide various types of operation as may be desired for particular switches. For example, the cam surface may be shaped so as to provide detenting action in cooperation with the cam follower 68 to retain the switch rotor at one or more selected switch stations. Also, the cam surface may be shaped so as to provide automatic spring return of the rotor from certain other selected switch stations.

Considering first the cam profile on the upper end of the actuating lever illustrated at FIGURE 1, it will be noted that four upwardly facing notches 69 are provided on the upper end of the actuating lever. Each of these notches corresponds to a selectable switching station, and when one of the switching stations has been selected, the spring 64 biases the cam follower 68 downwardly into the selected notch 69 so as to releasably retain the switch rotor at the selected switch station. In the actuating lever embodiment shown in FIGURE 4, two notches 69 are provided adjacent the center of the upper portion of the actuating lever, and arcuate surfaces 70 extend outwardly from the notches 69. As described above, the cam follower 68 cooperates with the notches 69 to provide releasable detent means for retaining the switch rotor at a selected switch station. When the actuating lever is pivoted to a position where the cam follower rides upon one of the arcuate surfaces 70 to a selected switch station, it will be readily understood that when the lever is released, the spring 64 will function to return the actuating lever to the switching station corresponding to the detent 69. From the foregoing it should be apparent that the upper surface of the actuating lever may be shaped so as to define a wide variety of switching positions and modes of operation for the switch.

As can be best seen in FIGURE 4, the sides 71 and 72 of the actuating lever diverge upwardly from the lower lever end 45 to the enlarged lever portion 46. Sides 71 and 72 define abutments which are engageable with the walls 27 and 28 provided on the switch frame so as to provide means for limiting the pivotal movement of the actuating lever.

Turning now to FIGURES 5 to 10, wherein another embodiment of the lever switch is illustrated, a switch stator 74 is shown having a plurality of stator contacts 75 affixed thereto. A rotor 76 is rotatable relative to the stator 74 and includes a rotor contact 77 cooperating with the stator contacts 75 to define a plurality of switching stations. The rotor 76 is carried by a manually operable lever 78 which is provided for operating the switch rotor between the various switching stations.

As can be best seen in FIGURE 10, lever 78 is provided with a pair of rearwardly extending generally U-shaped tabs 79 and 80. Tabs 79 and 80 extend rearwardly through a suitable opening 81 provided in the stator 74. Tabs 79 and 80 include further rearwardly extending portions 82 and 83, respectively, the purpose of which will hereinafter appear.

A drive washer 84 is fixed to the rotor 76 by tab portions 82 and 83, and the elements are stacked in a sandwich relationship, as shown in FIGURE 9. To this end, it will be noted from FIGURE 9 that the rotor 76 is supported upon the U-shaped tabs 79 and 80. Rotor 76 and drive washer 84 include aligned slots 85 and 86, respectively, which receive tab portions 82 and 83 therethrough. The rearmost portions of tabs 82 and 83 are deformed, as at 87, into engagement the rearward face of the drive washer 84 to retain the drive washer and the rotor against the U-shaped tabs 79 and 80. Second slots 88 and 89 are provided in the rotor 76 and drive washer 84, respectively, at right angles to the slots 85 and 86. As can be best seen in FIGURE 8, slot 88 is slightly larger than slot 89.

Means are provided for coupling rotor 76 to additional switch section rotors, if it is desired to provide a multi-section switch, and includes a shaft 90 received in slots 88 and 89. Shaft 90 includes a notch 91 in the upper side thereof and spaced inwardly from the outer shaft end to define a shaft portion which is substantially the same size as slot 89. The corner on the shaft side opposite from notch 91 is provided with a rounded surface 92, so that the shaft may be coupled to the rotor by inserting the notch 91 in the slot 89, and by rocking the shaft from an inclined position shown in broken lines at 90' in FIGURE 8 to the full line position.

Means are provided for releasably retaining the switch rotor at a desired switching station, and includes a cam surface formed at the upper portion of the stator 74; and a detent member 94 movable longitudinally of the lever 78, and having a cam follower portion cooperating with the cam surface on the switch stator. Detent member 94 includes a longitudinal slot 95 which extends substantially from end-to-end thereof. Detent member 94 further includes a forwardly extending tab 96 adjacent the upper end of slot 95, and tab 96 is positioned in general vertical alignment with a forwardly extending tab 97 at the lower portion of the actuating lever 78. A coil spring 98 is connected between lever 78 and detent member 94 by having its hooked upper end 99 engage tab 96 and its hooked lower end 100 engage tab 97. From the foregoing it will be readily apparent that spring 98 biases the detent member 94 downwardly relative to the actuating lever 78.

The upper end of detent member 94 includes a rearwardly extending cam follower portion 101 which is positioned in vertical alignment with the stator 74. Cam follower portion 101 is slotted as at 102 to allow the actuating lever 78 to pass therethrough. Cam follower portion 101 includes an arcuate undersurface 103 for

engaging the cam surface on the stator to be hereafter described.

A mounting frame may be provided for the switch, if desired, and in the illustrated embodiment, the frame includes a generally planar front member **105** having a vertical opening or window **106**. It will be readily understood that window **106** provides easy access to the spring **98**, so that the spring can be changed without difficulty to vary the feel of the switch, when desired. Frame member **105** includes a generally rearwardly extending portion **109**, with still further rearwardly extending portions **107** and **108** being provided at opposite ends of portion **109**. Frame portions **107** and **108** are preferably provided with openings for mounting of the switch frame to a support, not shown. Frame portions **107** and **108** are engageable by the sides of the actuating lever **78** to limit the pivotal movement thereof.

Frame portion **105** includes rearwardly extending tabs **110** at opposite sides thereof, which impale suitable openings in the stator **74** to secure the stator to the frame. The rearward end of the tabs **110** are deformed into engagement with the rear face of the stator **74** to retain the same to the frame member **105**. It will be readily understood that if a multisection switch is to be provided, the tabs **110** are sufficiently long so as to accommodate the desired number of switch stator sections.

The cam surface at the upper portion of the stator may be provided with arcuate notches **112** which cooperate with the arcuate cam follower surface **103** to provide releasable detent means for retaining the switch rotor at a desired switch position. Also, the cam surface may include arcuate spring return portions **113** which cooperate with the cam follower **103** to automatically return the detent member **94** to the notch **112** adjacent surface **113** when the lever **78** is released. It will be readily understood that the configuration of the camming surface on the upper portion of the stator may be varied, as desired, to provide an appropriate number of detenting positions or spring return surfaces.

We claim:

1. An electric switch comprising: a frame, means for fixedly mounting a switch stator on said frame; a manually operable lever pivotally mounted on said frame and having tapered sides; switch rotor means associated with said lever and cooperating with said switch stator to define a plurality of switching stations; a detent lever pivotally mounted on said frame; cooperating detent portions on the external periphery of said manually operable lever and said detent lever for releasably retaining said rotor in a desired switching station; spring means biasing said cooperating portions into engagement with one another; and abutment means on said frame for limiting the pivotal movement of said lever, said abutment means including spaced walls on said frame inclined with respect to one another and each adapted to be engaged by one tapered side of said manually operable lever to limit the movement of the same in one direction.

2. An electric switch comprising: a frame with a generally planar portion having means defining a first pivot axis, means defining a second pivot axis parallel to said first axis and spaced vertically above and to one side thereof, and guide means below said first and second axes at the lower portion of the frame; means for fixedly mounting a switch stator on said frame; a manually operable lever pivotally mounted on said first axis and having a manually engageable gripping portion extending downwardly from said first axis and through said guide means; switch rotor means associated with said lever and cooperating with said switch stator to define a plurality of switching stations; a cam surface on the upper end of said lever disposed at generally right angles with respect to said planar frame portion, said cam surface having at least one detent portion; a detent lever pivotally mounted on said second axis and having cam follower means engaging said cam surface, said cam follower means cooperating with said cam surface detent portion to define detent means for releasably retaining said rotor in a desired switching station; and spring means connected between said frame and said detent lever on the side of said first axis opposite from said second axis to bias said cam follower downwardly into engagement with said cam surface.

3. An electric switch comprising: a frame with a generally planar portion having means defining a first pivot axis, and means defining a second pivot axis parallel to said first axis and spaced vertically above and to one side thereof; means for fixedly mounting a switch stator on said frame; a manually operable lever pivotally mounted on said first axis and having switch rotor means associated therewith, said switch rotor means cooperating with said switch stator to define a plurality of switching stations; a cam surface on the upper end of said lever disposed at generally right angles with respect to said planar frame portion, said cam surface having at least one detent portion and at least one cam follower return portion adjacent said detent portion; a detent lever pivotally mounted on said second axis and having cam follower means engaging said cam surface, said cam follower means cooperating with said cam surface detent portion to define detent means for releasably retaining said rotor in a desired switching station; and spring means connected between said frame and said detent lever on the side of said first axis opposite from said second axis to bias said cam follower downwardly into engagement with said cam surface whereby said cam follower means is automatically returned to said cam surface detent portion by said spring to thereby return the switch rotor to the switching station corresponding to said cam surface detent portion.

4. An electric switch comprising: a frame with a generally planar portion having means defining a first pivot axis, and means defining a second pivot axis parallel to said first axis and spaced vertically above and to one side thereof; a hook on said planar frame portion; means for fixedly mounting a switch stator on said frame; a manually operable lever pivotally mounted on said first axis and having switch rotor means associated therewith, said switch rotor means cooperating with said switch stator to define a plurality of switching stations; a cam surface on the upper end of said lever disposed at generally right angles with respect to said planar frame portion, said cam surface having at least one detent portion; a detent lever pivotally mounted on said second axis and having cam follower means engaging said cam surface, said cam follower means cooperating with said cam surface detent portion to define detent means for releasably retaining said rotor in a desired switching station; an offset end portion on said detent lever aligned with said hook; and spring means connected between said offset end portion and said hook on the side of said first axis opposite from said second axis to bias said cam follower downwardly into engagement with said cam surface.

5. An electric switch comprising: a switch stator; a pivotally mounted lever having means thereon defining a switch rotor and further means defining a guide member, said switch rotor cooperating with said switch stator to define a plurality of switching stations; a cam surface on said stator having at least one detent portion corresponding to a switching station; and detent means for releasably retaining said rotor means at said last named switching station including a detent member confined for movement longitudinally along said lever by said guide member, said detent member having a cam follower portion engaging said cam surface and movable therealong to said cam surface detent portion; and spring means biasing said detent member longitudinally of said lever to urge said cam follower portion toward said cam surface.

6. An electric switch comprising: a switch stator; a pivotally mounted lever having means thereon defining a switch rotor, said switch rotor means cooperating with said switch stator to define a plurality of switching stations; a cam surface on said stator having at least one detent portion corresponding to a switching station and at least one cam follower return portion adjacent said detent portion;

and detent means for releasably retaining said rotor means at said switching station, including a detent member movable longitudinally along said lever, said detent member having a cam follower portion engaging said cam surface and movable therealong between said cam follower return portion and said cam surface detent portion; and spring means biasing said detent member cam follower portion toward said cam surface whereby said spring automatically returns said cam follower to said cam surface detent portion.

7. An electric switch comprising: a frame; means on said frame defining a switch stator; a pivotally mounted lever having means thereon defining a switch rotor and having further means defining a guide member, said switch rotor cooperating with said switch stator to define a plurality of switching stations; a cam surface on said stator having at least one detent portion corresponding to a switching station; and detent means for releasably retaining said rotor means at said last-named switching station including a detent member confined for movement longitudinally along said lever by said guide member, said detent member having a cam follower portion engaging said cam surface and movable to said cam surface detent portion; and spring means biasing said detent member longitudinally of said lever to urge said cam follower portion toward said cam surface and to urge said cam follower portion toward said cam surface detent portion when said rotor has been moved to a switching station other than that corresponding to said detent means.

8. An electric switch comprising: a frame; means on said frame defining a switch stator; a pivotally mounted lever with a forwardly extending tab at the lower end thereof, said lever having means thereon defining a switch rotor, said switch rotor means cooperating with said switch stator means to define a plurality of switching stations; a cam surface on said stator having at least one detent portion corresponding to a switching station; and detent means for releasably retaining said rotor means at said last named switching station including a detent member having a generally forwardly extending tab adjacent the upper end thereof positioned in alignment with the tab on said lever, said detent member having a slotted rearwardly extending cam follower portion engaging said cam surface and movable to said cam surface detent portion, said cam follower portion having a surface bearing against the rearward face of said lever and said cam follower slot receiving said lever therethrough, and spring means connected between said tabs to bias said detent member cam follower portion toward said cam surface to urge said cam follower member toward said cam surface detent portion when said rotor has been moved to a switching station other than that corresponding to said detent means.

9. An electric switch comprising: a frame; means on said frame defining a switch stator; a pivotally mounted lever having means thereon defining a switch rotor, said switch rotor means cooperating with said switch stator means to define a plurality of switching stations; a cam surface on said stator having at least one detent portion corresponding to a switching station; and detent means for releasably retaining said rotor means at said last named switching station including a longitudinally slotted detent member receiving said lever in said slot to confine said detent member for movement longitudinally along said lever, said detent member having a cam follower portion engaging said cam surface and movable to said cam surface detent portion; and spring means connected between said lever and said detent member to bias said detent member cam follower portion toward said cam surface to urge said cam follower member toward said cam surface detent portion when said rotor has been moved to a switching station other than that corresponding to said detent means.

10. An electric switch comprising: a frame; means on said frame defining a switch stator; rotor means including a rotor rotatable relative to said stator and having an aperture, said rotor means cooperating with said switch stator means to define a plurality of switching stations; a pivotally mounted lever having at least one lug extending outwardly therefrom received in said rotor aperture, the outer end of said lug being deformed into engagement with an adjacent face of said rotor means to retain the same on said lug; a cam surface on said stator having at least one detent portion corresponding to a switching station, and at least one cam follower return portion adjacent said detent portion corresponding to a switching station; and detent means for releasably retaining said rotor means at said last named switching station including a detent member movable longitudinally along said lever, said detent member having a cam follower portion engaging said cam surface and movable to said cam surface detent portion; and spring means biasing said detent member cam follower portion toward said cam surface to urge said cam follower member toward said cam surface detent portion when said rotor has been moved to the switching station corresponding to said at least one cam return portion.

11. An electric switch comprising: a frame; means on said frame defining a switch stator; rotor means including a rotor rotatable relative to said stator and having a pair of apertures, said rotor means cooperating with said switch stator means to define a plurality of switching stations; a pivotally mounted lever having a pair of lugs extending outwardly therefrom each received in one of said rotor apertures, the outer end of said lugs each being deformed into engagement with an adjacent face of said rotor means to retain the rotor means on said lugs; a cam surface on said stator having at least one detent portion corresponding to a switching station; detent means for releasably retaining said rotor means at said last-named switching station including a detent member movable longitudinally along said lever, said detent member having a cam follower portion engaging said cam surface and movable to said cam surface detent portion; and spring means biasing said detent member cam follower portion toward said cam surface to urge said cam follower member toward said cam surface detent portion when said rotor has been moved to a switching station other than that corresponding to said detent means.

12. An electric switch comprising: a frame; means on said frame defining a switch stator; rotor means including, a rotor rotatable relative to said stator and having an aperture, and a drive washer having a first slot aligned with said rotor aperture and a second slot extending generally transversely of said first slot, said rotor means cooperating with said switch stator means to define a plurality of switching stations; a pivotally mounted lever having at least one lug extending outwardly therefrom received in said rotor aperture and said drive washer first slot, the outer end of said at least one lug being deformed into engagement with the outer face of said drive washer to retain the rotor means on said at least one lug; a cam surface on said stator having at least one detent portion corresponding to a switching station; and detent means for releasably retaining said rotor means at said last-named switching station including a detent member movable longitudinally along said lever, said detent member having a cam follower portion engaging said cam surface and movable to said cam surface detent portion; and spring means biasing said detent member cam follower portion toward said cam surface to urge said cam follower member toward said cam surface detent portion when said rotor has been moved to a switching station other than that corresponding to said detent means.

13. The invention set forth in claim 12 wherein a shaft is provided in the second slot of said drive washer for coupling of additional rotors to said rotor means.

14. The invention set forth in claim 13 in which said shaft is larger than said drive washer second slot, and wherein said shaft is provided with a notch spaced inwardly from the outer end thereof to define a shaft portion substantially the same size as said second slot, said shaft

being provided with an arcuate surface at the outer end thereof on the side opposite from said notch to facilitate the assembling of said shaft to said drive washer.

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