

June 18, 1963

J. FISHER

3,094,592

ROTARY SWITCH CONTROL UNIT

Filed Sept. 15, 1959

2 Sheets-Sheet 1

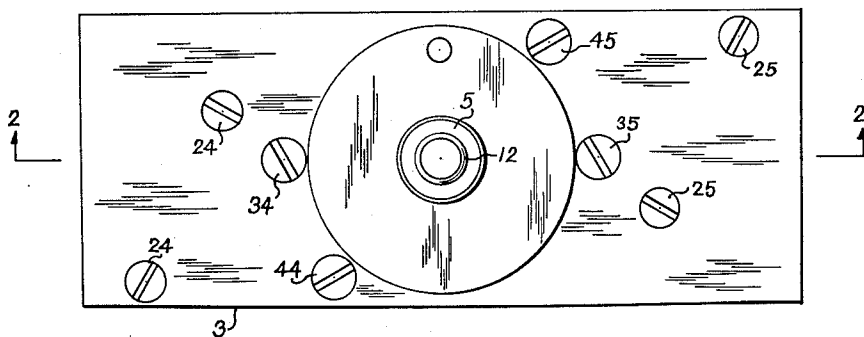


FIG. 1

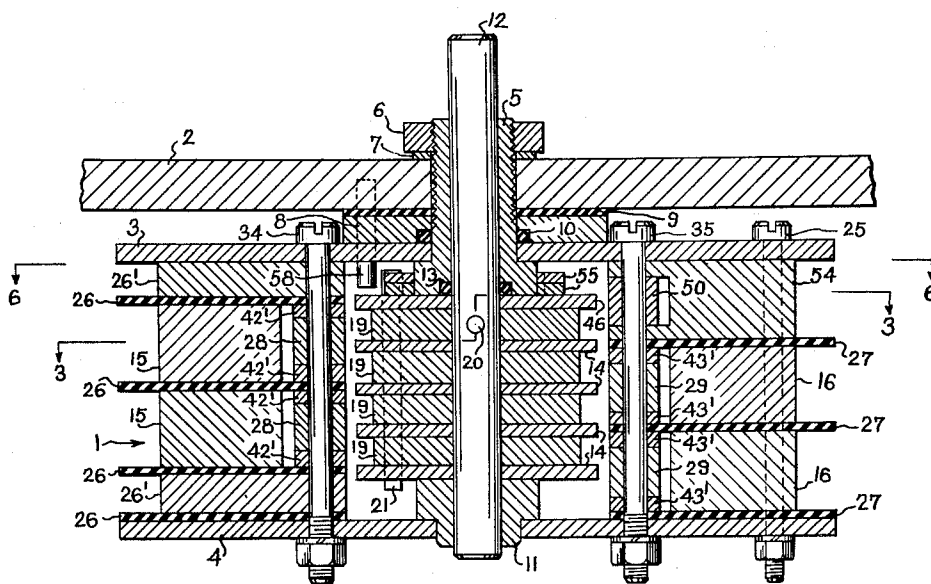


FIG. 2

INVENTOR.

JOHN FISHER

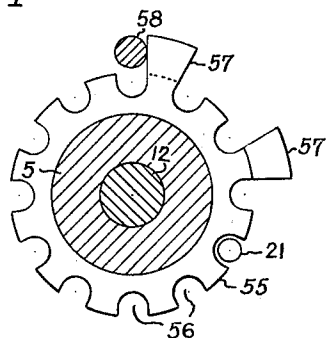
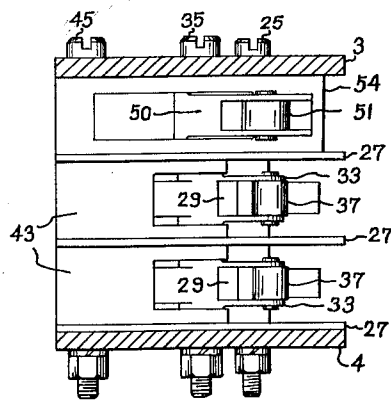
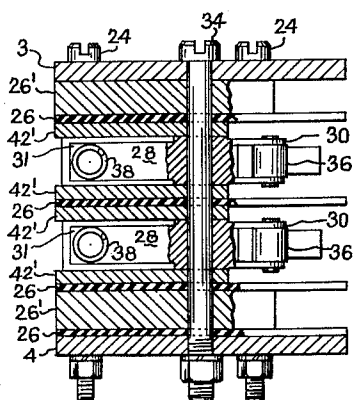
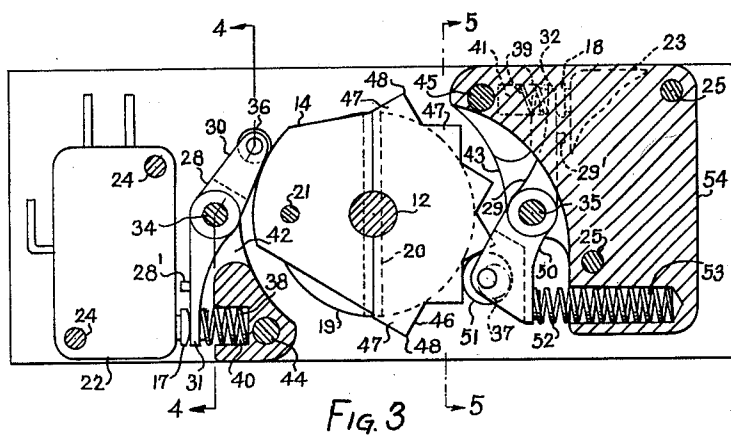
BY Hudson, Broughton,

Williams, David & Hoffmann
ATTORNEYS

J. FISHER

ROTARY SWITCH CONTROL UNIT

2 Sheets-Sheet 2



INVENTOR.

JOHN FISHER

BY Hudson, Broughton,
ams, David & Hoffmann

ATTORNEYS

1

3,094,592

ROTARY SWITCH CONTROL UNIT

John Fisher, Cleveland, Ohio, assignor to The Warner & Swasey Company, Cleveland, Ohio, a corporation of Ohio

Filed Sept. 15, 1959, Ser. No. 840,158
4 Claims. (Cl. 200—6)

This invention relates to control units and has particular relation to switch control units of the rotary type.

In the present invention a control unit is provided which includes a rotatable control member, preferably in the form of a shaft, having mounted thereon one or more cam members preferably in the form of flat disks which are mounted to be rotatable with the control shaft for controlling operation of one or more translating devices preferably in the form of switches.

The switches employed in connection with the control unit of the present invention are preferably of the snap acting type of high sensitivity in which a small amount of movement of associated switch actuating members is effective to operate the switch. In order to effect operation of the switches from the cam disks the present invention provides a control unit including a unique cam follower arrangement positioned between the switches and the associated cam disks for effecting operation of the switches in response to rotation of the cam disks. The cam follower arrangement is such that a number of switches may be employed in connection with a corresponding number of cam disks in a manner to provide positive operation of the switches in spite of varying positions of the switches and variations in dimensions of the switches and the cam disks from standard tolerances.

The control unit is assembled to provide a very compact and efficient arrangement of parts which contributes to a relatively low cost control unit of high accuracy. In the present invention the parts of the unit are arranged so that the cam disks may be readily assembled and disassembled with respect to the control shaft to permit the addition or subtraction of cam disks relative to the control unit. The control unit may be referred to as a sandwich type unit in which the various cam disks and switches are arranged in stacked relation between a pair of spaced support plates. The parts of the unit may be securely clamped together by the provision of securing screw and nut assemblies which are supported by the support plates. The control unit includes parts which are mounted for pivotal movement about axes. In order to support these parts for such movement the control unit includes pivot studs which are also supported by the support plates.

In order to provide a positive positioning of the control shaft and the cam disks in the various switching positions the control unit is further provided with an index cam which is mounted for rotation with the control shaft and with the various switch cam disks. A unique spring biased detent arrangement is provided for engaging the index cam to provide the positive positioning of the shaft and the switch cam disks.

In many installations it may be desired to limit rotation of the shaft and the switch cam disks through a preselected angle which may be a complete revolution or less than one complete revolution. For this purpose one or more stop rings are provided which conveniently are positioned to surround the control shaft. These stop rings include projections which are arranged to engage a suitable stop pin in order to provide the limiting action. The stop rings are mounted for rotation with the shaft and with the switch cam disks relative to the stop pin.

The control unit of the present invention may satisfy a variety of switching combinations. The arrangement of the parts is such that the switch cam disks and the

2

switches may be readily assembled and disassembled with respect to the support plates. By increasing the number of switches and the number of switch cam disks a considerable number of switching combinations may be realized.

It is therefore an object of the invention to provide a control unit of improved construction.

It is another object of the invention to provide a control unit of the rotary type which is arranged to permit the ready addition and subtraction of control parts thereto.

It is a further object of the invention to provide a rotary switch control unit including a control shaft having a plurality of switch cam disks mounted for rotation therewith to control operation of a plurality of switches with improved means for effecting operation of the switches in response to rotation of the cam disks.

It is still another object of the invention to provide a control unit as defined in the preceding object wherein the switches and cam disks are arranged for ready assembly and disassembly with respect to the control shaft.

It is a further object of the invention to provide a rotary switch control unit including a control shaft having a plurality of switch cam disks mounted for rotation therewith to control operation of a plurality of switches with spring biased lever cam follower means positioned between the cam disks and actuating means for the switches to effect displacement of the actuating members in response to rotation of the cam disks.

It is still another object of the invention to provide a rotary switch control unit which is of compact, sturdy and inexpensive construction with an improved arrangement of parts which may be readily assembled and disassembled.

Other objects of the invention will become apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a view in top plan of a control unit embodying the teachings of the present invention;

FIG. 2 is a view in section of the unit taken along the line 2—2 of FIG. 1;

FIG. 3 is a view of the unit taken along the line 3—3 of FIG. 2;

FIG. 4 is a view in section of the unit taken along the line 4—4 of FIG. 3;

FIG. 5 is a view of the unit taken along the line 5—5 of FIG. 3; and

FIG. 6 is a view taken along the line 6—6 of FIG. 2 with parts removed showing the stop rings.

The control unit of the present invention is susceptible of numerous uses and will be described as employed to control the operation of one or more switch devices. In the general arrangement the control unit includes a shaft which rotates about an axis and which has associated therewith one or more cam disks which are rotatable in response to rotation of the shaft for controlling the operation of one or more switch devices. The switches and the cam disks are located between a pair of spaced support plates in a so-called sandwich arrangement. Depending upon the number and configuration of the cam disks and upon the number of switches controlled thereby any desired switching pattern or combination may be realized by the control unit. The unit is arranged so that the switches and the switch cam disks may be readily removed and installed with respect to the control shaft to permit variation of the switching pattern.

Referring now to the drawings, there is illustrated in FIG. 2 the control unit of the present invention represented generally by the numeral 1 illustrated as being secured to a suitable support or panel structure 2. In the preferred embodiment of the invention the control

3

unit includes a pair of spaced support plates 3 and 4 having a substantially rectangular configuration as viewed in FIG. 1. These support plates may be constructed of any suitable material and in the preferred embodiment are formed of a metallic material such as steel. The panel 2 and the plate 3 positioned directly therebeneath include openings which when aligned may receive a threaded bushing 5 having external threads which cooperate with internal threads of a suitable nut 6 applied to the bushing 5 above the panel 2 for rotation with respect to the bushing. Positioned between the nut 6 and the upper surface of the channel 2 is a lock washer 7.

The lower surface of the support plate 3 is positioned to engage a shoulder of the bushing 5 with the plate 3 in spaced relation with the panel 2. Within this space between the panel 2 and the plate 3 is located a sealing retaining member 8 which surrounds the bushing 5. Between the member 8 and the lower surface of the panel 2 there is located a suitable compressible washer 9 which is in a compressed condition when the nut 6 is rotated to draw the bushing 5 and the control unit upwardly toward the panel 2. The member 8 includes a suitable annular recess in which is positioned an O-ring 10 which bears against the peripheral surface of the bushing 5. The lower support plate 4 includes an opening in which is positioned a bushing 11 which cooperates with the bushing 5 to mount a shaft 12 for rotation about a vertical axis as seen in FIG. 2 with respect to the plates 3 and 4. The shaft 12 may be referred to as a control shaft and is rotated in any suitable manner to effect the control function. For example, the shaft 12 may be rotated manually by means of a suitable knob (not shown) affixed to the upper portion of the shaft 12. If desired, the shaft 12 may be rotated automatically by suitable mechanical means under the control of a suitable timing device. The lower surface of the bushing 5 includes an annular recess in which is positioned a suitable O-ring 13 which bears against the peripheral surface of the shaft 12.

The control unit includes further one or more cams 14 which are mounted for rotation in response to rotation of the shaft 12 to control the operation of one or more translating devices which may be in the form of switch devices. In the embodiment illustrated a plurality of the cams 14 are provided with each of the cams in the form of a flat disk constructed of a suitable metallic material such as steel. The number and configuration of the cam disks 14 may be varied as desired in order to realize different switching patterns or combinations. The manner of mounting the cam disks 14 for rotation with the shaft 12 will be described in detail hereinafter.

The cam disks are provided to control the operation of one or more switch devices. In the illustrated embodiment a plurality of switch devices are provided on each side of the shaft 12, as viewed in FIG. 2. On the left hand side of the shaft as seen in FIG. 2 there is provided a pair of switches 15 and on the right hand side of the shaft as seen in FIG. 2 there is provided a pair of switches 16. The switches 15 and 16 may be of any suitable construction and in the preferred embodiment the switches are of the type which have a high sensitivity and which are snap acting. By the term "high sensitivity" it is meant that the switches may be transferred between their operating conditions by a very small movement of the actuating members associated with the switches. Each of the switches may include suitable terminals to which electrical connections may be made.

The switches 15 and 16 are provided respectively with actuating members 17 and 18, each of which is displaceable between two positions along an axis to provide open and closed conditions of the associated switch. It is noted that the members 17 and 18 are displaceable along parallel axes which are spaced in a direction perpendicular to the shaft 12 and that the axes of the members 17 and 18 are in alternating relation in a direction parallel to

4

the shaft 12. The switches 15 and 16 may be normally open or normally closed when the members 17 and 18 are displaced outwardly of the switch casings as shown in FIG. 3, depending upon the particular switching pattern desired.

As best shown in FIG. 2, the cams 14 are spaced from one another by a plurality of spacers 19, with each of the spacers positioned between a separate pair of the cams 14. These spacers may be formed of any suitable material and are illustrated as having a circular configuration.

In the present invention each of the cams 14 and each of the spacers 19 include an opening through which the shaft 12 extends. These openings are proportioned so that the cams and spacers may be slidable along the shaft when mounted thereon to permit the ready assembly and disassembly thereof with respect to the shaft. It is noted that the cams and spacers are sandwiched between the upper surface of the bushing 11 and the lower surface of the bushing 5.

In order to mount the cam and spacer assembly for rotation with the shaft 12 the present invention provides a pin locking arrangement. For this purpose the shaft 12 includes a bore extending transversely therethrough in which is located a pin 20 which also extends through one of the spacers 19. In the embodiment illustrated the pin 20 extends through the upper one of the spacers 19 which is located between the upper one of the cams 14 and an index cam referred to more fully hereinafter. A suitable pin 21 is positioned within aligned openings of the cams 14 and spacers 19 to extend parallel to the shaft 12 for locking the cams 14 and spacers 19 for rotation as a unit in response to rotation of the shaft 12. With this arrangement the cams 14 are readily assembled and disassembled with respect to the shaft to permit the addition or subtraction of a desired number of cams to vary the switching pattern. The pins 20 and 21 may be held in the associated openings by a press fit condition with such openings. It is observed that each of the cams 14 is associated with a separate one of the switches with the switches staggered on opposite sides of the shaft 12.

Each of the switches 15 and 16 is housed within a suitable casing structure with the switches 15 being provided with casings 22 and the switches 16 having casings 23. The switches 15 and 16 are mounted in stacked relation, as viewed in FIG. 2, and may be rigidly secured in such positions by suitable screw and nut assemblies which are secured to the support plates 3 and 4. In the illustrated embodiment a pair of screw and nut assemblies are provided for each set of stacked switches. As best shown in FIGS. 3, 4 and 5 screw and nut assemblies 24 are located at diagonally spaced points of the casings 22, whereas screw and nut assemblies 25 are similarly positioned with respect to the casings 23. The screws extend through suitable openings of the casings and are provided with threaded ends for receiving nuts which bear against the lower surface of the supporting plate 4. The screws include headed portions which engage the upper surface of the support plate 3. With this arrangement the switches are readily installed and removed with respect to the control unit. In addition, the switches may be tightly clamped between the plates 3 and 4 in proper alignment by means of the screw and nut assemblies. It is noted that the switches are spaced from one another by suitable spacers positioned between the casings of the adjacent switches. As shown in FIG. 2, the switches 15 and 16 may be spaced respectively by including spacers 26 and 27. Additional insulating spacers 26' may be provided to equalize the heights of the left and right hand switch assemblies as viewed in FIG. 2.

According to the present invention the control unit includes an improved arrangement for operating the various switches in response to rotation of the cam disks 14. The arrangement includes a unique spring biased cam

5

follower construction which is effective to reliably operate the switches regardless of whether or not the switches are properly positioned with respect to the associated cam disks. As a result, a positive switching action is realized in spite of variations in the dimensions of the casings and actuating members of the various switches.

The cam follower construction is best shown in FIG. 3. In the embodiment illustrated a separate cam follower arrangement is employed between each switch and the associated cam disk so that only one switch is associated with each of the cam disks. The cam follower arrangement for the two sets of switches 15 and 16 are of identical construction.

As best shown in FIG. 3 each of the cam follower constructions for the switches 15 includes a pivotally mounted lever 28, whereas each of the switches 16 is associated with a pivotally mounted lever 29. The levers 28 each includes a pair of ends 30 and 31, whereas the levers 29 include ends 32 and 33. The levers are mounted for pivotal movement intermediate their ends about axes which extend parallel to the axis of the shaft 12. For this purpose a pair of pivot studs 34 and 35 are provided respectively to mount the levers 28 and 29 for the desired pivotal movement. These studs are best shown in FIG. 2 and extend through suitable openings of the levers to be clamped to the support plates 3 and 4 by suitable nuts which are threaded on the threaded ends of the studs to engage the lower surface of the plate 4. It is noted that the studs 34 and 35 are located in a common plane which also includes the shaft 12 between the studs.

The ends of the levers are arranged for association respectively with the cam disks 14 and with the actuating members 17 and 18 of the switches. As shown in FIGS. 3 and 5, the ends 30 and 33 of the levers 28 and 29 carry respectively rollers 36 and 37 which are rotatably mounted by such ends about axes extending parallel to the axis of the shaft 12. These rollers are adapted to engage the surfaces of the peripheral edges of the cam disks 14 as the cam disks are rotated. The remaining ends 31 and 32 of the levers 28 and 29 are biased into engagement respectively with the actuating members 17 and 18 of the switches by suitable resilient means illustrated in the form of coil springs 38 and 39.

The springs 38 and 39 have first terminal portions which surround suitable extensions of the ends 31 and 32 of the levers, and second terminal portions located within openings 40 and 41 of blocks 42 and 43 respectively. The arrangement is such that the springs are maintained under compression to force the associated ends 31 and 32 of the levers into engagement with the actuating members 17 and 18. The members 17 and 18 are normally maintained in an outwardly displaced position with respect to the switch casings when the normal large radius of the cams 14 is presented to the rollers 36 and 37. When the cam disks 14 present a decreasing radius to the associated rollers 36 and 37 the levers 28 and 29 are pivoted in clockwise directions, as viewed in FIG. 3, under the action of the springs 38 and 39 so as to displace the members 17 and 18 inwardly toward the associated switch casing for operating the switches. It is noted that the blocks 42 and 43 are also secured in position by the pivot studs 34 and 35 which extend through aligned openings of the several stacked blocks. In addition, suitable screws 44 and 45 may be provided to extend through other aligned openings of the blocks 42 and 43 to assist in securing the blocks 42 and 43 in position between the plates 3 and 4. The blocks 42 and 43 each includes a pair of spaced legs 42' defining a cavity in which a portion of the associated lever 28 is located. The blocks 43 similarly include spaced legs 43'.

A very clean appearing design is provided which employs to good advantage the small space available. It is observed that the axes of the studs 34 and 35 and the shaft 12 are located in a common plane with the shaft

6

12 centrally located between the studs 34 and 35. The switch assemblies and the cam follower devices are positioned on opposite sides of a plane transverse to the common plane with the switches in staggered relation on the opposite sides.

The levers 28 and 29 may be provided with suitable projections 28' and 29' respectively which are arranged to strike the casing of the associated switch to serve as a stop for limiting the degree of pivotal movement of the levers so as to limit the amount of displacement of the members 17 and 18 inwardly of the switch casings. This stop arrangement assures against damage to the mechanism of the various switches. The cams 14 are mounted with the portions of reduced radius in predetermined relation to one another and to the rollers 36 and 37 to provide the desired switching pattern.

The control unit of the present invention may also include means for indexing the rotation of the shaft 12 to provide a positive positioning of the shaft and the cams 14 in the various switch positions. For this purpose there is provided an index cam 46 which is mounted for rotation with the shaft 12. As illustrated in FIGS. 2 and 3, the cam 46 is in the form of a flat plate having a plurality of identically configured recesses formed in its peripheral edge to provide a plurality of teeth 47 spaced angularly about the center of the cam 46. The teeth 47 are provided with pointed flat outer surfaces 48.

The cam 46 is conveniently mounted to the shaft 12 in the same manner as the cams 14. To this end the cam 46 includes a central opening proportioned to receive the shaft 12 to permit sliding movement of the cam 46 on the shaft so that the cam 46 may be readily removed from the shaft 12 and replaced if desired. It is noted that the pin 21 also extends through an opening of the index cam which is thereby rotatable with the cams 14 in response to rotation of the shaft 12. Any desired number of indexed positions may be provided by the index cam depending upon the number of notches provided in its periphery. For example, the index cam may be provided with 12, 16 or 32 notches, to give a corresponding number of switching positions.

The index cam is associated with a suitable spring biased detent arrangement which includes a lever 50 which is pivotally mounted about an axis parallel to the shaft 12 conveniently by means of the pivot stud 35. The free end of the lever 50 rotatably carries a suitable roller 51 which is biased into engagement with the peripheral edge of the index cam by means of a coil spring 52 engaging the free end and supported in compression within an opening 53 of a block 54. It is noted that the block 54 occupies a position directly beneath the support plate 3 and above the upper one of the switches 16 as viewed in FIG. 2. The block 54 may be secured in its operative position by means of the screw and nut assemblies 25 and 45 the screws of which pass through suitable openings in the block 54. This detent arrangement assures a positive indexing lock and permits rapid and easy rotation of the shaft 12.

The control unit of the present invention is further provided with means for limiting the amount of rotation of the shaft 12. Limiting means are provided which are effective to limit rotation of the shaft 12 through a complete revolution or through any desired portion of a complete revolution. For this purpose the limiting means includes a stop ring 55 positioned to surround the shaft 12 and the bushing 5. The stop ring 55 is provided with a plurality of peripheral notches 56 shown in FIG. 6 which are equal in number to the peripheral notches in the index cam 46. In order to mount the ring 55 for rotation with the shaft 12 and the cams 14 the pin 21 is provided with a length dimension sufficient so that the pin 21 may extend through one of the notches 56 of the ring 55. The ring 55 includes a projection 57 which extends from its peripheral edge to engage a stop pin 58, which may be secured to the panel 2 to extend down-

wardly as shown in FIG. 2 into the path of the projection 57. The arrangement is such that when a single ring 55 is employed the shaft 12 may be rotated through substantially a complete revolution to provide a number of switch positions which are equal to the number of notches or index positions of the cam 46.

If it is desired to limit rotation of the shaft 12 through only a portion of a complete revolution, then a pair of rings 55 may be provided as shown in FIG. 6 and positioned in overlying relation so that the two projections 57 are spaced angularly about the axis of the shaft 12 with respect to each other. In this manner the pin 58 will engage the spaced projections 57 to prevent a full revolution of the shaft 12. In FIG. 6 a total of ten of the notches 56 are included between the projections 57 which provides ten switching positions.

Although the invention has been described with reference to certain specific embodiments thereof numerous modifications are possible and it is desired to cover all modifications falling within the spirit and scope of the appended claims.

Having described my invention, I claim:

1. In a rotary switch control unit, a pair of spaced substantially parallel support plates, a shaft extending substantially perpendicular to said plates and rotatably mounted by said plates, a plurality of axially spaced switch cam disks surrounding said shaft and slidable therealong, a plurality of spacers surrounding the shaft each between a separate pair of cam disks and slidable along said shaft, a plurality of first switches stacked in the direction of extension of said shaft between said plates on one side of a plane including the shaft, a plurality of second switches stacked in the direction of extension of said shaft between said plates on the other side of said plane, said first and second switches having respectively first and second actuating members displaceable along parallel axes which extend perpendicular to said first plane, said first and second actuating members being located on opposite sides of a second plane perpendicular to said first plane, a pair of spaced pivot studs secured to said plates extending parallel to said shaft on opposite sides thereof, said studs and said shaft being included in said second plane, a plurality of first levers pivotally mounted intermediate their ends by one of said studs, a plurality of first rollers carried by said first levers at first ends thereof for engagement with said cams, a plurality of first resilient means biasing second ends of said first levers into engagement with said first actuating members to force said first rollers into engagement with said cams, a plurality of second levers pivotally mounted intermediate their ends by the other of said studs, a plurality of second rollers carried by the second levers at first ends thereof for engagement with said cams, a plurality of second resilient means biasing second ends of said second levers into engagement with said second actuating members to force said rollers into engagement with said cams, a first pin extending transversely through the shaft and through one of said spacers to lock said one spacer for rotation with the shaft, and a second pin extending parallel to the shaft through each of the cam disks and through each of the spacers to lock all the cam disks for rotation as a unit with the shaft.

2. In a rotary control unit, a shaft rotatable about a first axis, a plurality of cam disks mounted on said shaft for rotation therewith, spacer means positioned between each of said cams and encircling said shaft for rotation therewith, a plurality of movable actuating members associated with said cams and moved upon rotation of said cams, an index cam encircling said shaft for rotation therewith, stop plate means encircling said shaft and rotatable therewith, a first pin extending parallel to said shaft and through openings in said cam disks, said spacer means, said index cam, and said stop means to

secure said cam disks, spacer means, index cam, and stop means together forming a stacked structure, and a second pin extending substantially perpendicular to said shaft and through an opening in a spacer means and an opening in said shaft to secure said stacked structure to said shaft for rotation therewith.

3. In a rotary control unit, a shaft rotatable about a first axis, a plurality of cam disks mounted on said shaft for rotation therewith and spaced therealong, a plurality of spacers encircling said shaft and positioned between each of said cams, a plurality of movable actuating members associated with said cams and moved upon rotation of said cams, an index cam mounted on said shaft for rotation therewith, index cam detent means biased into engagement with said index cam, a pair of stop plates encircling said shaft and movable about said shaft relative to each other, a plurality of teeth around the periphery of each of said stop plates forming notches therein equal to the number of index positions provided by said index cam, a projection extending from one of said teeth on each of said plates, said relative movement of said stop plates causing said projections to move relative to each other and spacing said projections annularly about said shaft, a first pin extending parallel to said shaft and through each of said cam discs, said spacers, and said index cam, and through a notch on each of said stop plates to secure said cam discs, spacers, index cam and stop plates together forming a stacked structure, a second pin extending substantially perpendicular to said shaft and through an opening in a spacer and said shaft for securing said stacking structure to said shaft for rotation therewith, and fixed stop means in the path of rotary movement of said projections to limit rotation of said shaft through less than a complete revolution determined by the annular spacing of said projections.

4. In a rotary control unit, a shaft rotatable about a first axis, a plurality of cams mounted on said shaft for rotation therewith and spaced therealong, a plurality of movable actuating members associated with said cams and moved upon rotation of said cams, an index cam mounted on said shaft for rotation therewith, index cam detent means biased into engagement with said index cam, a pair of stop plates encircling said shaft and movable about said shaft relative to each other, a projection extending from the periphery of each of said stop plates, said relative movement of said stop plates causing said projections to move relative to each other and spacing said projections annularly about said shaft, means for securing said stop plates in position on said shaft with said projections in predetermined positions so that said stop plates rotate with said shaft, and fixed stop means in the path of rotary movement of said projections to limit rotation of said shaft through less than a complete revolution determined by the annular spacing of said projections.

References Cited in the file of this patent

UNITED STATES PATENTS

798,160	Carichoff	Aug. 29, 1905
2,096,402	Molloy	Oct. 19, 1937
2,181,829	Jeffrey	Nov. 28, 1939
2,305,290	Fuscaldo	Dec. 15, 1942
2,319,503	Glogau	May 18, 1943
2,423,361	Wood	July 1, 1947
2,603,725	Dietrich	July 15, 1952
2,804,527	Snyder	Aug. 27, 1957
2,872,553	Hatfield	Feb. 3, 1959
2,903,528	Kuhn	Sept. 8, 1959
2,920,152	Werner	Jan. 5, 1960
2,993,966	Smith	July 25, 1961

FOREIGN PATENTS

1,019,370	Germany	Nov. 14, 1957
-----------	---------	---------------