

# United States Patent [19]

Cork et al.

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[45] July 3, 1973

[54] **SELECTOR SWITCH MECHANISM WITH  
ADJUSTABLE RADIAL CAM INSERT  
MEMBERS HAVING CIRCUMFERENTIAL  
OVERLAP FLANGE**

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Mich.**

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[21] Appl. No.: **224,467**

[52] U.S. Cl. .... **200/6 B, 200/153 LB, 200/8 R,  
74/568 R**

[51] Int. Cl. .... **H01h 21/82**

[58] Field of Search .... **200/6 R, 6 B, 6 BB,  
200/17 R, 14, 27 R, 30 R, 38, 153 LB, 153 T,  
166 SD; 74/568 R**

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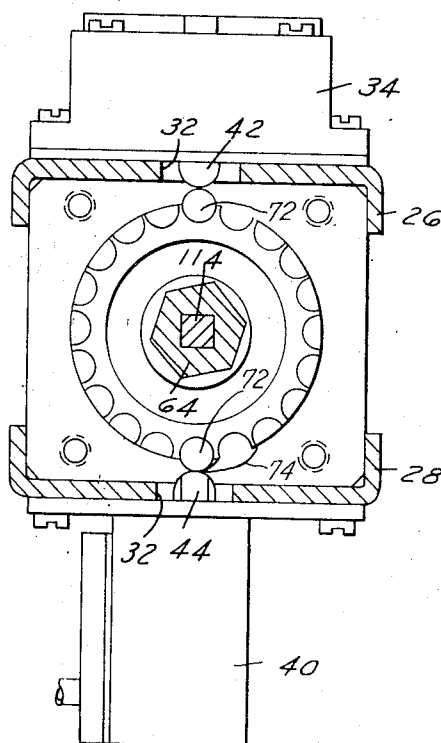
*Primary Examiner—J. R. Scott  
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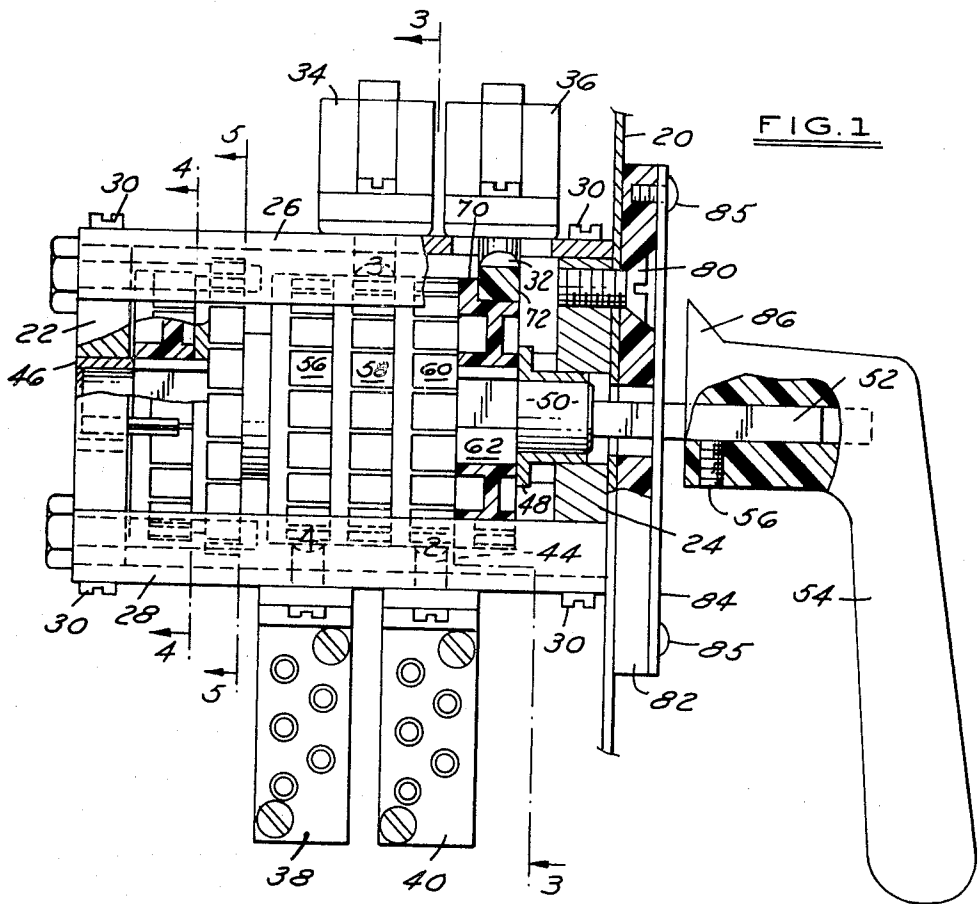
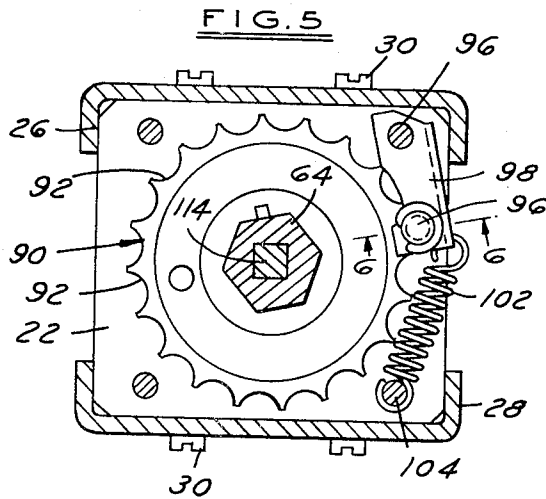
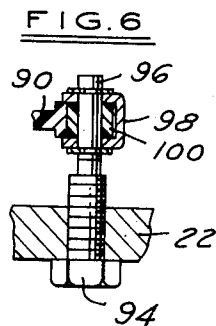
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## ABSTRACT

A selector switch mechanism for actuating a plurality of switch means, including an individual disk-like cam for each switch means, said cams being removably mounted on a non-circular shaft, each such cams having a plurality of identical uniformly spaced-apart reentrant recesses about its periphery, and resilient switch actuating elements removably snap-fitted into selected of said recesses to actuate the associated switch means at any predetermined position of rotation of the cams.

**2 Claims, 14 Drawing Figures**





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4 Sheets-Sheet 2

FIG. 3

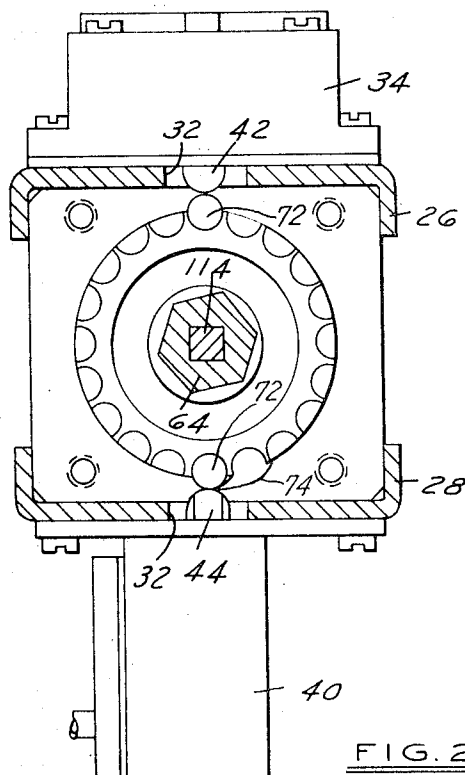


FIG. 4

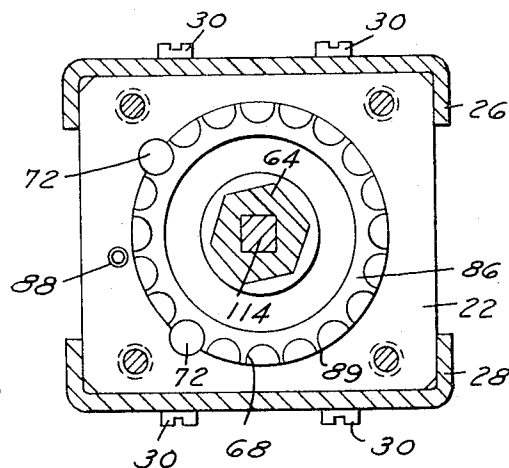
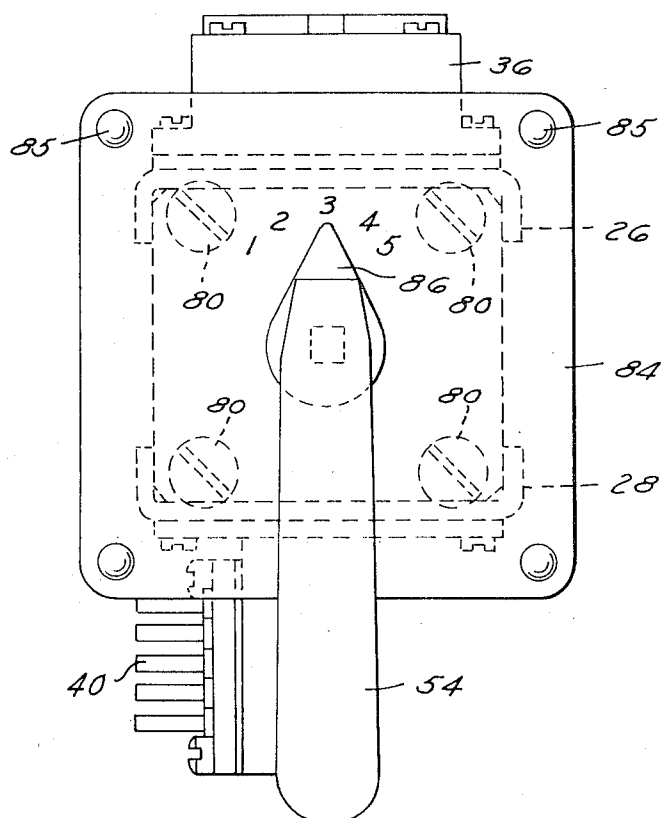


FIG. 2



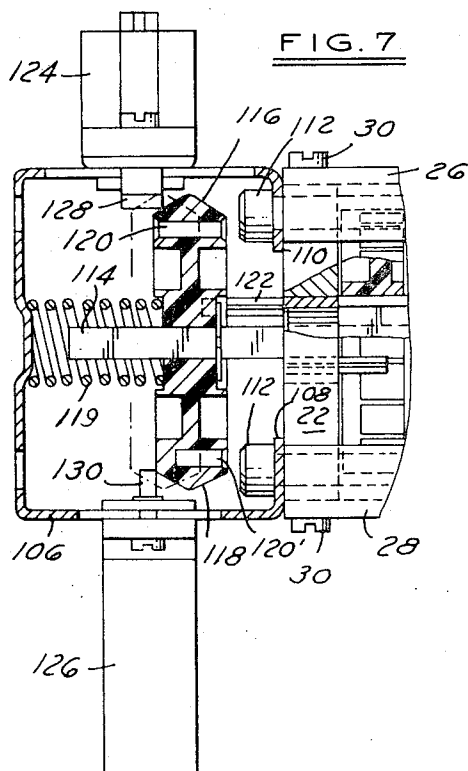
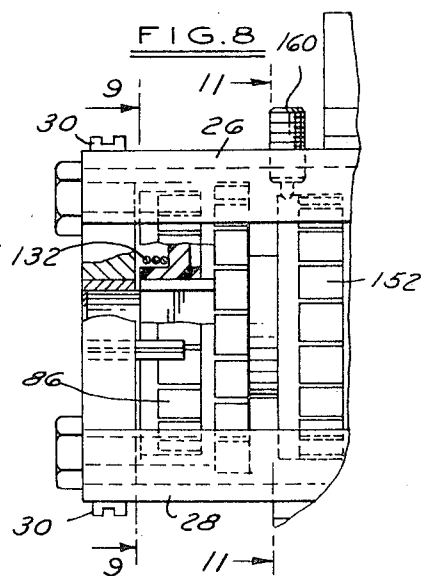
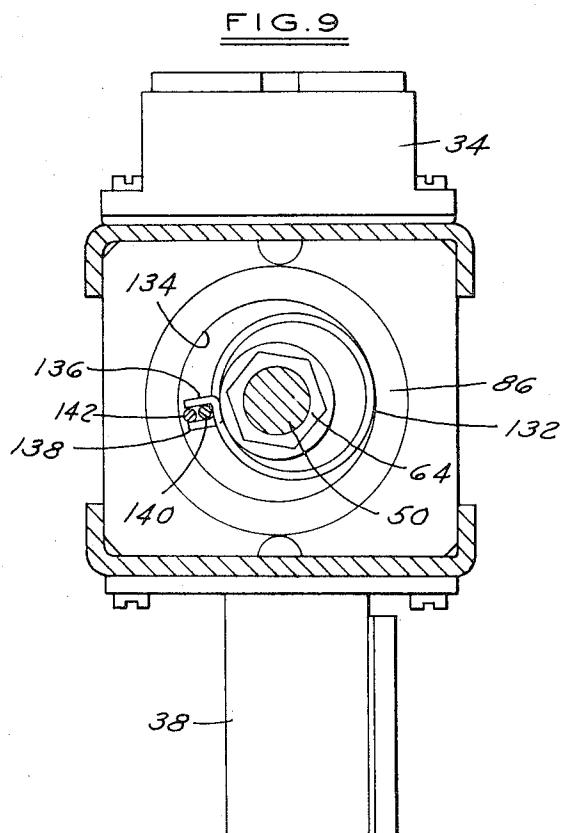


FIG. 10

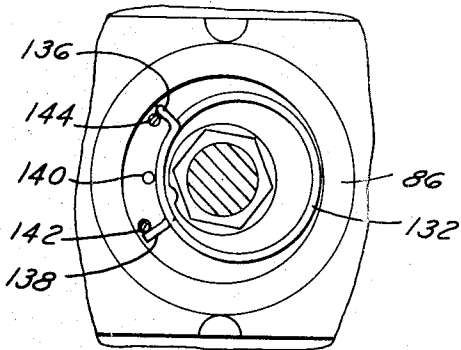


FIG. 12

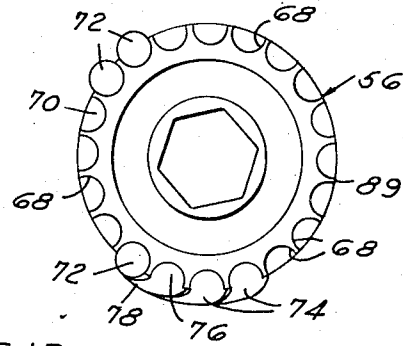


FIG. 13



FIG. 14

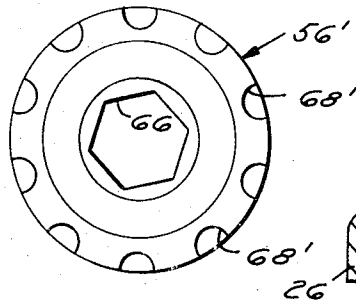
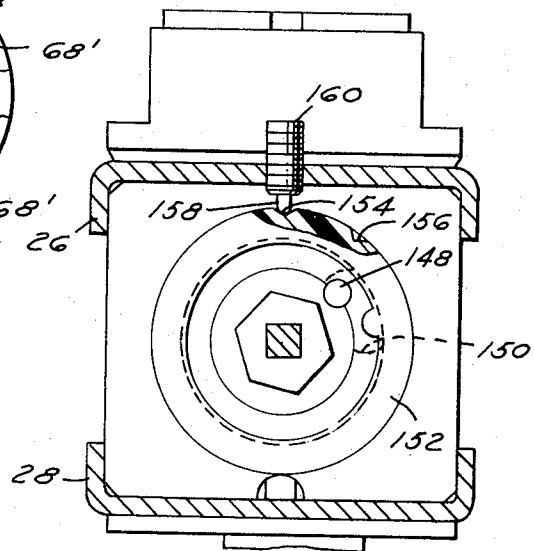


FIG. 11



# SELECTOR SWITCH MECHANISM WITH ADJUSTABLE RADIAL CAM INSERT MEMBERS HAVING CIRCUMFERENTIAL OVERLAP FLANGE

## BACKGROUND OF THE INVENTION

The invention relates generally to the field of switches, and more particularly to the class of switches commonly referred to as selector switches. It is to be understood that the term "switch" or "switch means" as used herein is meant to broadly encompass any device capable of performing a switching function, and is not restricted to any particular kind of switch. Two different types of switches are shown in the drawings and will be described in the following specification, namely air switches and electric snap switches. It will be obvious to one skilled in the art that various other types of devices falling into the general category of switches might be substituted for the specific air and electric switches hereinafter described.

The mechanism embodying the instant invention may be advantageously utilized in a variety of environments. It may be coupled to a Geneva drive and used to control a batch process or a repetitively operating machine, or it may be provided with a handle for manual actuation for controlling a machine and as a simple selector switch. No matter what the environment, the switch mechanism is very versatile, and lends itself to any application wherein multiple switch actuation is required.

The prior art may be conveniently divided into two categories, the first of which is the stepping drum programmer, exemplified by U. S. Pat. Nos. 3,101,435 and 3,330,917. These patents disclose a rotating cylindrical drum which is provided with perforations or slots into which are inserted small pins or plugs which actuate the switches upon rotation of the drum. The second category is best exemplified by U. S. Pat. No. 2,255,012, wherein there is shown a circular disk having recesses adapted to receive insertable cam elements at predetermined spaced-apart locations about its periphery. The cam elements must be inserted into the recesses in a predetermined orientation and then rotated into their operable position in order to actuate the switch.

## SUMMARY

The invention is concerned with the provision of a selector switch mechanism comprising a support having a shaft journaled thereon for rotation, one or more switch means on the support, and an individual cam means for each switch means mounted on the shaft, each cam having a plurality of uniformly spaced, identical reentrant recesses about its periphery, with at least one switch actuating element positioned in a respective recess, one of said cam means and element being made of a resiliently resilient material to enable snap-fitting engagement of the element within the recess and withdrawal therefrom.

One of the drawbacks in the stepping drum programmers above mentioned is that they are generally quite large and cumbersome, and do not lend themselves to versatility of operation. While they have been used with quite satisfactory results to control comparatively complicated batch processing operations and the like, they are pretty much restricted to controlling continuous processes wherein the drum is rotated at constant speed or is step-driven as by a Geneva drive. The so-

called stepping switches or selector switches of the prior art have the disadvantage that the switch actuating elements are either fixed in position, or must be rather laboriously inserted into the device, making assembly quite difficult.

The instant invention overcomes many of the difficulties present in the prior art by providing a device including any desired number of cam disks which can be stacked up on a shaft and provided with switch actuating elements snap-fitted into the cam recesses and easily removed therefrom in the event the program is changed. The cam disks may be individually programmable, i.e., may be provided with different numbers of recesses to add to the versatility of the mechanism. Further, the fact that the switch actuating elements are snap-fitted within the cam recesses for ease of insertion and removal makes the mechanism quickly adaptable to any given program. A further feature is the provision of switch actuating elements which bridge the gap between adjacent recesses in the cam disks, thereby enabling uninterrupted switch actuation throughout a plurality of cam positions without the necessity of providing a special cam structure.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation, partly in section, of a selector switch mechanism embodying the invention, showing a plurality of cam means having switch actuating elements for actuating both electric switches and air switches;

FIG. 2 is a front end elevation of the mechanism shown in FIG. 1 taken in the direction of arrow 2 of FIG. 1;

FIGS. 3, 4 and 5 are cross-sectional views taken along lines 3—3, 4—4 and 5—5 respectively of FIG. 1 showing various details of construction of the switch actuating mechanism;

FIG. 6 is a partial sectional view taken along line 6—6 of FIG. 5 showing a detent mechanism;

FIG. 7 is a partial side elevation of the mechanism shown in FIG. 1, partly in section, showing a "push-to-turn" feature and safety switch means;

FIG. 8 is a partial side elevation similar to FIG. 7 showing a modified switch mechanism incorporating a spring-return and a slip-maintain structure;

FIG. 9 is a cross-sectional view taken along line 9—9 of FIG. 8 showing the spring-return structure;

FIG. 10 is a partial view similar to FIG. 9 showing a slightly modified spring-return structure;

FIG. 11 is a cross-sectional view taken along line 11—11 of FIG. 8 showing the slip-maintain mechanism;

FIG. 12 is an end elevation of one of the cam disks showing the switch actuating elements disposed in the cam reentrant recesses;

FIG. 13 is a perspective view of one of the switch actuating elements; and

FIG. 14 is a view similar to FIG. 12 illustrating a modified cam disk.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and particularly FIGS. 1—4 inclusive, there is shown a switch mechanism embodying the invention in the form of a manually operated selector switch, which is shown in FIG. 1 mounted on an upright panel member or the like 20.

The device includes a support comprising a pair of square end plates 22 and 24, and a pair of shallow U-shaped brackets 26 and 28 extending between the end plates and secured thereto by screws or the like 30.

Each of the brackets 26 and 28 is suitably apertured as shown in 32 in FIG. 3, for example, to accommodate the projecting actuatable part of the switch means to be controlled. In FIG. 1 there are shown four such switch means, a pair of electric snap-action switches 34 and 36, and a pair of air switches 38 and 40. Each electric switch has a projecting actuator 42, while each air switch has a similar actuator 44.

Extending between the end plates 22 and 24 and journaled for rotation in bearings 46 and 48 is a shaft 50 having a projecting end portion 52 projecting through panel 20 to which a manually actuatable handle 54 is secured as by means of a set screw 56. Rotation of the handle 54 produces corresponding rotation of the shaft 50.

Supported on the shaft 50 are a plurality of cam disks, four being shown in FIG. 1 and identified by the numerals 56, 58, 60 and 62. Intermediate its ends, the shaft 50 is of non-circular cross section, and is shown as six-sided in the drawings at 64 in FIG. 3, for example. Each of the cam disks is provided with correspondingly shaped axial apertures to permit sliding engagement of the disks on the shaft while preventing relative rotation therebetween. Referring to FIG. 12, one of the cam disks 56 is shown as comprising a circular disk having a central aperture 66 conforming to the shaft configuration, and a plurality of equidistantly spaced reentrant recesses 68 about its periphery, each one of the recesses being arcuately shaped and defining an included angle of slightly more than 180°. The recesses 68 do not extend completely across the disk, but are open at one end and closed at the other end by an end wall 70 (FIGS. 1 and 12).

Disposed within certain selected of the reentrant recesses 68 are switch actuating elements 72 and 74, which are constructed to be snap-fitted into the reentrant recesses as shown in FIG. 12. The elements 72 are in the form of small cylinders, and may be utilized when it is desired to actuate a particular switch means in one position of cam disk rotation, or in a plurality of selected positions, with the switch means being deactuated between such positions, as hereinafter more fully described. The switch actuating elements 74 are designed for use in conjunction with at least one element 72 when it is desired to maintain switch actuation throughout a plurality of adjacent cam disk positions. The elements 74 as shown in FIGS. 12 and 13 may be characterized as comma-shaped, and each includes a cylindrical body 76 and a tail portion 78. The cylindrical portion 76 of the element 74 is snap-fitted into the reentrant recess 68, with the tail or circumferentially extending portion thereof bridging the gap and overlying an adjacent element to provide a continuous switch actuating surface bridging a plurality of cam recesses 68.

The cam disks 56 may be provided with any desired number of reentrant recesses 68. The cam disk 56 shown in FIG. 12 is provided with twenty reentrant recesses, and is therefore capable of actuating its associated switch every 18° during its rotation, or actuating its switch and maintaining such actuation throughout any desired rotation in multiples of 18°. For example, assuming the cam disk 56 having the switch actuating

elements 72 and 74 positioned as shown in FIG. 12, as the disk is rotated step-by-step through twenty positions, its associated switch would be actuated and then deactuated by each of the elements 72 shown at the upper left in FIG. 12, then would remain deactuated throughout the remaining positions of rotation until it came to the group of four actuating elements shown at the bottom of the Fig., at which point the switch would be actuated and maintained in actuated position through four positions of rotation, or 72°.

Shown in FIG. 14 is a modified cam disk 56' having identical reentrant recesses 68', but only ten in number, as opposed to the twenty recesses on the disk 56. The number of recesses shown in FIGS. 12 and 14 has been arbitrarily chosen, and it will be obvious to those skilled in the art that any desired number of recesses could be employed depending upon the particular application. Furthermore, in the mechanism shown in FIG. 1, all of the disks 56, 58, 60 and 62 could have the same number of recesses 68, or they could have different numbers of recesses depending upon the particular switch function they controlled.

Referring back to FIG. 1, the mechanism is illustrated therein as a multi-position selector switch which is manually actuatable by means of the handle 54. In this embodiment, the mechanism is supported on the panel or the like 20 by screws 80 which are threaded into the block 24, the opposite side of the panel being covered by a spacer 82 within which the heads of the screws 80 are countersunk. Spacer member 82 is preferably covered by a legend plate or decal 84 by rivets 85, the plate having position-indicating legends printed thereon such as the numerals 1, 2, 3, 4, 5 shown in FIG. 2, while handle 54 has a pointer portion 86 for indicating the position of the selector switch during its rotation.

As stated above, the mechanism is not restricted to manual selector switch operation, and the shaft 50 may be coupled to a Geneva drive and operated in similar fashion to a rotary drum programmer, i.e. the shaft may be continuously rotated in step-by-step fashion by the Geneva drive. The device could also be coupled through a speed reducer to an electric motor or the like for continuous rotation at a uniform velocity to satisfy some applications. The following description will place primary emphasis on the manual selector switch embodiment which is shown in the drawings.

As shown in FIG. 1, the cam disks 56, 58, 60 and 62 are considerably narrower than the switch means 34, 36, 38 and 40 which they actuate. In order to provide a compact assembly, the cam disks are stacked in end-to-end relation on the shaft 50, with alternate disks positioned in radial alignment with the switch actuators to actuate adjacent switches as shown. All of the switch bodies are secured to the brackets 26 and 28 by means of screws or the like shown at 88 to permit easy and convenient installation and removal of an individual switch. The end wall 70 of each cam disk, which serves as a stop for the elements 72 and 74 may also be provided on its circumferentially extending surface 89 with numerals or other indicia which indicate the relative position of rotation of the cam disk. In addition, the cam disks themselves may be made out of a colored material, and different colors used for different disks to make identification easier. Preferably the cam disks are made out of a relatively hard plastic material such as nylon which may be made in different colors.

Assuming that the selector switch as shown in FIG. 1 requires less positions than the number of recesses in the cam disks associated therewith, there is shown in FIG. 4 construction for limiting rotation of the mechanism. This construction includes a separate cam disk 86 positioned on the shaft portion 64 adjacent the end thereof opposite the handle 54, which disk is identical to those previously described. Projecting from the end plate 22 into radial confrontation with the disk 86, and spaced slightly from the disk periphery, is a stop pin 88. A pair of elements 72 are positioned as shown in FIG. 4 in preselected disk recesses 68, whereby upon rotation of the disk 86 in response to movement of handle 54, the element 72 will abut against stop 88, thereby limiting further rotation of the shaft and the switch actuating cam disks associated therewith. The number and/or location of operative positions may thereafter be changed merely by shifting the elements 72 to different recesses 68 within the disk 86.

In FIGS. 5 and 6 there is shown a detent mechanism comprising a disk 90 mounted on the shaft portion 64 for rotation therewith, such disk having a plurality of recesses or cutouts 92 spaced uniformly about its periphery and corresponding in number to the maximum number of positions, i.e. the maximum number of recesses on any one of the switch actuating cam disks 56, 58, 60 and 62. A bolt 94 extending through the end plate 22 is provided with a cylindrical end portion 96 upon which is journaled a rocker arm 98 generally U-shaped in cross section, and carrying adjacent its opposite end a detent roller 100 positioned for engagement within the recesses 92 of the disk 90. The roller 100 is biased into engagement with the recesses 92 by a coil spring 102 connected at one end to the rocker arm 98 and at its opposite end to a pin 104 projecting from end plate 22. Upon rotation of the handle 54 and the switch actuating cam disks mounted thereon, disk 90 will also be rotated, with the detent mechanism shown and described operating to retain the shaft in any preselected position of rotation until it is forcibly shifted to the next position.

In order to insure against accidental rotation of handle 54, there is shown in FIG. 7 a safety device which requires that the handle 54 be shifted axially and held in its axially shifted position during rotation of the handle in order to accomplish switch actuation. Such comprises a box-like housing 106 which may be made of metal or the like, and having inwardly extending flanges 108 and 110 through which cap screws 112 extend to fasten the housing onto the end plate 22 as shown in FIG. 6. An inner shaft 114 which extends completely through and beyond opposite ends of shaft 50 projects axially into the housing 106. Shaft 114 replaces shaft portion 52 above described and is slidable within a correspondingly shaped aperture in shaft 50, with the handle 54 being mounted on the opposite end of shaft 114, permitting relative longitudinal movement between shafts 50 and 114, but preventing relative rotational movement therebetween.

A circular cam 116 is fixed to shaft 114 for rotation therewith, the cam 116 having a crowned periphery 118 for actuating switch means to be described. A coil spring 120 is interposed between a wall of the housing 106 and the cam 116 urging the cam to the right as shown in FIG. 7. The cam member 116 is provided with a plurality of apertures 122 corresponding to the number of positions of rotation of the selector switch mechanism,

in this case twenty. A pin 122 fixed to end plate 22 projects into one of the apertures 120 at each position of selector switch operation. Referring to FIGS. 1 and 7, the handle 54 of FIG. 1 must be shifted axially to the left against the bias of spring 120 (FIG. 7) a sufficient distance to free cam member 116 from engagement with pin 122 in order to rotate the handle and the associated switch actuating cam disks. Engagement of the pin 122 within one of the apertures 120 prevents rotation of the handle in its normal at-rest position. This construction insures that the handle 54 cannot be accidentally rotated as by a workman bumping his arm thereagainst, which could cause damage to an expensive piece of machinery or injury to the operator.

As shown in FIG. 7, the apertures 120 in cam member 116 may be of two different types, i.e. those shown at 120 which extend completely through the member 116, and those shown as at 120' which extend only part way therethrough. This construction permits utilization of the same cam member 116 in association with cam disks having different numbers of recesses. For example, if the cam member 116 is to be used with the cam disks 56 and 56' heretofore described, such member would be provided with twenty apertures with alternate apertures extending only part way through the member as shown at 120'. When used with a twenty position program, cam member 116 is positioned as shown in FIG. 7, rendering all twenty apertures 120 and 120' operative. To be used with a ten position program, the member 116 would be reversed on the shaft, to render the blind apertures 120' inoperative, thereby providing a ten position locking cam.

Also shown in FIG. 7 are an electric master switch 124 and an air master switch 126, each of which are provided with projecting actuating members 128 and 130 respectively, normally disposed in axially spaced relation to the crowned periphery 118 of cam member 116. The switches 124 and 126 are provided to insure deactuation of all of the control switches of the mechanism, such as the switches 34, 36, 38 and 40 of FIG. 1 and to this end these master switches are connected in series with the operating switches. Upon axial movement of the handle 54 and shaft 114 to enable rotation of the shaft and associated cam disks, the cam member 116 is shifted axially to its dotted outline position shown at 116' in FIG. 7, thereby shifting the switch actuators 128 and 130, and in turn shifting switches 124 and 126 to their positions deactuating all of the remaining control switches. With the arrangement shown, the mechanism cannot be rotated to vary control switch actuation without shifting the master switches 124 and 126 to their positions deactuating all of the control switches.

In some applications, it is desirable to provide a so-called "spring return" mechanism for a selector switch. For example, the switch mechanism may be utilized to control a machine tool having forward and reverse movements. The selector switch is then provided with a handle 54 as shown in FIG. 1 where in the normal or at-rest position, the machine would be in stop position, rotation of the handle in one direction actuating one switch controlling forward machine travel, and rotation in the other direction actuating a second switch controlling reverse machine travel. As a safety and convenience feature, the mechanism may be provided with a spring return mechanism urging the device to the stop position so that if the manual actuator or handle is re-

leased, the machine will automatically stop. Such a construction is shown in FIGS. 8 and 9, and comprises a torsion spring 132 which may be positioned in an annular cutout 134 in cam disk 86 previously described above with reference to FIG. 4. The peripheral reentrant recesses 68 in the disk 86 have not been shown in FIG. 9 for simplicity of illustration. The torsion spring 132 has opposite generally radially extending end portions 136 and 138 which embrace a short pin 140 projecting from the body of disk 86. A second pin 142 fixed to end plate 22 also projects between the ends 136 and 138 of the spring, as shown in FIG. 9. As disk 86 is rotated in either direction, pin 140 abuts one or the other of the spring portions 136 and 138, while the other end of the spring is held stationary by the pin 142. Upon release of rotational force, the spring will operate to return the disk 86 to the normal at-rest positions indicated in FIG. 9.

A somewhat modified form of the spring return construction is shown in FIG. 10. The construction shown in FIG. 10 may be utilized wherein it is desired to be able to maintain the selector switch in certain operative positions, but to have the mechanism spring return from certain other operating positions. A typical example would occur in the control of a machine having essentially a five position possibility, namely a stop position, and operating positions such as slow forward, fast forward, slow reverse and fast reverse. It is frequently desirable to permit machine operation in fast forward and fast reverse travels only while the operator maintains pressure on the actuating handle or the like. In FIG. 2 there is shown the numbers 1, 2, 3, 4, 5 on the legend plate 84 wherein the 3 denotes the at-rest or stop position, number 2 the slow reverse and number 1 the fast reverse, number 4 the slow forward and number 5 the fast forward. Considering FIG. 10, the construction is similar to that shown in FIG. 9 except for the fact that an additional stationary stop pin 144 projects from the base plate 22, and the opposite ends 136 and 138 of the spring 132 are spread to abut the pins 142 and 144. Pin 140 is provided on the disk 86 as above described with reference to FIG. 9. With the handle 54 in position number 3 of FIG. 2, namely the off or stop position, the parts of the spring-return device are positioned as illustrated in FIG. 10. It is apparent that the handle may be shifted to the slow speeds positions 2 and 4 which will in turn shift pin 140 radially opposite pin 142 or 144 depending upon the direction of rotation, but that such movement will not cause the spring-return mechanism to become operative. However, when the handle is shifted to the 1 or 5 position, namely the fast forward or reverse speed, the pin 140 will contact one or the other spring ends, carrying the spring with it during its rotation, and upon release of the handle 54 the spring will operate to return the disk 86 to the respective slow speed position 2 or 4 as the case may be.

In FIG. 11 there is shown mechanism for controlling the indicating means for incorporation in the switch mechanism when it is desirable to provide visual indication of preceding switch actuation. For example, the selector switch shown in FIG. 2 may be a three-position switch having positions 2, 3 and 4 as shown, wherein position 3 is a stop or inoperative position, and positions 2 and 4 are forward and reverse positions respectively. When the indicator 86 is at the stop position, it is frequently desirable to be able to visually ascertain

whether the machine has been last in its forward or reverse position.

In order to accomplish this visual indication, one of the switch actuating cams on the six-sided shaft 64 is provided with a laterally projecting pin 148, which projects into an annular recess 150 of an adjacent disk 152 which is journaled for rotation on the shaft 50. Disk 152 is provided with a pair of V-shaped slots 154 and 156 in its periphery, which grooves are spaced apart an angular distance equal to the distance between adjacent selector switch positions, that is at an angle of  $18^\circ$ , assuming the cam disks shown in FIG. 12 are utilized. The annular recess or cutout 150 also extends through an angle of 18 degrees, or equal to the angle between the slots 154 and 156. A spring-loaded detent pin 158 having a threaded body 160 is engaged in the upper plate 26, and the detent engages the slots in the disk 152.

With the device in the position shown in FIG. 11, the actuating handle 54 shown in FIG. 2 is at its stop position indicated by numeral 3, and the detent 158 is in engagement with slot 154. Upon rotation of the handle 54 toward the 2 position, rotation of the shaft 50 and disks carry the pin 148 in a counterclockwise direction, abutting the end wall of slot 150, and shifting the disk 152 counterclockwise until the detent 158 engages the slot 156, at which point the switch controlling forward machine operation is actuated. Handle 54 may thereafter be rotated back to the stop or 3 position, which rotates pin 148 to its position adjacent the opposite end of the slot 150, but does not shift disk 152, because it is journaled on the shaft, and the detent 158 is engaged with slot 156. Movement of the handle 54 to the reverse or 4 position will operate to shift the disk 152 to the position shown in FIG. 11 by engagement of the pin 148 against the end wall of the slot 150.

There is thus shown a very simple and compact selector switch mechanism which may be fabricated from a minimum of standard parts to provide virtually any desired number of switch actuators operable in any desired relationship. the cam disks 56 and/or 56' may be stacked up on the shaft portion 64 in any given number and with any desired number of reentrant recesses 68 to provide a virtually infinite number of switch combinations. Furthermore, the mechanism lends itself to utilization and programming applications where rotary drum programmers have heretofore been utilized, the mechanism being driven in step-by-step rotation by a Geneva drive or the like. The mechanism is suitable for many other specific applications requiring a plurality of switches which are to be actuated and deactuated in predetermined relationship.

What is claimed is:

1. In a selector switch mechanism including a support carrying a shaft for rotation with respect thereto and at least one switch means mounted on the support having a shiftable part, switch actuating means for actuating the shiftable switch part disposed in radial alignment therewith comprising a disk-like circular cam member mounted on said shaft for rotation therewith and having a plurality of uniformly spaced apart reentrant recesses about its periphery, each of said recesses defining an arcuate surface extending axially of the disk and encompassing an included angle greater than one hundred eighty degrees, and a plurality of switch actuating elements seatable in said recesses, each element having a cylindrical surface portion conforming to the recesses

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and a switch-part engaging surface portion projecting radially beyond the disk outer surface into abutting engagement with said shiftable switch part, at least one of said recess and said element being resiliently deformable to permit snap-fitting insertion and removal of said elements radially of said recesses, at least some of said switch actuating elements having an integral circumferentially extending tapering projection having an arcuate outer surface bridging the space between adjacent

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recesses and overlying an adjacent element to provide a continuous switch actuating surface extending circumferentially of the disk.

2. Switch actuating means as defined in claim 1 characterized in that said disk recesses open through one radial face of said disk and terminate spaced from the opposite face to define a radial abutment against which said switch actuating elements abut.

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