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POSITIVE ACTING, MULTIPOSITION DETENT SWITCH

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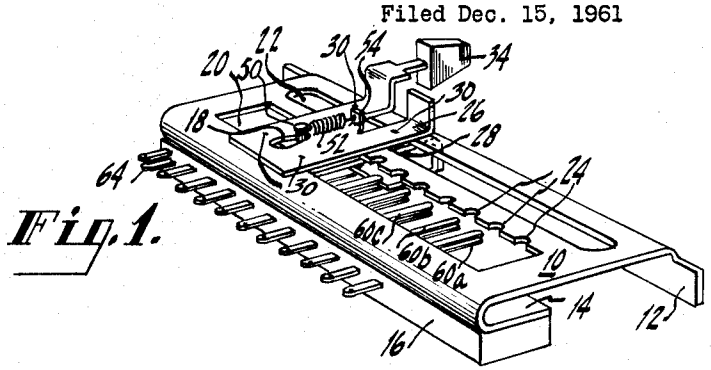


Fig. 1.

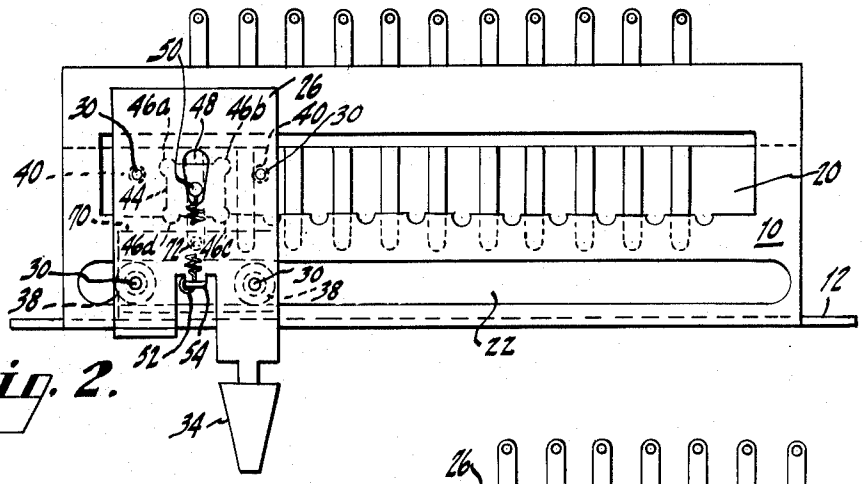


Fig. 2.

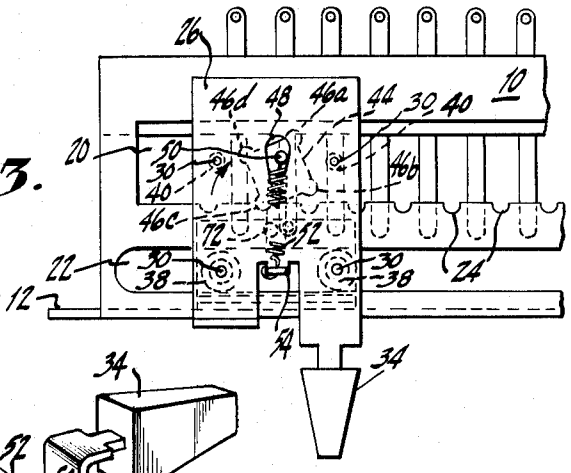


Fig. 3.

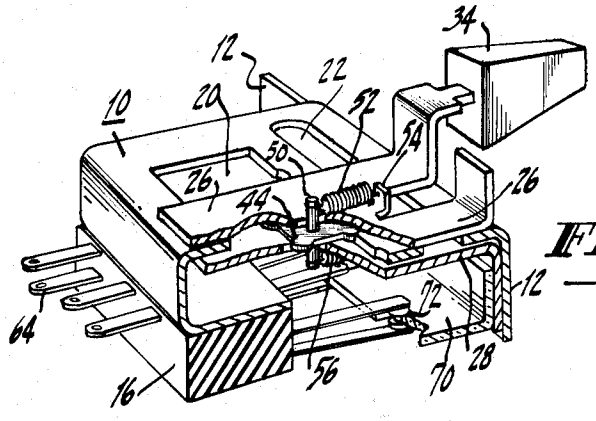


Fig. 4.

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POSITIVE ACTING, MULTIPOSITION DETENT SWITCH

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This invention relates to switches and, in particular, to an improved multiposition switch.

One disadvantage of many prior art multiposition switches is the necessity for precise manual setting of the movable switch mechanism. If the switch is improperly set, the movable mechanism may come to rest in a position where no positive switch contact is made. It is thus necessary for the operator to exercise great care in operating the switch in cases where the reliability of the system is important and is, in part, a function of operator performance.

It is an object of the present invention to provide an improved multiposition switch that does not require precise manual setting.

It is another object of this invention to provide a multiposition detent switch in which the movable mechanism comes to rest in a positive contact position even if the mechanism is manually set ambiguously between switch positions.

These objects are accomplished in a preferred embodiment of the invention by a switch mechanism movable along a track having a number of spaced notches. The mechanism includes a rotatable member having spaced fingers for engaging the notches. The rotatable member is biased toward the track and constrained to a rest position in which at least two of the fingers engage notches in the track. The mechanism further includes means for cooperating with different switch contacts for different rest positions of the mechanism.

In the accompanying drawing, like reference characters refer to like components, and:

FIGURE 1 is a view in perspective of a preferred embodiment of a multiposition switch according to the invention;

FIGURE 2 is a plan view of the switch in which the switch mechanism is illustrated in a stable, rest position;

FIGURE 3 is a partial plan view of the switch in which the switch mechanism is illustrated in an unstable position; and

FIGURE 4 is a cut-away view in perspective illustrating the details of the switch mechanism.

The preferred embodiment of the invention is a linear type switch, where the term "linear" defines the motion imparted to the switch by an operator. It will be apparent from the description which follows that the invention in its broader aspects is not limited to use in linear type switches and that various modifications may be made in the switch to be described without departing from the spirit of the invention. What is illustrated and will be described is the preferred form of the invention as contemplated for a specific use.

Referring now to the various figures of the drawing and particularly to FIGURES 1 and 4, there is illustrated a frame **10** bent at one edge to form a forward wall **12** adapted to be riveted, bolted or otherwise mounted on a control panel (not shown) or other suitable support. The opposed or rear edge of the frame **10** is bent in the form of a substantially U-shaped portion **14** to which is secured a switch contact assembly **16**. The switch contact assembly may be, for example, a contact carrying block of insulating material bolted or riveted to the outer surface of the U-shaped portion **14**. The top of the

frame **10** has first and second elongated slots or channels **20** and **22** formed therein. A plurality of equally spaced notches **24** are provided in one inner wall of the frame **10** along the length of the elongated slot **20**. The frame **10**, which preferably is made of metal, such as steel, may be manufactured by first stamping or punching out the channels **20** and **22** and notches **24** and then bending the forward and rear edges to provide a relatively inexpensive apparatus.

The movable mechanism of the switch includes a pair of plate members **26**, **28** separated by the frame **10** top and fastened together by means of pins or rivets **30**. The top plate **26** has affixed thereto a handle **34** for moving the switch mechanism to a desired position. The plates **26** and **28** are spaced apart at the forward end of the switch mechanism by means of idler or guide wheels **38** which are located in the channel **22**. These wheels **38** are adapted to ride along the walls of the channel **22** and limit movement of the plates **26** and **28** to a direction along the length of the channel **22**. The rivets serve as shafts for the guide wheels **38**. As illustrated in FIGURE 2, the inner diameters of the idler wheels **38** are greater than the diameters of the corresponding rivets **30**, whereby the wheels **38** fit loosely on the rivets **30** and are free to rotate. The plates **26** and **28** are spaced apart at the rear thereof by means of spacers **40** through which the rivets **30** are fitted. The idler wheels **38** and spacers **40** are best illustrated in FIGURES 2 and 3.

Positioned between the plates **26**, **28** in the channel or slot **20** is a rotatable member **44** having apices **46***a* . . . **46***d* projecting from the rotatable member **44** and integral therewith. The apices **46***a* . . . **46***d* serve as fingers for engaging the notches **24** in the frame **10**. The exact geometrical shape of the rotatable member **44** is not critical and is illustrated by way of example only as being substantially square. The distance between the ends of adjacent fingers should be substantially the same as the distance between the centers of adjacent notches **24** so that the fingers **46***a* . . . **46***d* properly engage the notches **24**, as illustrated in FIGURE 2.

The finger **46***a* . . . **46***d* are shaped at the extremities to match propely with the notches **24**. The notches **24** may be semi-circular, as illustrated in which case the fingers are rounded at the extremeties and preferably have substantially the same radius of curvature as the notches. Centrally located on the rotatable member **44** is a hub **50** which projects from the top and bottom of the member **44** through tear shaped apertures **48** in the top and bottom plates **26** and **28**. A first tension spring **52** is connected between the upper projection of the hub **50** and a tab **54** at the forward end of the top plate **26**. A similar tension spring **56** (FIGURE 4) connects the bottom projection of the hub **50** to a similar tab (not shown) on the bottom plate **28**. These springs **52** and **56** are under sufficient tension to spring load or bias the rotatable member **44** toward the notched track.

A plurality of pairs **60***a* . . . **60***n* of normally open switch contacts extends from the switch contact assembly **16** toward the front side wall **12** of the frame **10**. In general, there may be one set of switch contacts for each positive setting of the switch mechanism. By "positive setting" of the switch mechanism is meant any position in which two fingers are engaged with a pair of notches **24**, as in FIGURE 2. The upper switch contact of each pair extends through the mounting assembly **16** and emerges at the rear of the assembly. The lower switch contacts of the pairs **60***a* . . . **60***n* may be connected to a common bus in the switch contact assembly **16** and a common lead **64** may be brought out at the rear of the assembly **16**. The lower contacts also may extend through the assembly block **16** and be brought out separately at the rear of the assembly **16** if desired or required.

Connections between the switch contacts **60***a* . . . **60***n* and external apparatus to be controlled by these switch contacts may be made at the rear of the switch assembly **16**.

Secured to the lower plate **28**, and movable therewith, is a body **70** of insulating material (FIGURE 4) which is thinner than the normal open spacing between the top and bottom switch contacts and which moves therebetween when the handle **34** is actuated. Secured to, and extending outward from, the top and bottom surfaces of the body **70** is an electrically conductive button contact **72** adapted to electrically close the pairs of switch contacts successively as the plate members **26**, **28** are moved along the channel **22**. A portion of the body **70** is broken away in FIGURE 4 to better illustrate the button contact **72**. The distance between the outer ends of the button contact **72** preferably is slightly greater than the normal spacing between the lower and upper contacts to assure good physical contact. The ends of the button contact **72** are rounded to provide smooth interaction between the switch contacts and the button contact **72**. In those cases wherein it is the function of the switch to connect different switch contacts to ground for different positive settings of the switch mechanism, only a single switch contact of each pair **60***a* . . . **60***n* need be provided and the button contact **72** may be used to connect the single switch contacts to ground directly by constructing the button contact **72**, plate **70** of an electrically conductive material and grounding the frame **10**.

As will be described more fully hereinafter, the movable switch mechanism comprising the plates **26**, **28**, the rotatable member **44** and the button contact **72** and its support **70** is constrained always to come to a stable rest position, or positive setting, with two adjacent ones of the fingers **46***a* . . . **46***d* engaging two adjacent notches **24** in the frame **10**. The pairs of switch contacts **60***a* . . . **60***n* are spaced along the length of the switch so that the button contact **72** shorts a different pair of contacts **60***a* . . . **60***n* for each different positive setting of the switch mechanism. The tension springs **52**, **56** spring load the rotatable member **44** and bias the rotatable member **44** toward the notched track. The notches **24** engage the fingers **46***a* . . . **46***d* and function as detents to prevent movement of the switch assembly, except when force is applied to the handle **34** by an operator. The manner in which the switch mechanism operates so also always to come to rest in a stable, contact closing position will now be described.

The switch mechanism is illustrated in FIGURE 2 in the left-most position. Fingers **46***d* and **46***c* are in engagement with the left-most two notches **24**. The contact button **72** then is interposed between the pair of switch contacts **60***a* to short these contacts electrically. The tear shaped apertures **48** are located in the plates **26**, **28** so that the hub **50** is positioned in the forward, narrow portion of the apertures **48** when the mechanism is at rest. The apertures **48** permit the hub **50** and rotatable member **44** to move a slight distance away from the notched track when the switch mechanism is moved in response to external force applied on the handle **34**.

Assume now that it is desired to move the switch mechanism to the right one position so as to close the pair of switch contacts **60***b*. As the switch mechanism is moved to the right, the rotatable member **44** pivots about the outer end of the finger **46***c* as the finger **46***c* turns in the associated notch **24**, and the rotatable member **44** rotates in a clockwise direction (FIGURE 3). During this rotation there is a corresponding movement of the hub **50** and rotatable member **44** away from the notched track. The hub **50** rides along the left side wall of the aperture **48** until the rotatable member **44** reaches a dead-center position. The fingers **46***c* and **46***a* then are aligned perpendicular to the notched track. The hub **50** swings toward the right wall of the aperture **48** when the rotatable member **44** is rotated further in a clockwise direction off the dead-center position of unstable equilibrium. The tension in the springs **52**, **56** is greatest in the dead-center position of the rotatable member **44**. These springs **52**, **56** produce a turning moment on the rotatable member **44** and, after the rotatable member **44** passes the dead-center position, the rotatable member **44** is rotated in a clockwise direction under the force of the tension springs **52**, **56**. The member **44** pivots on the engaged finger **46***c* and rotates to a rest position wherein the fingers **46***b* and **46***c* are engaged with an adjacent pair of notches in the track. The switch mechanism is held stably in this position by the detent action of the notches **24**. When the rotatable member **44** has the geometry illustrated, the flat side of the member **44** between the engaged fingers may rest against the side wall of the frame **10** (FIGURE 2) and, in so doing, enhances position stability.

It is unnecessary for the operator to position the switch mechanism precisely to the rest position immediately aforementioned. It is only necessary that the operator move the mechanism sufficiently to rotate the member **44** from the position illustrated in FIGURE 2 to a position past dead center. The tension springs **52**, **56** then complete the movement of the switch mechanism by a snap action without external force applied if the operator then releases the handle **34**. Of course, the rotatable member **44** will return to its initial position (FIGURE 2) if the handle **34** is released before the rotatable member **44** reaches dead center. The switch mechanism may be moved from any rest position to any other position, depending upon the particular pair of switch contacts it is desired to close, and positive switch action is provided, as described above.

What has been illustrated and described is an improved multiposition switch which increases system reliability by reducing the possibility of human error. This is accomplished by providing a switch which always comes to rest in one of several predetermined positions without the necessity of precise setting by the operator. The switch has the further advantages of simple construction and relatively few components, and adaptability for mass production in that the frame **10** may be manufactured by a simple stamping and bending process.

What is claimed is:

1. The combination comprising: a frame having an elongated slot defining first and second spaced inner walls in said frame; a number of equally spaced notches in one of said walls disposed along the length of said slot; a pair of members separated by said frame and movable together in a direction along the length of said slot, each of said members having an aperture therein; a rotatable member positioned in said slot between said pair of members and having a hub which projects through each said aperture, said rotatable member having spaced fingers for engaging said notches; and bias means coupled between said hub and said pair of members and urging said rotatable member toward said one of said walls.

2. The combination comprising: a frame having a slot therein defining first and second spaced walls in said frame; a number of equally spaced notches in one of said walls disposed in a direction along the length of said slot; a pair of members separated by said frame, normal to said walls, and restricted to movement in a direction along the length of said slot; a rotatable member positioned in said slot between said pair of members and having a hub which is normal to, and engaged by, said pair of members, said rotatable member having a number of spaced fingers for engaging said notches, the spacing between the ends of adjacent said fingers being equal substantially to the spacing between adjacent ones of said notches; and bias means operatively connected to said hub for urging said rotatable member toward said one of said walls.

3. The combination comprising: a frame having an elongated slot therein defining first and second spaced

walls in said frame; a number of equally spaced notches in one of said walls disposed along the length of said slot; a pair of apertured members separated by said frame, normal to said walls, and movable together in a direction along the length of said slot; a rotatable member positioned in said slot between said apertured members and having a hub which projects through an aperture in each of said apertured members, said rotatable member having a number of spaced fingers for engaging said notches, the spacing between the ends of adjacent said fingers being equal substantially to the spacing between adjacent ones of said notches; and a pair of springs each connected between a different end of said hub and the associated one of said apertured members for biasing said rotatable member toward said one of said walls.

4. The combination comprising: a frame having a slot therein defining first and second spaced walls in said frame; a number of equally spaced notches in one of said walls disposed along the length of said slot; a pair of apertured members separated by said frame, normal to said walls, and movable together in a direction along the length of said slot; a rotatable member positioned in said slot between said apertured members and having a hub which projects through an aperture in each of said apertured members, said rotatable member having a number of spaced fingers for engaging said notches, the spacing between the ends of adjacent said fingers being equal substantially to the spacing between adjacent ones of said notches; and a pair of springs each connected between a different projecting end of said hub and a point on the associated one of said apertured members near said one of said walls so that each of said springs is substantially normal to said walls, said springs acting to bias said rotatable member toward said one of said walls.

5. The combination comprising: a frame having an elongated slot defining first and second spaced walls in said frame; a number of equally spaced notches in one of said walls disposed along the length of said slot; an elongated channel in said frame parallel to said slot; a pair of apertured members separated by said frame; a pair of guide wheels positioned in said channel parallel to said members and rotatable about pins through said apertured members for limiting movement of said members to a direction along the length of said channel; a rotatable member positioned in said slot parallel to said apertured members and having a hub which projects through an aperture in each of said apertured members, said rotatable member having spaced fingers for engaging said notches, the distance between the ends of adjacent ones of said fingers being equal to the spacing between adjacent ones of said notches; and bias means coupled between each end of the hub and the respective apertured member and urging said rotatable member toward said one of said walls.

6. The combination comprising: a frame having an elongated slot therein defining first and second spaced walls in said frame; a number of equally spaced notches in one of said walls disposed along the length of said slot; a pair of apertured members separated by said frame, normal to said walls, and movable together in a direction along the length of said slot; a rotatable member positioned in said slot between said apertured members and

having a hub which projects through an aperture in each of said apertured members, said rotatable member having a number of spaced fingers for engaging said notches, the spacing between the ends of adjacent said fingers being equal substantially to the spacing between adjacent ones of said notches; a pair of springs each connected between a different projecting end of said hub and a point on the associated one of said apertured members near said one of said walls so that each of said springs is substantially normal to said walls, said springs acting to bias said rotatable member toward said one of said walls; a plurality of switch contacts positioned along the length of said frame; and contact engaging means mounted on one of said apertured members for engaging said contacts sequentially as said apertured members are moved in a direction along the length of said slot.

7. The combination as claimed in claim 6 wherein said switch contacts are positioned so that a switch contact is engaged by said contact engaging means when an adjacent pair of said fingers is engaged with an adjacent pair of said notches.

8. The combination comprising: a frame having an elongated slot therein defining first and second spaced walls in said frame; a number of equally spaced notches in one of said walls disposed along the length of said slot; a pair of apertured members separated by said frame, normal to said walls, and movable together in a direction along the length of said slot; a rotatable member positioned in said slot between said apertured members and having a hub which projects through an aperture in each of said apertured members, said rotatable member having a number of spaced fingers for engaging said notches, the spacing between the ends of adjacent said fingers being equal substantially to the spacing between adjacent ones of said notches; a pair of springs each connected between a different projecting end of said hub and a point on the associated one of said apertured members near said one of said walls so that each of said springs is substantially normal to said walls, said springs acting to bias said rotatable member toward said one of said walls; a plurality of switch contacts positioned along the length of said frame; contact engaging means mounted on one of said apertured members for engaging said contacts sequentially as said apertured members are moved in a direction along the length of said slot; and a handle attached to one of said apertured members for manually moving said apertured members in a direction along the length of said slot.

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