May 17, 1966 H. M. FREDERICK 3,251,240

MECHANICAL BISTABLE DEVICE

Filed Oct. 16, 1963

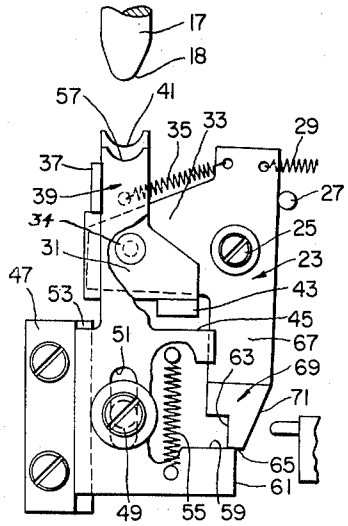


FIG. 2

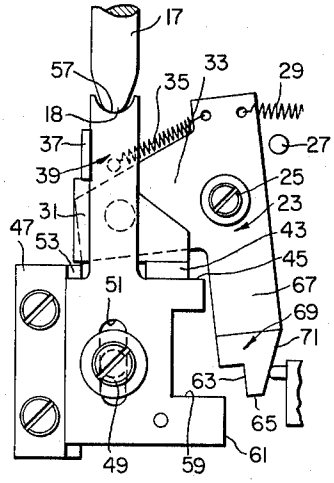


FIG. 3

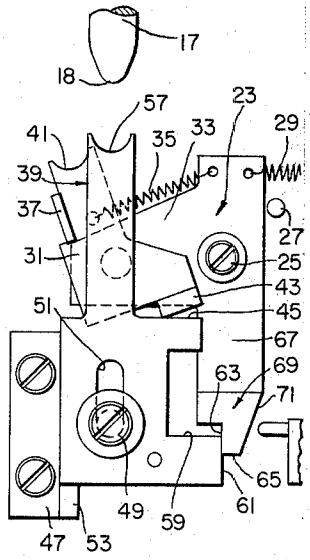


FIG. 4

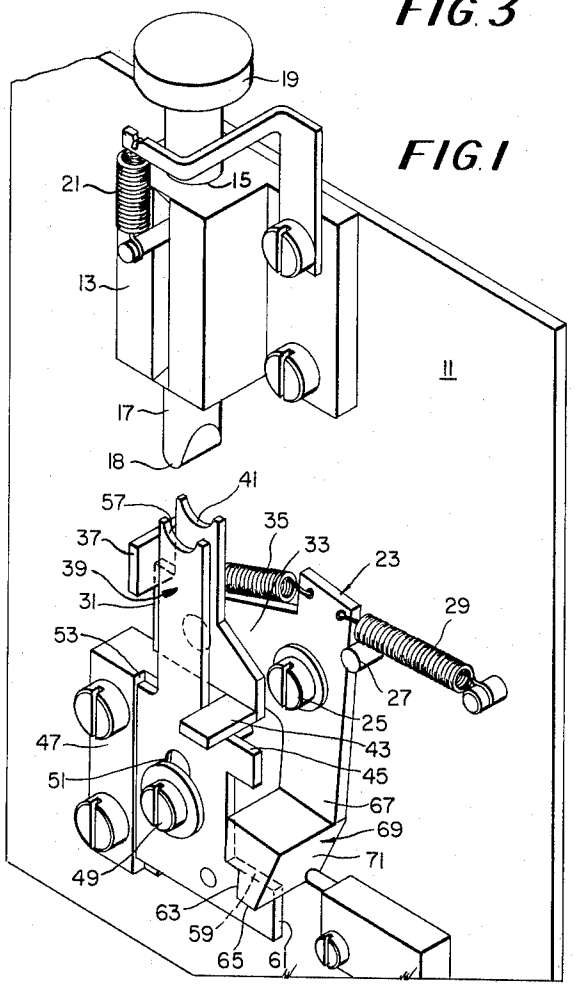


FIG. 1

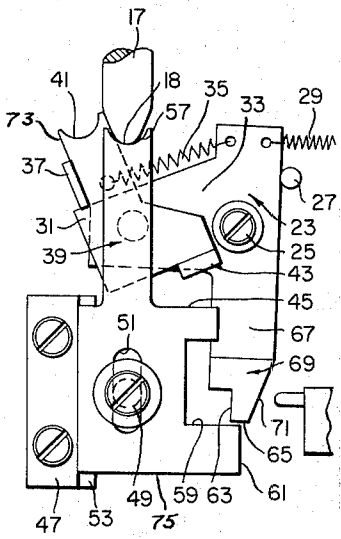


FIG. 5

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United States Patent Office 3,251,240 Patented May 17, 1966

3,251,240

MECHANICAL BISTABLE DEVICE

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Filed Oct. 16, 1963, Ser. No. 316,702
10 Claims. (Cl. 74—527)

This invention relates to mechanical bistable devices and, more particularly, to a bistable actuating mechanism which is operated by successively depressing a single plunger.

Alternate action mechanisms, commonly called push-push mechanisms, are frequently employed to operate or selectively position devices, the two stable states of which may be characterized as: on, off; open, closed; go, no go; operate, rest; latched, free; etc.

Plunger operated switches are frequently operated by such alternate action mechanisms. Plunger operated switches are well known in the electrical switching art and are readily available in a large variety of current and voltage ratings as well as sizes and shapes. However, in order for a designer to avail himself of the advantages of ready availability and low cost attendant shelf item switches, it is often necessary to incorporate a switch actuating mechanism between the control panel and the physical location of the switching means within the assembled equipment. However, the cost involved in designing and machining a special actuating mechanism for each separate switching need would greatly outweigh any savings in time and cost which would be derived from utilizing readily available low cost switches.

One solution to the above problems would be to utilize a standard or universal alternate action mechanism; that is, one which is readily adaptable to perform a variety of switch actuating functions. To be practical, such a standard or universal alternate action mechanism would have to be: reasonable in cost, rugged in construction, reliable in performance, accurate in operation and versatile in actuation.

The principal object of this invention is to provide an improved bistable actuating mechanism.

Another object is to provide a bistable actuating mechanism which is rugged and has a minimum of moving parts.

A further object is to provide a bistable actuating mechanism which is economical to manufacture.

A still further object is to provide a bistable actuating mechanism which is reliable in operation and insensitive to mounting attitude.

Yet another object is to provide a bistable actuating mechanism which is versatile and adaptable in regard to the positioning of the device to be actuated thereby.

In attaining the above objects applicant has utilized a biased oscillatory member, in the form of a bell crank of limited movement, controlled by two interposers, the interposers being driven alternately by a reciprocatory input. One of the interposers is pivotally mounted on one arm of the bell crank and biased into position to be driven by the input. The second interposer is reciprocatory and is driven in line by the input against a bias. When moving under bias, i.e., when returning to undriven portion after actuation by the input, the second interposer cams the first interposer out of position to be driven by the input.

The second arm of the bell crank and the second interposer have interlocking detent surfaces. When the first interposer is in position to be driven, the bell crank is positioned by bias and a detent surface on the second arm of the bell crank holds the second interposer in its driven position against bias. When the first interposer is driven, the bell crank is rocked against bias, the second interposer is released to its bias, returning to its undriven position.

Upon the release of the second interposer, a detent surface thereon interacts with the second arm of the bell crank to hold the bell crank in its rocked position.

Three elements of applicant's novel mechanism have bistable states, namely the bell crank and the two interposers. Surfaces on any of these elements may be used for actuating switches, or other purposes when bistable devices are required.

The above listed objects, aspects, and features will become apparent from the following description of the invention referring to the drawings in which:

FIG. 1 is a perspective view of the bistable mechanism in the first stable state with the actuator positioned at the start of a stroke.

FIG. 2 is a fragmentary view showing the bistable mechanism in the first stable state.

FIG. 3 is a fragmentary view similar to FIG. 2 with the actuator fully depressed and the mechanism in a transistory state between the first and second stable state.

FIG. 4 is a fragmentary view of the bistable mechanism in the second stable state.

FIG. 5 is a fragmentary view showing the mechanism in a transistory state from the second to the first stable state.

Secured to a base plate 11 by any known means, such as screws or rivets, is guide block 13 which has a longitudinal bore 15 therein. Driving member 17 is preferably mounted for linear reciprocation within guide block 13 and is tapered at the driving end 18. Push button 19 is attached to the opposite end of the driving member 17 from the taper, and coil spring 21 biases the driving member to an inactive position.

It is apparent that the driving member may be positively reciprocated to both the driven and inactive positions and that the movement of the driving means need not be linear. An oscillating rocker arm with a driving stud thereon, for example, could serve the same function.

Bell crank 23 is oscillatively mounted on base plate 11 by means of bearing post 25. Stop 27 limits the clockwise travel of bell crank 23 under the bias developed by spring 29, thereby determining one stable position thereof.

Coupling pawl 31, being the first interposer member, is pivotally mounted on arm 33 of bell crank 23 by means of a bearing post 34. Tension spring 35 biases pawl 31 in a clockwise direction about its mounting. Clockwise movement of pawl 31 is limited by an upturned projection 37 thereon which engages a surface of a rod member 39. With the pawl 31 thus positioned, its concave surface 41 is disposed for engagement by the tapered end 18 of reciprocatory driving member 17 and an upturned lug 43 on pawl 31 is positioned to coact with a camming surface 45 on rod member 39.

Rod member 39, being the second interposer member, is slidably supported on a base-affixed slide block 47 and is secured to base plate 11 by means of headed stud 49 which extends through longitudinal slot 51 in rod 39. Shoulder 53 of slide block 47 forms a lineal guide for rod 39 to prevent pivoting of the rod during reciprocation. Tension spring 55 as shown in FIG. 2 biases rod member 39 toward the driving member 17 and into a first stable position.

Rod member 39 has a concave surface 57 for cooperation with the tapered end 18 of the driving member 17. On the end of the rod member 39 opposite the concave surface 57 there are two detent surfaces 59, 61 substantially at right angles to each other. The detent surfaces 59, 61 are mutually interlocking with detent surfaces 65, 63 on the second arm 67 of the bell crank 23. In the preferred embodiment an actuating block 69 is formed on the outer end of the arm 67 with the detent surfaces 63, 65 thereon. An actuating surface 71 is formed on block 69 on a side away from the detent surfaces.

FIG. 2 shows applicant's device in a first stable state with the driving member 17 disengaged. In this stable state bell crank 23 is positioned by the bias of spring 29 against the stop 27. Pivotally mounted pawl 31 is biased into parallel alignment with the rod member 39 so that the concave surfaces 41, 57 of the pawl and rod member, respectively, are both positioned in line with the driving member 17. Detent surface 59 of rod member 39 coacts with detent surface 65 of the actuating block 69 to maintain the rod member 39 extended against the bias of spring 55.

The pawl 31 extends outwardly beyond the rod member 39 toward the driving member 17 sufficiently that the pawl 31 may be driven and the bell crank 23 rocked before the concave surface 57 of the rod member 39 is engaged by the driving member.

FIG. 3 shows the mechanism in a transition state from the first stable position to the second stable position. Driving member 17 is shown fully depressed and engaging both the concave surfaces 41, 57 of the pawl and rod member, respectively. Bell crank 23 has been rocked releasing the detent surface 59 of the rod member 39 from the control of the detent surface 65 of the block 69. Rod member 39 is thereby permitted to follow the withdrawal of the driving member 17 in its reciprocation.

FIG. 3, for purposes of illustration, exaggerates the rocked position of the bell crank 23. For the operation of applicant's device the bell crank 23 need be rocked only far enough to release the rod member 39 from the restraint of detent surface 65. If desirable, this driving action of the member 17 may also coact slightly with the rod member 39 to further extend its position against the bias of spring 55 to reduce friction and undue wear between the detent surfaces 59, 65.

As indicated above, bell crank 23 is caused to rotate counterclockwise about bearing post 25 against the bias developed by spring 29 by means of the moment created by the depressed pawl member 31 mounted on arm 33 of the bell crank. Counterclockwise rotation of bell crank 23 frees the detent surface 59 from engagement with detent surface 65 of the actuating block 69, leaving rod member 39 free to return under the bias of spring 55 to its nonextended position during the return stroke of driving member 17.

FIG. 4 shows the bistable mechanism in the second stable state. Detent surface 61 on the rod member 39 is acting against surface 63 of bell crank 23 to hold the bell crank in its rocked position against the bias of spring 29. This restraint of the bell crank starts immediately with the release of the rod member from the restraint of the detent surface 65 of the actuating block 69 and continues during the undriven return movement of the rod member 39. During this return movement of rod 39, upturned lug 43 of pawl 31 coacts with cam surface 45 of rod 39 to rotate pawl 31 counterclockwise to a position out of alignment with rod 39 and driving member 17 against the bias of spring 35.

FIG. 5 shows the driving member 17 engaging surface 57 of rod 39 during the transition from the second stable state back to the first stable state. Rod 39 is depressed against the bias of spring 55 by the driving member and detent surface 61 of rod 39 is thereby removed from detent surface 63 of actuating block 69. With detent surface 61 of rod 39 disengaged from detent surface 63, bell crank 23 is free to rotate about its bearing post 25 under the influence of spring 29 until it engages stop 27. Surface 65 of actuating block 69 is again cooperably positioned to engage detent surface 59 of rod 39, thereby inhibiting its biased undriven return under the influence of spring 55. With rod 39 thus restrained in the extended position, cam surface 45 of rod 39 no longer restrains pawl 31 against the bias of spring 35. Therefore, upon withdrawal of driving member 17, pawl 31 rotates clockwise about its bearing post 34 under the influence of spring 35 until projection 37 of pawl 31 again engages

the surface of rod 39. When the projection 37 of pawl 31 engages the surface of rod 39, pawl 31 is again in alignment with rod 39 and the mechanism has returned to its first stable state.

In the preferred embodiment, the plunger operated switch or similar device to be controlled by applicant's bistable mechanism would be juxtapositioned with the actuating surface 71 of block 69. However, this mounting position for the switch actuating member is by way of illustration only, and as apparent to anyone skilled in the art, the actuating surface could be positioned on any one of the bistable members, i.e., the bell crank 23, or either of the interposers 31, 39, without departing from the spirit of the invention. On the interposer 31 the actuating surface could be placed, for example, on the side 73 (FIG. 5) near the projection 37. On the interposer 39 an actuating surface could be placed on the end 75 (FIG. 5) opposite the driving member 17. It is apparent that with such arrangements one, two or three mechanisms could be controlled concurrently, each having two stable states.

What I claim is:

1. A mechanical bistable device actuated to alternate stable positions by a successively operated driver comprising

a pivoted driven member having a biased position and and a driven position,

pivotal interposer means mounted on said driven member for moving said driven member from its biased to its driven position,

means biasing said interposer means into position to be actuated by said driver,

a reciprocable interposer member juxtapositioned to said pivotal interposer means, said interposer member being biased into one position to be actuated by said driver and actuatable by said driver into another position,

means on said interposer member for camming said interposer means out of position to be actuated by said driver when said interposer member is positioned to be actuated thereby, and

mutually interlocking detent means on said pivoted driven member and said reciprocable interposer member for restraining the member in the driven position by the member in the biased position.

2. A mechanical device having alternate stable positions and a push-push driving means comprising

an oscillatory bell crank member having a biased position and a driven position,

first and second spaced-apart interposer members,

said first interposer being a two-armed lever mounted on one arm of said bell crank and having one arm positioned by bias for actuation by said driving means, whereby said bell crank member is rocked from its biased position to its driven position,

said first interposer also having cam follower means on its other arm,

said second interposer being reciprocated between a biased position and a driven position by said driving means,

said second interposer also having means interacting with said cam follower means for camming said first interposer out of position to be actuated by said driving means as said second interposer is returning under bias from its driven position to its biased position, and

mutually interacting means on the second arm of said bell crank member and on said second interposer member for restraining the member in its driven position by the member acting under its bias and for releasing the restrained member by the member being driven.

3. The combination of claim 2 wherein said bell crank member and said interposer members have optional switch-actuating surfaces.

4. The device of claim 2 in which said mutually interacting means comprise first and second substantially orthogonal surfaces on both said second arm of said bell crank member and said second interposer member.

5. The device of claim 2 in which said second interposer member is a rod having thereon a shorter lug and a longer lug forming an inverted F whose means interacting with said cam follower means is a surface on said shorter lug and whose mutually interacting means are substantially orthogonal surfaces on the outer end of the longer lug.

6. A mechanical bistable device comprising

a planar mounting surface,

a reciprocable driving rod mounted on said planar surface,

a bell crank mounted on said planar surface and having a first arm extending into the projection of said driving rod, and a second arm substantially parallel to the projection of said driving rod,

a two-armed interposer pivotally mounted on said first arm of said bell crank and having one arm resiliently biased into position to be actuated by said driving rod,

a reciprocating interposer mounted on said planar surface outwardly from said first interposer, and in spaced relation therewith lying substantially in the projection of said driving rod and actuatable thereby against a resilient bias,

first and second projections on said second interposer,

a camming surface on said first projection,

a cam follower on the second arm of said two-armed interposer coacting with said camming surface on said reciprocating interposer when said reciprocating interposer is moving under bias to pivot said two-armed interposer out of position to be actuated by said driving rod,

first and second substantially orthogonal detent surfaces on said second projection on said second interposer,

first and second substantially orthogonal detent surfaces on said second arm of said bell crank coacting with said detent surfaces on said second interposer and conjugate therewith, and

resilient means urging said second arm of said bell crank toward said second projection on said second interposer.

7. The combination of claim 6 including a switch actuating block affixed to said second arm of said bell crank and having said conjugate detent surfaces thereon.

8. A mechanical bistable device actuated to alternate stable states by a successively operated driving means comprising

a driven member having limited oscillatory movement between a biased position and a driven position,

first and second interposer means alternately positioned to coact with said driving means wherein

said first interposer means includes a pivotal member for urging said driven member to its driven position, and

said second interposer means includes a reciprocable member having a biased position and a driven position, and

mutually interlocking detent means on said driven member and said second interposer means for alternately arresting said driven member and said second interposer means against bias, each in its respective driven position.

9. A mechanical bistable device actuated by successive operations of a driving member comprising

oscillatory means and

longitudinally reciprocatory means, said means being driven alternately by said driving member from a biased position to a driven position and said means being mutually interlatching and releasing, the means in the biased position respectively latching the other in the driven position, and the means in the driven position respectively releasing the other from latching position.

10. A mechanical bistable device actuated by successive operations of a driving means comprising

oscillatory means including a pivoted interposer biased into position to be driven by said driving means,

reciprocatory means biased into position to be driven by said driving means and including means for camming said pivoted interposer out of position to be driven by said driving means and means for latching said oscillatory means in its driven position, both of said last-named means being operative when said reciprocatory means is acting under bias, and

means on said oscillatory means for latching said reciprocatory means in its driven position when said oscillatory means is acting under bias, whereby said oscillatory means and said reciprocatory means are driven alternately and are interlatching.

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MILTON KAUFMAN, *Primary Examiner.*