Sept. 10, 1963 R. W. HARTOP 3,103,127

OPERATING MECHANISM FOR ELECTRIC SWITCHES

Filed April 6, 1962 2 Sheets-Sheet 1

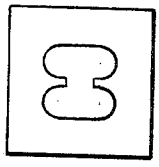

FIG.8a

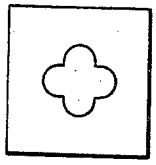

FIG8b

FIG.1

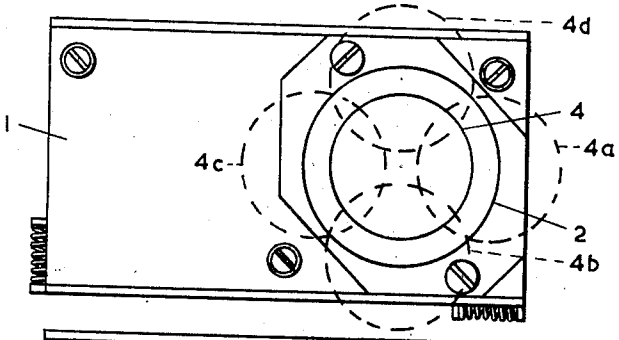

FIG.2

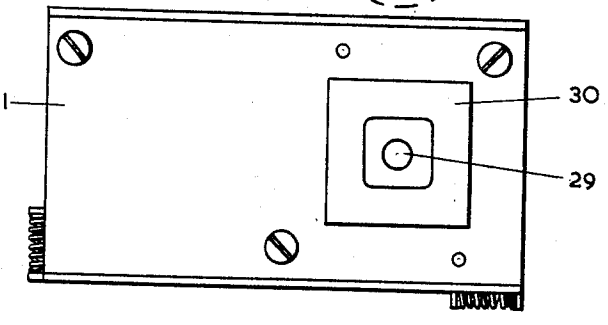

FIG.7

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OPERATING MECHANISM FOR ELECTRIC SWITCHES

Filed April 6, 1962 2 Sheets-Sheet 2

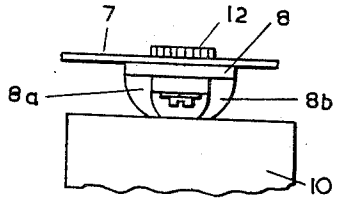


FIG.3

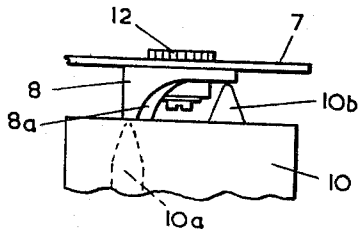
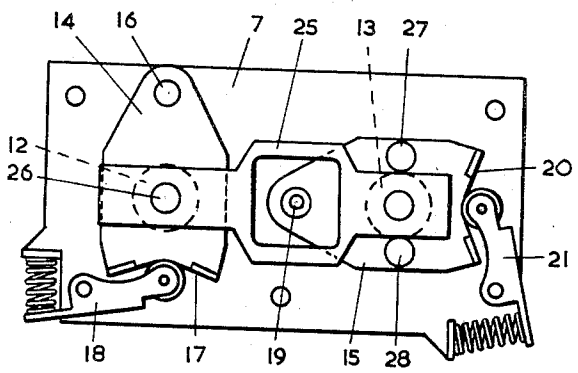


FIG.4

FIG.5



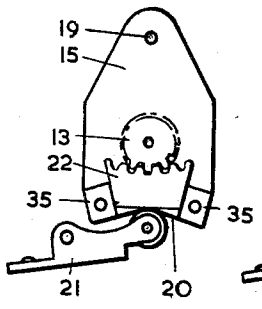


FIG.6

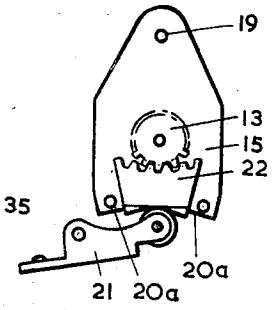


FIG.9

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3,103,127

OPERATING MECHANISM FOR ELECTRIC SWITCHES

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Claims priority, application Great Britain May 3, 1961
12 Claims. (Cl. 74—471)

This invention relates to plunger actuating mechanism and has for its primary object the provision of such mechanism which will actuate a plurality of plungers one or more at a time under the control of a single operating member.

Accordingly, in its broadest aspect, the invention provides a mechanism for actuating a plurality of plungers one or more at a time, comprising cams each movable to engage one or more of said plungers so as to effect actuation thereof, and means linking said cams for movement individually or in combination under the control of a single operating member.

A particular object of the invention is the provision of a so-called "joystick" manual actuating mechanism for a plurality of associated plunger-actuated electric switches. In one form of the invention, the actuating mechanism is particularly adapted to operate plunger switches of the kind described in the Nolden et al. Patent No. 2,930,859, dated March 29, 1960, and assigned to the asignee of this application. One embodiment of this form of the invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a side view of the mechanism, partly in section,

FIGURE 2 is a plan view of the mechanism,

FIGURES 3 and 4 are side views of a detail of the mechanism,

FIGURE 5 is a plan view of selector mechanism included in the operating mechanism,

FIGURE 6 is an underside view of a detail of the selector mechanism,

FIGURE 7 is a plan view of a gate plate in situ,

FIGURES 8*a* and 8*b* are plan views of alternative gate plates, and

FIGURE 9 is a scrap view, with modification, of the detail shown in FIGURE 6.

Referring to FIGURES 1 and 2, the embodiment comprises a top plate **1** carrying on its upper side a housing **2** within which is located the universal pivot mounting of a "joystick" operating lever **3**. One end of the lever carries a suitable handle **4** and the opposite end **5** extends through the housing **2** and through a hole in the top plate **1** to engage in a selector mechanism hereinafter described. The operating lever is provided with a spherical enlargement **6** which lies within the housing **2** and is held captive in such a manner that the lever may be deflected, by the handle **4**, in any direction from its center position so as to pivot about the enlargement **6** and produce a corresponding, oppositely directed, deflection of the end **5** of the lever. Four deflected positions of the operating lever are indicated in FIGURE 2, in which the handle **4** is shown in alternative positions **4***a* to **4***d*.

The selector mechanism is mounted on a mounting plate **7** and lies between that plate and the top plate **1**, the two plates being connected and held in spaced relationship by suitable bolts and spacers. This mechanism operates, on deflection of the operating lever **3**, to rotate one or both of two cams **8**, **9** mounted on the lower side of the mounting plate **7**.

A pair of plunger-actuated switches **10** and **11** (e.g. of the kind shown and described in the specification of the

aforesaid Patent No. 2,930,859) are secured to the underside of the mounting plate by suitable bolts and spacers and each switch comprises a pair of spring-loaded plungers **10***a*, **10***b*, and **11***a*, **11***b*, respectively which, when depressed, open (or close) electrical contacts contained within the switch. The detailed construction of these switches does not form part of the present invention and therefore will not be described. Each plunger, such as **10***a*, is shaped in the form of a cone having a rounded apex. In one condition of the switch, the plunger projects from the switch housing (as shown in FIGURE 1), so as to be engaged by the associated cam **8** or **9** when the latter is rotated in the appropriate direction. On such engagement, the plunger is forced to retract into the switch housing, thereby actuating the switch to its alternative condition.

FIGURES 3 and 4 show scrap views of the switch **10** and the associated cam **8**, for different positions of the cam **8**. The plungers **10***a*, **10***b* are not shown in FIGURE 3 but are assumed to be in their projected positions (as shown in FIGURE 1). The cam **8** is circular in plan and is provided with a pair of inclined cam surfaces **8***a*, **8***b*. The cam is secured to the mounting plate **7** by a bolt passing upwardly through its centre axis and riveted into a pinion or spur wheel **12** lying on the upper side of the mounting plate, the arrangement being such that rotation of the spur wheel produces corresponding rotation of the cam. In FIGURE 4, the spur wheel and cam have been rotated by 60 degrees in an anti-clockwise direction (looking downwardly on the spur wheel), with the result that the cam surface **8***a* has engaged the plunger **10***a* and the latter has been forced downwardly into the body of the switch **10** so as to actuate the associated switch contacts. The plunger **10***b* remains in its projected position but, if the spur wheel and cam are subsequently rotated through 120 degrees in a clockwise direction, first the plunger **10***a* will return to its projected position and then the cam surface **8***b* will engage the plunger **10***b* and force the latter plunger to retract into the switch housing and actuate its associated switch contacts. The cam **9** is secured to a spur wheel **13**, similar to the spur wheel **12**, and the operation of this cam and the associated plungers **11***a*, **11***b* is similar to that described in connection with the cam **8** and the plungers **10***a*, **10***b*.

A general view of the selector mechanism, looking down on the mounting plate **7**, is shown in FIGURE 5 and comprises a rocker plate **14** which, when deflected or pivoted, effects rotation of the spur wheel **12** and a rocker plate **15** for effecting rotation of the spur wheel **13**. Plate **14** is pivoted at **16** to the mounting plate **7** and is provided with a cam surface **17** which co-operates with a spring-loaded arm **18**, carrying a cam following roller, to return the rocker plate to its central position, as shown. In this position of the rocker plate, the cam **8** is in the position shown in FIGURE 1 in which both plungers **10***a* and **10***b* are in their projected positions. The rocker plate **15** is similar to the plate **14** but is mounted with its axis of symmetry at right angles to that of the plate **14**. The rocker plate **15** is pivoted to the mounting plate **7** at **19** and is provided with a cam surface **20** which co-operates with a spring-loaded arm **21** to return the plate **15** to its central position in a similar manner to that described for the plate **14**. When the plate **15** is in its central position, the cam **9** is in the position shown in FIGURE 1, in which the plungers **11***a*, **11***b* are in their projected positions.

FIGURE 6 shows an underside view of the rocker plate **15** from which it will be seen that a toothed rack **22** is secured to the under surface of the rocker plate and has its teeth meshed with the spur wheel **13**, the two parts

forming together a rack and pinion drive. Thus, if the rocker plate is provided about the pivot 19 so as to be deflected from its neutral position to a position in which the wheel carried at the end of the lever 21 is pressing against one end of the cam surface 20, the spur wheel 13 will be rotated thereby rotating the cam 9 and causing one or other of the plungers 11*a*, 11*b* to be operated. The selector mechanism is so arranged that maximum permissible deflection of the rocker plate is sufficient to rotate the spur wheel by 60 degrees in the appropriate direction. A similar rack and pinion arrangement is provided in connection with the rocker plate 14.

Deflection of the rocker plates 14, 15 is effected through a linkage plate 25 (FIGURE 5) which, at one end, is pivotally engaged with an upwardly projecting stud 26 on the rocker plate 14 and, at the other end, lies between a pair of upwardly projecting studs 27, 28 on the rocker plate 15. At the end of the link plate which lies between the studs 27, 28 a hole 29 is provided in the link plate into which is inserted the lower end 5 of the operating lever 3 (see also FIGURE 1). Thus, deflection of the operating lever in one direction will produce longitudinal movement of the linkage plate 25 so that the latter slides between the studs 27, 28 and effects, through the stud 26, deflection of the rocker plate 14. If the operating lever is deflected at right angles to the aforesaid direction, the linkage plate pivots about the stud 26 and is pressed against either stud 27 or stud 28 to effect deflection of the rocker plate 15.

In order that deflection of the operating lever 3 shall not exceed the amount necessary to produce, through the selector mechanism, the desired 60 degrees rotation of the approprate cam 8 or 9, a gate plate 30 (FIGURES 1 and 7) is provided which lies in a suitable recess in the bottom of the housing 2 and contiguous with the top plate 1. This gate plate has a square, centrally-located aperture through which the end 5 of the operating lever projects. Thus, the sides of the gate plate aperture limit the degree of deflection of the lever end 5 and the aperture is dimensioned accordingly.

In operation, the centering effect of the spring-loaded arms 18 and 21, acting on their associated cam surfaces 17 and 20, reacts through the rocker plates 14, 15, the linkage plate 25 and the lever end 5 to hold the operating lever in a normal, central position in which it rests perpendicular to the top plate 1. If, now, the operating lever is deflected so that its handle lies in the position 4*a* (FIGURE 2), the lever end 5 will move the linkage plate 25 longitudinally so as to deflect the rocker plate 14 to the left (as seen in FIGURE 5). This will produce rotation of the cam 8 so that the plunger 10*b* is depressed and the associated switch contacts operated, the other plungers remaining in their projected positions. If the handle 4 is moved through the central position to the position 4*c*, the cam 8 will be rotated so that plunger 10*a* is depressed while plunger 10*b* will return to its projected position. Likewise, if the handle is moved to the position 4*b*, rocker plate 15 will be deflected and rotate the cam 9 so as to depress plunger 11*a*. Alternatively, when the handle is in the position 4*d*, plunger 11*d* is depressed.

With the square-shaped gate plate aperture described, it is possible to effect depression of two plungers at the same time by moving the operating lever to a position in which the handle 4 lies between any two of the positions 4*a* or 4*d*. For example, if the operating lever is deflected so that the handle lies between the positions 4*a* and 4*b*, the linkage plate 25 will bear against the stud 27 and deflect the rocker plate 15 in that direction. Also, the rocker plate 14 will be deflected to the left. The increased movement of the operating lever, due to its being moved along a diagonal of the square aperture, produces the full 60 degrees rotation of both cams 8 and 9 so that both plungers 11*a* and 11*b* are depressed; plungers 11*b* and 10*a* remaining in their projected positions.

In certain applications of the invention, it may be desired to limit the possible positions to which the operating lever may be deflected. For example, it may be desired to prevent operation of the lever to a position in which more than one switch plunger is depressed at any one time. In this case, the square apertured gate plate 30 may be replaced by a gate plate having an aperture shape as shown in FIGURE 8*b*, which aperture prevents the lever end 5 from taking up a position in which two plungers are depressed together. A further example of a restricted gate aperture is shown in FIGURE 8*a*, which aperture prevents operation of the lever 3 to positions in which the handle lies in the positions 4*a* or 4*c* of FIGURE 2. Furthermore, this aperture also has the effect of requiring the operating lever to be moved to the central, or neutral position when moving the lever between certain deflected positions. Thus, suitable shaping of the gate aperture enables certain switch operations to be restricted and also enables certain switching sequences to be imposed. Preferably, the housing 2, together with the operating lever 3, is constructed as one unit which is bolted to the top plate 1 so as to facilitate ready interchange of different gate plates. Thus, the unit is merely unbolted from the top plate, the existing gate plate dropped out of its recess, the desired gate plate inserted in the recess and the control lever unit bolted back into place on the top plate.

In the embodiment as so far described, the cam surfaces 17 and 20 of the rocker plates are smooth surfaces inclining from each side of the rocker plate towards a centrally located notch corresponding to the central position of the rocker plate. Thus, when the rocker plate is deflected, the associated spring-loaded arm is forced outwardly against its spring and, when the deflecting force is removed, the force of the spring causes the end of the arm to slide back relatively to the central notch. Thus, a switch plunger remains depressed for only so long as the operating lever 3 is held deflected in a given position.

In case it is required that the operating lever shall remain deflected until positively pulled away from its deflected position, provision may be made for altering the shape of the rocker plate cam surface so that the end of the spring-loaded arm latches into a notch at the end of the cam surface when the rocker plate is deflected. This facility is provided by forming the end of each cam surface by a removable cam piece 35 (FIGURE 6). These pieces are secured to the rocker plate by screws and, when removed, reveal (as shown in FIGURE 9) recesses 20*a* previously formed in the cam surface end of the rocker plate. Thus, when the rocker plate is deflected, the end of the spring loaded arm drops into one of the recesses 20*a* and is prevented from returning to the centre notch until force is applied, through the operating lever, to release it from the cam recess. If desired, one plate 35 may be removed so that automatic centering is obtained when the rocker plate is deflected in one direction and latching is obtained when the rocker plate is deflected in the other direction.

Referring to FIGURE 1, it will be appreciated that the switches 10 and 11 are not an integral part of the invention in as much as the "joystick" operating mechanism may be supplied as such for use in conjunction with any suitably-designed form of plunger operated switch. However, it is envisaged that when the switches are attached to the operating mechanism, the whole will be enclosed in a protective housing 40, as indicated in broken lines.

Furthermore, the selector mechanism may be supplied as such, without the operating lever and alternative forms of operating means may be employed instead of the lever described. Again, it is to be understood that the invention is in no way limited to use with electric switches as the actuating mechanism is capable of use with any suitable plunger-actuated apparatus whether electrical or otherwise.

I claim:

1. A mechanism for actuating a plurality of plungers one or more at a time, comprising cams which are rotat-

able on axes parallel to the direction of movement of said plungers to engage and actuate the same, an operating lever pivoted for movement in directions radially of its pivot point, and a cam rotating linkage mechanism for rotating one or more of said cams according to the direction of movement of said lever.

2. A mechanism according to claim 1 wherein each cam is rotatable to engage one or the other of two of said plungers and wherein said cam rotating linkage includes rack and pinion drive assemblies for each cam and a linkage member engaged with each rack and engageable by said operating lever according to the movement of the latter.

3. A mechanism according to claim 2, comprising two cams each adapted for engagement with a different pair of plungers.

4. A mechanism according to claim 3, wherein each pinion is secured to the associated cam for coaxial rotation therewith, said racks and said linkage member moving in planes perpendicular to the cam-pinion axes, and wherein said linkage member is pivotally coupled to one rack and slidably coupled to the other rack, said linkage member pivoting relative to said one rack when said other rack is priven and sliding relative to said other rack when said one rack is driven.

5. A mechanism according to claim 3, wherein each rack may be driven between two limiting positions, each limiting position, corresponding to a plunger-actuating position of the associated cam.

6. A mechanism according to claim 5, including means for locking a rack in one or both of its limiting positions pending further operation of said operating lever.

7. A mechanism according to claim 5 including means for returning a rack from one or both of its limiting positions to a central position.

8. A mechanism according to claim 3, wherein each rack is secured to a separate rocker plate and each rocker plate is pivotally mounted on one side of a common mounting plate, the associated cams lying on the other side of said mounting plate.

9. A mechanism according to claim 8, wherein both rocker plates are pivotable between two limiting positions and are substantially perpendicular to each other when each rocker plate occupies a position mid-way between its limiting positions.

10. A mechanism according to claim 6 comprising means for restricting operation of said single operating lever so as to prevent one or more possible movements of one or more of said cams.

11. A mechanism according to claim 6 wherein said operating lever is pivotally mounted between its ends, one end of said lever engaging said linkage member so that pivotal deflection of said lever effects movement of said linkage member in a plane perpendicular to said cam-pinion axis.

12. A mechanism according to claim 11, comprising a gate plate lying between the pivotal mounting of said one end of said lever, the lever extending through an aperture in said gate plate, whereby the peripheral edge of said aperture determines the extent to which said lever may be pivotally deflected.

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