

[54] SINGLE SWITCH WITH MULTIPLE TRANSVERSE ACTUATORS

[75] Inventors: **Bernhard Dietrich**, Eichenau; **Erich Huber**, Munich, both of Germany

[73] Assignee: **Schaltbau Gesellschaft mbH**, Munich, Germany

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[58] Field of Search.....200/153 LB, 157, 200/6 R, 6 B, 153 T, 83 D, 81.5, 172 A, 153 LA, 61.69, 5 E, 5 EA, DIG. 29; 337/12, 2; 251/289

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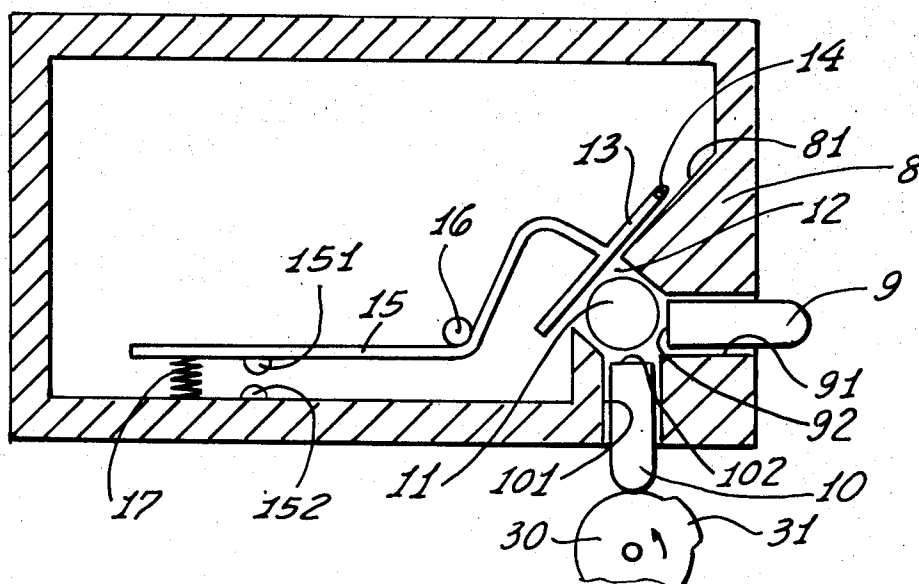
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Primary Examiner—Robert K. Schaefer
Assistant Examiner—Robert A. Vanderhye
Attorney—Ralph H. Siegemund

[57] ABSTRACT

Apparatus for operating an electrical switch including an actuator disposed for displacement in a particular direction from a first position with displacement to continue towards a second position, the switch having different switching states in the two positions of the actuator, actuator means operating in and along a plurality of different directions having angle smaller than 180° relative to the particular direction. Displacement transmission means including at least one transmission element and being operated by the actuator means for engagement with and displacement of the actuator, for the actuator to move in the particular direction as the actuator means is displaced in one of the different directions of the plurality. Means for limiting the displacement of the transmission element along one or more linear paths, the number of paths not exceeding the number of different directions of the plurality.

19 Claims, 4 Drawing Figures



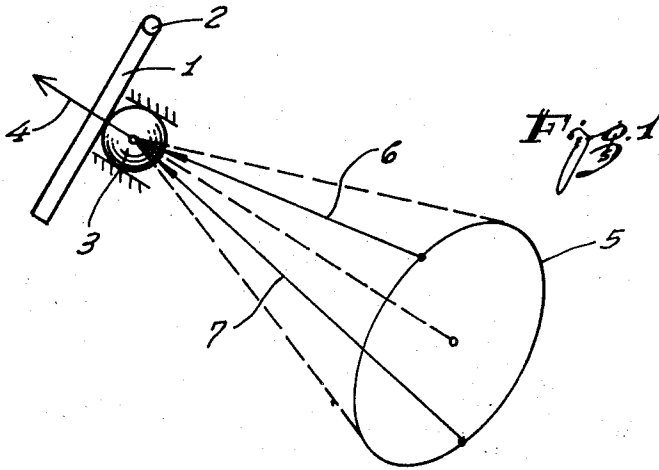


Fig. 2

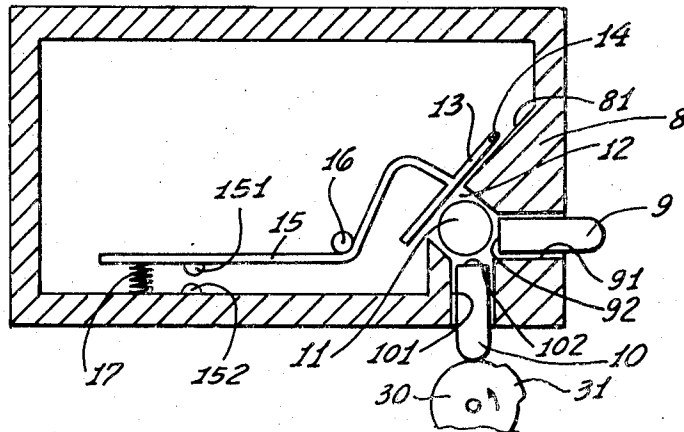
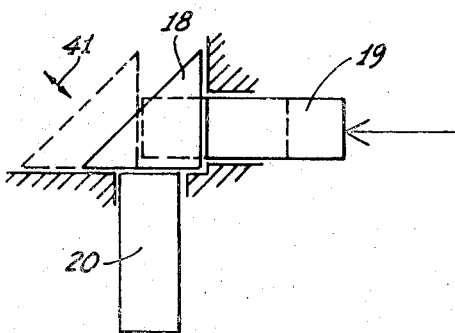
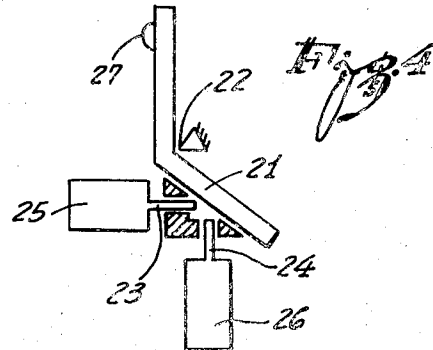


Fig. 3



INVENTORS:
Bernhard Dietrich
Erich Huber
Smith, Reuten & Pavitt
By Ralf H. Siegmund
ATTORNEYS

SINGLE SWITCH WITH MULTIPLE TRANSVERSE ACTUATORS

The present invention relates to apparatus for mechanically triggering and/or releasing electrical switching operations by moving a solid body under the influence of forces that may act on the body from different directions.

The type of problem to be solved by the present invention is best to be explained on basis of a particular example involving, for example, electric snap action switches. Such switches are often arranged in the plurality, e.g., in a row, one next to the other, and their mechanical actuating and triggering elements (e.g., push buttons) are disposed in one plane. These actuator buttons may be operated upon by cam action to be operated, for example, in a predetermined sequence and/or timing relation. It is a disadvantage of such an arrangement that the individual switches are not accessible for purposes of testing, control or any other unprogrammed operation, unless the cam shaft is removed first. This is, of course, quite undesirable because the removal and re-installation of the cam shaft may require an extensive period of time. This then is a particular example for the problem of obtaining switching operating from different, independent sources by means of one and the same switch but through differently directed actuation displacement.

Generally, then, the invention relates to switching operations on basis of differently directed actuation forces, as it cannot be expected that in conventional switching arrangements differently directed operations provide the same switching action, nor are they amenable for supplemental structure to this effect, at least not without reverse engineering.

It is, therefore, an object of the present invention to provide for pivoting or parallelly displacing of an actuator for immediate or indirect triggering of electrical switching operations by means of forces that may act from different directions. For this, actuator means are provided, such as plural trigger pins or the like, operating along different directions that have angle smaller than 180° , preferably smaller than 90° relative to the direction of initial displacement of the actuator. Displacement transmission means are provided having one or more transmission elements and operated by the actuator means, whereby the displacement of the transmission element or elements is limited to linear displacement path or paths, not exceeding in number, the number of different directions. The transmission means displace the actuator in each case along the displacement path direction thereof. In the preferred, though not exclusive form of practicing the invention, a single transmission element is provided and subject to constraint of movement along one linear path, or along as many linear, but angularly oriented paths, as there are independent actuator means.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed that the invention, the objects and features of the invention and further objects, features and advantages thereof will be better understood from the following description taken in connection with the accompanying drawings in which:

FIG. 1 illustrates somewhat schematically a force and action diagram relevant for explaining the principle of

the present invention, but incorporating also the essential features of the preferred embodiment of the invention;

FIG. 2 illustrates a cross section view through a switch constructed in accordance with the preferred embodiment of the present invention;

FIG. 3 illustrates somewhat schematically a different example of the preferred embodiment of the present invention; and

FIG. 4 illustrates somewhat schematically another embodiment of the present invention.

Proceeding now to the detailed description of the drawings, I refer at first to an explanation of displacements and motions in a rather general configuration and as they occur in accordance with the teaching of the invention. The object is to displace a switch arm 1, that is also the switch actuator, for example, by pivoting the arm on pivot 2. For this, the arm 1 is subject to displacement along arrow 4, indicating the direction of the displacement, at least out of an initial position of arm 1 (representing, for example, a switch closing position).

The actuation forces that produce displacement act preferably radially on the surface of a ball, guided for moving only along a path that is colinear with direction 4. The ball constitutes a single transmission element for converting plural, differently directed actuator forces into a displacement along arrow 4. The arrow 4 can be considered as being on an axis of displacement for the apex of a cone 5, which is a hypothetical and geometric figure in this drawing and used for explanation purposes only; it is not a real object. The apex of the cone is assumed to be in the center of ball 3.

Now, it is assumed that 6 and 7 denote two vectors among many, in representation of differently directed forces that may act on the ball 3. The forces are assumed to arise in the developing surface as genatrix of a cone extending around arrow 4 as axis. The apex of the cone is always on that axis. Therefore, any force can be regarded as a force that acts radially upon the ball 3. The displacement path of ball 3 under the influence of such force is constrained, so that by necessity the ball will be displaced along the direction of arrow 4, and the switch arm 1 or actuator is pivoted similarly in either case. In the preferred embodiment, therefore, forces act preferably radially on a single transmission element, here a ball.

Another example of the preferred embodiment is shown in FIG. 2. In this example, the number of available directions from which to act on a single transmission element is reduced further by the requirement that they extend in a plane. This permits employment of a cylindrical body 11, guided for displacement along a direction that is transverse to the axis of the cylinder.

FIG. 2 illustrates a housing 8, which includes a switch arm or lever 15, pivoted on a pin 16. One end of double arm lever 15 is spring biased by means of a spring 17; the same arm carries a contact 151 for co-action with a stationary contact 152. The spring 17 biases the switch into a contact open position. The other end of arm 15 carries an actuator element 13 for engagement on a shoulder 81 in housing 8, but be displaceable therefrom by means to be described next.

There are two displaceable actuator pins 9 and 10 disposed as actuator means in two transversely oriented bores, 91 and 101, in housing 8. The two pins can be moved and displaced along their respective axes only,

which are the respective axes of the two bores 91 and 101 in housing 8. The cylindrical element 11 is disposed so that its axis extends transversely to the plane of the drawing in FIG. 2. Therefore, the end faces 92 and 102 respectively of the two pins 9 and 10, face the cylindrical periphery of body 11.

There is provided a bore 12 in the housing which permits movement of the cylinder only in a direction transverse to the axis and coplanar with the directions of permissible displacement of actuator pins 9 and 10. The direction of permissible displacement of cylindrical transmission element 11 is furthermore characterized in that it has angle to the axes of displacement of guides pins 9 and 10 that is about 45° in each case.

Now, if one of the pins 9 or 10 is pushed into the housing, the cylinder body 11 will move in direction of the axis of bore 12, and the cylindrical transmission element 11 will be displaced towards the element 13 which is the switch actuator proper in this case. Accordingly, switch arm lever 15 is pivoted about pivot point 16, against the bias of spring 17, so that contact pieces 151 and 152 engage for a switch closing operation.

It should be considered that FIG. 2 can be interpreted actually as a cross section through an arrangement that extends over a considerable length transverse to the plane of the drawing. Thus, it will be apparent that a number of similar switches are provided and stacked in a row. They are individually operated and separated from each other except for being mounted in a common housing. Therefore, it can readily be assumed that, for example, the several pins corresponding to pin 10 are actuated by cams, such as 31, on a cam shaft 30, extending also transverse to the plane of the drawing.

One can readily see that, of course, these individual pins, such as 10, can be operated by the cam 31 only; as to any other operation the arm shaft is in the way. Therefore, the second pin for each switch, such as pin 9, is provided as an alternative actuator, and its operation is not impeded as to access by cam shaft 30; pins 9 are easily accessible from the side. Each pin, 9 or 10, acts on transmission element 11 from a different direction, but the operation is the same as far as switch actuation is concerned. Furthermore, it can be seen that the spring 17 operates as a reset element for either pin, 9 and 10, whichever has been actuated but released. The example of the preferred embodiment, as illustrated in FIG. 2, shows also that actually each pin, when pressed, provides a lateral barrier for the actuating face (92 or 102) of the respective other pin, i.e., the pins mutually block each other.

Turning now to FIG. 3, there is illustrated a prism-like body 18 having cross section in the geometric configuration of an isosceles triangle 19 with a right angle between the two short sides. As illustrated, the particular body 18 can be moved along either cathetus or short side of the rectangle-triangle, through properly oriented guiding means. The pins 19 and 20 correspond to the pins 9 and 10 in FIG. 2 as far as the actuator means is concerned, and they serve to move the prism along one or the other of the short side surfaces depending upon which one of the pins is being pushed. Moreover, each pin 19 and 20 when protracted (i.e., pushed into the housing) serves also as barrier for the other pin, and that, in turn, impedes any other displacement of the prism. There may be additional guide

means for the prism to permit its displacement along two linear paths only, each being colinear with the displacement of one of the pins, 19 or 20.

The hypotenuse of the triangle of body 18 has function somewhat analogous to lever 13 in FIG. 2, but for purposes of providing for parallel displacement, the body 18 serves as functional replacement for the cylinder body 11 in FIG. 2 with the provision that actuation is by parallel shift, and not pivotal, along arrow 41. The switching operation may also be cam operated as described with reference to FIG. 2.

Another embodiment of the invention is shown in FIG. 4. A rocking lever 21 is provided in the form of a rectangular, contoured element with two arms extending at an obtuse angle from a fulcrum point 22. The lever is pivoted at fulcrum 22 accordingly. One arm carries a switching contact 27, the other arm is actuated by two transmission elements 23 and 24 extending from pins 25 and 26 colinearly and being integral therewith. Therefore, transmission pins 23 and 24 follow by necessity displacement of the respective actuator pins. One or the other of the two actuators 25 and 26 pivots lever element 21 on fulcrum point 22, and it can also be seen here in this case that the pins when extended block each other. The pivot motion imparted upon the element 21 is used again for purposes of obtaining electric switching operations.

The invention is not limited to the embodiments described above but all changes and modifications thereof not constituting departures from the spirit and scope of the invention are intended to be included.

We claim:

1. Apparatus for operating an electrical switch including an actuator disposed for displacement in a particular direction from a first position with displacement to continue towards a second position, the switch having different switching states in the two position of the actuator, comprising:

actuator means operating in and along a plurality of different directions, each direction having an angle positively smaller than 90° relative to the particular direction and being directed towards a common center or center line;

a single, movable transmission element located on said center or center line and being physically separated from and disposed for being operated by the actuator means from each of said different directions as directed towards said center or center line for displacement of the element in direction which includes always at least a component of displacement in said particular direction, the element when displaced and operated by the actuator means, providing for engagement with and displacement of the actuator, so that the actuator moves in the particular direction as the actuator means is displaced in one of the different directions of the plurality; and

means for limiting the displacement of the transmission element along one or more linear paths but resulting in a displacement component in said particular direction in either case, the number of paths not exceeding the number of different directions of the plurality.

2. Apparatus as in claim 1, the actuator means including a plurality of individual actuator elements, each one movable in one particular direction of the plurality.

3. Apparatus as in claim 2, the single transmission element limited in its movement along a linear path colinear with the particular direction.

4. Apparatus as in claim 2, the actuator means being plural actuator pins each having a displacement path for acting axially on the transmission element from different directions of advance and each one disposed for advancing into the displacement path and blocking the others when the one has been actuated and when having displaced the element so as to obtain mutually blocking displacement of the element by more than one actuator pin.

5. Apparatus as in claim 1, wherein the single element transmission means is a cylindrical body with an axis, being the center axis towards which the actuator means is directed, the means for limiting defining a displacement path for the body transverse to the axis thereof.

6. Apparatus as in claim 1, the transmission element being a prism having in cross section contour of a right angle isosceles triangle, the actuator means being two pins acting on the cathedes thereof, the hypotenuse being in engagement with the actuator.

7. Apparatus as in claim 1, the transmission element being a ball, the actuator means acting within a cone on the ball, the apex of the cone coinciding with the center of the ball when in resting position, the means for limiting, limiting the displacement of the path to displacement colinear with said one direction.

8. Apparatus as in claim 1, the transmission element acting onto the actuator for pivoting same.

9. Apparatus as in claim 1, the actuator means being two transversely oriented and acting actuator pins, the particular direction having about a 45° angle to each element.

10. Apparatus as in claim 9, there being a single transmission element peripherally acted upon by the pins, and including a cam for actuating one of the pins, while permitting unimpeded access to the other pin.

11. Apparatus for operating an electrical switch including an actuator disposed for displacement in a particular direction from a first position with displacement to continue towards a second position, the switch having different switching states in the two positions of the actuator; actuator means operating in and along a plurality of different directions having an angle smaller than 180° relative to the particular direction;

a cylindrical transmission element having an axis and disposed for being acted upon by the actuator means from different directions and moved by the actuator means so that the resulting displacement of the transmission element includes always a component in the particular direction, said angle being smaller than 90°; and

means for limiting the displacement of the cylindrical transmission element along one or more linear paths, transverse to the axis of the cylindrical element, the number of paths not exceeding the number of different directions of the plurality.

12. Apparatus as in claim 11, the actuator means including plural pins acting upon the cylinder surface, transverse to the axis.

13. Apparatus as in claim 12, the pins positioned for mutual locking.

14. Apparatus as in claim 12, there being two pins disposed for displacement in two different directions,

the cylinder disposed for a linear displacement path having similar angles to the two different directions.

15. Apparatus for operating an electrical switch including an actuator disposed for displacement in a particular direction from a first position with displacement to continue towards a second position, the switch having different switching states in the two positions of the actuator; actuator means including two actuator pins, movable respectively in two directions, oriented by 90°, each direction having an angle smaller than 90° to the particular direction;

a prism having a cross section contour of a right angle, isosceles triangle, the hypotenuse being in engagement with the actuator for moving the actuator in direction transverse to the hypotenuse of the triangle, the pins acting respectively on the cathedes of the triangle; and

means for limiting displacement of the prism by the pins to run along said cathodes.

16. Apparatus for operating an electric switch including a switching arm operated as a pivot lever, having a particular fulcrum point, one lever arm provided for receiving pivot action for pivoting the switch arm on the fulcrum point;

a single transmission element having a center or center axis, the transmission element having disposition for displacement in a particular direction, running from the center or center axis (transverse to the latter) towards the one lever arm and engaging the lever arm remote from the fulcrum and when displaced in the particular direction for causing the switch arm to pivot on the fulcrum; and

plural actuator elements disposed for acting on the transmission element from different directions, each having a non zero angle but less than 90° to the particular direction, and each acting towards the center or center axis of the transmission element for causing the transmission element to be displaced in the particular direction to obtain pivot action of the switch arm.

17. Apparatus as in claim 16, and means for limiting the displacement of the single transmission element along plural linear paths colinear respectively with the different directions of the plurality.

18. Apparatus as in claim 16, and including means for limiting the displacement of the single transmission element along said particular direction.

19. Apparatus for operating an electric switch including a switching arm operated as a pivot lever, having a particular fulcrum point; a plurality of actuator pins each having a transmission pin, the actuator pins with transmission pins each mounted for displacement and guided in one particular direction for each pin, the several actuator pins with transmission pin each displaceable in different directions, each direction having an angle less than 90° to a particular direction of actuation, the transmission pins all directed towards one particular point on the lever arm remote from the fulcrum, so that upon displacement of the respective pins a component direction of displacement of the respective pins a component direction of displacement results in said particular direction of actuation and for actuation of each said actuator pins, one at a time, thereby pivoting the switching arm on the fulcrum in either case;

the transmission pins being mounted and having disposition to be normally disengaged from the lever arm so that upon actuation of one of them, the others are blocked from engagement of the lever arm.

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