Dec. 24, 1957 J. D. ROCHFORT ET AL 2,817,725

OVERTRAVEL MECHANISM FOR SENSITIVE SWITCHES

Filed Feb. 3, 1956 3 Sheets-Sheet 1

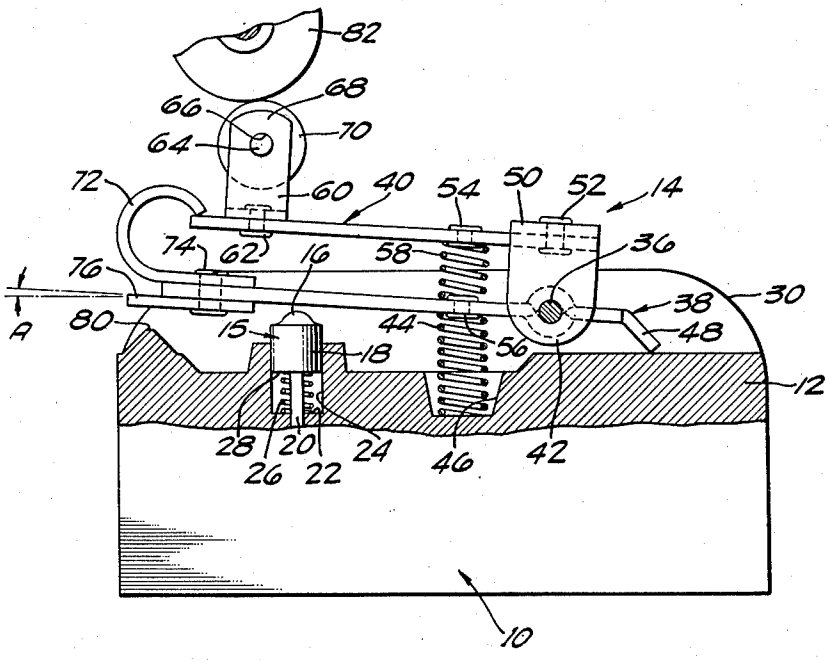


FIG. 1.

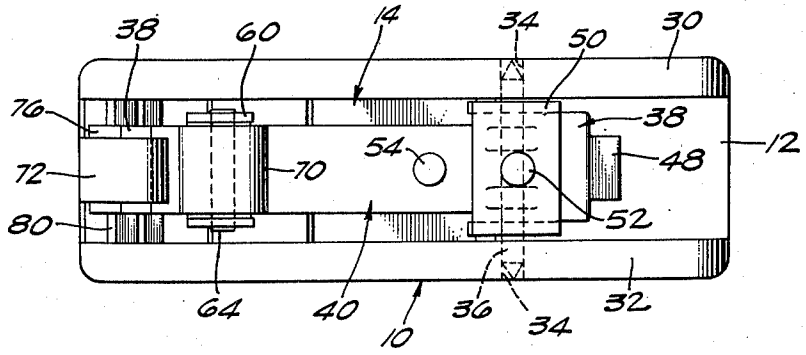


FIG. 2.

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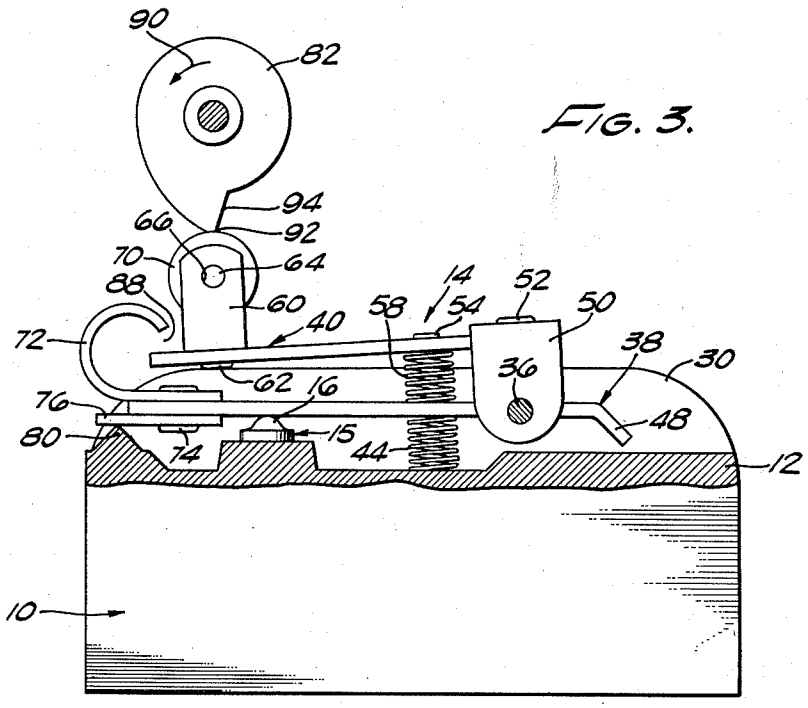


FIG. 3.

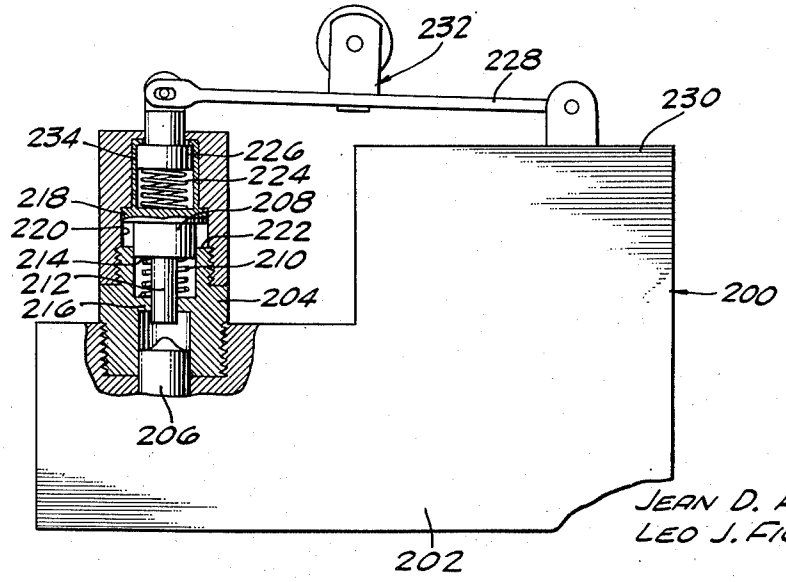


FIG. 7.

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OVERTRAVEL MECHANISM FOR SENSITIVE SWITCHES

Filed Feb. 3, 1956 3 Sheets-Sheet 3

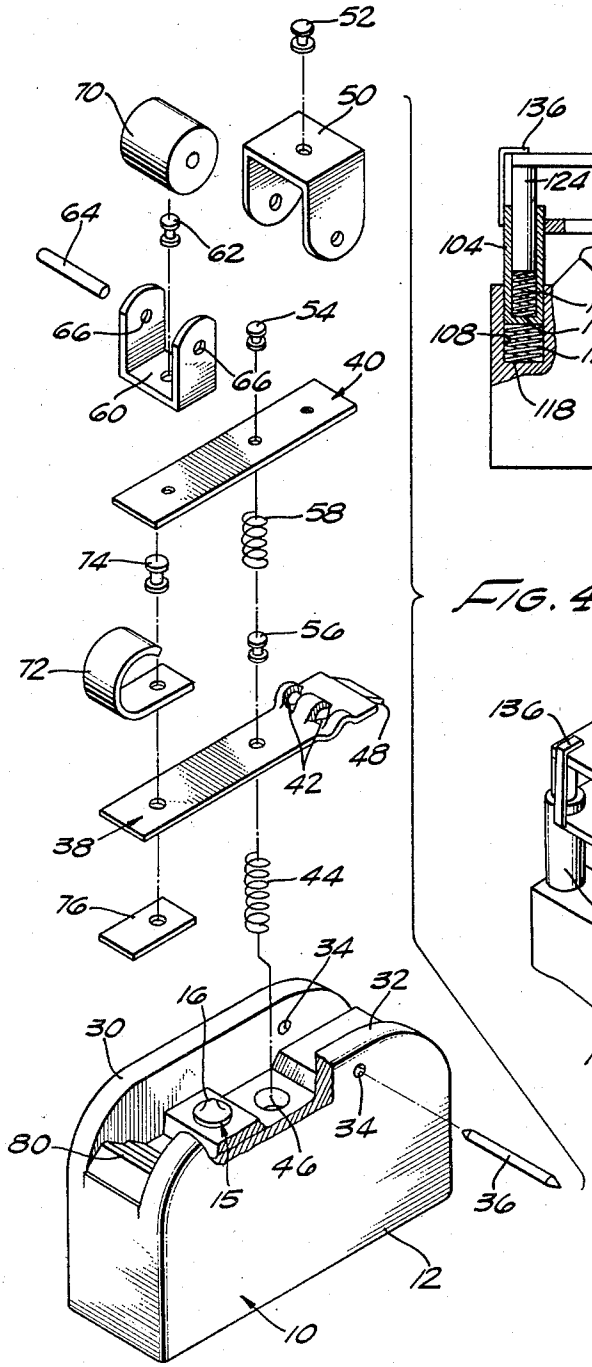


FIG. 5.

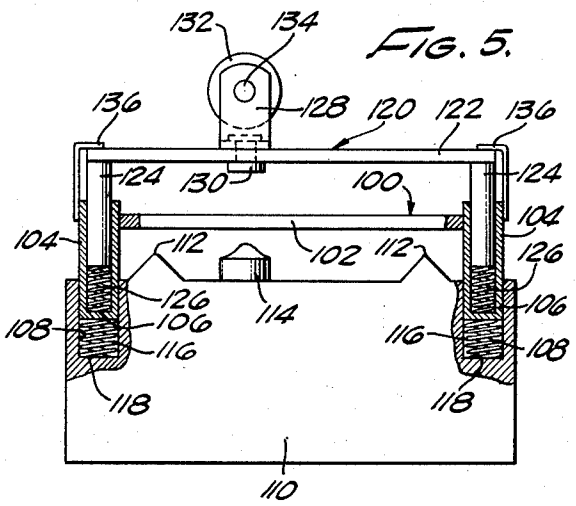


FIG. 4.

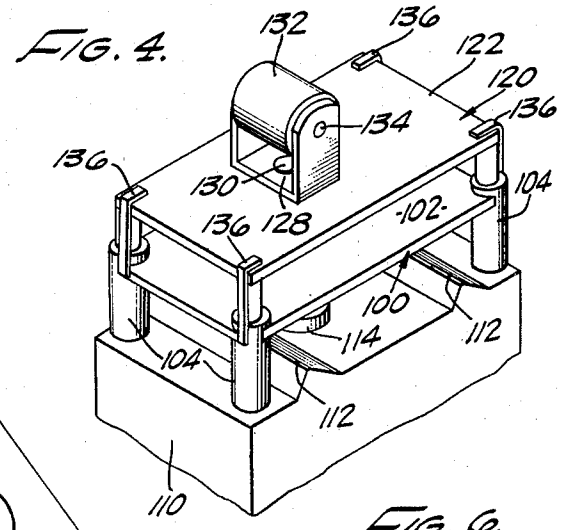


FIG. 6.

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2,817,725

OVERTRAVEL MECHANISM FOR SENSITIVE SWITCHES

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Application February 3, 1956, Serial No. 563,324

7 Claims. (Cl. 200—47)

This invention relates to means for operating a switch sensitive to extremely small mechanical movements, and more particularly to a device for increasing the maximum distance through which such means are normally permitted to move during the actuation of the switch.

The invention may be usefully employed in a number of ways, however, it has been found particularly useful in extending the maximum overtravel of a sensitive switch actuable in response to movement of a follower on a cam.

For other uses of overtravel mechanisms and for the mechanism themselves, see U. S. Patents Nos. 1,960,020; 2,289,108; 2,331,997; and 2,532,859.

All such switches are somewhat inaccurate in their operation by a cam and follower. That is, a sensitive switch may be opened or closed when such a cam is rotated to any angle within a certain switching range. This range is normally small, but accuracy is still limited proportionately. In order to reduce this inaccuracy, it is desirable to construct the cam with a relatively large rate of change of diameter with respect to its angular position. Thus positive actuation is insured within a relatively small angular movement of the cam.

It is obvious that the rate of change of the diameter of a cam with respect to its angular position may not be infinite because the cam would not then urge a follower inwardly or outwardly from the axis of rotation of the cam. This, however, is not one of the principal factors limiting the maximum rate of change of cam diameter with angle. Such a limitation arises largely from the fact that relatively long overtravel is required for a cam follower operating a sensitive switch from a cam having a relatively large rate of change of diameter. This is true for a number of reasons. In the first place, it is difficult to machine such a cam for extremely small overtravel. Secondly, the sharpness of the edge of the maximum diameter of the cam, near where switch actuation is accomplished, is increased as the rate of change of diameter is increased near that edge. This causes a high rate of wear at the edge by the movement of a follower therearound. Wear, in turn, reduces the rate of change of diameter of the cam near the edge where switch actuation occurs. Thus wear reduces the accuracy of the switch. Further, if the cam is not replaced, the switch must be mounted in an adjustable holder so that the switch may be moved radially toward the axis of rotation of the cam as the cam becomes worn, whereby the switch may always be actuated by and at the same selected angular position of the cam. In order to overcome these difficulties, it is necessary to actuate a switch when the follower is spaced a substantial distance from the edge. This means that relatively large overtravel is required for the switch.

Only a certain maximum overtravel is recommended for highly sensitive switches because overtravel larger than that recommended causes deformation and/or the rupture of switch components through fatigue increased by extended overtravel. For these reasons the rate of change

of diameter of the cam is limited by the maximum recommended overtravel of a sensitive switch. Stated syllogistically, the maximum practical rate of change of a cam diameter is generally limited by the maximum permissible overtravel of a switch to be used with the cam. Maximum permissible overtravel is limited by the physical character of the highly sensitive switch. Therefore, the maximum rate of change of diameter of a cam to be used with a highly sensitive switch is limited by the physical character of the switch, i. e. overtravel above a predetermined maximum is not permitted in order to ensure that the switch may be kept in use a practical length of time.

The device of the present invention overcomes the above described and other limitations of conventional sensitive switching devices by providing a novel overtravel mechanism for highly sensitive switches. This overtravel mechanism provides means whereby a cam having a relatively large rate of change of diameter may be employed. That is, the rate of change of diameter of the cam is, in accordance with the invention, no longer limited by the maximum permissible overtravel of a sensitive switch. The invention, accordingly, incorporates a first member movable toward a sensitive switch to actuate it, a second member movable with respect to the first member, and resilient means disposed between the first and second members to resist resiliently the movement of the second member toward the first member. A stop is normally provided on a sensitive switch to limit the overtravel thereof. Such a stop may be provided with the present invention to limit the movement of the first member. A follower may be mounted on the second member to move in response to the movement of and while in engagement with a cam. Thus the cam may have a large rate of change of diameter at the point where the follower causes both the first and second member to move toward and to actuate the switch. When the stop on the switch limits the movement of the first member, the second member then moves toward the first member as its movement is resisted by the resilient means. Movement of the second member thus provides overtravel for the cam and follower arrangement although the overtravel of the switch itself is limited by the stop provided on it.

Such a sensitive switch normally is provided with an actuating button that is urged outwardly by a spring. Preferably the force constant of the resilient means is sufficiently large to prevent substantial compression thereof when force required to depress the actuating button is applied to the first member through the follower, second member and resilient means.

It is therefore an object of the invention to provide an overtravel mechanism for a sensitive switch.

It is another object of the invention to provide means to increase the maximum permissible overtravel of a cam and follower arrangement employed in the actuation of a highly sensitive switch.

It is still another object of the invention to provide novel means to limit the overtravel of a sensitive switch without, at the same time, limiting the overtravel of a cam follower employed to actuate the switch.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention.

Fig. 1 is an elevation view of a sensitive switch and an overtravel mechanism constructed in accordance with the present invention;

Fig. 2 is a plan view of the switch and mechanism shown in Fig. 1;

Fig. 3 is an elevation view of the switch and mechanism shown in Fig. 1 with a cam shown in a position to actuate the switch;

Fig. 4 is an exploded view of the switch shown in both Figs. 1 and 2;

Figs. 5 and 6 are elevation and perspective views of an alternative embodiment of the invention; and

Fig. 7 is an elevation view of still another embodiment of the invention.

In the drawings in Fig. 1, a switch **10** having a body portion **12** is shown connected to an overtravel mechanism **14** constructed in accordance with the present invention. In a broken away section of the body portion **12** the switch **10** is shown incorporating an actuating element or button **15** having an upper projection **16**, an intermediate cylinder **18** and a lower cylinder **20**. A shoulder **22** is formed in a recess **24** provided for cylinder **18** and for housing a spring **26**. The intermediate cylinder **18** is larger than that of the lower cylinder **20**. A shoulder **28** is thus formed at the lower surface of the intermediate cylinder **18** against which the spring **26** or first resilient means urges the actuating button **15** upwardly. In this case, the switch **10** is normally unactuated.

The body **12** of the switch **10** is provided with two longitudinal projections **30** and **32** on each side thereof, only one of which is shown in Fig. 1. A transverse hole **34** is provided in the projections **30** and **32** through which a shaft **36** is disposed. A first member or arm **38** and a second member or arm **40** are rotatably mounted about said shaft **36**. The first arm **38** is provided with a semicircular turn intermediate its ends to engage the surface of the shaft **36** adjacent the upper surface of the switch body **12**. A spring **44** is disposed in a recess **46** in the top of the switch body **12** to urge resiliently the first arm **38** of the switch mechanism **14** in a clockwise direction around the shaft **36**. A stop **48** is provided on the right end of the first arm **38** to limit the movement of the first arm **38** around the shaft **36** in the clockwise direction.

In the unactuated state of the switch **10**, the first arm **38** is normally disposed at an angle with respect to the switch **10**, for example, at the angle A. The shaft may be slip fit into the holes **34** in the projections **30** and **32**. Preferably the shaft **36** is press fit into a bracket **50** to which the second arm **40** is fixed by means of a rivet **52**. Thus both the first and second arms **38** and **40** have at least a certain amount of freedom to rotate about the shaft **36** toward or away from each other and toward or away from the switch body **12**.

A rivet **54** is disposed in the second arm **40** above a rivet **56** in the first arm **38**. The rivets **54** and **56** are employed to center a second resilient means or spring **58** which is disposed between the first and second arms **38** and **40**. The rivet **56** in the first arm **38** is additionally employed to center the spring **44** disposed below and in engagement with the lower surface of the first arm **38** and the bottom of the recess **46**.

At the left end of the second arm **40** bracket **60** is fixed to the second arm **40** by means of a rivet **62**. A shaft **64** is then slip fit into holes **66** in upwardly projecting ends **68** of the bracket **60** provided therefor. The shaft **64** is preferably press fit in a follower or roller **70** which may serve as a follower for a cam.

Preferably a curved portion **72** is fixed to the left end of the first arm **38** by means of a rivet **74** to retain the left end of the second arm **40** against movement clockwise about the shaft **36** away from the first arm **38**. It is obvious that the second arm **40** will tend to rotate in this direction due to the force of the spring **58** disposed between the first and second arms **38** and **40**. The rivet **74** is also employed to fix a projection **76** to the lower surface of the first member **38** to engage a stop **80** at its left end. The stop **80** is provided on the upper surface and on the left end of the switch body **12**.

A cam and follower arrangement need not necessarily be employed to actuate the switch **10** since any convenient means may be used to depress the second arm **40** to actuate the switch. The arms **38** and **40** need not necessarily be pivoted although this is preferred as will be explained subsequently. The use of the stop **80** is, of course, old in the art to prevent the depression of the actuating button **15** more than a predetermined allowable distance. Thus the new and useful structure provided by the mechanism **14** is the arm **38** and the arm **40** and the spring **58** disposed therebetween to take up overtravel of any means employed to depress the arm **40** without increasing the overtravel of the actuating button **15** in the switch **10**. If the force constant of the spring **26** in the switch **10** is rather high, use of the spring **56** below the first arm **38** may be omitted. Use of the spring **56** is preferred to ensure that the switch **10** is not actuated by vibration, the inertia force of the mechanism **14** thereby actuating the switch when the first arm **38** is thrown into violent contact with the button **15**.

Preferably the force constant of the spring **58** is substantial to maintain the left end of the second arm **40** in engagement with the curved portion **72** fixed to the left end of the first arm **38** during the actuation of the switch **10**. This means that the force constant of the spring **58** should be sufficiently large to transmit force applied to the roller or follower **70** through the second arm **40**, through the spring **58** to the first arm **38** to depress the button **15** to its actuating position. The actuating position of the button **15** is shown in Fig. 3 with a cam **82** having its outer surface in contact with the follower **70**. It is to be noted that the overtravel of the switch itself is limited by the stop **80**, i. e., the button **15** will be depressed only a predetermined amount depending upon its position, i. e., the distance the top of the button **15** is above the stop **80**.

By keeping the spring **58** normally in compression before the first arm engages the stop **80**, the first and second arms **38** and **40** may be caused to rotate about the shaft **36** as a unitary structure.

The rotation of the cam **82** for actuation of the switch **10** may be in a counter clockwise direction as indicated by an arrow **90**. A sharp edge **92** on the cam **82** represents the point at which the radius of the cam **82** is a maximum. The cam **82** is positioned in a manner such that switching action takes place, for example, at a point **94** therealong at a radius substantially shorter than that of the edge **92**. Compensation for large follower overtravel is made in the movement of second arm **40** toward first arm **38** as indicated at **88**. The spring **58** thus is compressed and wear at the edge **92** does not interfere with the accurate actuation of the switch **10**.

It is obvious from Fig. 3 that bracket **50** is not in any way connected to the first arm **38** so that both the second arm **40** and the bracket **50** can move freely about the shaft **36** independently of each other. A better understanding of the exact configuration of each of the separate component parts of the switch mechanism **14** will be better understood with reference to the exploded view shown in Fig. 4.

Although the embodiment of the invention shown in Figs. 1 through 4 is preferred, other embodiments may be employed without departing from the spirit and scope of the invention. For example, in Fig. 5 an embodiment is shown comprising a first member **100** comprising a platform **102** which is rigidly connected to four hollow cylinders **104** having closed ends **106** disposed in recesses **108** in a switch body **110**. The switch body is provided with stops **112** to prevent the movement of the first member **100** below a predetermined height, this height being sufficient to depress an actuating button **114** in the switch body **110** to actuate a sensitive switch contained in the body **110** and not shown. Movement of the first member **100** into the body **110** is resisted resiliently by springs **116** disposed between the closed ends **106** of the cylinder

104 and the bottom surfaces 118 of the recesses 108. A second member 120 is also shown in Fig. 5 comprising a platform 122 which is supported by four rods 124 projecting into the hollow cylinders 104.

Movement of the rods 124 and therefore movement of all the second member 120 is resiliently resisted by a plurality of springs 126 disposed between the lower ends of the rods 124 and the upper surfaces of the portions 106 closing the ends of the hollow cylinders 104.

The maximum movement of the second member 120 away from the first member 100 is preferably limited by appendages 136 fixed to cylinder 104.

A bracket 128 is fixed to the top of the plate 122 by means of a rivet 130 in a manner similar to the construction of the bracket 60 on the second arm 40 shown in Fig. 1. A follower 132 is then mounted on a shaft 134 in the bracket 128 in a manner similar to the mounting of roller 70 in bracket 60 shown in Fig. 1.

Operation of the overtravel mechanism shown in Figs. 5 and 6 is analogous to that shown in the operation of the mechanism 14 shown in Fig. 1. Specifically force applied to the follower 132 causes both the first and second members 100 and 120 to be depressed simultaneously, the springs 126 having substantially greater force constant than the springs 116. When the first member 100 reaches the stops 112 the button 114 will be depressed to its actuated position. As actuating means depresses the follower 132 still further, the second member 120 will be moved toward the first member 100 against the force of the spring 126.

Still another embodiment of the invention is shown in Fig. 7 where the switch 200 is shown comprising a body portion 202 having a cylindrical projection 204 thereabove to house an actuating button 206. The button is actuated by means of an intermediate cylinder 208 which may be forced downwardly against the action of a spring 210 disposed around a lower projection 212 of the cylinder 208 between a shoulder 214 thereon and a shoulder 216 internal of the cylinder 204. A radial projection 218 is also provided on the cylinder 208 to move in a groove 220 in the cylinder 204. When the projection 218 engages a lower shoulder 222 internal of the cylinder 204, downward vertical movement of the cylinder 208 is stopped. The shoulder 222 thus forms the overtravel stop for the button 206. A spring 224 is disposed between the lower surface of an upper cylinder 226 and the upper surface of the lower cylinder 208. The cylinder 208 thus becomes equivalent to the member 100 shown in Fig. 5 and the first arm 38 shown in Fig. 1.

A cup-shaped projection 234 is fixed to the intermediate cylinder 208 and limits movement of the cylinder 226 away from cylinder 208. Thus the projection 234 is equivalent to the curved portion 72 and the appendages 136 in the other embodiments of the invention.

The spring 224 corresponds functionally to the springs 126 shown in Fig. 5 and the spring 58 shown in Fig. 1. The upper cylinder 226 corresponds to the second member 120 shown in Fig. 5 and the second arm 40 shown in Fig. 1. Force is applied to the cylinder 226 by means of a linkage 228 which is hingedly connected to both the cylinder 226 and a platform 230 provided on top of the right end of the switch body 202. A bracket and follower assembly 232 is then mounted on the linkage 228, the assembly 232 being substantially identical to those shown in both Figs. 1 and 5.

It is to be understood that in the preferred embodiment of the invention shown in Fig. 1, spring 44 may be omitted and use of spring 26 utilized to urge both push button 15 and the assembly of the overtravel mechanism to its inoperative position. Still further, it is noted that first and second arms 38 and 40 may be pivoted from different points on the body and the switch 10, i. e., through axes of rotation, may be represented as dots in Fig. 1 spaced from each other. In this case, stop means 72 may have the identical shape. It can easily be seen that changes in the axis of rotation of first and second arms 38 and 40 need not be accompanied by any unusual modification of the remainder of the structure of the invention or of the structure of switch 10.

While the invention has been described in connection with a particular type cam and follower apparatus, other applications will be readily apparent to those skilled in the art. The invention, therefore, should not be limited to the particular arrangements shown and described, but should cover all modifications within the spirit and scope thereof.

What is claimed is:

1. A switching device having an actuating element self-returning to an unactuated position, an overtravel mechanism for said switch, said overtravel mechanism comprising: a first arm rotatably mounted on said device to move said element from an inoperative to an operative actuating position; a second arm rotatably mounted on said switch to receive an actuating force; a follower on said second arm; and resilient means to resist movement of said second arm in a predetermined direction relative to the position of said first arm, said first arm being adapted to move said switch actuating element to its operative position upon application of a force sufficiently large to overcome the force of said resilient means, said force being applied to said second arm in said predetermined direction and through said resilient means to said first arm.

2. A switching device having an actuating element self-returning to an unactuated position, an overtravel mechanism for said switch, said overtravel mechanism comprising: a first arm rotatably mounted on said device to move said element from an inoperative to an operative actuating position; a second arm rotatably mounted on said switch to receive an actuating force; a follower on said second arm; a cam positioned adjacent said second arm to operate said follower; and resilient means to resist movement of said second arm in a predetermined direction relative to the position of said first arm, said first arm being adapted to move said switch actuating element to its operative position upon application of a force sufficiently large to overcome the force of said resilient means, said force being applied to said second arm in said predetermined direction and through said resilient means to said first arm.

3. In a switching device having an actuating element self-returning to an unactuated position, an overtravel mechanism for said switch, said overtravel mechanism comprising: a first arm rotatably mounted on said device to move said element from an inoperative to an operative actuating position; a second arm rotatably mounted on said switch to receive an actuating force; resilient means maintained in a position to be put in compression when said actuating force is applied to said second arm, said resilient means resisting movement of said second arm towards said first arm, said first arm being adapted to move said switch actuating element to its operative position upon application of a force sufficiently large to overcome the force of said resilient means, said force being applied to said second arm toward said first arm through said resilient means.

4. In a switching device having an actuating element self-returning to an unactuated position, an overtravel mechanism for said switch, said overtravel mechanism comprising: a first arm rotatably mounted on said device to move said element from an inoperative to an operative actuating position; a second arm rotatably mounted on said switch to receive an actuating force; resilient means maintained in a position to be put in compression when said actuating force is applied to said second arm, said resilient means resisting movement of said second arm towards said first arm, said first arm being adapted to move said switch actuating element to its operative position upon application of a force sufficiently large to overcome the force of said resilient means, said force being

applied to said second arm toward said first arm through said resilient means; and an extension on said first arm to loop around and provide stop means for said first arm to limit the movement thereof away from said second arm.

5. In a switching device having an actuating element self-returning to an unactuated position, an overtravel mechanism for said switch, said overtravel mechanism comprising: a first arm rotatably mounted on said device to move said element from an inoperative to an operative actuating position; a second arm rotatably mounted on said switch to receive an actuating force; resilient means maintained in a position to be put in compression when said actuating force is applied to said second arm, said resilient means resisting movement of said second arm towards said first arm, said first arm being adapted to move said switch actuating element to its operative position upon application of a force sufficiently large to overcome the force of said resilient means, said force being applied to said second arm toward said first arm through said resilient means; an extension on said first arm to loop around and provide stop means for said first arm to limit the movement thereof away from said second arm; and an extension on said second arm to engage said device to provide stop means to limit movement of both said second arm and said actuating element.

6. In a switching device having an actuating element self-returning to an unactuated position, an overtravel mechanism for said switch, said overtravel mechanism comprising: a first arm rotatably mounted on said device to move said element from an inoperative to an operative actuating position; a second arm rotatably mounted on said switch to receive an actuating force; a helically coiled spring disposed between said arms maintained in a position to be put in compression when said actuating force is applied to said second arm, said spring resisting movement of said second arm towards said first arm, said first arm being adapted to move said switch actuating element to its operative position upon application of a force sufficiently large to overcome the force of said spring, said force being applied to said second arm toward said first arm through said spring.

7. A switching device comprising: a sensitive switch having an actuating button and first means to resist resiliently the movement of said button to its actuating position, a first arm rotatably mounted on said switch, a stop on said switch to limit movement of said first arm towards said switch and thereby to limit the movement of said button to a predetermined distance, a second arm rotatably mounted on said switch about the same axis of rotation as said first arm, and second means disposed between said first and second arms to resist resiliently the movement of said second arm towards said first arm, said second resilient means having a force constant sufficiently large to prevent substantially any compression thereof when force required to depress said first resilient means is applied to said first arm through said second arm, and said second resilient means; third means fixed to the end of said first arm to limit movement of said second arm to a predetermined distance away from said first arm, a shaft in said switch to retain said arms, said first arm extending beyond each side of said shaft and having a stop on its end opposite said third means, said first arm also being forced around said shaft on the side thereof adjacent said switch; and a spring between said first arm and said switch to urge the side of said first arm on which third means are fixed away from said switch, whereby said last named stop may engage said switch, said second resilient means having a force constant sufficiently large to prevent any substantial compression thereof when force required to depress both said first resilient means and said spring is applied to said first member through said second member and said second resilient means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,960,020	McGall	May 22, 1934
2,039,568	Tamsitt	May 5, 1936
2,289,108	Eaton	July 7, 1942
2,331,997	Mensenkamp	Oct. 19, 1943
2,454,341	Repka	Nov. 23, 1948
2,532,859	Rosche	Dec. 5, 1950