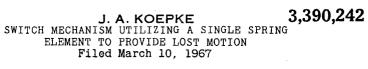
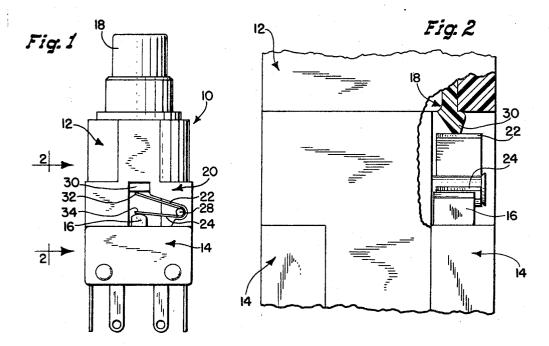
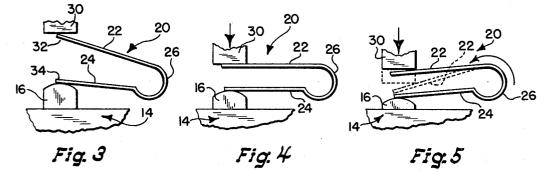
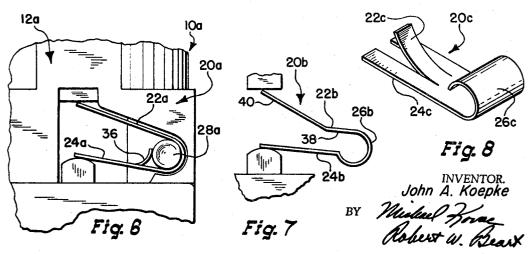
June 25, 1968









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# United States Patent Office

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Patented June 25, 1968

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3,390,242 SWITCH MECHANISM UTILIZING A SINGLE SPRING ELEMENT TO PROVIDE LOST MOTION John A. Koepke, Mount Prospect, Ill., assignor to Illinois Tool Works Inc., Chicago, Ill., a corporation of Delaware Filed Mar. 10, 1967, Ser. No. 622,166 6 Claims. (Cl. 200-153)

#### ABSTRACT OF THE DISCLOSURE

A lost motion mechanism or device capable of being employed between spaced reciprocating switch components to increase pre-travel and over-travel beyond the limits normally enjoyed by the switch device.

### BACKGROUND OF THE INVENTION

#### (1) Field of the invention

The ability to provide pre-travel and over-travel movement characteristics between components in a switch device is an important factor in the overall design of plunger or actuator operated switch devices. As generally understood, the term "pre-travel" in a plunger or actuator operated switch device relates to the distance traveled in moving the plunger or actuator from its unengaged or free position to the operating position of the switch while the term "over-travel" in a plunger or actuator operated switch device has been generally interpreted to mean the distance beyond the operating position of the switch that the plunger or actuator will travel.

It has been found that failure to incorporate the pretravel and over-travel characteristics in a plunger or actuator operated switch may result in stress and damage to the working components of the switch as well as creating the possibility that the switch may not make proper electrical connections.

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#### (2) Description of the prior art

The prior art is replete with many designs which incorporate pre-travel and over-travel characteristics, and which have generally taken the form of helical or coil springs. As a typical example of prior art developments in this regard, reference is hereby made to U.S. Patent No. 2,840,657 which discloses and claims a switch device employing a helical or coil spring in cooperation with a switch plunger or actuator to achieve the pre-travel and over-travel features desired. 50

While switch devices are normally provided with pretravel and over-travel features, there are switch assemblies utilizing auxiliary plunger or actuator elements where pre-travel and over-travel beyond the minimum limits of a switch device are desired, and it is to this aspect 55 with which the present invention is concerned.

# SUMMARY OF THE INVENTION

It is an object of the present invention to provide a switch button switch assembly having one or more switch 60 devices which incorporates a lost motion mechanism capable of operating beyond the limits of the switch device or devices.

Another object of the present invention is to provide a lost motion mechanism which is capable of operating in the aforementioned manner, and which is exceedingly simple, yet rugged in construction, quite sensitive yet durable in operation, and capable of being manufactured and assembled to the switch assembly at a low cost, yet with a minimum amount of effort. 70

These and other objects and advantages of the present invention are attained by the provision of a lost motion 2

mechanism in a push button switch assembly which is disposed between one end of a reciprocal push button and an outwardly biased switch actuator operating a switch device, the over-travel mechanism comprising a spring element mounted to the push button switch assembly intermediate the push button and switch actuator and including a pair of spaced spring arms with the outer free extremities thereof positioned for engagement with the push button and switch actuator in such a manner that the spring arms prior to complete closing movement there-10 between are capable of developing a sufficient spring force when the spring arm engaged by the push button is deflected a predetermined distance to move the spring arm engaging the switch actuator a predetermined distance causing depression of the switch actuator and operation of the switch device, the push button capable of being further depressed a predetermined additional amount corresponding to the spacing between the spring arms after operation of the switch device to provide over-travel of 20 the push button beyond the limits of the switch device.

#### BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of a switch assembly incorporating a lost motion mechanism or device constructed in accordance with the teachings of the present invention;

FIG. 2 Is an enlarged fragmentary end elevational view showing the manner in which the lost motion mechanism is disposed between reciprocating switch components of the switch assembly;

FIGS. 3-5 are diagrammatic views illustrating the lost motion mechanism in its normal or rest position, just after it has been engaged by a reciprocating switch button, and finally after operation of the switch device, but before complete closing movement therebetween except as shown in the illustrated dotted lines;

FIG. 6 is an enlarged fragmentary view showing a modified form of lost motion mechanism coming within the purview of the present invention;

FIG. 7 is a side elevational view of a modified form of lost motion mechanism which comes within the scope of the present invention; and

FIG. 8 is a perspective view showing yet still another form of lost motion mechanism of the present invention.

# DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is particularly useful in the environment of a push button switch assembly 10 as depicted in FIG. 1 of the drawing. The push button switch assembly 10 is illustrated as including a housing 12 of any desired configuration which is preferably molded from an insulating plastic material, one or more switch devices 14 mounted to the housing 12 at a lower end thereof and including a switch actuator or plunger element 16 which operates a snap-action switch mechanism (not shown) mounted within the switch device 14 and biasing the switch actuator or plunger element 16 outwardly therefrom as shown, and a hollow push button element 18 slidably mounted with respect to the housing 12 and designed to engage the switch actuator or plunger element 16 of each switch device for operating the same. Although not shown, the hollow push button element 18 preferably encompasses a lamp bulb which is fixedly mounted relative to the housing 12, the reciprocation of the push button element 18 effecting the lit and unlit conditions of the lamps (not shown).

The present invention is directed toward increasing the amount of pre-travel and over-travel of the hollow push button element 18 beyond that which is normally enjoyed by the switch devices 14. The lost motion mechanism generally identified 20 comprises a one-piece formed metal 3,390,242

or plastic part having spaced spring arms 22, 24 each joined at one end to a curvilinear portion 26 which provides a pivot mounting for the lost motion mechanism or spring element 20 as will be presently described.

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The curvilinear portion 26 of the lost motion mechanism 5 or spring element 20 is complementary in configuration to and adapted to be mounted relative to an integral pivot pin 28 extending from the housing 12 as illustrated in FIG. 1 of the drawing. The integral pivot pin 28 is located on the housing 12 such that it is disposed gen-10 erally intermediate a switch actuator element 16 and the lower end 30 of the push button element, but laterally offset from both the switch actuator element 16 and the lower end 30 of the push button element 18 for mounting the spring element 20 in the manner illustrated in FIG. 1 of the drawing with the outer free extremities 32, 34 of the spring arms 22, 24 respectively being positioned for engagement with the lower end 30 of the push button element and the switch actuator element 16 respectively. After the spring element 20 is mounted to the housing 12 with the 20 curvilinear portion 26 thereof encompassing the pivot pin 28, the end of the pivot pin 28 is staked to flair the plastic material over the curvilinear portion 26 to prevent inadvertent lateral displacement thereof relative to the housing 12. Thus, the lost motion mechanism or spring element 20 is permanently affixed to the housing 12, and is designed to provide additional pre-travel and over-travel greater than the switch device 14 as will now be described.

The semi-diagrammatic illustrations in FIGS. 3-5 of 30 the drawing clearly depict the various positions of the lost motion mechanism or spring elements 20 during the reciprocation of the push element 18. Specifically, FIG. 3 of the drawing shows the rest or free position of the lost motion mechanism or element 20 wherein the outer free extremity 32 of the upper arm 22 is in contact with the lower end 30 of the push button element 18 while the outer free extremity 34 of the lower spring arm 24 is resting upon the upper face or surface of the switch actuator element 16. When the push button element 18 is depressed, the lower end 30 thereof as shown by the arrow in FIG. 4 of the drawing will be moved downwardly carrying with it the upper spring arm 22. The upper spring arm 22 will thus be deflected or moved downwardly during its initial or pre-travel movement which occurs prior to the operation of the switch device 14.

As the spring arms 22, 24 are brought closer to one another, a force is developing therebetween which will, after a predetermined amount of travel, match the operating force of the switch device causing operation of the same. In the present instance, the spring arms 22, 24 are capable of developing a sufficient spring force to cause actuation of the switch device prior to complete closing movement therebetween. This is illustrated in FIG. 5 of the drawing where it will be seen that once the upper spring arm 22 is moved to the full line position illustrated 55which is below its dead center position, it will cause the entire spring element 20 to pivot on the pin 28 as illustrated in FIG. 5, and this together with the inherent force which has been developed as a result of the closing movement between the spring arms 22, 24 is sufficient to cause 60 actuation of the switch device 14 by reason of the lower spring arm 24 engaging and depressing the switch actuator or plunger element 16.

It is important to note that once operation of the switch device 14 is achieved, the spring arms 22, 24 of the spring element 20 are still positioned in spaced apart relationship to one another, thereby permitting over-travel of the pushbutton 18 and its lower end 30 beyond the limits of the switch device 14. As illustrated in FIG. 5 of the drawing, the full line position of the spring arms 22, 24 are intended to depict the location thereof once operation of the switch device 14 is achieved, and the dotted line position of the spring arm 22 is intended to illustrate the amount of over-travel which is still possible between the

the parts will again assume the position shown in FIG. 3 of the drawing, the spring arms 22, 24 also serving in the capacity of a return spring for the push button element 18.

Various modifications of the lost motion mechanism or spring element of the present invention are possible, and in the discussion that is to follow similar reference numerals will be employed to identify like parts in the just discussed embodiment, but with different suffixes employed to identify the type of variations or modifications that are possible with the present invention.

The switch assembly 10a illustrated in FIG. 6 of the drawing is identical in all respects with the FIGS. 1-5 embodiment with the exception of the spring element 20aIn this form of the invention, a tab element 36 is struck 15 from the lower arm 24a, and is configured and dimensioned with respect to the pivot pin 28a that it provides a resilient and releasable mounting therebetween. The upstanding tab element 36 is designed to engage the pivot pin 28 in such a manner that it will retain the spring element 20a to the pivot pin 28a while preventing inadvertent disassociation therebetween. Thus, this form of the invention may be used as an alternative in assembling and maintaining the spring element 20a and pivot pin 28arelative to one another. 25

In FIG. 7 of the drawing, the lost motion mechanism or spring element 20b illustrated is generally fashioned after the FIGS. 1-5 embodiment, the modification here being in the shape or configuration of the upper arm 22b. Specifically, the upper arm 22b has been subdivided into two sections 38, 40 which are annularly disposed relative to one another in such a manner that they will increase the spring rate of the upper arm 22b. Specifically, the first section 38 of the upper spring arm 22b diverges away from the lower spring 24b as they proceed away 35 from the curvilinear portion 26b; however, the second

section 40 of the upper spring arm 22b diverges from the lower spring arm 24b at an even greater amount to provide the increased spring force or rate for the upper spring arm 22b. This particular embodiment indicates that the upper 40

spring arm as well as the lower spring arm may be configured in any desired manner to increase or for that matter decrease the spring force or rate characteristics thereof as may be desired.

The last illustrated embodiment of the present inven- $\mathbf{45}$ tion is shown in FIG. 8 of the drawing. The lost motion mechanism or spring element 20c here illustrated indicates that various modifications in the type of spring arms which are employed can be made. As illustrated, the upper spring arm 22c is formed from material portions of the spring arm 24c, the two arms being configured as shown to perform the desired pre-travel and over-travel characteristics. Additionally, it will be noted that the curvilinear portion 26c is in the form of a reversely curved or hook portion which can be configured to a shape complementary with the pivot pin to which it will be associated for the pivotal mounting desired.

Although specific embodiments of the invention have been shown and described, it is with full awareness that many modifications thereof are possible. The invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim:

1. In a push button switch assembly, a lost motion mechanism disposed between one end of a reciprocal push button and an outwardly biased switch actuator associated with a switch device, said lost motion mechanism comprising a spring element pivotally mounted to the push button switch assembly intermediate the push button and switch actuator, said spring element including a pair of spaced spring arms with the outer free extremities thereof positioned for engagement with the push button and switch actuator, said spring arms prior to complete closing movement being capable of developing a spring arms 22, 24. When the push button 18 is released, 75 sufficient spring force when the spring arm engaged by

the push button is deflected a predetermined distance to move the spring arm engaging the switch actuator a predetermined distance causing depression of the switch actuator and operation of the switch device, said spring element being adapted to rotate about its pivot mounting 5 upon deflection of the spring arm engaged by the push button a predetermined distance to cause movement of the other spring arm and the switch actuator engaged thereby, continued deflection of the spring arm engaging the push button and rotation of the spring element de-10 veloping a sufficient force to provide operation of the switch device prior to complete closing movement by the spring arms, said push button capable of being depressed a predetermined additional distance corresponding to the spacing between the spring arms after operation of the 15 switch device to provide lost motion of the push button beyond the limits of the switch device.

2. The assembly as defined in claim 1 wherein said spring element includes a pivotal portion which is associated with a pivot pin integrally formed on said push 20 H. BURKS, Assistant Examiner. button switch assembly.

3. The assembly as defined in claim 3 wherein one of said spring elements and pivot pin includes means for fastening said parts to each other.

4. The assembly as defined in claim 1 wherein the spring element is formed as a one piece member.

5. The assembly as defined in claim 1 wherein the spring arm engaging the push button includes at least two sections which are angularly offset to one another in a manner to increase the spring rate thereof.

6. The assembly as defined in claim 1 wherein the spring element comprises integral first and second spring finger portions, one of which is formed from material portions of the other.

# **References Cited**

UNITED STATES PATENTS

3,115,555 12/1963 Lescarboura \_\_ 200-153.19 XR

ROBERT K. SCHAEFER, Primary Examiner.