May 24, 1966 W. J. RUSSELL 3,252,345

ACTUATING MECHANISM AND PARTS THEREFOR OR THE LIKE

Filed Aug. 2, 1963

3 Sheets-Sheet 1

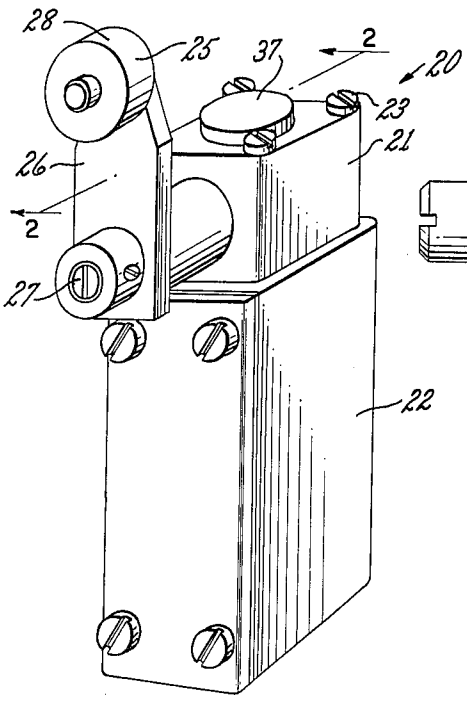


FIG.1

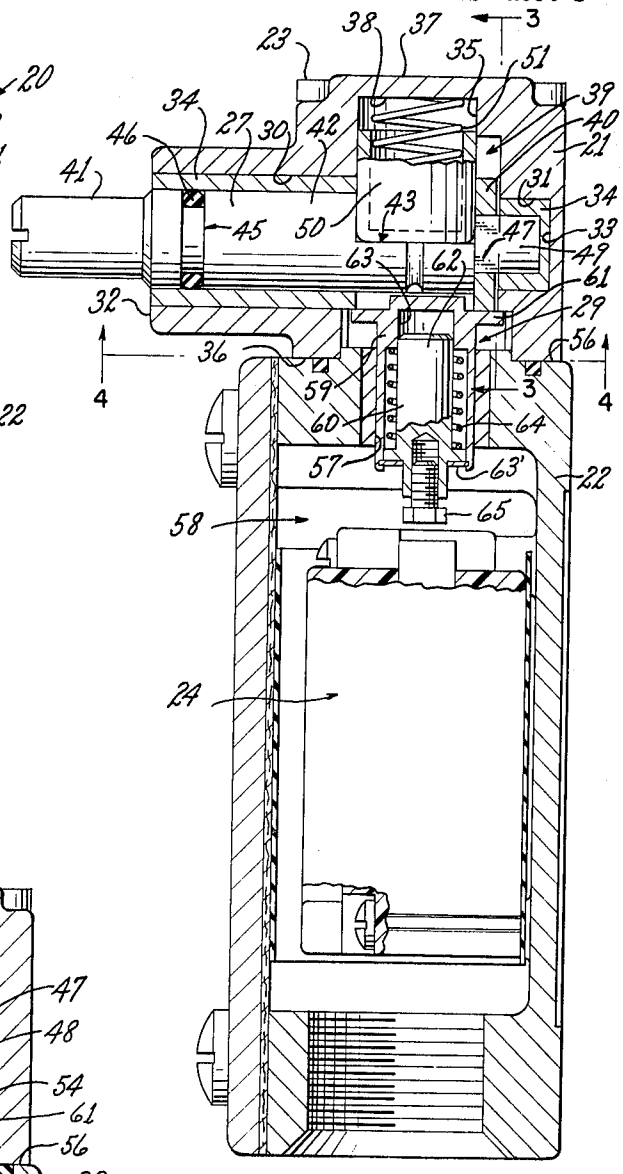


FIG.2

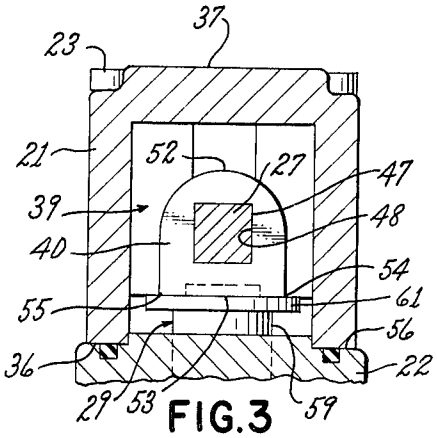


FIG.3

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ACTUATING MECHANISM AND PARTS THEREFOR OR THE LIKE

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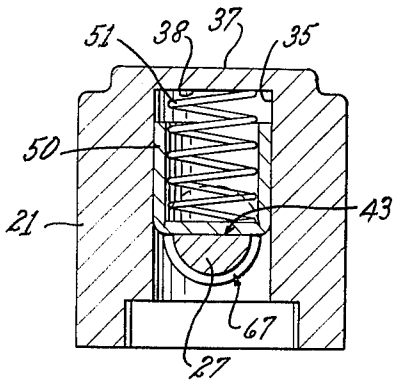


FIG.5

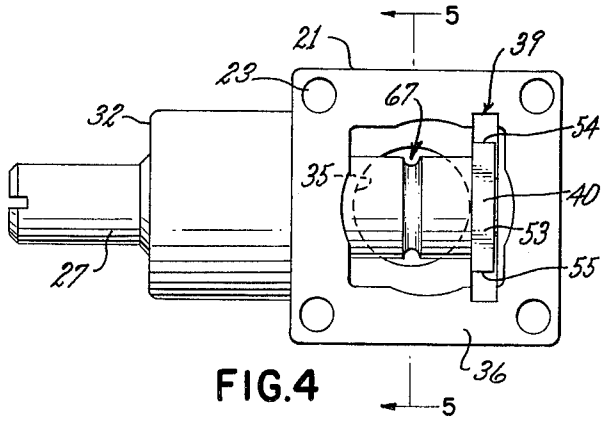


FIG.4

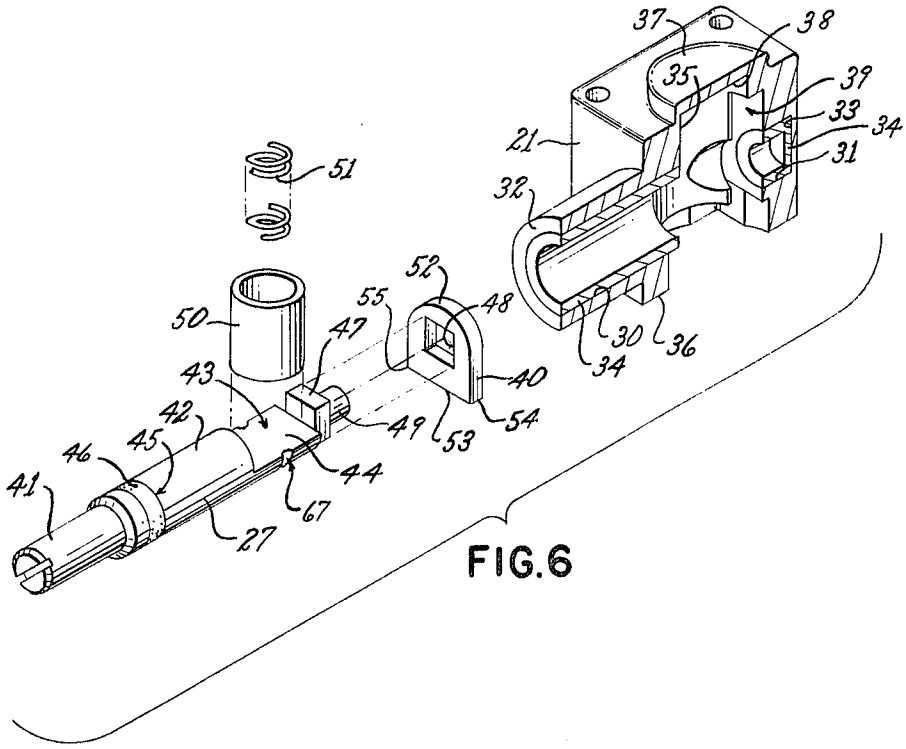


FIG.6

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ACTUATING MECHANISM AND PARTS THEREFOR OR THE LIKE

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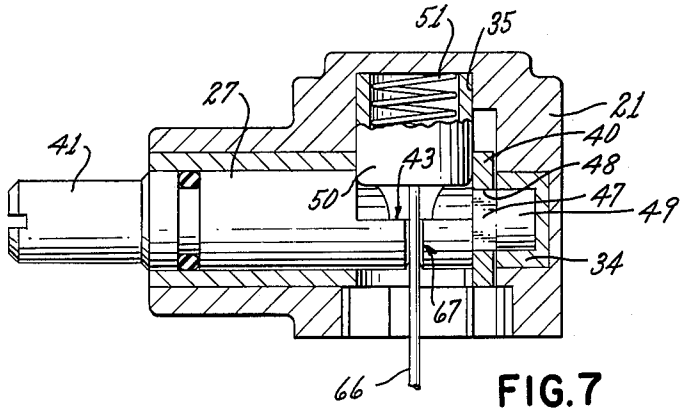


FIG.7

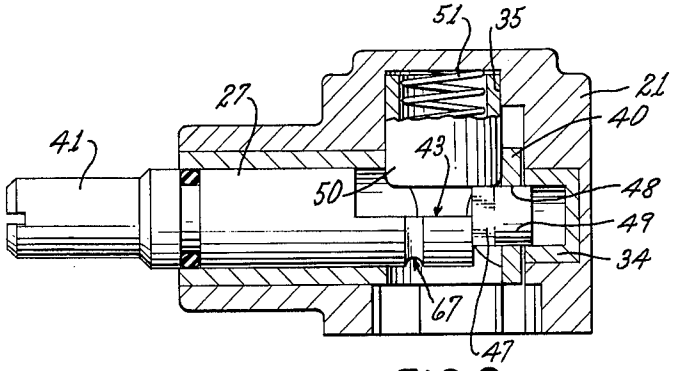


FIG.8

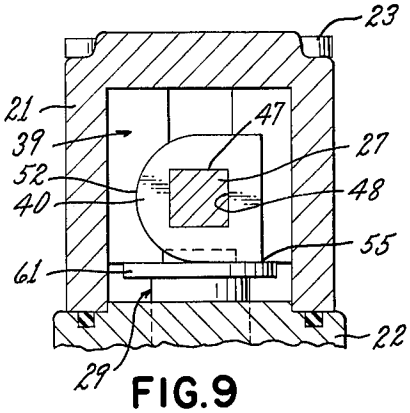


FIG.9

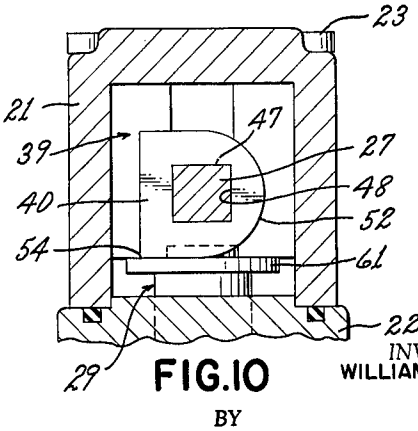


FIG.10

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3,252,345

ACTUATING MECHANISM AND PARTS THEREFOR OR THE LIKE

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Filed Aug. 2, 1963, Ser. No. 299,612
18 Claims. (Cl. 74—107)

This invention relates to an improved actuating mechanism and to improved parts for such an actuating mechanism or the like.

One feature of this invention is to translate rotary motion of an operating shaft into reciprocating motion of an actuating plunger means or the like in a direction perpendicular to the axis of rotation of the operating shaft.

Such an actuating mechanism is particularly adaptable to be utilized in connection with limit switch means wherein an operating arm is fixed to one end of the operating shaft so that upon movement of the roller end of the actuating arm in a particular direction by a moving part of a machine or the like, the subsequent rotation of the operating shaft causes the plunger means to axially move in a manner to operate a limit switch that terminates the movement of the moving part of a machine or the like whereby the limit switch construction can control the operation of a machine or the like.

One feature of this invention is to provide a means for variably adjusting the interconnection between the operating shaft of the actuating mechanism and the actuating plunger by means of varying the position of a cam on the operating shaft so that the operating shaft can cause movement of the plunger means when the shaft is rotated in either direction or cause movement of the plunger means when the shaft is rotated in only one direction.

Accordingly, it is an object of this invention to provide an improved actuating mechanism having one or more of the novel features set forth above or hereinafter shown or described.

Another object of this invention is to provide improved parts for such an actuating mechanism or the like.

Other objects, uses and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIGURE 1 is a perspective view of an improved limit switch construction of this invention.

FIGURE 2 is an enlarged, cross-sectional view taken substantially on line 2—2 of FIGURE 1 with the operating arm removed.

FIGURE 3 is a fragmentary, cross-sectional view taken on line 3—3 of FIGURE 2 and illustrates one position of the operating cam of this invention.

FIGURE 4 is a bottom view of part of the construction illustrated in FIGURE 2 and is taken substantially on line 4—4 of FIGURE 2.

FIGURE 5 is a fragmentary, cross-sectional view taken on line 5—5 of FIGURE 4.

FIGURE 6 is an exploded, partial cross-sectional, perspective view of the various operating parts of the structure illustrated in FIGURES 4 and 5.

FIGURE 7 is a view illustrating the parts of FIGURE 6 in assembled relation and illustrates one of the steps in changing the position of the operating cam thereof.

FIGURE 8 is a view similar to FIGURE 7 and illustrates another step in the method of this invention.

FIGURE 9 is a view similar to FIGURE 3 and illustrates the operating cam in another adjusted position thereof.

FIGURE 10 is a view similar to FIGURE 3 and illustrates the operating cam in still another adjusted position thereof.

While the various features of this invention are hereinafter described and illustrated as being particularly adaptable for operating a limit switch means or the like, it is to be understood that the various features of this invention can be utilized singly or in any combination thereof to provide actuating means for other devices as desired.

Therefore, this invention is not to be limited to only the embodiments illustrated in the drawings, because the drawings are merely utilized to illustrate one of the wide variety of uses of this invention.

Referring now to FIGURE 1, an improved limit switch construction of this invention is generally indicated by the reference numeral **20** and comprises a pair of housing members **21** and **22** secured together by fastening means **23** whereby the housing member **22** is adapted to contain an electrical limit switch means **24**, FIGURE 2, to be actuated upon movement of the roller end **25** of an actuating arm **26** about an axis of rotation of an operating shaft **27** journaled in the housing member **21**.

For example, the operating arm **26** is fixed to the shaft **27** in any suitable manner so that movement of the free end **25** of the operating arm **26** causes like rotation of the operating shaft **27** which, through mechanism hereinafter described, causes operation of the limit switch means **24**.

Thus, it can be seen that the limit switch construction **20** of this invention can be utilized in a conventional manner with a machine or the like to limit the amount of movement of a moving part thereof by having the moving part engage the roller **28** of the actuating arm **26** and move the same the desired distance before the operating shaft **27** causes the limit switch means **24** to be operated and terminate the movement of the moving part of the machine or the like.

In order to accomplish the above function of the limit switch means **24** of the limit switch construction **20**, means are provided for translating the rotational movement of the operating shaft **27** into reciprocating movement of an actuating plunger means **29**, FIGURE 2, which in turn, reciprocates a suitable plunger (not shown) on the limit switch means **24** to actuate the same.

The particular details of such actuating mechanism will now be described.

As illustrated in FIGURES 2–6, the housing member **21** has a pair of step coaxial bores **30** and **31** formed therein with the bore **30** interrupting the front side **32** of the housing member **21** while the bore **31** defines an end wall **33** in the housing **21**.

If desired, the bores **30** and **31** in the housing member **21** can be lined with a suitable bearing material **34** as illustrated.

A transverse bore means **35** is formed in the housing member **21** and intersects the bore means **30** and **31** in the manner illustrated in FIGURE 2, the bore means **35** interrupting the bottom surface **36** of the housing member **21** while terminating short of the top surface **37** thereof to define an end wall **38** for a purpose hereinafter described.

As illustrated in FIGURES 2 and 6, the bore means **35** includes a recess **39** to receive a cam **40** constructed in a manner hereinafter set forth.

As illustrated in FIGURES 2 and 6, the operating shaft **27** has a reduced end portion **41** to be fastened to the operating arm **26** in any suitable manner. The medial portion **42** of the operating shaft **27** is substantially cylindrical and has a recess **43** provided therein to provide a flat surface **44** for a purpose hereinafter described.

The medial portion **42** of the shaft **27** also has an

annular recess 45 provided therein and adapted to receive a flexible O-ring 46 or the like in the manner illustrated in FIGURE 2 to seal the shaft 27 in the bore 30 of the housing member 21.

A substantially square portion 47 is disposed adjacent the recess 43 in the shaft 27 and is complementary to a square bore 48 passing substantially centrally through the cam 40 for a purpose hereinafter described. A reduced cylindrical portion 49 extends from the square portion 47 of the shaft 27 and is adapted to be rotatably received in the bore 31 of the housing member 21 in the manner illustrated in FIGURE 2.

However, the cylindrical portion 49 of the shaft 27 has a diameter which is slightly smaller than one side of the square bore 48 of the cam 40 for a purpose hereinafter described.

In order to retain the operating shaft 27 in one axial position in the housing member 21 and also to tend to hold the operating shaft 27 in one rotational position thereof, a cup-shaped retainer 50 is slidably disposed in the upper part of the transverse bore means 35 in the manner illustrated in FIGURE 2 and is complementary to the recess 43 which is bounded on one side by the uncut portion of the cylindrical part 42 of the shaft 27 and on the other side by the square portion 47 of the shaft 27. A compression spring 51 is disposed in the cup-shaped retainer 50 and bears against the surface 38 of the housing 21 to tend to urge the cup-shaped retainer 50 into the recess 43 and against the flat surface 44 of the shaft 27 in the manner illustrated in FIGURE 2 to not only tend to hold the operating shaft 27 in the rotational position illustrated in FIGURE 2, but also to prevent axial movement of the shaft 27 relative to the housing member 21 by engaging against the sides of the cylindrical part 42 and square part 47 of the shaft 27 in the manner illustrated in FIGURE 2.

However, when a force is applied to the roller 28 of the operating arm 26 to move the roller 28 in an arcuate path about the axis of rotation of the operating shaft 27, the shaft 27 is rotated in a particular direction as the flat surface 44 of the shaft 27 can cam the retainer 50 upwardly in FIGURE 2 against the force of the compression spring 51. However, when the operating force against the roller 28 of the operating arm 26 is removed, the compression spring 51 returns the shaft 27 to the rotational position illustrated in FIGURE 2 which is hereinafter referred to as the "zero" position of the operating shaft 27.

The retainer 50 and bore means 35 are so constructed and arranged that rotation of the shaft 27 is prevented beyond the limits of the restoring movement of bias of the spring 51 and retainer 50 on the flat surface 44 of the shaft 27.

The cam 40 has opposed ends 52 and 53 with the end 52 defining part of a substantially circular configuration having an axis of curvature extending from the center of the bore 48 while the end 53 of the cam 40 defines part of a square configuration that has two corners 54 and 55 equidistant from the center of the bore 48 for a purpose hereinafter described.

The cam 40 is adapted to be disposed in the recess 39 in the housing member 21 and receive the key or square portion 47 of the operating shaft 27 in the complementary bore means 48 thereof whereby the cam 40 is keyed to the shaft 27 to rotate in unison therewith for a purpose hereinafter described.

However, when the cylindrical part 49 of the shaft 27 is received in the bore means 48 of the cam 40, the cam 40 is adapted to be rotatably adjusted relative to the operating shaft 27 to change its adjusted position thereon for a purpose hereinafter described.

As illlustrated in FIGURE 2, the housing member 21 is secured on the top surface 56 of the housing member 22 and has the lower portion of the bore means 35

thereof aligned with a bore means 57 formed in the housing member 22 and leading to a compartment 58 receiving the limit switch means 24.

The actuating plunger means 29 is disposed for sliding movement in the lower portion of the bore means 35 of the housing member 21 and projects through the bore means 57 in the housing member 22 to actuate a suitable plunger (not shown) of the limit switch means 24 in a manner hereinafter described.

The plunger means 29 comprises a pair of members 59 and 60 disposed in telescoping relation with the member 59 having an annular shoulder or flange 61 engageable by the cam 40 to cause reciprocating motion of the plunger means in a direction perpendicular to the axis of rotation of the operating shaft 27 in a manner hereinafter described.

The member 60 of the plunger means 29 has a shaft-like portion 62 disposed in a bore 63 in the member 59 and is normally held against a split retainer ring 63' by a compression spring 64 disposed between the members 59 and 60.

The member 60 carries an adjusting screw 65 at the lower end thereof which is adapted to operate the plunger of the limit switch means 24.

Therefore, it can be seen that when the shaft 27 rotates, the cam 40 is adapted to push the member 59 downwardly whereby the member 60 is moved in unison therewith because of the compression spring 64 to permit the adjusting screw 65 thereof to operate the plunger of the limit switch 24.

However, should the plunger means 29 be moved downwardly beyond the limits of the plunger of the limit switch means 24, the member 60 begins to telescope upwardly relative to the downwardly moving member 59 in opposition to the force of the compression spring 64 to provide an overshoot means so that the plunger means 29 will not adversely damage the plunger of the limit switch means 24 should the plunger means 29 be moved downwardly beyond the limits of the plunger of the limit switch means 24.

The operation of the limit switch construction 20 of this invention will now be described.

With the cam 40 disposed in the adjusted position illustrated in FIGURES 2 and 3, it can be seen that when the operating shaft 27 is in its zero position, the plunger means 29 is adapted to be urged upwardly by the plunger of the limit switch means 24 until the flange 61 of the plunger means 29 abuts against the flat end 53 of the cam 40 whereby the limit switch means 24 is in one operating position thereof.

Thereafter, should the operating shaft 27 be rotated in a clockwise direction in FIGURE 3 upon movement of the roller 28 by a moving part of an apparatus or the like, the corner 54 of the cam 40 will be likewise rotated in a clockwise direction in FIGURE 3 to cause downward movement of the plunger means 29 to operate the limit switch means 24 in the manner previously described.

Similarly, should the shaft 27 be rotated in a counterclockwise direction in FIGURE 3, the corner 55 of the cam 40 will move the plunger means 29 downwardly to operate the limit switch means 24.

Thus, it can be seen that when the cam 40 is disposed in the adjusted position illustrated in FIGURE 3, any rotational movement of the shaft 27 from its zero position in any direction will cause operation of the plunger means 29.

When it is desired to change the adjusted position of the cam 40 on the operating shaft 27, the housing member 21 is removed from the housing member 22 in the manner illustrated in FIGURES 4, 5 and 7 so that a suitable tool 66 can be inserted upwardly through the lower portion of the bore means 35 of the housing 21 to urge the retainer 50 upwardly until the same clears the square-shaped portion 47 of the shaft 27 whereby the shaft 27

can then be moved axially outwardly in the manner illustrated in FIGURE 8 until the cylindrical portion **49** of the shaft **27** is received in the bore means **48** of the cam **40** as illustrated in FIGURE 8, the cam **40** being held from axial movement in unison with said axial movement of the shaft **27** by the retainer **50**.

Thereafter, the cam **40** can be rotated relative to the shaft **27** until the same is in the desired adjusted position relative to the shaft **27** because the cam **40** is now on the cylindrical portion **49** of the shaft **27**.

With the cam **40** in its newly adjusted position, the shaft **27** is axially moved back to the right from the position illustrated in FIGURE 8 to the position illustrated in FIGURE 2 to cause the key portion **47** of the shaft **27** to be again received in the bore means **48** of the cam **40** to interconnect the cam **40** to the shaft **27** to operate in a manner hereinafter described.

In order to facilitate the use of the tool **66** to raise the retainer **50** in the manner illustrated in FIGURE 7, the shaft **27** has a groove means **67** formed therein and extending from one side of the recess **43** to the other side thereof in the manner illustrated in FIGURES 4 and 5 whereby the tool **66** can be readily received in the groove means **67** in the manner illustrated in FIGURE 7 and be guided upwardly to engage the retainer **50** for the purpose previously described.

For example, the tool **66** can comprise a forked member whereby the opposed tines of the tool **66** can be respectively received on opposite sides of the operating shaft **27** in the groove means **67** thereof to urge the retainer **50** upwardly in opposition to the force of the compression spring **51** to permit adjustment of the cam **40** relative to the shaft **27** in the manner previously described.

When the cam **40** has been adjusted in the manner illustrated in FIGURE 9, it can be seen that when the shaft **27** is rotated in a clockwise direction in FIGURE 9, the corner **55** of the cam **40** will still cause downward movement of the plunger means **29** in the manner previously described to cause operation of the limit switch means **24**.

However, should the operating shaft **27** be rotated in a counterclockwise direction from its zero position illustrated in FIGURE 9, the rounded portion **52** of the cam **40** causes the plunger means **29** to remain in its up position illustrated in FIGURE 9 so that counterclockwise movement of the shaft **27** will not cause operation of the plunger means **29**.

Similarly, should the cam **40** be adjusted on the shaft **27** in the manner illustrated in FIGURE 10, only counterclockwise rotation of the shaft **27** from its zero position will cause operation of the plunger means **29** as the corner **54** of the cam **40** will cause axial movement of the plunger means **29** upon counterclockwise rotation of the shaft **27** from its zero position.

However, clockwise rotation of the shaft **27** from its zero position in FIGURE 10 will not affect the plunger means **29** as the rounded portion **52** of the cam **40** will be brought into engagement with the flange **61** of the plunger means **29**.

Therefore, it can be seen that the cam **40** of this invention can be readily adjusted relative to the operating shaft **27** without causing removal of the operating shaft **27** from the housing **21** and that the cam **40** can be utilized in such a manner that the cam **40** will cause operation of the plunger means **29** upon clockwise and counterclockwise rotation of the shaft **27**, cause operation of the plunger means **29** only upon clockwise rotation of the shaft **27** or cause operation of the plunger means **29** only upon counterclockwise rotation of the shaft **27** because of novel means of this invention for permitting a selective positioning of the cam means **40** on the key portion of the shaft **27**.

Therefore, it can be seen that the actuating mechanism

of this invention permits an ease of adjustment from multidirectional to unidirectional operation.

Further, the cooperation of the retainer **50** with the key portion **47** of the shaft **27** permits the shaft restoring force means and shaft retention means of the actuating mechanism to be combined in one part whereby the actuating mechanism of this invention is very inexpensive to manufacture.

Therefore, it can be seen that this invention provides an improved actuating mechanism as well as improved parts for such an actuating mechanism or the like.

While the form of the invention now preferred has been disclosed as required by the statutes, other forms may be used, all coming within the scope of the claims which follow.

What is claimed is:

1. In combination, a housing having a bore means therein, a shaft rotatably disposed in said bore means and being axially movable therein, radially movable retainer means carried by said housing and when in one position preventing axial movement of said shaft and when in another position permitting axial movement of said shaft, and a cam disposed in said bore means and held from axial movement by said housing and said retainer, said cam being operatively interconnected to said shaft to be rotatable in unison with said shaft when said shaft is in one axial position and to be adjustably movable relative to said shaft when said shaft is in another axial position.

2. Combination, a housing having a bore means therein, a shaft rotatably disposed in said bore means and being axially movable therein, radially movable retainer means carried by said housing and when in one position preventing axial movement of said shaft and when in another position permitting axial movement of said shaft, said shaft having a key portion and a non-key portion, and a cam disposed in said housing and held from axial movement by said housing and said retainer, said cam being disposed on said key portion of said shaft to be rotated in unison with said shaft when said shaft is in one axial position in said bore, said shaft being axially movable in said bore from said one position to another axial position to position said cam on said non-key portion thereof whereby said cam can be adjusted relative to said shaft before said shaft is moved back to said one position to hold said cam in its adjusted position on its said key portion.

3. A combination as set forth in claim **2** wherein said key portion of said shaft has a square cross-sectional configuration and said cam has a complementary square bore passing therethrough.

4. A combination as set forth in claim **3** wherein said non-key portion has a circular cross-sectional configuration provided with a diameter smaller than one side of said bore in said cam.

5. In combination, a housing having a first bore means therein and a second bore means transverse to said first bore means and intersecting said first bore means, a shaft rotatably disposed in said first bore means and being axially movable therein and having a recess provided therein, biasing means disposed in one part of said second bore means and being received in said recess of said shaft to tend to hold said shaft in one rotational position thereof, said biasing means also holding said shaft in one axial position thereof when said biasing means is received in said recess and permitting axial movement of said shaft when said biasing means is moved out of said recess, and a cam disposed in said housing and held from axial movement by said housing and said biasing means, said cam being operatively interconnected to said shaft to be rotatable in unison with said shaft when said shaft is in said one axial position and to be adjustably movable relative to said shaft when said shaft is in another axial position.

6. In combination, a housing having a first bore means therein and a second bore means transverse to said

first bore means and intersecting said first bore means, a shaft rotatably disposed in said first bore means and being axially movable therein and having a recess provided therein, a retainer slidably disposed in one part of said second bore means and being biased by biasing means into said recess to tend to hold said shaft in one rotational position thereof, said retainer means also holding said shaft in one axial position thereof when said retainer means is received in said recess and permitting axial movement of said shaft when said retainer means is moved out of said recess, and a cam disposed in said housing and held from axial movement by said housing and said retainer, said cam being operatively interconnected to said shaft to be rotatable in unison with said shaft when said shaft is in said one axial position and to be adjustably movable relative to said shaft when said shaft is in another axial position.

7. A combination as set forth in claim **6** wherein said one part of said second bore means is closed by part of said housing and said biasing means is disposed between said part of said housing and said retainer.

8. A combination as set forth in claim **6** wherein said retainer is cup-shaped.

9. A combination as set forth in claim **6** wherein said shaft has groove means provided therein and intersecting said recess to provide access means for receiving a tool to move said retainer out of said recess when said tool is inserted in the other part of said second bore means.

10. In combination, a housing having a bore means therein, a shaft rotatably disposed in said bore means and being axially movable therein, radially movable retainer means carried by said housing and when in one position preventing axial movement of said shaft and when in another position permitting axial movement of said shaft, an actuating plunger means disposed in said bore means to be axially moved by rotation of said shaft, and a cam disposed in said bore means and held from axial movement by said housing and said retainer, said cam being adjustably carried by said shaft, said cam being rotatable in unison with said shaft when said shaft is in said one axial position and being adjustably movable relative to said shaft when said shaft is in another axial position, said cam operating said plunger.

11. A combination as set forth in claim **10** wherein said cam moves said plunger means in one direction when said shaft is rotated in one direction.

12. A combination as set forth in claim **10** wherein said cam moves said plunger means in one direction when said shaft is rotated in either direction.

13. A combination as set forth in claim **10** wherein said cam moves said plunger means in one direction when said shaft is rotated in one direction and said cam is ineffective to move said plunger means when said shaft is rotated in the other direction.

14. A combination as set forth in claim **10** wherein said shaft has a zero position and said cam is ineffective to operate said plunger when said shaft is in said zero position.

15. A combination as set forth in claim **10** wherein said cam has opposed ends, one end defining part of a square configuration and the other end defining part of a circular configuration.

16. A combination as set forth in claim **10** and including a switch means or the like to be actuated by movement of said plunger means.

17. A combination as set forth in claim **16** wherein said plunger means has overshoot means to prevent damage to said switch means should said plunger be moved towards said switch means too great a distance.

18. A combination as set forth in claim **17** wherein said plunger means comprises two members disposed in telescoping relation and normally held in one position relative to each other by a compression spring whereby said spring compresses to provide said overshoot means.

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