United States Patent [19]

Rys

[11] **3,875,360**

[45] **Apr. 1, 1975**

[54] **STORED-ENERGY OPERATING MECHANISM FOR SWITCH BLADES**

[75] Inventor: **Tadeusz J. Rys**, Monroe, Ohio

[73] Assignee: **Square D. Co.**, Park Ridge, Ill.

[22] Filed: **Feb. 25, 1974**

[21] Appl. No.: **445,735**

Related U.S. Application Data

[63] Continuation of Ser. No. 329,804, Feb. 5, 1973, abandoned.

[52] **U.S. Cl.** ..... **200/153 SC**, 200/50 A

[51] **Int. Cl.**..... **H01h 3/30**, H01h 9/22, H01h 31/06

[58] **Field of Search**..... 200/153 SC, 153 H, 70; 185/374

[56] **References Cited**

UNITED STATES PATENTS

1,938,408	12/1933	Thumim	200/92
2,910,557	10/1959	Salzer	200/74
3,496,319	2/1970	Norden	200/146
3,582,595	6/1971	Stein	200/153

FOREIGN PATENTS OR APPLICATIONS

1,948,209	11/1970	Germany	200/153

Primary Examiner—T. E. Lynch
Assistant Examiner—John W. Redman
Attorney, Agent, or Firm—Harold J. Rathbun; Ernest S. Kettelson

[57] **ABSTRACT**

A spring-charging handle of the mechanism is turned in one direction to charge a closing spring for the switch blades and in an opposite direction to charge an opening spring. Either spring may be charged first, but both springs must be charged before the closing spring can be discharged to close the switch blades. An interlock is provided between a door for enclosing the switch mechanism and a latch releasing means.

9 Claims, 20 Drawing Figures

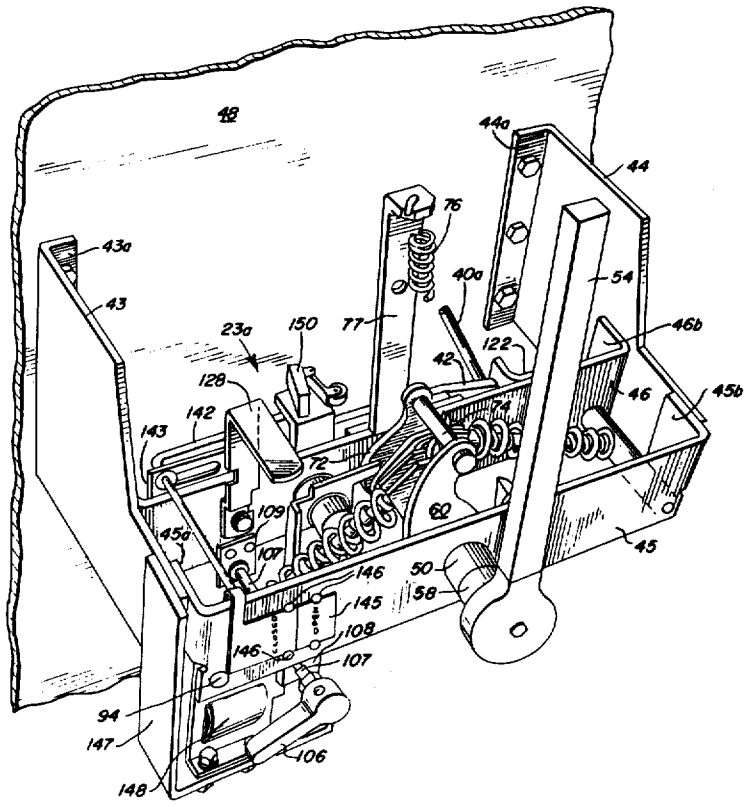
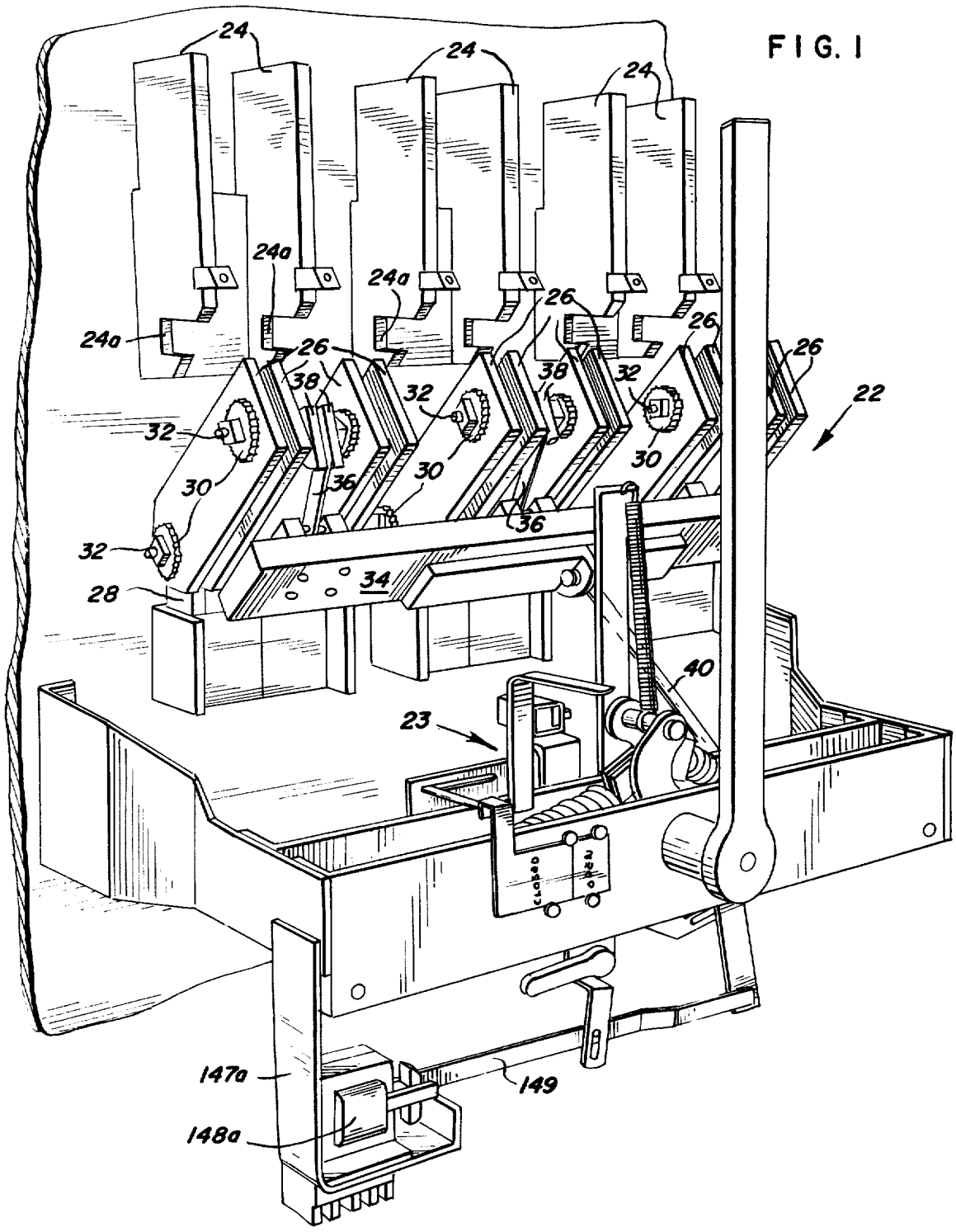


FIG. 1


24
24
24
24a
24a
24a
26
26
26
26
26
38
38
32
32
32
32
30
30
30
30
36
36
34
28
22
23
40
CLOSED
OPEN
147a
148a
149

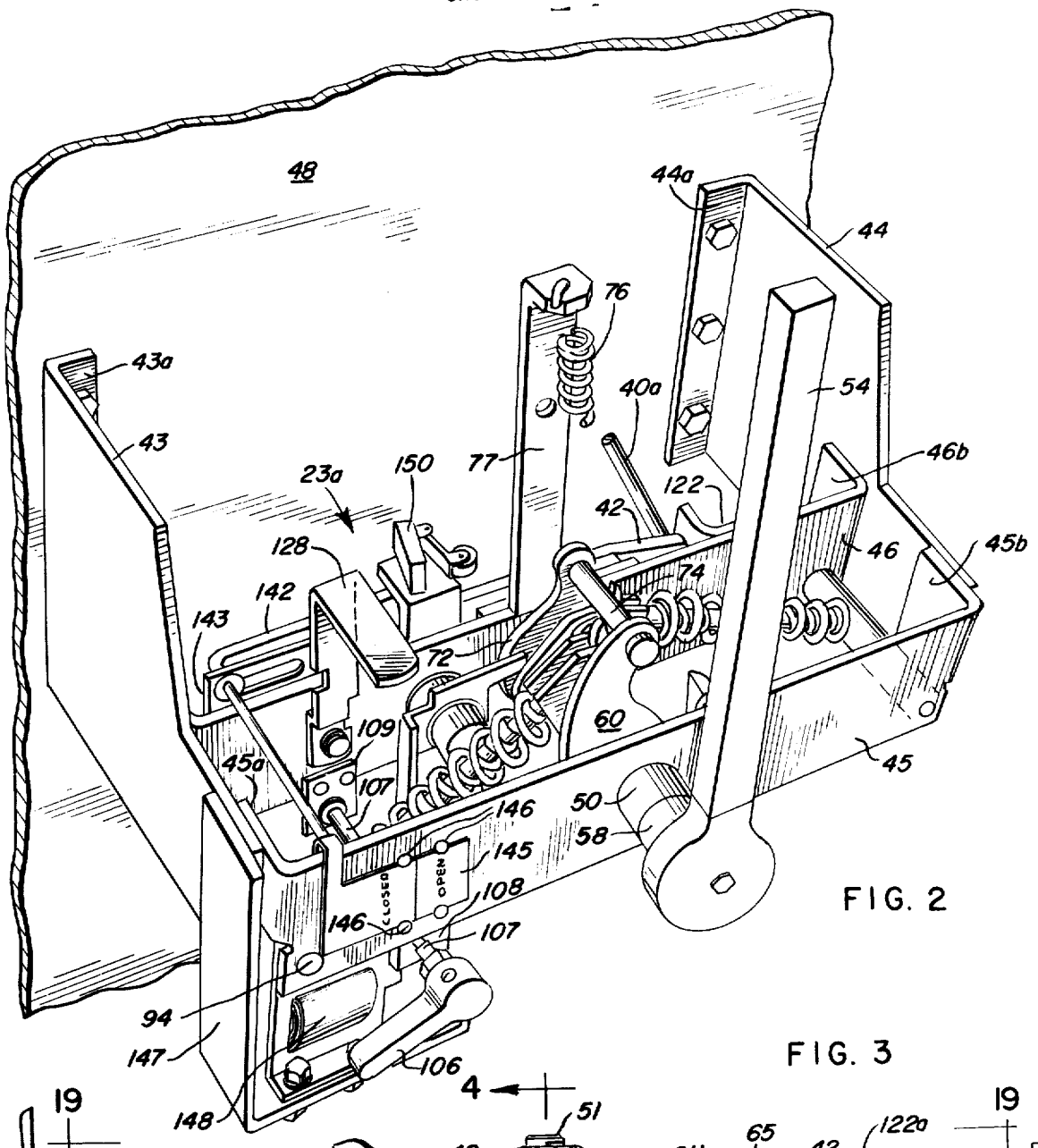
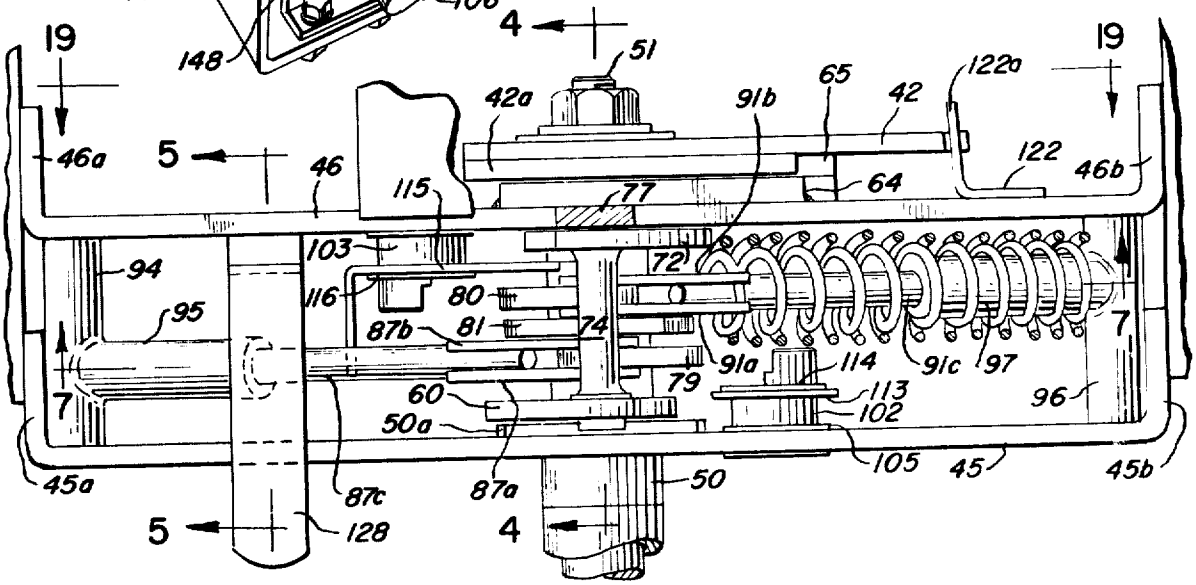

48
44a
44
76
43a
43
40a
54
23a
150
77
46b
122
42
128
74
46
45b
142
143
72
109
60
45a
107
45
146
50
58
145
OPEN
CLOSED
108
146
107
94
147
106
148

FIG. 2

FIG. 3


19
4
51
19
42a
91b
65
42
122a
46a
5
46
122
46b
115
77
64
103
72
94
116
80
95
87b
81
74
91a
114
91c
97
7
7
79
60
113
96
50a
102
105
45
45a
45b
87c
87a
50
5
128
4

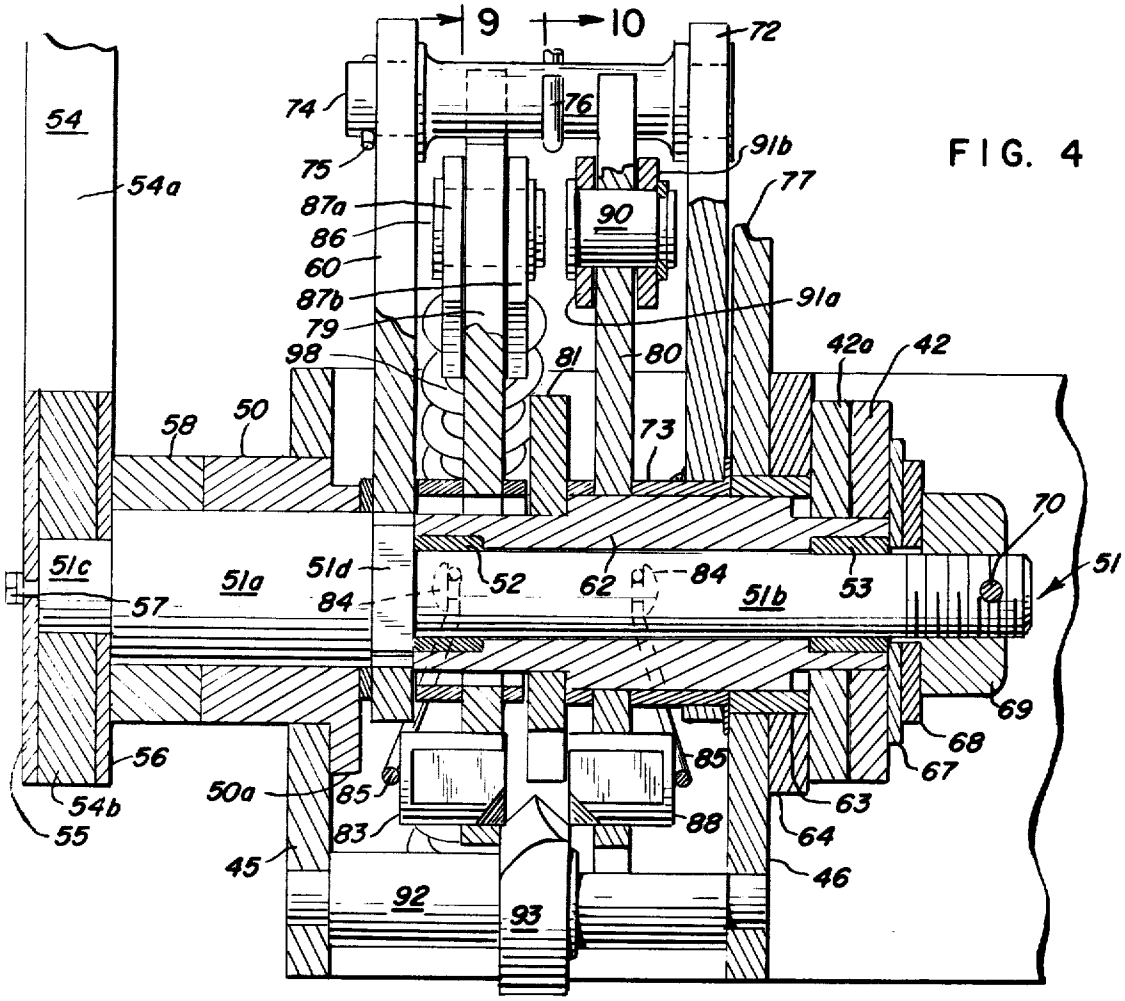


FIG. 4

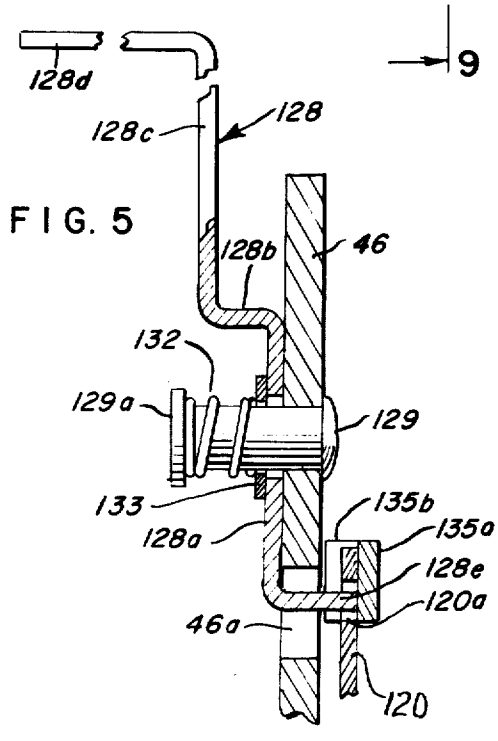


FIG. 5

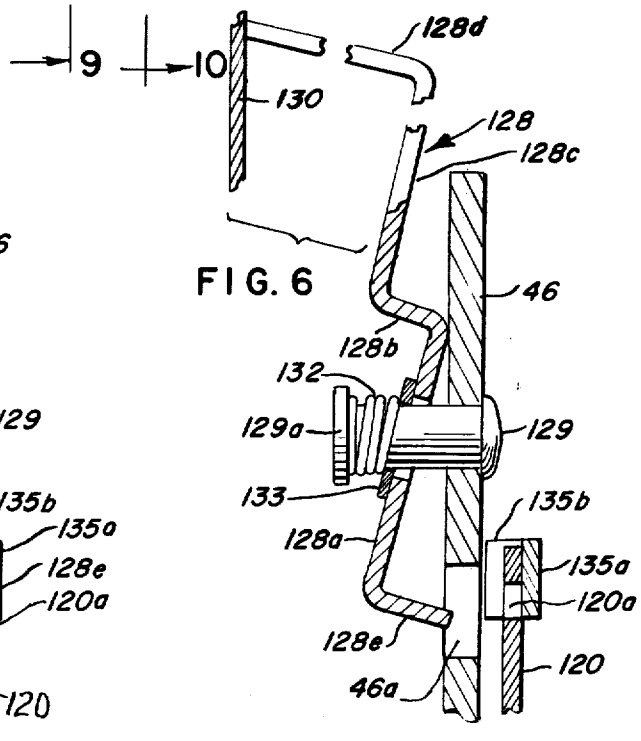


FIG. 6

FIG. 7

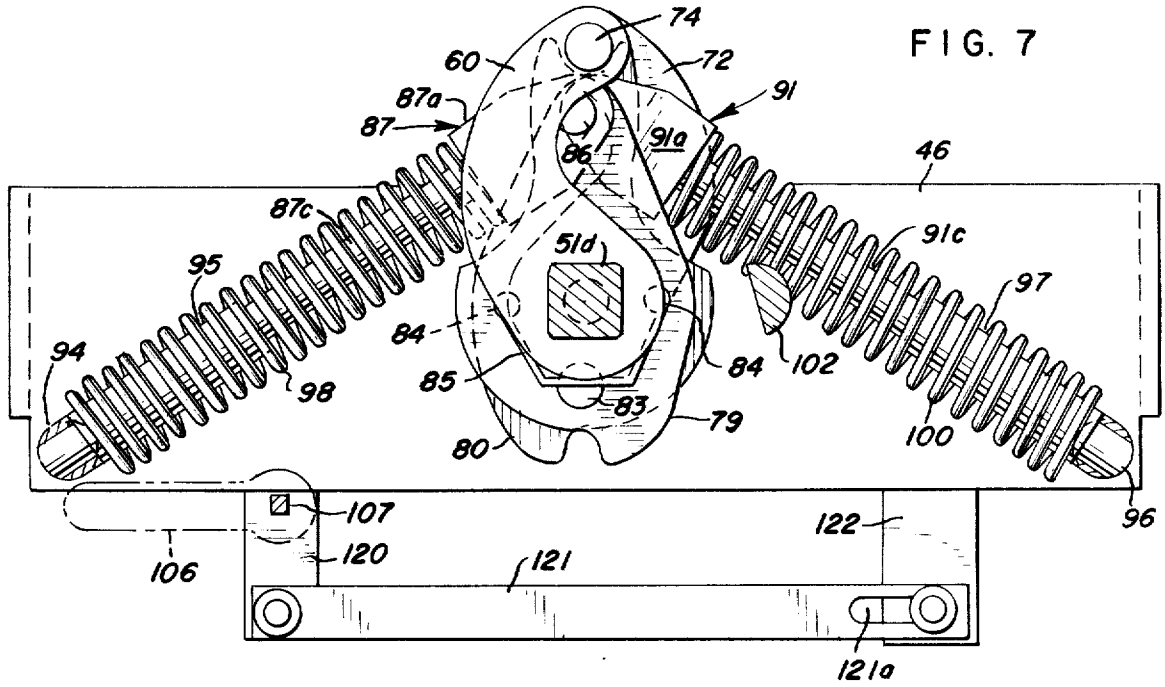
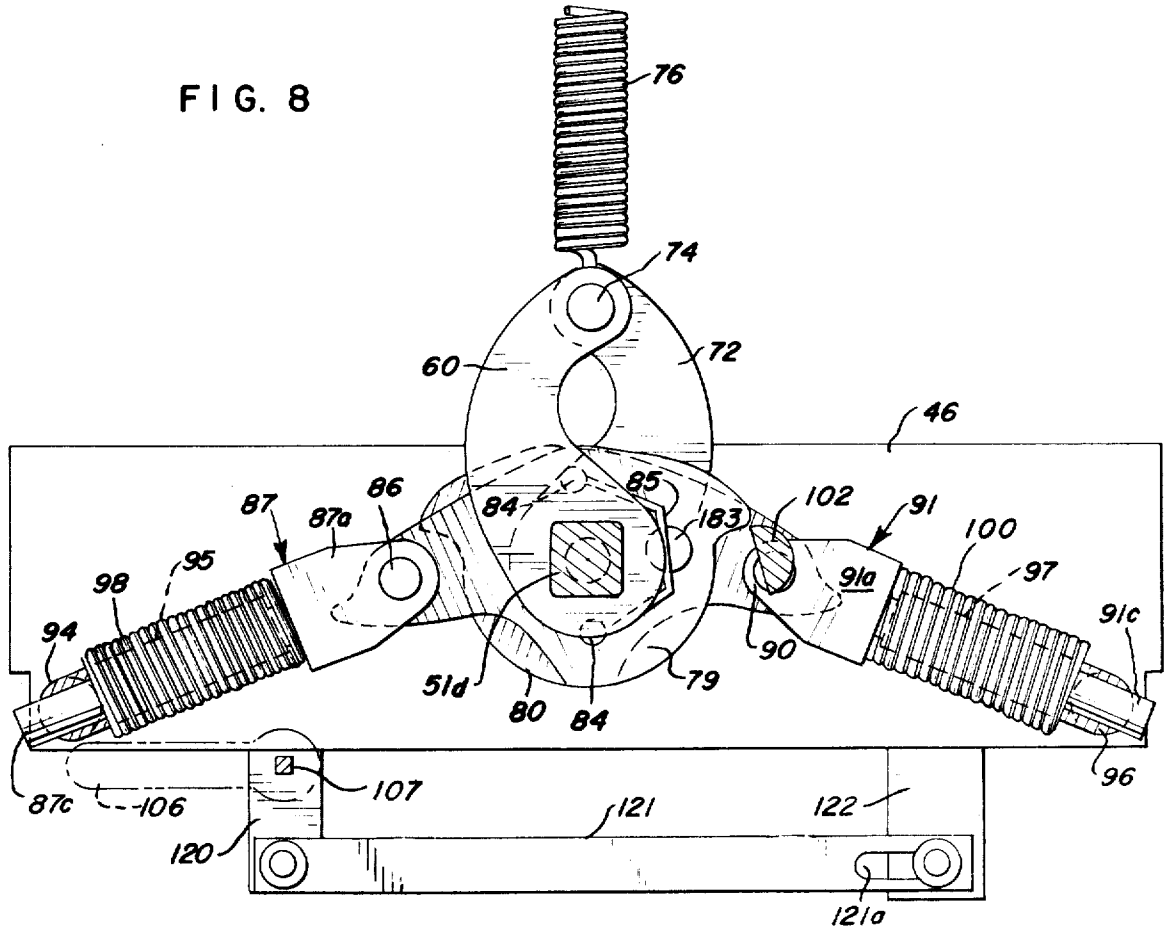

74
60
72
87a
87
91
91a
86
46
87c
91c
51d
95
97
84
94
98
85
84
102
83
79
80
100
96
107
122
106
120
121
121a

FIG. 8


76
74
60
72
46
87
87a
86
84
85
183
102
91
100
98
95
91a
97
94
91c
90
51d
80
84
79
96
87c
106
107
121
122
120
121a

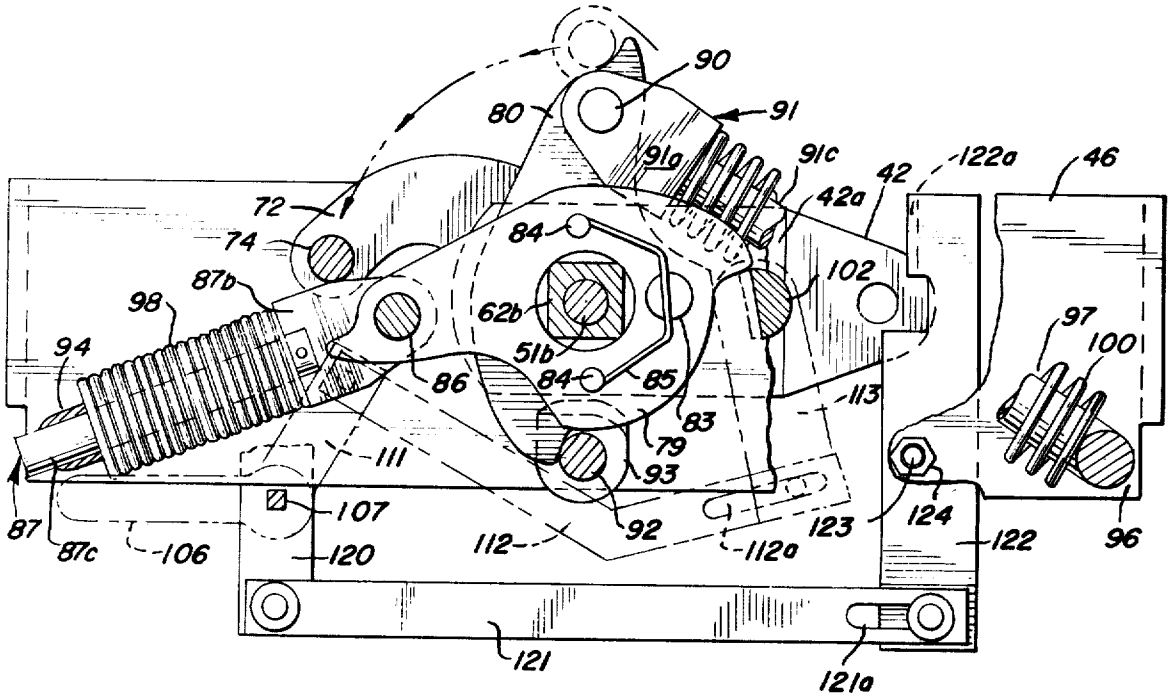

90
80
91
91a
91c
42
122a
46
72
74
84
42a
102
87b
98
62b
51b
97
100
94
86
84
85
83
113
79
93
111
87
87c
106
107
120
112
92
112a
123
124
122
96
121
121a

FIG. 9

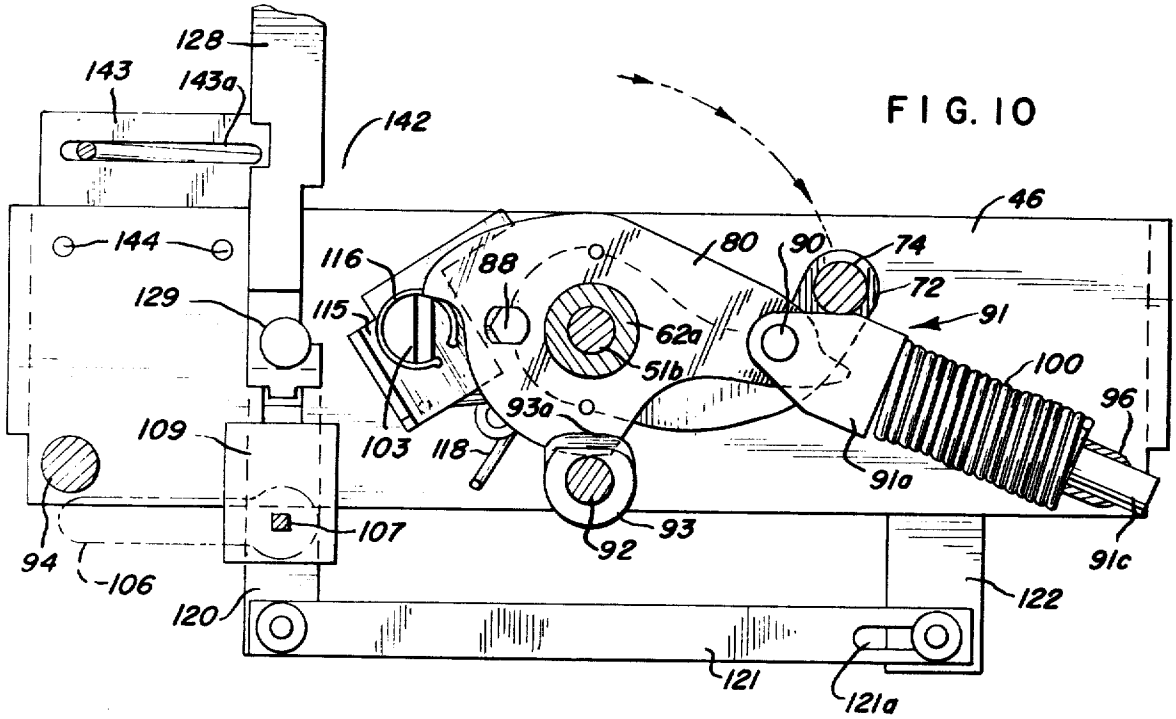

128
143
143a
142
144
46
116
88
80
90
74
72
129
115
91
62a
51b
100
96
93a
109
103
118
91a
93
92
94
106
107
91c
120
122
121
121a

FIG. 10

FIG. 11

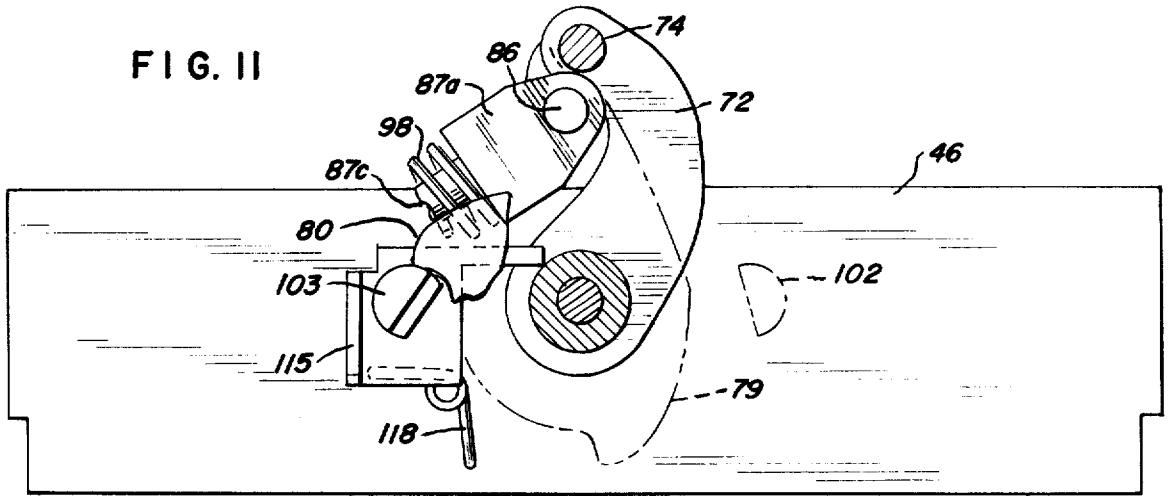


FIG. 12

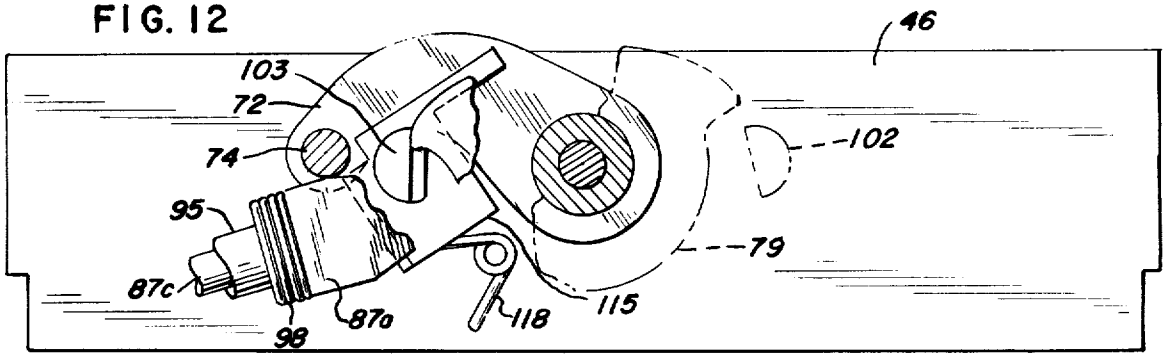


FIG. 13

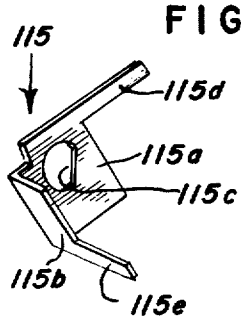


FIG. 14

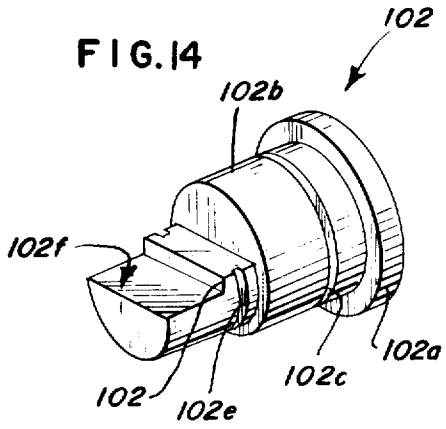
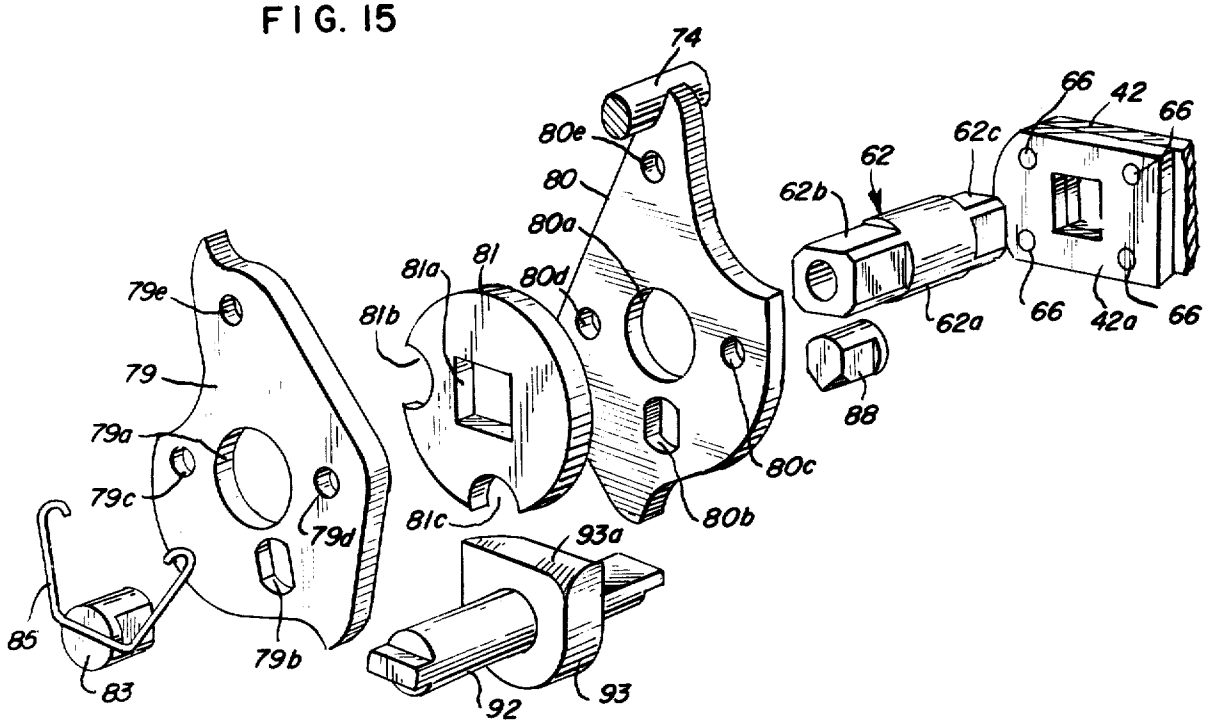


FIG. 15



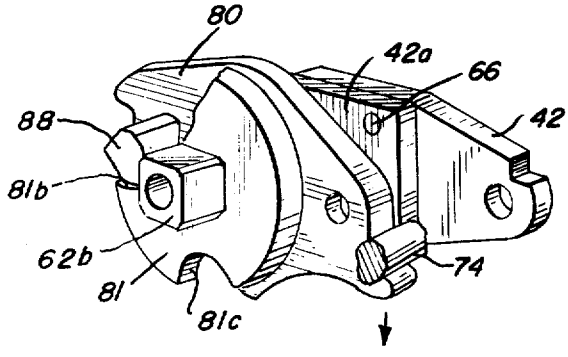


FIG. 16

FIG. 17

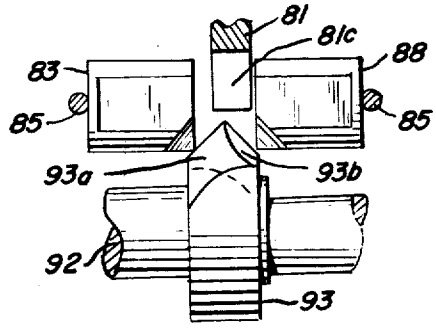


FIG. 18

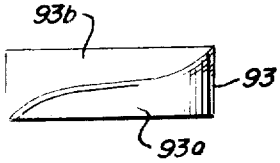


FIG. 19

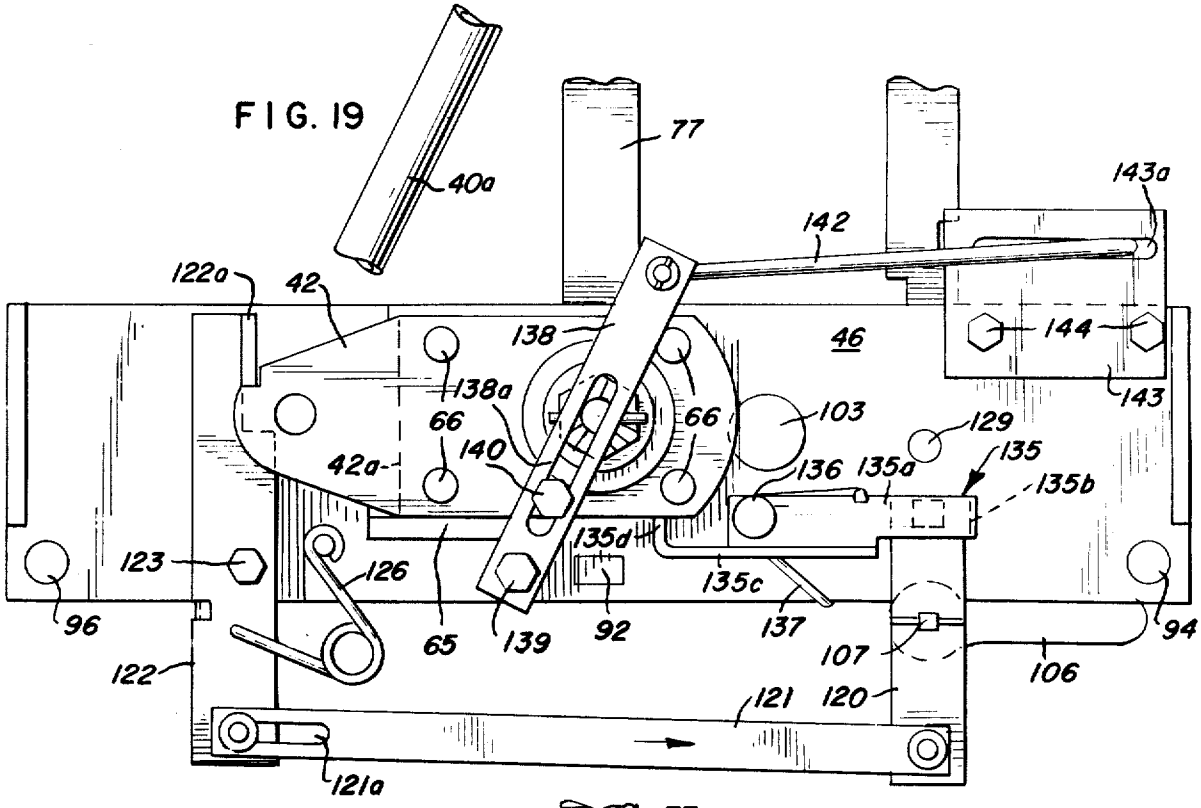
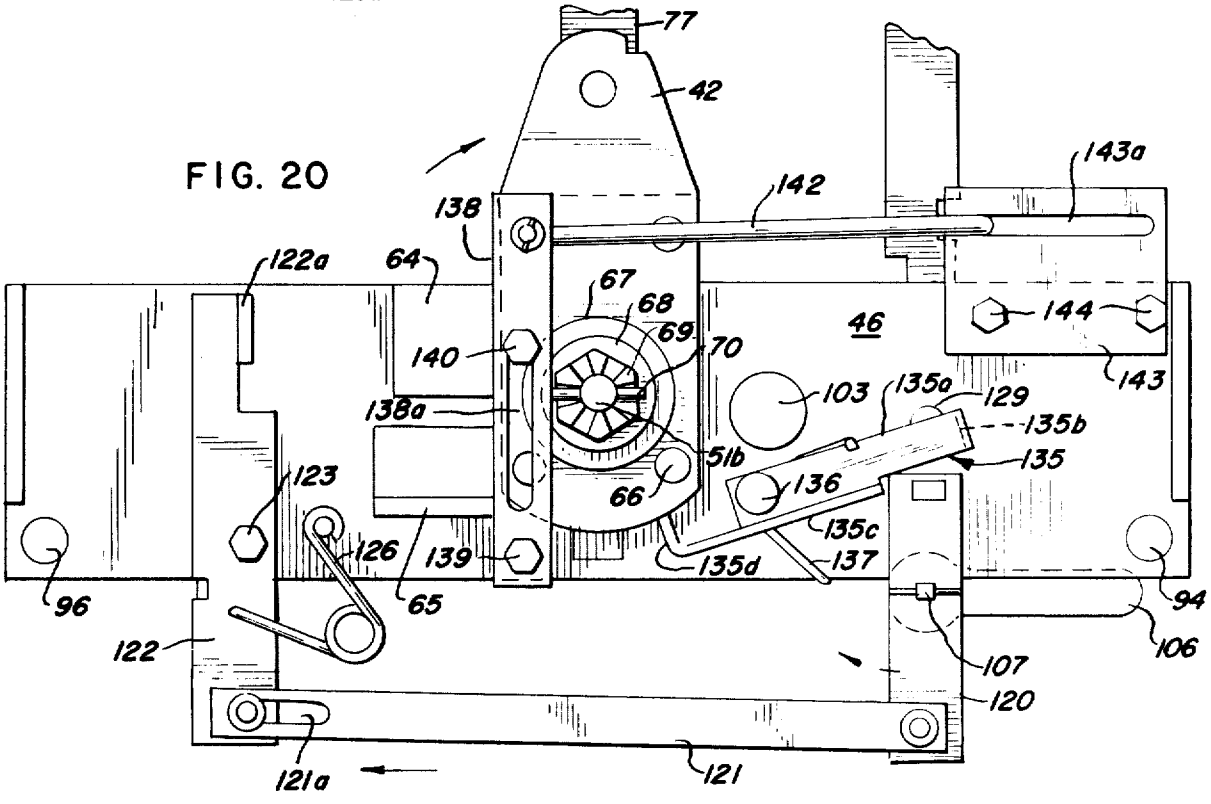

40a
77
143a
142
122a
42
138
46
144
138a
66
66
103
129
143
42a
140
136
135a
135
135b
123
126
135d
135c
96
65
139
92
137
107
94
122
106
121
120
121a

FIG. 20


77
42
143a
142
138
64
122a
67
68
69
70
144
46
140
103
135a
129
143
138a
135b
135
51b
66
136
123
126
139
135c
135d
137
96
65
94
106
122
107
120
121
121a

STORED-ENERGY OPERATING MECHANISM FOR SWITCH BLADES

This application is a continuation of prior application Ser. No. 329,804, filed Feb. 5, 1973 now abandoned.

Prior stored energy operating mechanisms for switch blades permitted closing of the switch blades without charging of the opening spring. Warning signals were activated when this dangerous condition occurred, but there was always the possibility that the warning would be ignored or misunderstood.

An object of this invention is to provide an improved stored energy operating mechanism for switch blades, the mechanism having means preventing closing of the switch blades unless both the opening and closing springs have been charged.

Other objects and advantages will become apparent when the following specification is considered along with the accompanying drawings in which:

FIG. **1** is a fragmentary perspective view of a relatively large switch having a stored-energy operating mechanism constructed in accordance with my invention, an enclosure for the switch being omitted;

FIG. **2** is a fragmentary perspective view of a switch similar to that of FIG. **1**, but relatively smaller, and showing mainly the stored-energy operating mechanism thereof, which is also constructed in accordance with the invention;

FIG. **3** is a fragmentary top view of the operating mechanism of FIG. **2**, with certain parts omitted and other parts shown in section;

FIG. **4** is an enlarged fragmentary sectional view taken generally along the line **4—4** of FIG. **3**;

FIG. **5** is a fragmentary sectional view of the operating mechanism of FIG. **2** taken generally along the line **5—5** of FIG. **3**;

FIG. **6** is a view similar to FIG. **5**, but including a portion of a closed door of an enclosure for the switch and showing an interlock member of FIG. **5** in a different position;

FIG. **7** is a fragmentary sectional view of the operating mechanism of FIG. **2** taken generally along the line **7—7** of FIG. **3**, with certain parts omitted, and showing opening and closing springs of the operating mechanism in discharged condition;

FIG. **8** is a view similar to FIG. **7**, but showing the opening and closing springs of the operating mechanism in charged condition;

FIG. **9** is a fragmentary sectional view of the operating mechanism of FIG. **2** taken generally along the line **9—9** of FIG. **4**, with certain parts shown in phantom and other parts broken away, and showing the charging of the opening spring;

FIG. **10** is a fragmentary sectional view of the operating mechanism of FIG. **2** taken generally along the line **10—10** of FIG. **4**, and showing the charging of the closing spring;

FIGS. **11** and **12** are simplified views similar to FIG. **9** and illustrating the change of position of a latch pin for an actuating plate of the closing spring as the condition of the opening spring is changed from a discharged condition of FIG. **11** to a charged condition of FIG. **12**;

FIG. **13** is a perspective view of a release member for the latch pin for the actuating plate of the closing spring;

FIG. **14** is a perspective view of a latch pin for one of the actuating plates of the opening and closing springs;

FIG. **15** is an exploded perspective view of certain parts shown in FIG. **4**;

FIG. **16** is a perspective view of certain parts shown in FIG. **15**, the parts being assembled and shown in their position assumed upon charging of the closing spring of the operating mechanism;

FIG. **17** is a side view of certain parts shown in FIG. **15**;

FIG. **18** is a top view of a cam member shown in FIGS. **15** and **17**;

FIG. **19** is a fragmentary view of the operating mechanism of FIG. **2** taken in the direction of arrows **19—19** of FIG. **3** and depicting an open condition of the switch; and

FIG. **20** is a view similar to FIG. **19**, but depicting a closed condition of the switch.

With reference to the drawings, a switch **22** having an operating mechanism **23** constructed in accordance with the invention is shown in FIG. **1**. The switch **22** is of a relatively high capacity and includes a pair of connected stationary contact blades **24** in each of three poles. In the closed condition of the switch **22**, each blade **24** is clamped by a pair of movable contact blades **26**. Each pair of blades **26** is pivotally mounted on a mounting blade **28** and clamps the respective blade **28** in the closed condition of the switch **22**. The clamping means by which each pair of blades **26** at one end clamps a contact blade **24** and at the other end clamps a mounting blade **28** includes a pair of nuts **30** non-rotatably mounted on each blade **26** on one side thereof respectively adjacent opposite longitudinal ends thereof. The nuts **30** on one blade **26** of a pair face oppositely and are oppositely threaded from those on the other blade **26** of the pair. A pair of studs **32**, one of which is mounted in the respective mounting blade **28**, is provided for each pair of blades **26**. Each stud **32** is provided with oppositely threaded portions for mating with the pair of oppositely threaded nuts **30** mounted thereon.

In a manner not shown, the 12 blades **26** are operatively connected to a crossbar **34** movable to pivot the blades **26** to open and closed positions with respect to the stationary contact blades **24**. The blades **26** pivot about the studs **32** mounted in the mounting blades **28**, and the stud **32** mounted adjacent the free end of each pair of blades **26** is received in a slot **24***a* of the respective blade **24** when the blades **26** are moved to closed position. The blades **26** and the crossbar **34** pivot as a unit during their movement from fully open to fully closed position, but when the blades **26** are substantially in fully closed position, the cross bar **34** is caused, by mechanism not shown, to pivot about its operative connections (not shown) to the blades **26**. This relative pivotal each pole movement operates three links **36**, one for the four blades **26** of, and is more fully disclosed in copending application, Ser. No 336,147, filed Feb. 26, 1973. The links **36** are pivotally connected adjacent one end respectively to pairs of members forming part of the operative connections of the crossbar **34** to the blades **26**, and pivotally connected adjacent the other end respectively to pairs of crank members **38** each of which is non-rotatably secured relatively to one of the studs **32** extending through the free end portions of a pair of blades **26**. The studs **32** mounted in the mounting blades **28** are also provided with crank members similar to the crank members **38** and operatively connected to the crossbar **34** by links similar to the

links **36**. When the crossbar **34** pivots relatively to the blades **26** substantially at the end of their closing movement, the links such as links **36** operate the crank members **38** to turn the studs **32** relative to the fixed nuts **30** and clamp the pairs of blades **26** to the respective stationary contact blades **24** and the respective mounting blades **28** to provide good electrical connections. Upon opening movement of the blades **26**, the crossbar **34** first pivots with respect to the blades **26**, turning the studs **32** in an unclamping direction, and thereafter the crossbar **34** and blades **26** pivot as a unit to the open position.

The crossbar **34** is driven by a link **40** having spherical bearing type connections at opposite ends respectively to the crossbar **34** and to a crank member not shown in FIG. **1** but similar to a crank member **42** (FIGS. **2**, **3**, **4**, **9**, **15**, **16**, **19** and **20**) of an operating mechanism **23***a* (FIG. **2**) of a relatively smaller switch. The operating mechanism **23** of the switch **22** of FIG. **1** is substantially the same as the operating mechanism **23***a* disclosed in FIGS. **2–20** and hereinafter described. The mechanism **23***a* includes a driving link **40***a* similar to the link **40**.

A frame of the mechanism **23***a* includes a pair of left-hand and right-hand side plate members **43** and **44** and a pair of front and rear cross plate members **45** and **46**. The side plate members **43** and **44** are provided respectively with rear flanges **43***a* and **44***a* by which they are suitably secured to a supporting plate **48** formed of insulating material. The cross plate members **45** and **46** are provided at opposite ends respectively with flanges **45***a*, **45***b* and flanges **46***a*, **46***b* by which they are suitably secured to the side plate members **43** and **44**.

A flanged bushing **50** is received in a suitable aperture in the cross plate member **45** and has a flange **50***a* suitably secured to the rear surface of the cross plate member. As best shown in FIG. **4**, a shaft **51** includes a front cylindrical portion **51***a* rotatably mounted in the bushing **50** and a rear cylindrical portion **51***b* of relatively smaller diameter rotatably mounted in a pair of spaced needle bearings **52** and **53**. A spring charging handle **54** is mounted on an extreme front portion **51***c* of the shaft **51**. The portion **51***c* has a generally square cross section. The handle **54** includes an outer portion **54***a* in the form of a rectangular tube and an inner core portion **54***b* extending the length of the tube **54***a* on the inside thereof and projecting outwardly therefrom at the end shown in FIG. **4**. Preferably the core portion **54***b* is of laminated construction, being formed of a stack of stamped plates each having a square aperture in the projecting end portion for mounting on the square portion **51***c*. Two generally circular but flat-topped filler plates **55** and **56** are provided, one on each side of the projecting portion of the core **54***b*. The plate **56** has a square aperture for receiving the square portion **51***c*, and the plate **55** has a relatively smaller circular aperture for receiving a screw **57** threaded into the square portion **51***c* to secure the handle **54** thereon. A spacer **58** is provided on the portion **51***a* of the shaft **51** between the bushing **50** and the filler plate **56**.

The shaft **51** includes a portion **51***d* between the cylindrical portions **51***a* and **51***b*. The portion **51***d* has a generally square cross section and has a front drive crank **60**, with a matching square aperture, mounted thereon. A sleeve **62** is mounted over the cylindrical portion **51***b* of the shaft **51** on the needle bearings **52** and **53**. The sleeve **62** is best shown in FIG. **15** and includes a central cylindrical portion **62***a* and a pair of opposite end portions **62***b* and **62***c* each having a generally square periphery with rounded corner portions which are extensions of the cylindrical periphery of portion **62***a*. A rear part of the portion **62***a* is rotatably mounted in a needle bearing **63** secured in a suitable aperture in the cross plate member **46** and in a reinforcing plate **64** welded thereto. An angle bracket **65** (FIGS. **3**, **19** and **20**) which acts as a stop for the crank member **42** is welded to the cross plate member **46** adjacent the reinforcing plate **64**.

The crank member **42** and a reinforcing plate **42***a* secured thereto by a plurality of pins **66** each have a square aperture therein, as shown in FIG. **14**, for mounting thereof on the end portion **62***c* of the sleeve **62**. The free end of the portion **51***b* of the shaft is threaded and a pair of washers **67** and **68** and a nut **69** are provided thereon to retain the crank member **42** and plate **42***a*. Preferably the nut **69** is slotted (FIG. **20**) and the portion **51***b* is cross drilled to receive a cotter pin **70** and prevent the nut **69** from loosening.

A rear idler crank **72** is welded to a bushing **73** rotatably mounted on the sleeve **62**. The free ends of the cranks **60** and **72** are joined by a crank pin **74** welded to the crank **72** and secured to the crank **60** by a retaining pin **75**. A spring **76** secured at one end to the crank pin **74** and at the other end to a bracket **77** (FIG. **2**) welded to the cross plate member **46** normally maintains the crank pin **74** in an upper position and thereby the handle **54** in a vertically upright position.

An actuating plate **79** best shown in FIG. **15** has a circular aperture **79***a* by which it is rotatably mounted on the rounded corner portions of sleeve portion **62***b*. Another actuating plate **80** has a circular aperture **80***a* by which it is rotatably mounted on a front part of the sleeve portion **62***a*. A driving disc **81** having a central square aperture **81***a* matching the square portion of the periphery of the sleeve portion **62***b* is mounted thereon between the actuating plates **79** and **80**, which are identical but reversely positioned with respect to each other. Suitable spacers and washers are provided between the various members along the shaft **51** and sleeve **62**.

The plate **79** has a non-circular aperture **79***b* (FIG. **15**) in which a clutch pin **83** is reciprocably mounted, a pair of apertures **79***c* and **79***d* in which a pair of rivets **84** (FIG. **9**) are respectively received to secure a biasing spring **85** in position, and an aperture **79***e* in which a pin **86** (FIG. **4**, **7**, **8** and **9**) is received to pivotally connect the plate **79** and an actuating link **87**. The plate **80** has corresponding apertures **80***b*, **80***c*, **80***d* and **80***e*, a clutch pin **88** being reciprocably mounted in the aperture **80***b*, another pair of rivets **84** being respectively received in the apertures **80***c* and **80***d* to secure another biasing spring **85** in position, and a pin **90** being received in the aperture **80***e* to pivotally connect the plate **80** and an actuating link **91**. The springs **85** bias the clutch pins **83** and **88** respectively toward the driving disc **81**, which is provided with a pair of peripheral notches **81***b* and **81***c* spaced approximately 90° apart. The outer end portions of the clutch pins **83** and **88** are circular and will not pass respectively through the non-circular apertures **79***b* and **80***b*. Under one condition, as later explained, the inner end portion of the clutch pin **88** is receivable in the notch **81***b*, and under another condition, the inner end portion of the clutch pin **83** is receivable in the notch **81***c*.

A shaft **92** best shown in FIG. **15** has non-circular opposite end portions mounted respectively in corresponding apertures in the cross plate members **45** and **46**, as shown in FIGS. **4** and **19**. A cam **93** is non-rotatably mounted on a non-circular portion of the shaft **92** immediately below the driving disc **81**. The cam **93** includes a cam surface **93***a* (FIG. **18**) and a cam surface **93***b* which respectively hold the clutch pins **83** and **88** out of the notch **81***c*, as best shown in FIG. **17**, when the clutch pins are directly beneath the shaft **51**. As explained hereinafter, the cam **93** prevents both clutch pins **83** and **88** from being engaged in their respective notches **81***c* and **81***b* simultaneously. The shaft **92** acts as a stop for the actuating plates **79** and **80**.

The actuating link **87** includes a pair of spaced connecting plates **87***a* and **87***b* apertured for mounting on the pin **86** on opposite sides of the actuating plate **79** and rigidly secured to opposite sides of a flat end portion of a cylindrical rod **87***c*. A solid pivot shaft **94** (FIGS. **2** and **3**) has a pair of opposite, reduced-diameter end portions pivotally mounted respectively in the cross plate members **45** and **46** adjacent the flanges **45***a* and **45***a* thereof. An end of a tube **95** is welded to the shaft **94** crosswise thereof after the shaft **94** has been faced with an end mill to provide a flat circular surface thereon for joining to the tube. The shaft **94** is also cross drilled axially of the tube **95**, as shown in FIGS. **7** and **8**. The rod **87***c* of the actuating link **87** is reciprocably mounted in the tube **95** and the passage through the shaft **94**.

The actuating link **91** is identical to the link **87**, connecting plates **91***a* and **91***b* thereof being pivotally mounted on the pin **90** and rod **91***c* thereof being reciprocably mounted in a passage through a pivot shaft **96** and a tube **97** respectively identical to the shaft **94** and tube **95**. The unit comprising the shaft **96** and tube **97** is reversely positioned, end-to-end of the shaft **96**, with respect to that comprising the shaft **94** and tube **95** and is disposed adjacent the flanges **45***b* and **46***b* of the cross plate members.

Compression coil spring means is provided around the tube **95** and rod **89***c* and also around the tube **97** and rod **91***c*. This may be two concentric coil springs, as shown in FIG. **3** around the tube **97** and rod **91***c*, but for convenience only one such spring is shown in FIGS. **7–12**, a coil spring **98** being shown around the tube **95** and rod **87***c* and a coil spring **100** being shown around the tube **97** and rod **91***c*. Because of their functions in the operation of the switch, the spring **98** is referred to as the opening spring and the spring **100** as the closing spring.

A latch pin **102** (FIGS. **3** and **9**) for the actuating plate **79** is pivotally mounted in the cross plate member **45** and an identical latch pin **103** (FIGS. **3, 10, 11** and **12**) for the actuating plate **80** is pivotally mounted in the cross plate member **46**. As best shown in FIG. **14**, the latch pin **102** includes a circular outer end portion **102***a*, a circular intermediate portion **102***b* provided with a groove **102***c*, a non-circular intermediate portion **102***d* provided with a groove **102***e*, and a semi-circular inner end portion **102***f*. The portion **102***a* has a larger radius than the portion **102***b*, and the portions **102***d* and **102***f* have the same radius, smaller than that of portion **102***b*, but while the portion **102***f* is semi-circular, the portion **102***d* is larger than semi-circular in cross section. The pin **102** is axially held in the cross plate member **45**, in an aperture (not shown) of diameter corresponding to the portion **102***b*, by the portion **102***a* on one side and snap ring **105** (FIG. **3**) snapped into the groove **102***c* on the other side.

A latch release handle **106** (FIG. **2**) is mounted on a square shaft **107** (FIGS. **7–10**) rotatably mounted in a plate **108** (FIG. **2**) secured to the plate member **45** and a plate **109** (FIG. **10**) secured to the plate member **46**. As only shown in phantom in FIG. **9**, a crank **111** mounted on the square shaft **107** is pivotally connected to one end portion of a generally V-shaped link **112**. The other end portion of the link **112** is pivotally connected to a crank **113** having an aperture matching the portion **102***d* of the latch pin **102**. The crank **113** is held on the portion **102***d* against the portion **102***b* by a snap ring **114** mounted in the groove **102***e*.

As mentioned above, the latch pin **103** is identical to the latch pin **102**, but instead of a crank such as the crank **113** mounted on the latch pin **102**, the latch pin **103** has a release member **115**, best shown in FIG. **13**, mounted thereon by a snap ring **116**. The release member **115** includes two planar portions **115***a* and **115***b* generally at right angles to each other. The portion **115***a* is provided with an aperture **115***c* matching the portion of the latch pin **103** corresponding to the portion **102***d* of the latch pin **102**, and includes a tongue portion **115***d* engageable with the bushing **73** to limit rotation of the latch pin **103**. The portion **115***b* includes a tongue portion **115***e* engageable by the connecting plates **87***a* and **87***b* of the actuating link **87** to pivot the latch pin **103** out of latching position with respect to the actuating plate **80**, as more fully explained hereinafter. The release member **115** and the latch pin **103** are biased toward latching position by a torsion spring **118** having one end secured with respect to the cross plate member **46** and the other end secured in the release member **115**. The crank **113** and the latch pin **102** are similarly biased toward latching position with respect to the actuating plate **79** by a similar torsion spring (not shown).

Mounted on the square shaft **107** on the rear side of the cross plate member **46**, by means of a corresponding square aperture, is a crank **120** pivotally connected to one end portion of a link **121**. The other end portion of the link **121** is pivotally connected to a lower end portion of a latch member **122** for the crank member **42**. The latch member **122** is pivotally mounted at a midportion thereof on a bolt **123** threaded in the cross plate member **46** and locked by a nut **124** (FIG. **9**). While generally flat, the latch member **122** is provided with a bent tongue portion **122***a* for latching the crank member **42**. A torsion spring **126** (FIGS. **19** and **20**) having one end secured with respect to the cross plate member **46** and the other end secured in the latch member **122** biases the latch member **122** toward latching position. At its pivotal connection to the latch member **122**, the link **121** is provided with a slot **121***a* for required lost motion. Similarly, the link **112** (FIG. **9**) is provided with a slot **112***a* at its pivotal connection to the crank **113**.

An interlock member **128** best shown in FIGS. **5** and **6** includes a portion **128***a* loosely mounted on a pin **129** staked in the cross plate member **46**. At an upper end of the portion **128***a* an offsetting portion **128***b* offsets an upwardly extending portion **128***c* from the portion **128***a*. A portion **128***d* extends forwardly from the upper end of the portion **128***c* for engagement by a door **130**,

fragmentarily shown in FIG. 6, of an enclosure for the switch.

Besides extending downwardly from the shaft 107 for connection to the link 121, the crank 120 extends upwardly from the shaft 107 and is provided adjacent its upper end with an aperture 120*a* normally in registry with an aperture 46*a* provided in the cross plate member 46 beneath the pin 129. A portion 128*e* extends rearwardly from the lower end of the portion 128*a*. The member 128 is biased on the portion 128*a* toward the cross plate member 46 by a spring 132 disposed on the pin 129 between a head portion 129*a* thereof and a washer 133 disposed on the pin 129 adjacent the portion 128*a*. When the door 130 is open, the interlock member 128 is disposed as shown in FIG. 5 with the portion 128*e* extending through the aperture 46*a* of cross plate member 46 into registry with the aperture 120*a* of the crank 120. In this position, the portion 128*e* prevents turning of the crank 120 and thus of the handle 106 and shaft 107. When the door 130 is closed, it will engage the portion 128*d* and move the member 128 to the position shown in FIG. 6, wherein the portion 128*e* is retracted out of registry with the aperture 120*a*. thus enabling the crank 120, handle 106, and shaft 107 to be turned.

An interlock member 135 (FIGS. 19 and 20) includes an elongated flat portion 135*a* pivotally mounted adjacent one end on a pin 136 secured in the cross plate member 46. A portion 135*b* extends forwardly toward the cross plate member 46, from the end of the portion 135*a* opposite from the pin 136, into overlapping relationship with an upper side edge portion of the crank 120, as shown most clearly in FIGS. 5 and 6. A torsion spring 137 mounted on the pin 136 between the portion 135*a* and the cross plate member 46 biases the interlock member 135 clockwise as viewed in FIGS. 19 and 20. A portion 135*c* extending rearwardly at right angles to the portion 135*a* is provided with an upturned end portion 135*d* biased into engagement with the crank member 42 by the spring 137. When the crank member 42 moves from an open position of FIG. 19 to a closed position of FIG. 20, it pivots the interlock member 135 counter-clockwise as viewed therein to move the portion 135*b* out of alignment with the upper side edge portion of the crank 120. The handle 106, shaft 107, and crank 120 are then free to be rotated clockwise in FIGS. 19 and 20, as more fully explained hereinafter.

A crank 138 is pivotally mounted adjacent a lower end on a pin (not shown) mounted in the cross plate member 46 and having a screw 139 threaded therein to retain the crank 138 thereon. A driving pin (not shown) mounted on the crank member 42 extends through a slot 138*a* in the crank 138 and has a retaining screw 140 threaded therein. A bent rod 142 best shown in FIG. 2 is pivotally connected adjacent one end to the upper end portion of the crank 138 and is reciprocally mounted in a slot 143*a* of a guide plate 143 secured to the cross plate member 46 by a pair of screws 144. The other end of the rod 142 is operatively connected to an indicator 145 slidably mounted between two pairs of pins 146 mounted in the cross plate member 45. "OPEN" and "CLOSED" indicia provided on the indicator 145 are adapted to appear selectively in a window (not shown) in the door 130 (shown only fragmentarily in FIG. 6) to indicate the condition of the switch blades.

Provision may be made to open the switch electrically. For this purpose, an L-shaped bracket 147 (FIG. 2) is secured to the left-handed side plate member 43 and a solenoid 148 is mounted thereon. The solenoid 148 is operatively connected to the crank 113 (FIG. 9) by a link (not shown) similar to a link 149 (FIG. 1) associated with a solenoid 148*a* mounted on a bracket 147*a* of the switch 22. A limit switch 150 (FIG. 2) must be closed by the crank member 42 before the solenoid 148 can be operated.

OPERATION

Assuming that the switch is open, that the crank member 42 is therefore in the position shown in FIGS. 2, 3, 4, 9, 15, 16, and 19, that the opening spring 98 and the closing spring 100 are both in the uncharged condition as shown in FIG. 7, and that it is desired to close the switch, the handle 54 is rotated from the vertical position approximately a quarter turn either way to charge one of the springs 98 and 100 and then back to the vertical position and approximately a quarter turn the other way to charge the other of the springs 98 and 100.

Rotation of the handle 54 approximately one-fourth of a turn first clockwise as viewed in FIG. 2 also rotates the shaft 51, the drive crank 60 fixedly mounted thereon, the crank pin 74, and the idler crank 72. The crank pin 74 engages the end portion of the actuating plate 80 carrying the pin 90 and pivots the actuating plate 80 about the axis of the sleeve 62 from the position shown in FIG. 15 to that of FIG. 16, whereupon the clutch pin 88 enters the notch 81*b* of the driving disc 81 under the influence of its biasing spring 85, having initially been held out of the notch 81*c* by the cam 93. For convenience of illustration, the crank pin 74 is shown in engagement with the actuating plate 80 in FIG. 16, whereas actually, before the actuating plate 80 has been pivoted the approximate quarter turn, the crank pin 74 engages the connecting plates 91*a* and 91*b* of the actuating link 91 and further movement of the actuating plate 80 is by virtue of the pin 90, as notable from FIG. 10. The pin 90 also moves the actuating link 91 inwardly of the tube 97, and the spring 100 is charged by compression between the connecting plates 91*a* and 91*b* and the pivot shaft 96. The end portion of the actuating plate 80 carrying the clutch pin 88 pivots the latch pin 103, while moving upwardly along the flat side surface of the semi-circular inner end portion thereof, and moves past the upper end of the flat side surface, whereupon the latch pin 103 is pivoted to latching position, as shown in FIG. 11, by the spring 118 and release member 115. The rotation of the handle 54 clockwise is limited by engagement of the drive crank 60 with the circular portion 102*b* of the latch pin 102, and upon release of the handle, the spring 76 returns it to normal upright position.

Assuming that the door 130 is closed and the portion 128*e* of the interlock member 128 is retracted out of registry with the aperture 120*a* of the crank 120, as shown in FIG. 6, if an attempt is made to close the switch without first also charging the opening spring 98, rotation of the latch release handle 106 clockwise in FIGS. 2 and 9 (counter-clockwise in FIG. 19) moves the crank 120 and link 121 to pivot the latch member 122 out of latching engagement with the crank member 42, but the crank member 42 remains in the open position, corresponding to the open position of the switch

blades, because the actuating plate **80** remains latched by the latch pin **103.**

Rotation of the handle **54** approximately one-fourth of a turn counter-clockwise as viewed in FIG. **2** from the upright position to which it returns after charging of the closing spring **100** also rotates the shaft **51,** the drive crank **60,** the crank pin **74,** and the idler crank **72.** The crank pin **74** first engages the end portion of the actuating plate **79** carrying the pin **86** as shown in FIG. **7** and then the connecting plates **87***a* and **87***b* as shown in FIG. **9,** plate **87***a* being omitted, and the pin **86** moves the actuating link **87** inwardly of the tube **95** to charge the opening spring **98** by compression between the connecting plates **87***a* and **87***b* and the pivot shaft **94.** The clutch pin **83** is initially held out of the notch **81***c* by the cam **93,** and the end portion of the actuating plate **79** carrying the clutch pin **83** pivots the latch pin **102,** while moving upwardly along the flat side surface of the semi-circular inner end portion **102***f* thereof, and moves past the upper end of the flat side surface, whereupon the latch pin **102** is pivoted to latching position, as shown in FIGS. **8** and **9,** by the torsion spring (not shown, but similar to the spring **118**) connected to the crank **113.** The rotation of the handle **54** counter-clockwise is limited by engagement of the idler crank **72** with the intermediate circular portion of the latch pin **103.** Toward the end of this movement, the connecting plates **87***a* and **87***b* of the actuating link **87** strike the tongue portion **115***e* of the release member **115,** as shown in FIG. **12,** and pivot the latch pin **103** to an unlatching position, whereupon the actuating plate **80** is released. Discharge of the closing spring **100** does not occur at this time, however, because the crank member **42** is till latched by the latch member **122,** preventing rotation of the sleeve **62** and driving disc **81,** and the actuating plate **80** is tied to the driving disc by the clutch pin **88.** Upon release of the handle **54** after the counter-clockwise movement to charge the opening spring **98,** it is returned to normal upright position by the spring **76.**

The order of charging the springs **98** and **100** can be reversed. If the handle **54** is first rotated counter-clockwise, the opening spring **98** is charged, the actuating plate **79** is latched by the latch pin **102,** and the release member **115** and latch pin **103** are moved to and held in an unlatching position, in the manner explained above. Then when the handle **54** is rotated clockwise, the closing spring **100** is charged, and the actuating plate **80** is latched, not by the pin **103,** but by the clutch pin **88,** which engages the notch **81***b* of the driving disc **81.** The driving disc **81** is prevented from rotating because the latch member **122** holds the crank member **42** and sleeve **62.** Thus, when both springs **98** and **100** are charged, the position of the parts is the same after charging regardless of the order in which the springs are charged. However, when the closing spring **100** is charged first, the actuating plate **80** is temporarily latched by the latch pin **103,** whereas when the opening spring **98** is charged first, the latch pin **103** does not latch the actuating plate **80** at any time in the sequence.

With both springs **98** and **100** charged, the crank member **42** latched in open position by the latch member **122,** the door **130** closed, and portion **128***e* of the interlock member **128** retracted out of registry with the aperture **120***a* of the crank **120,** the handle **106** cannot be rotated counter-clockwise as viewed in FIG. **9** to move the crank **111,** link **112,** and crank **113** and rotate the latch pin **102** out of latching position with respect to the actuating plate **79,** thus discharging the opening spring **98** when the crank member **42** is already in open position, because the portion **135***b* of the interlock member **135** engages the crank **120** and prevents such counter-clockwise rotation of the handle **106.** Under these conditions, however, the handle **106** can be rotated clockwise as viewed in FIG. **9** (counter-clockwise as viewed in FIG. **19**) to pivot the crank **120,** move the link **121,** and pivot the latch member **122** out of latching position with respect to the crank member **42.** Because the latch pin **103** is already out of latching position with respect to the actuating plate **80** as a result of the pivoting of the release member **115** upon charging of the opening spring **98,** the closing spring **100** then discharges, driving the actuating link **91** outwardly of the tube **97** and rotating the actuating plate **80** by movement of the pin **90.** Excess movement of the actuating plate **80** is prevented by engagement thereof with the shaft **92.** Because the clutch pin **88** is engaged in the notch **81***b*, the driving disc **81** is rotated along with the actuating plate **80,** through approximately one-fourth of a turn, at the end of which the cam **93** moves the clutch pin **88** out of the notch **81***b* and the clutch pin **83** in the actuating plate **79** engages the notch **81***c*. The rotation of the driving disc **81** causes rotation of the sleeve **62** and pivoting of the crank member **42** and its reinforcing plate **42***a* to the closed position of FIG. **20.** The driving link **40** is thereby moved to pivot switch blades such as the blades **26** of FIG. **1** to closed position. With reference to FIGS. **19** and **20,** as the crank member **42** moves from the open position of FIG. **19** to the closed position of FIG. **20,** the pin carrying the screw **140** moves along the slot **138***a* and pivots the crank **138** to move the rod **142** and the indicator **145** (FIG. **2**) to closed position. The crank member **42** also pivots the interlock member **135** to move the portion **135***b* out of alignment with the upper side edge portion of the crank **120,** thereby freeing the crank **120** for the movement required for opening of the switch.

Assuming that the door **130** is still closed and the portion **128***e* of the interlock member **128** retracted out of registry with the aperture **120***a* of the crank **120,** the handle **106** can then be rotated counter-clockwise as viewed in FIGS. **2** and **9** to open the switch. The square shaft **107** can turn because the crank **120** is free of both interlock members **128** and **135,** and rotation of the shaft **107** pivots the crank **111** counter-clockwise, moves the link **112** leftward, and pivots the crank **113** and latch pin **102** clockwise to release the actuating plate **79.** The opening spring **98** then discharges, driving the actuating link **87** outwardly of the tube **95** and rotating the actuating plate **79** by movement of the pin **86.** Excess movement of the actuating plate **79** is prevented by engagement thereof with the shaft **92.** Because the clutch pin **83** is engaged in the notch **81***c*, the driving disc **81** is rotated along with the actuating plate **79,** through approximately one-fourth of a turn, at the end of which the cam **93** moves the clutch pin **83** out of the notch **81***c*. The rotation of the driving disc **81** causes rotation of the sleeve **62** and pivoting of the crank member **42** and its reinforcing plate **42***a* back to the open position of FIG. **19,** where the crank member **42** is again latched by the latch member **122.** The driving link **40***a* is thereby moved to pivot switch blades such as the blades **26** of FIG. **1** to open

position. The pin carrying the screw **140** pivots the crank **138** to move the indicator **145** (FIG. 2) to open position, and the spring **137** pivots the interlock member **135** to move the portion **135***b* back into alignment with the upper side edge portion of the crank **120.**

Various modifications may be made in the structure shown and described without departing from the spirit and scope of the invention.

I claim:

1. An operating mechanism for opening and closing an electrical switch comprising a supporting frame, a spring-actuated switch-closing means movably mounted on said frame; a spring-actuated switch-opening means movably mounted on said frame; manually-actuated means mounted on said frame for moving both of said spring-actuated means to a charged position; adjustable first means mounted on said frame for releasing said switch-closing means from said charged position and effecting movement thereof in a predetermined direction to a discharged position closing the switch only while said switch-opening means remains in a charged position; adjustable second means mounted on said frame for releasing said switch-opening means from said charged position and effecting movement thereof in a predetermined direction to a discharged position opening the switch; and connecting means for transmitting the movement of both of said spring means to the switch to effect closing and opening thereof.

2. The operating mechanism of claim **1** wherein the manually-actuated means for charging said spring-actuated means and components of both of said spring-actuated means are mounted on said frame for pivotal movement about a fixed common axis.

3. The operating mechanism of claim **2** wherein said manually-actuated means, when pivoted in one direction about said common axis charging only said switch-closing means, and when pivoted in a second direction, charging only said switch-opening means.

4. The operating mechanism of claim **3** including an elongated shaft means having the longitudinal axis thereof coincident to said common axis, and said common axis, and said manually-actuated means includes a crank member mounted on and movable as a unit with said shaft means, and an exposed handle mounted on and movable with said shaft means for imparting pivotal movement to said shaft means; said crank member engaging and imparting charging movement to the component of only one spring-actuated means when said handle is manually pivoted in one direction through a first predetermined sector and engaging and imparting charging movement to the component of only the other spring-actuated means when said handle is manually pivoted in the opposite direction through a second predetermined sector.

5. The operating mechanism of claim **4** wherein a pair of longitudinally spaced, interconnected crank members are mounted on and movable as a unit with said shaft means to effect charging of both of said spring-actuated means.

6. The operating mechanism of claim **5** wherein the components of said spring-actuated means comprise a pair of longitudinally spaced operator plates disposed intermediate said crank members, each operator plate encompassing said shaft means and being provided with a laterally extending portion engageable by said crank members when said shaft means is pivoted in a predetermined direction, the laterally extending portion of each operator plate being engaged by a compressible spring, said spring being compressed into a charged position only when the crank members engage an operator plate and are pivoted through a predetermined sector; releasable latch means mounted on said frame and engaging said operator plates to retain same in charged positions, and control means adjustably mounted on said frame to effect successive release of said latch means whereby discharge of the operator plate of said switch-closing means occurs only if the operator plate of said switch-opening means remains in charged position.

7. A stored-energy operating mechanism for switch blades comprising a frame, a shaft rotatably mounted in said frame, a spring charging handle fixedly mounted on a front end portion of said shaft, a sleeve disposed on said shaft and rotatable relatively thereto, a switch blade operating crank member fixedly mounted on a rear end portion of said sleeve, a driving disc fixedly mounted on a front end portion of said sleeve, an opening actuating plate and a closing actuating plate rotatably mounted on said sleeve respectively on opposite sides of said driving disc, a front drive crank fixedly mounted on said shaft adjacent said front end portion of said sleeve, a rear idler crank rotatably mounted on said sleeve rearwardly of said actuating plates, a crank pin disposed radially outwardly of and generally parallel to said shaft and having a front end portion mounted in said front drive crank and a rear end portion mounted in said rear idler crank, said opening actuating plate having a portion engageable by and disposed on one side of said crank pin and said closing actuating plate having a portion engageable by and disposed on an opposite side of said crank pin, an opening coil compression spring mounted on said frame on one side of said shaft and operatively connected to said opening actuating plate for compression to a charged condition upon rotation of said spring charging handle in one direction, a closing coil compression spring mounted on said frame on an opposite side of said shaft and operatively connected to said closing actuating plate for compression to a charged condition upon rotation of said spring charging handle in an opposite direction, a latch member pivotally mounted on said frame for latching said switch blade operating crank member in an open position, a latching means for said opening actuating plate pivotally mounted on said frame on an opposite side of said shaft from said opening spring, a latching means for said closing actuating plate pivotally mounted on said frame on an opposite side of said shaft from said closing spring, means pivoting said latching means for said closing actuating plate to an inoperative position upon charging of said opening spring, a latch releasing handle operatively connected to said latch member for said switch blade operating crank member and to said latching means for said opening actuating plate, said latch releasing handle being pivotable in one direction to release said switch blade operating crank member and in an opposite direction to release said opening actuating plate, means mounted on said closing actuating plate and operatively connecting said closing actuating plate to said driving disc when said closing spring is in a charged condition, and means mounted on said opening actuating plate and operatively connecting said opening actuating plate to said driving disc when said opening spring is in a charged

condition and said closing spring is in a discharged condition.

8. A mechanism as claimed in claim 7 including interlock means preventing operation of said latch releasing handle if a door of an enclosure for a switch having said operating mechanism is in an open position.

9. A mechanism as claimed in claim 7 including interlock means preventing operation of said latch releasing handle in a direction to release said opening actuating plate if said switch blade operating crank member is in said open position.

* * * * *