United States Patent [19]

Wilson

[11] **3,793,493**

[45] **Feb. 19, 1974**

[54] **DRAW OUT CIRCUIT BREAKER AND COMPARTMENT INTERLOCK AND SECONDARY CONTACT ACTUATION**

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[73] Assignee: **ITE Imperial Corporation,** Philadelphia, Pa.

[22] Filed: **Aug. 21, 1972**

[21] Appl. No.: **282,330**

[52] **U.S. Cl.** ..... **200/50 AA**

[51] **Int. Cl.** **H01h 33/46**

[58] **Field of Search**.... 200/50 AA, 153 SC; 317/99, 317/103

[56] **References Cited**

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3,019,309	1/1962	Goodwin, Jr.	200/50 AA

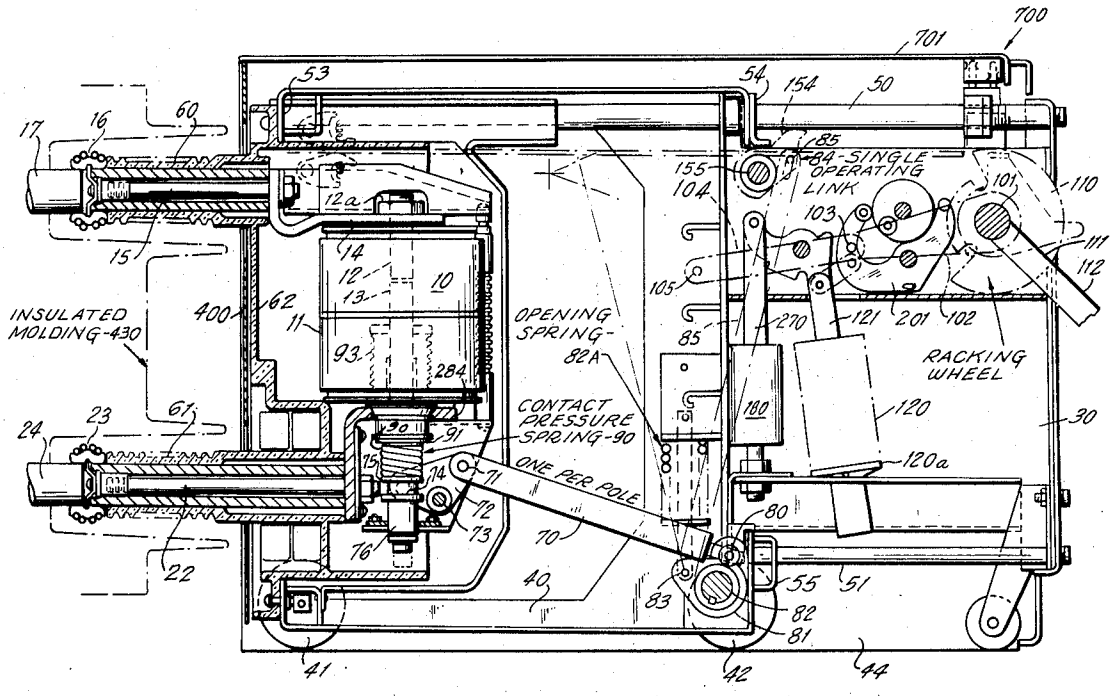
Primary Examiner—J. R. Scott

Attorney, Agent, or Firm—Ostrolenk, Faber, Gerb & Soffen

[57] **ABSTRACT**

Drawout switchgear having a truck insertable in a switchboard compartment and a circuit interrupter carrying frame carried by the truck frame and movable toward and away from the back wall of the compartment. Interlock means between the truck frame and the compartment including a hook carried by the truck frame; said interlock means also prevents full insertion of the truck into the compartment when the frame carrying the circuit interrupter is in any position other than a fully withdrawn or test position with respect to the truck frame; and secondary or auxiliary contacts; said interlock means prevent withdrawal of the truck from the compartment when the secondary contacts are engaged; and additional interlock means preventing separation of selected secondary contacts while the circuit interrupter carrying frame is in fully racked in or operative position with respect to stationary disconnect contacts in the compartment.

6 Claims, 44 Drawing Figures



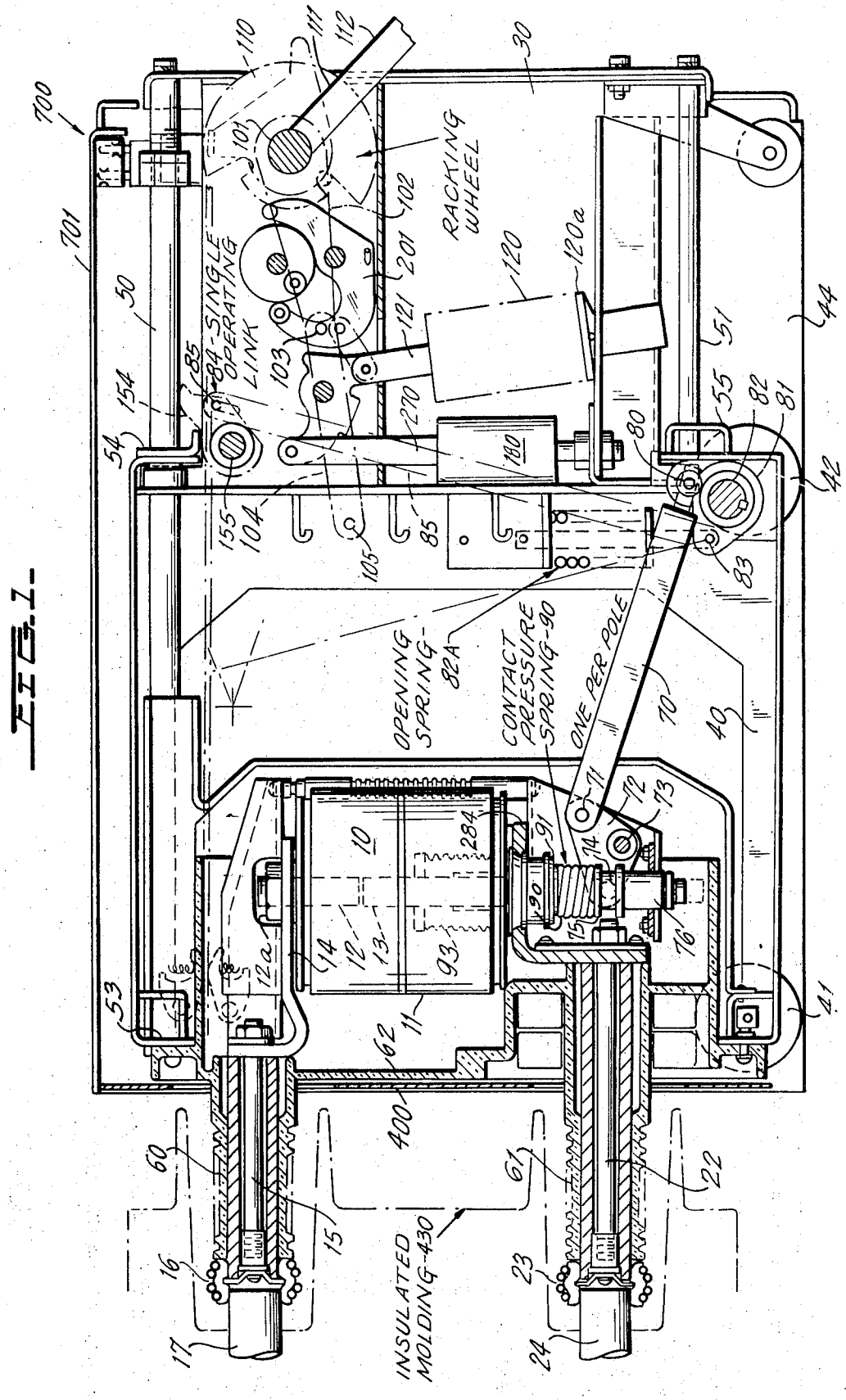
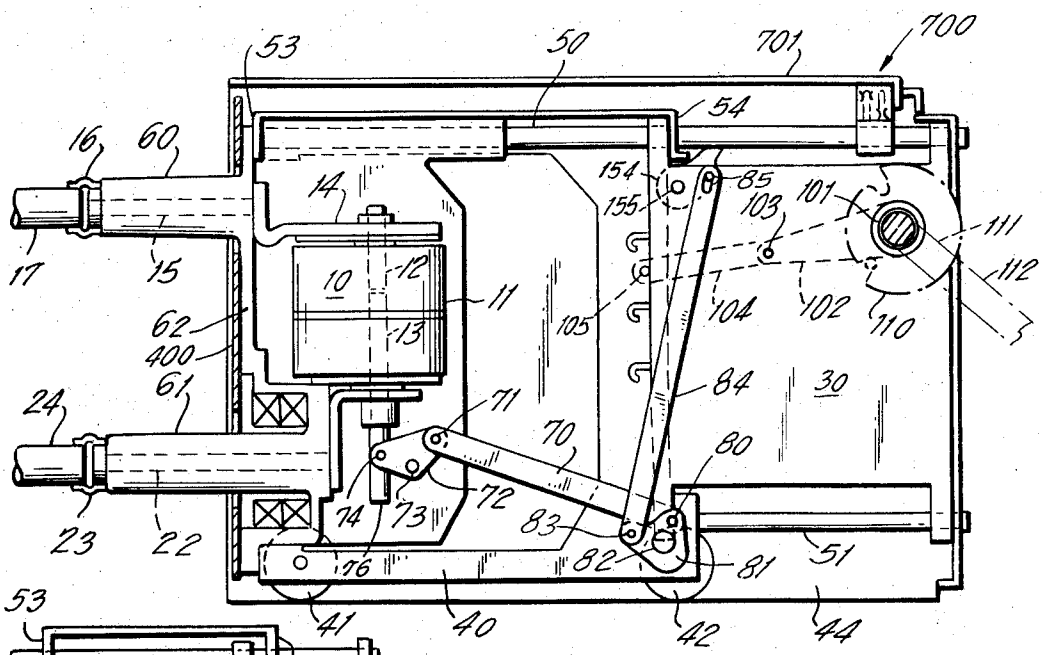

700
701
110
111
112
30
RACKING WHEEL
102
201
120
120a
121
50
84-SINGLE OPERATING LINK
85
103
154
54
270
180
80
55
82
81
51
44
42
155
104
105
85
83
OPENING SPRING-82A
CONTACT PRESSURE SPRING-90
ONE PER POLE
70
40
71
72
73
14
91
284
10
90
15
16
12
13
93
12a
53
11
62
41
400
60
61
22
16
15
23
17
24
INSULATED MOLDING-430

FIG. 1

FIG. 2.



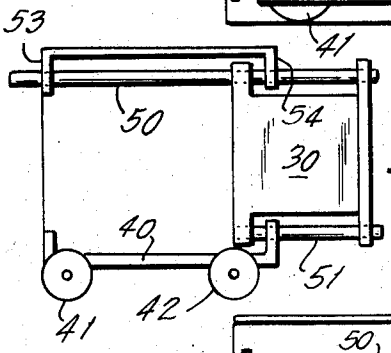


FIG. 3.

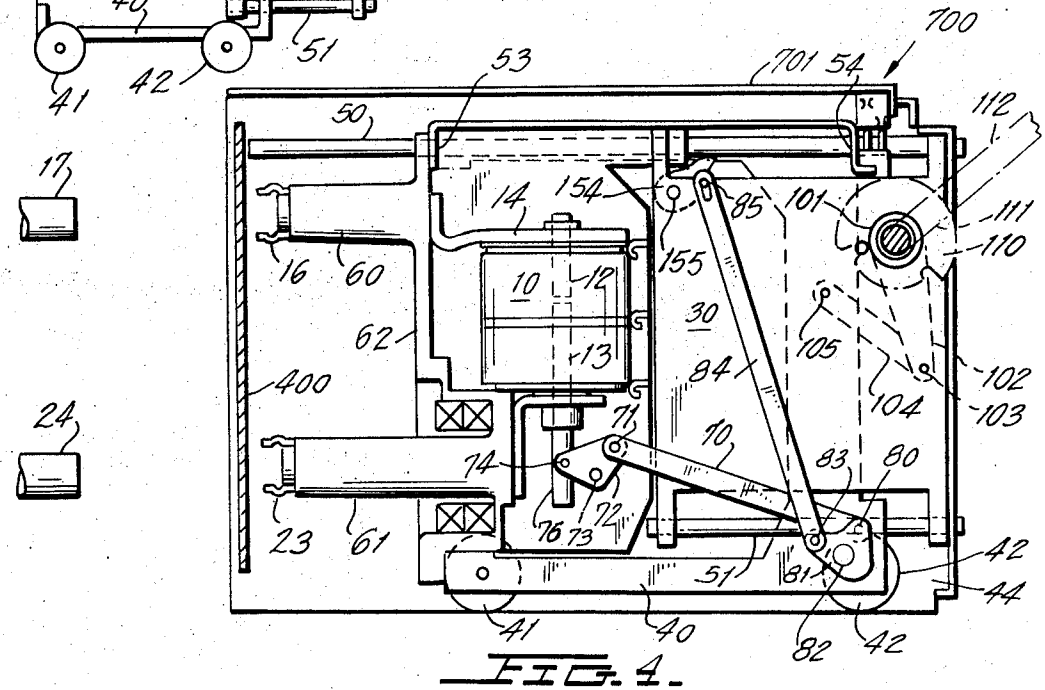


FIG. 4.

FIG. 5

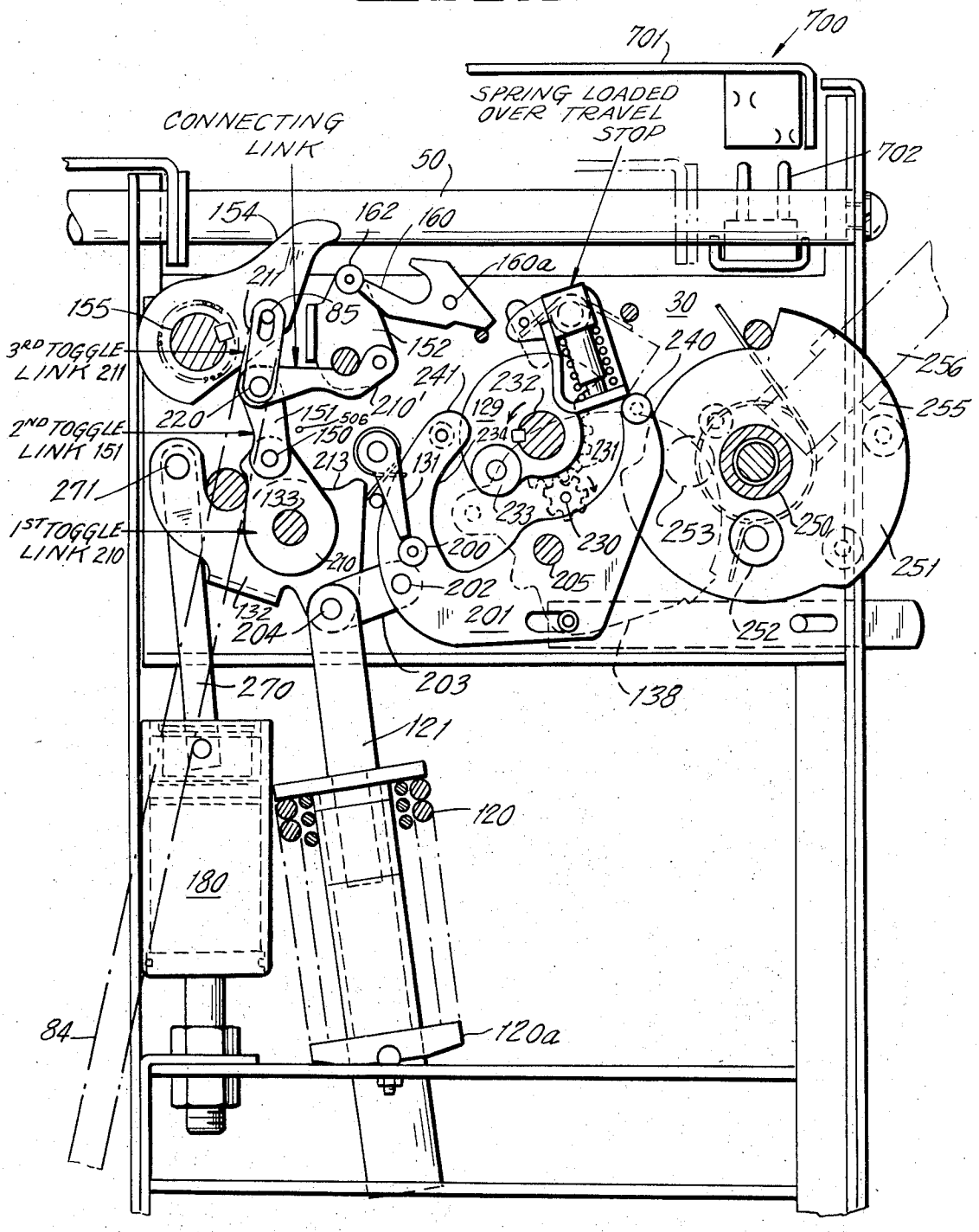

700
701
SPRING LOADED OVER TRAVEL STOP
CONNECTING LINK
50
702
154
162
160
160a
211
85
155
30
3RD TOGGLE LINK 211
152
240
256
241
232
255
2ND TOGGLE LINK 151
220
151
506
150
210'
129
234
213
131
231
271
133
233
253
250
1ST TOGGLE LINK 210
200
230
251
210
205
202
201
252
132
204
270
203
138
121
120
180
84
120a

FIG. 7.

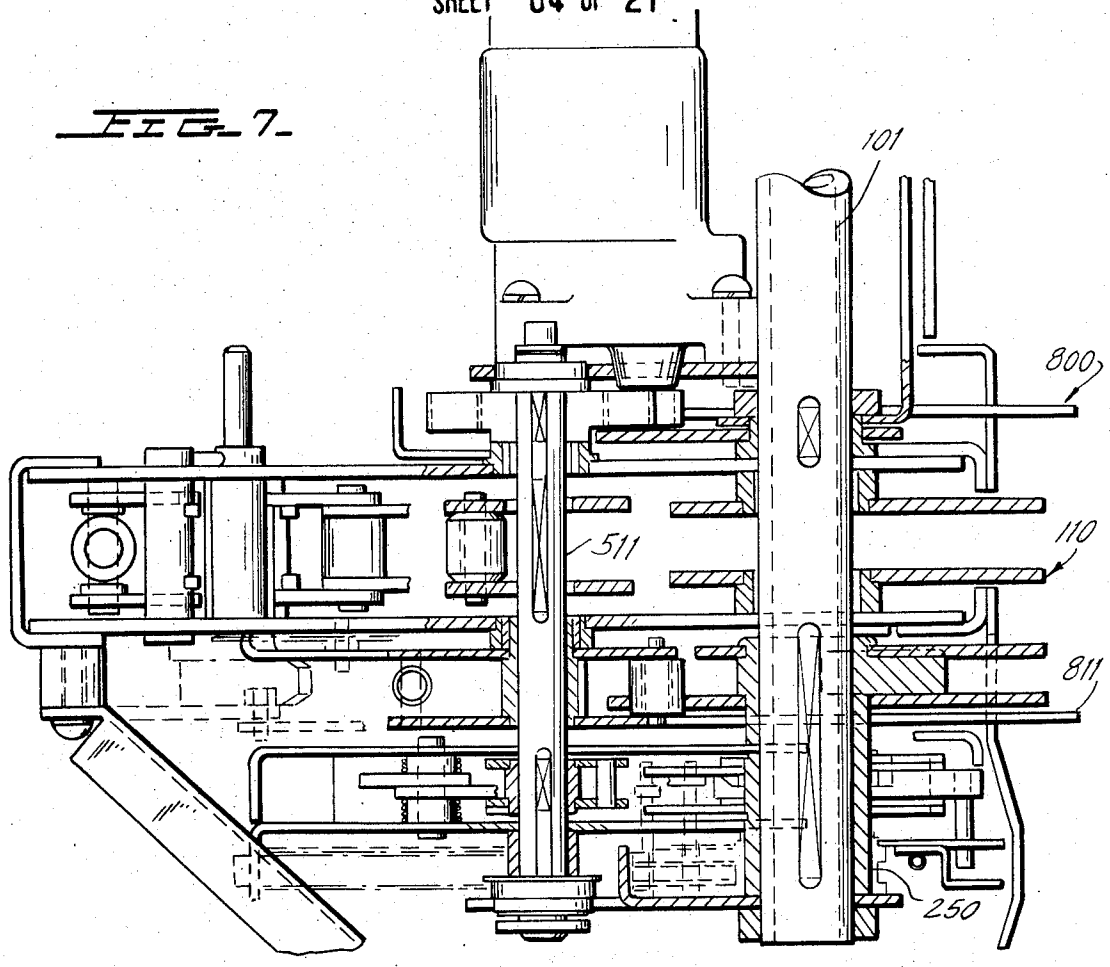

101
800
110
511
811
250

FIG. 6.

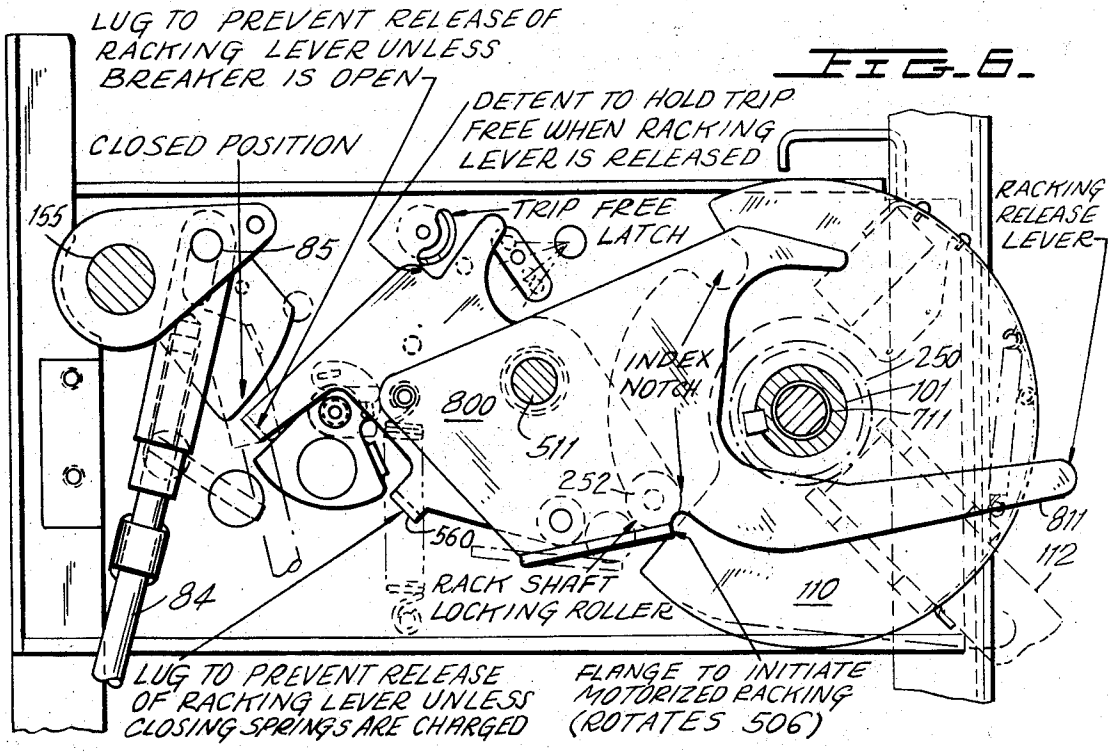

LUG TO PREVENT RELEASE OF RACKING LEVER UNLESS BREAKER IS OPEN
DETENT TO HOLD TRIP FREE WHEN RACKING LEVER IS RELEASED
CLOSED POSITION
RACKING RELEASE LEVER
155
TRIP FREE LATCH
85
INDEX NOTCH
250
101
711
800
511
252
811
112
560
84
RACK SHAFT LOCKING ROLLER
110
LUG TO PREVENT RELEASE OF RACKING LEVER UNLESS CLOSING SPRINGS ARE CHARGED
FLANGE TO INITIATE MOTORIZED RACKING (ROTATES 506)

FIG. 8.

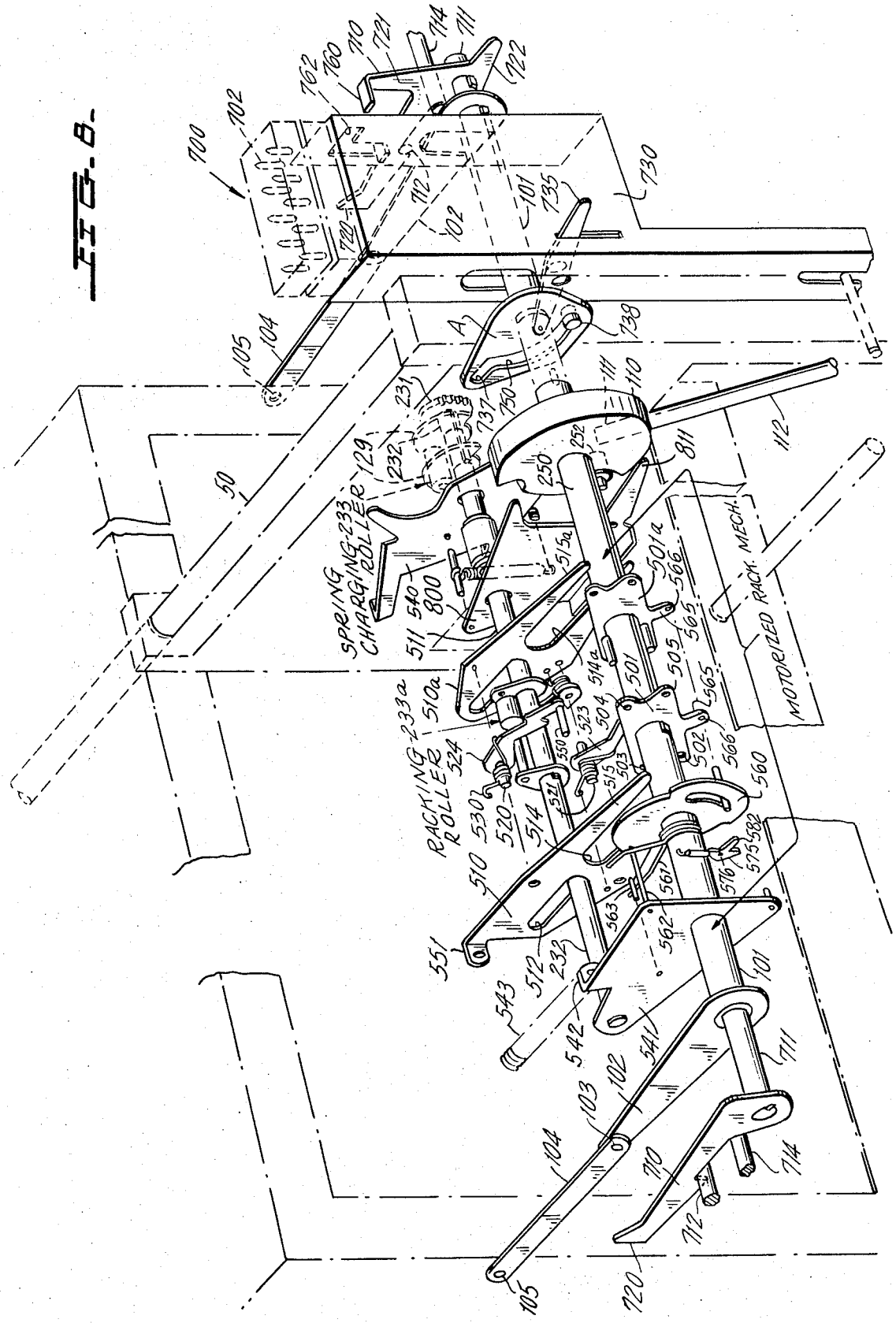
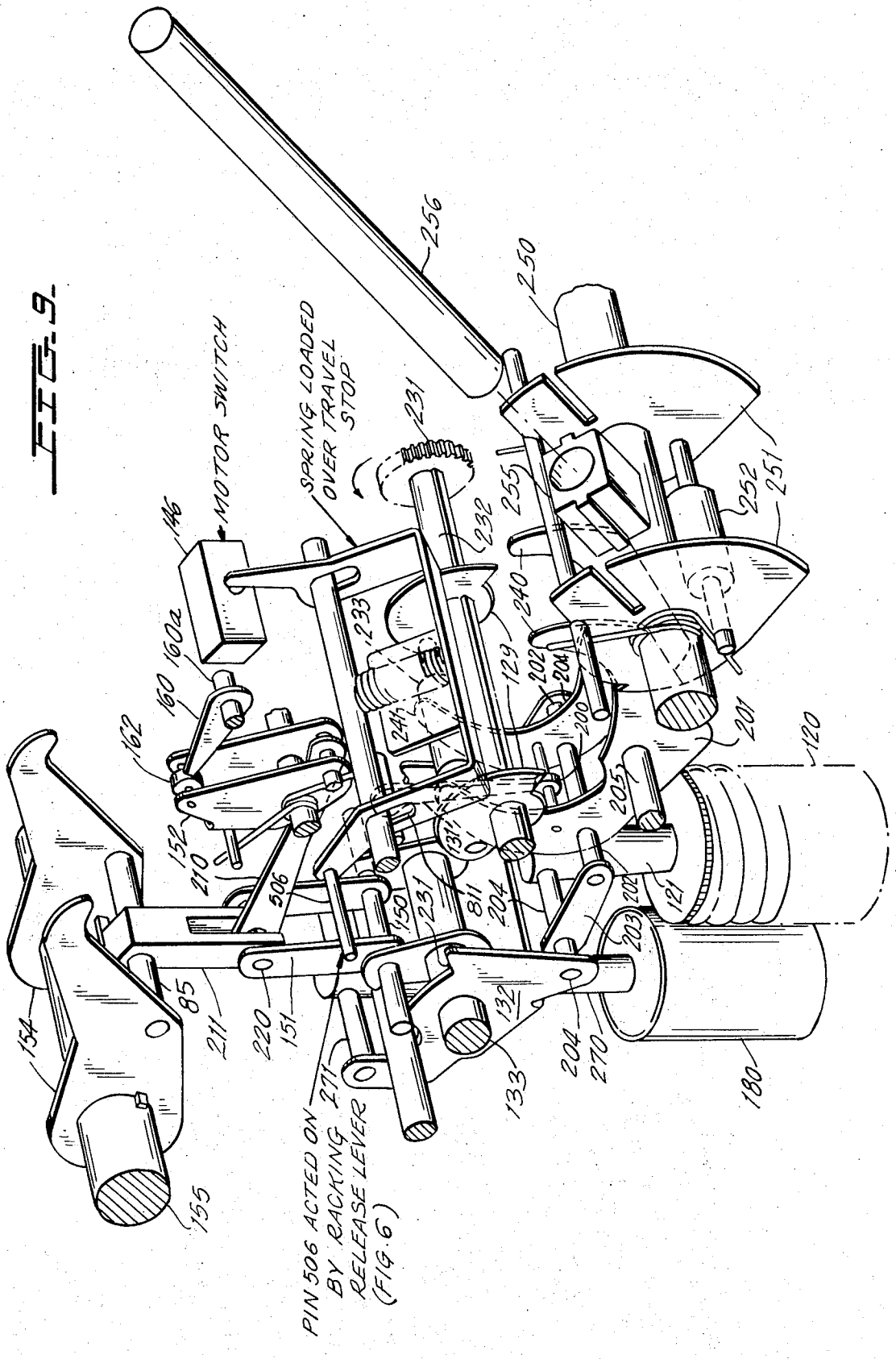

SPRING CHARGING ROLLER
RACKING ROLLER
MOTORIZED RACK MECH.

FIG. 9.


MOTOR SWITCH
SPRING LOADED OVER TRAVEL STOP
PIN 506 ACTED ON BY RACKING RELEASE LEVER (FIG. 6)
256
250
231
146
160a
160
162
233
232
255
252
251
240
129
202
204
200
201
120
205
152
210
506
150
231
81
204
121
203
85
211
220
151
132
133
270
180
154
155

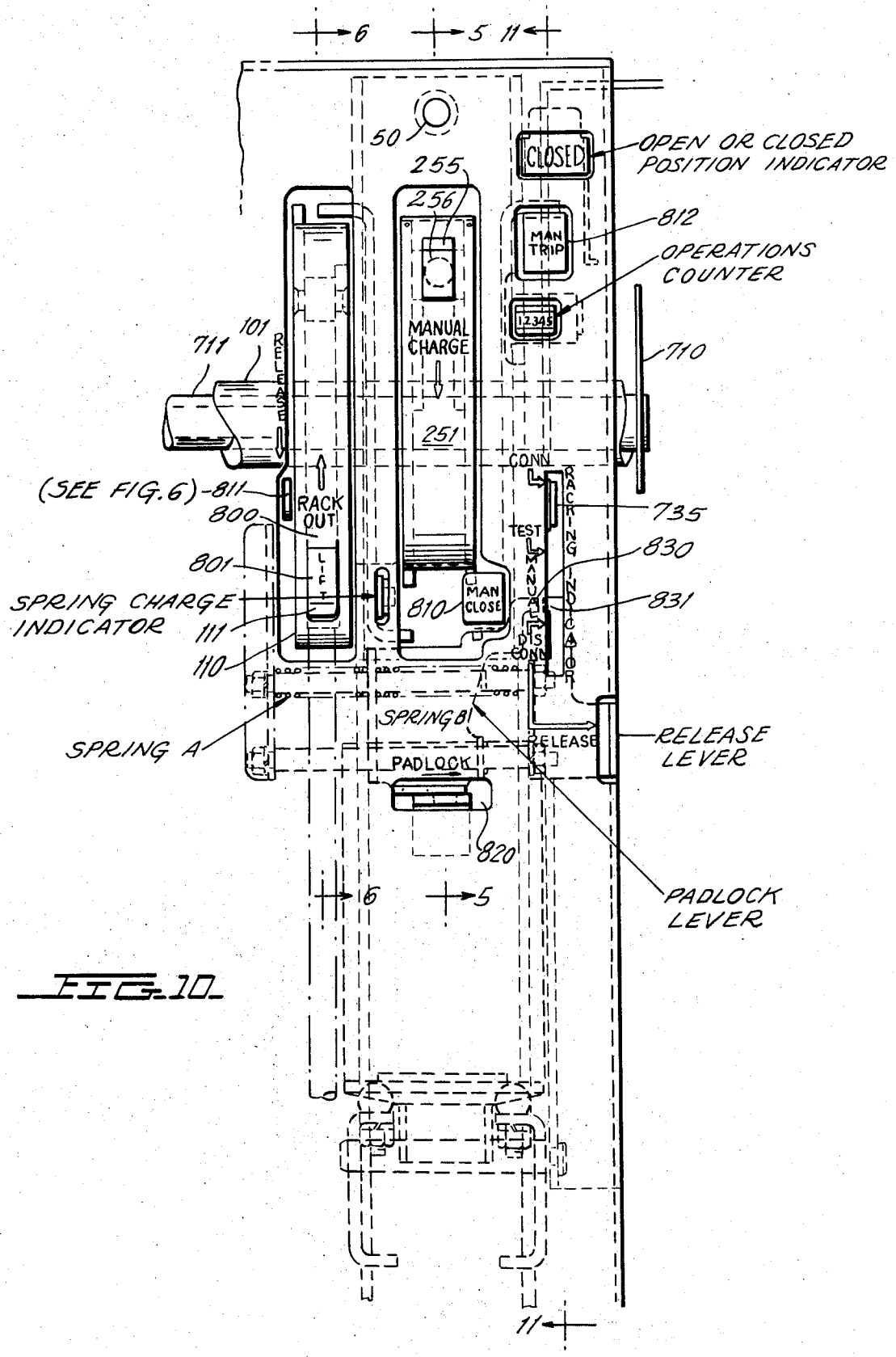

6
5
11
50
255
256
CLOSED
OPEN OR CLOSED POSITION INDICATOR
812
MAN TRIP
OPERATIONS COUNTER
12345
MANUAL CHARGE
711
101
710
251
CONN
(SEE FIG. 6)-811
RACK OUT
800
735
TEST
RACKING INDICATOR
830
801
SPRING CHARGE INDICATOR
MAN CLOSE
810
831
111
110
DISCONN
SPRING A
SPRING B
RELEASE
RELEASE LEVER
PADLOCK
820
PADLOCK LEVER

FIG. 10

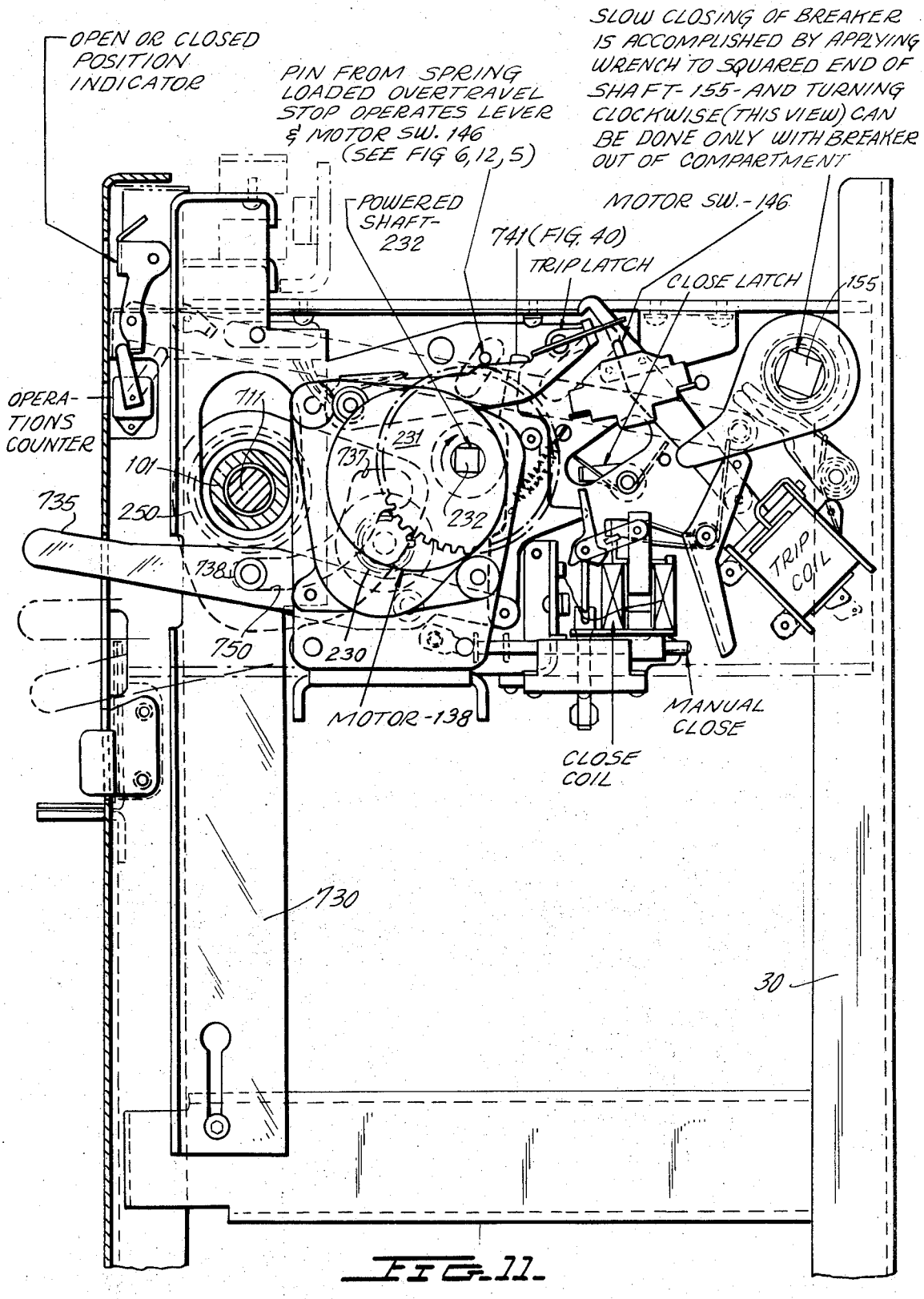

OPEN OR CLOSED POSITION INDICATOR
PIN FROM SPRING LOADED OVERTRAVEL STOP OPERATES LEVER & MOTOR SW. 146 (SEE FIG 6, 12, 5)
SLOW CLOSING OF BREAKER IS ACCOMPLISHED BY APPLYING WRENCH TO SQUARED END OF SHAFT-155-AND TURNING CLOCKWISE (THIS VIEW) CAN BE DONE ONLY WITH BREAKER OUT OF COMPARTMENT
POWERED SHAFT-232
MOTOR SW.-146
741 (FIG. 40)
TRIP LATCH
CLOSE LATCH
155
OPERATIONS COUNTER
111
231
737
101
735
250
232
TRIP COIL
738
750
230
MOTOR-138
MANUAL CLOSE
CLOSE COIL
730
30

FIG. 11

FIG. 12.

TRIP-FREE POSITION OF MECHANISM
BREAKER OPEN-SPRINGS DISCHARGED-
MOTOR STARTED

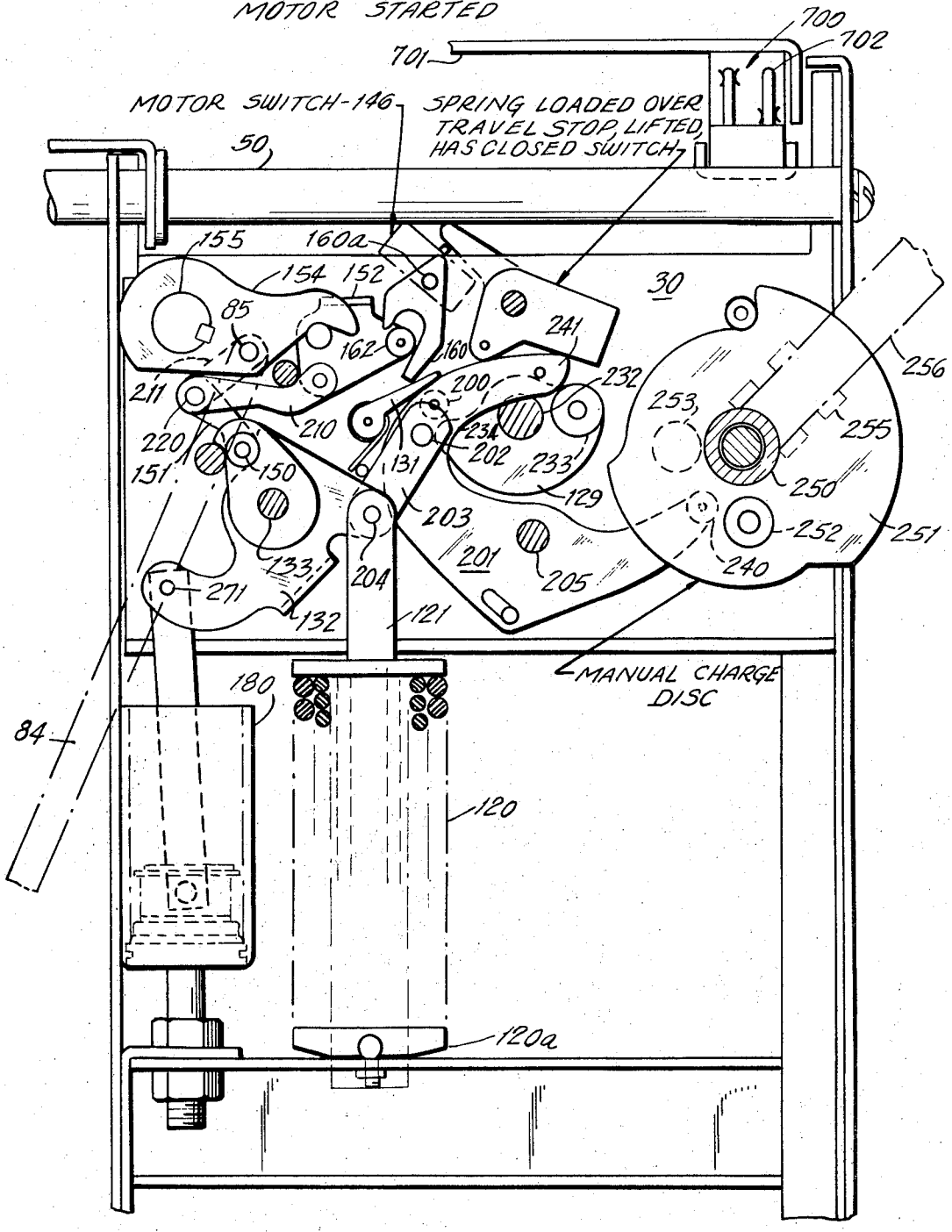


FIG. 14

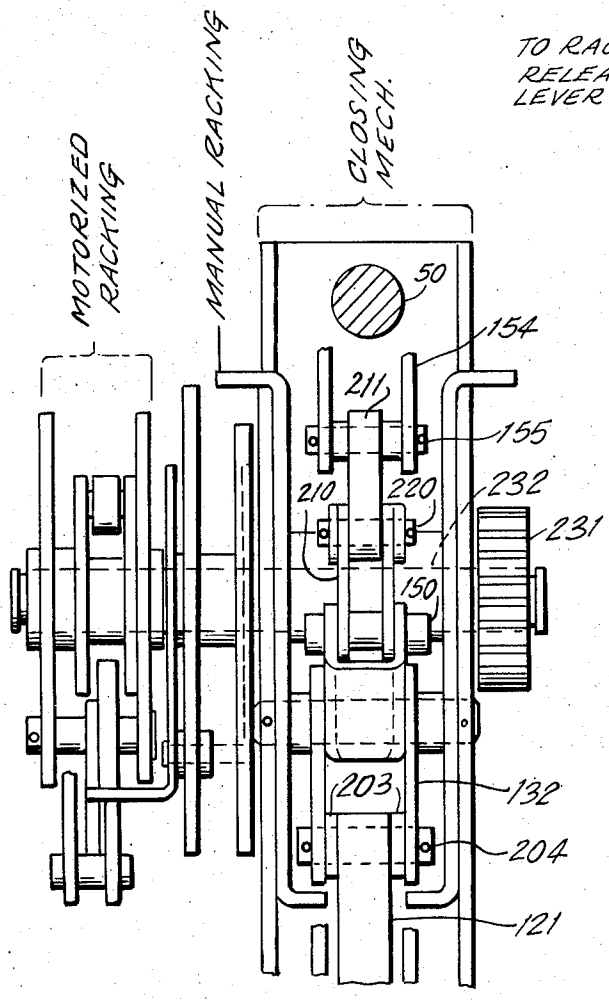


FIG. 13

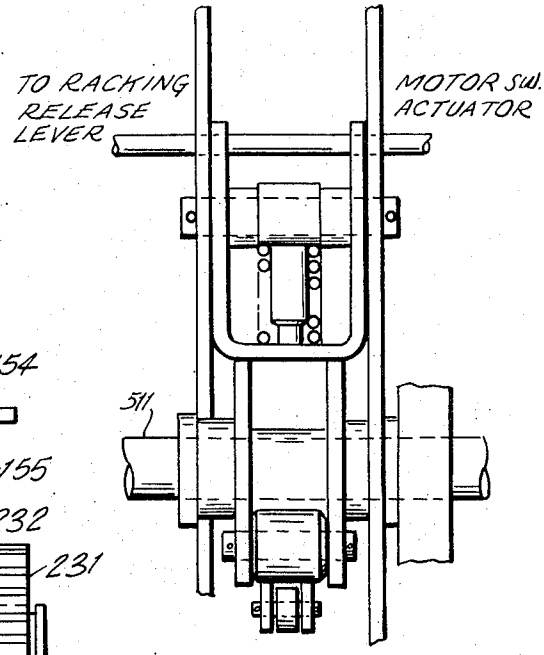
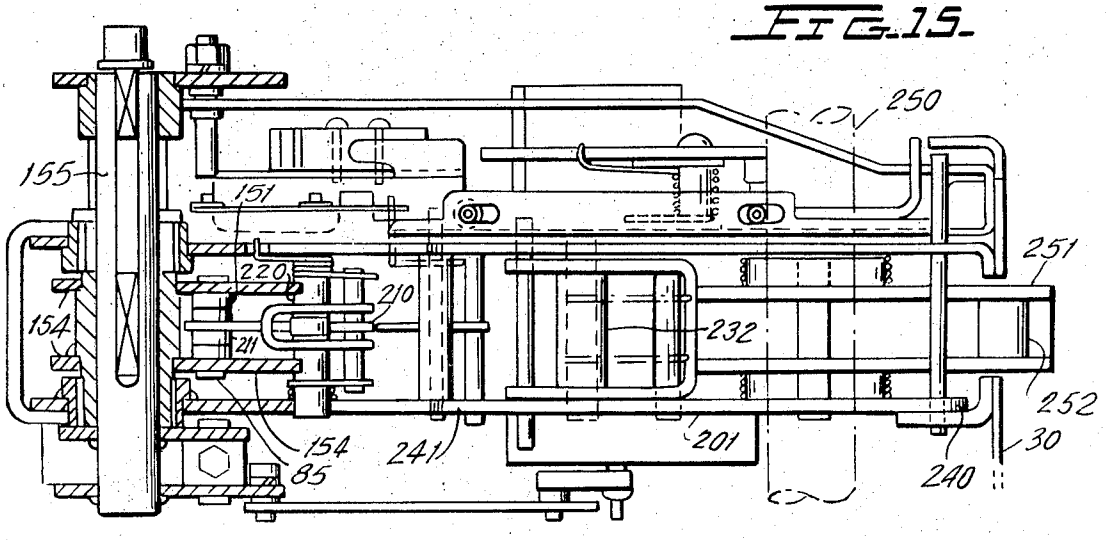


FIG. 15



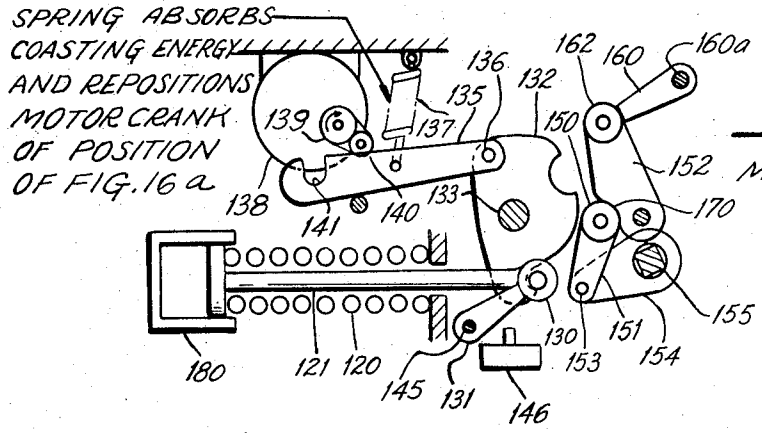


FIG. 16d

MOTOR COASTING STOPPED

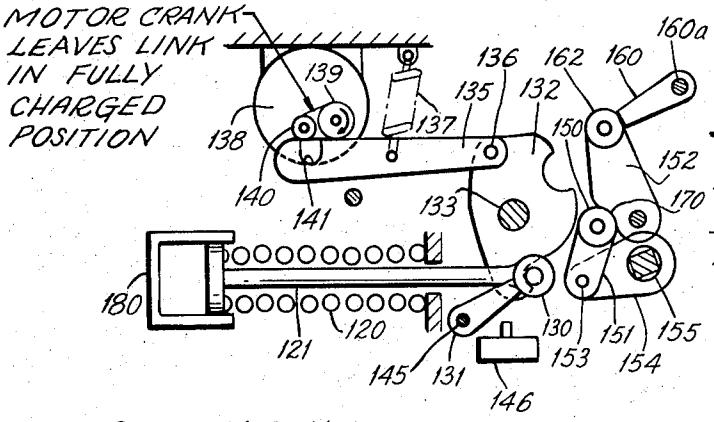


FIG. 16c

BREAKER CLOSED SPRINGS RECHARGED

MOTOR STARTING TO COAST

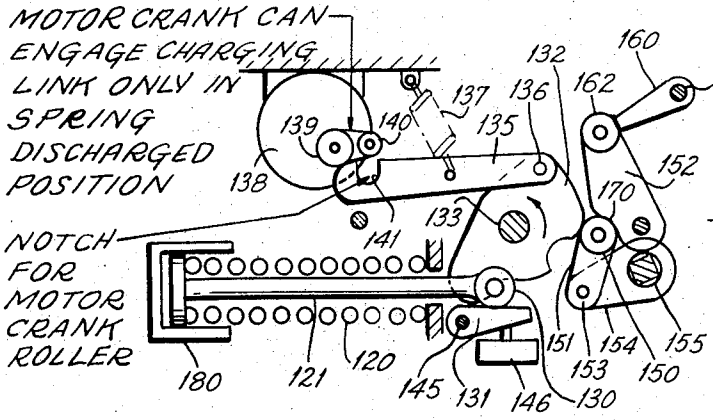


FIG. 16b

BREAKER CLOSED SPRINGS DISCHARGED

MOTOR STARTS

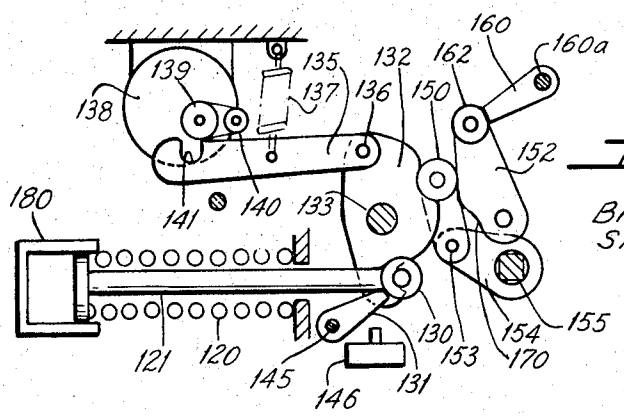


FIG. 16a

BREAKER OPEN SPRINGS CHARGED

FIG 17

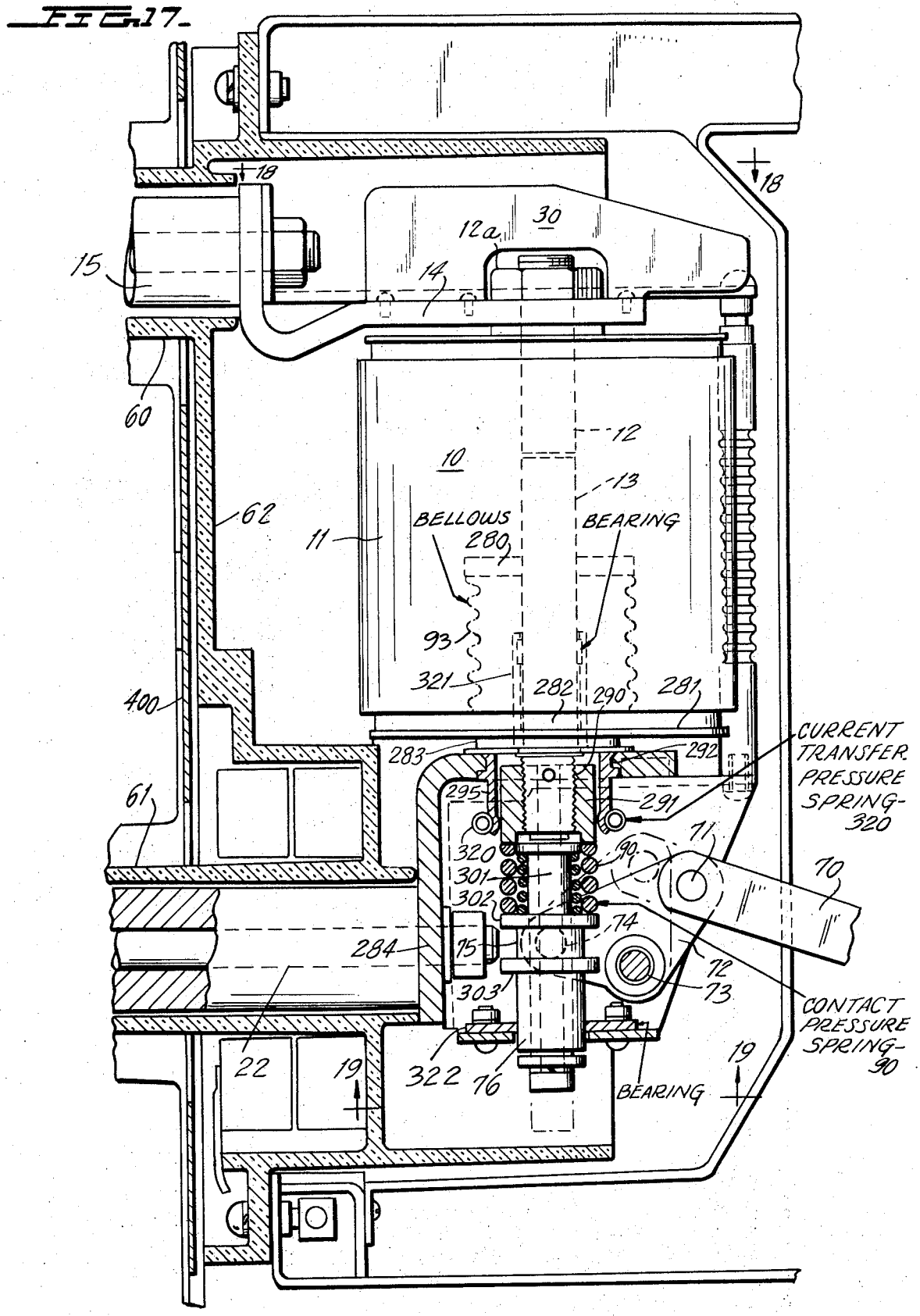

18
18
12a
30
15
14
60
12
10
13
62
11
BELLOWS
280
BEARING
93
321
282
290
281
400
283
292
CURRENT TRANSFER PRESSURE SPRING-320
295
291
61
320
90
71
70
301
302
74
284
75
72
303
73
CONTACT PRESSURE SPRING-90
22
19
322
76
BEARING
19

FIG. 18.

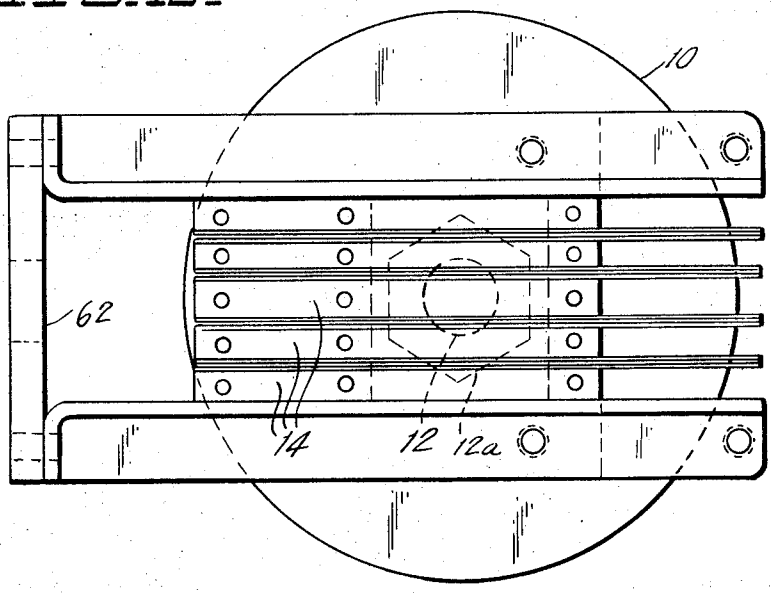


FIG. 19.

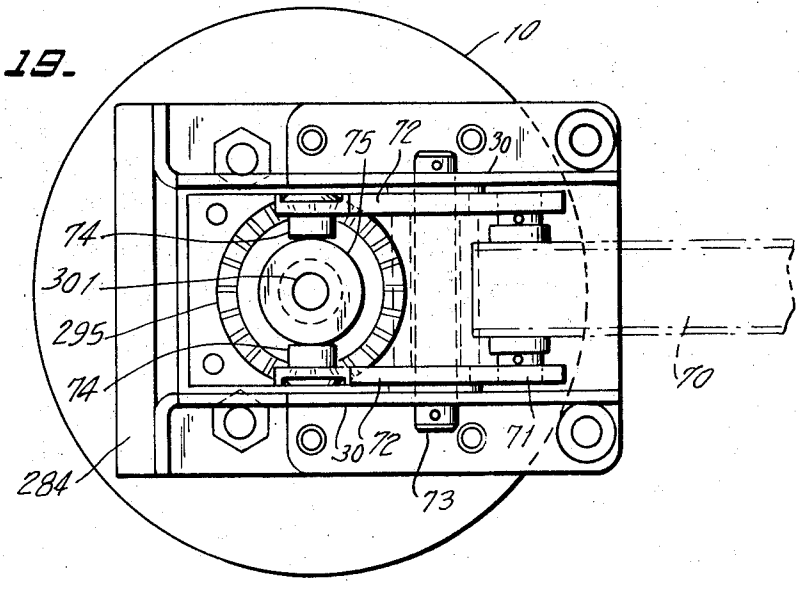


FIG. 20.

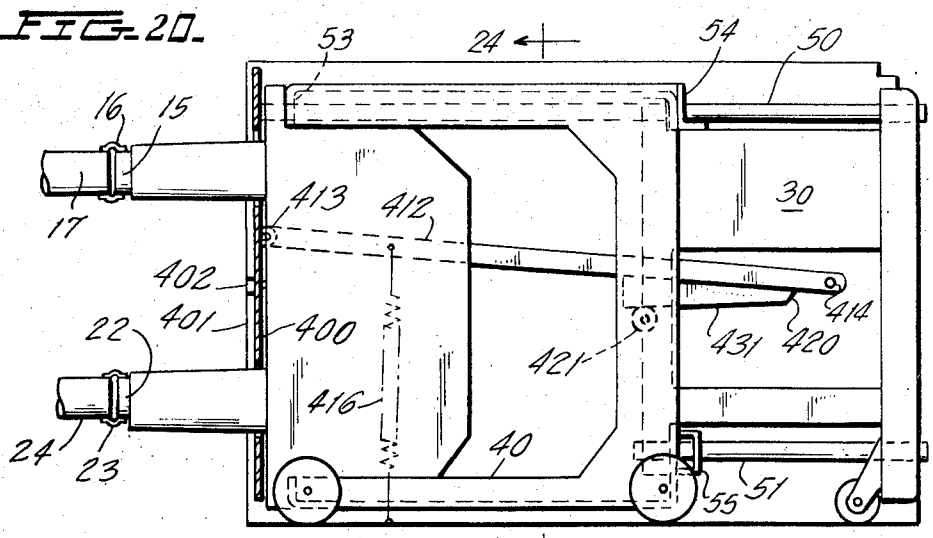


FIG. 21.

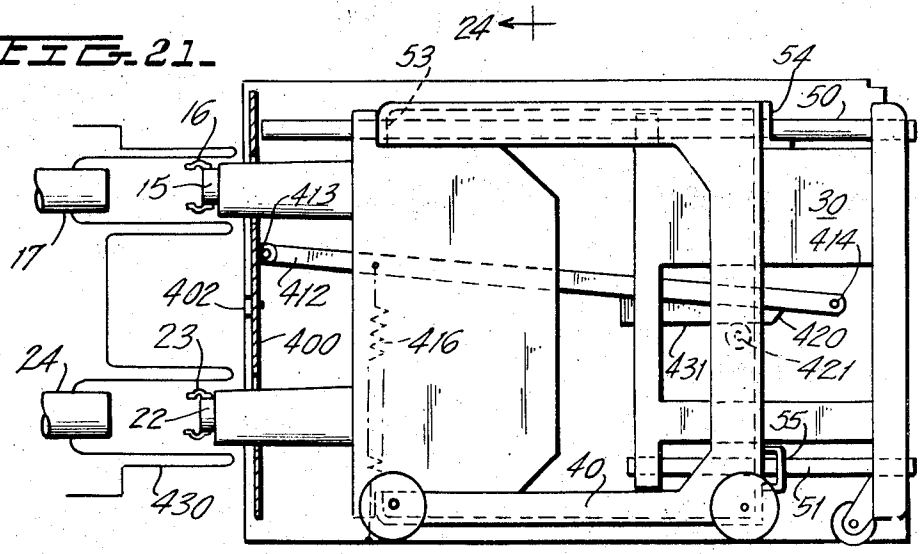


FIG. 22.

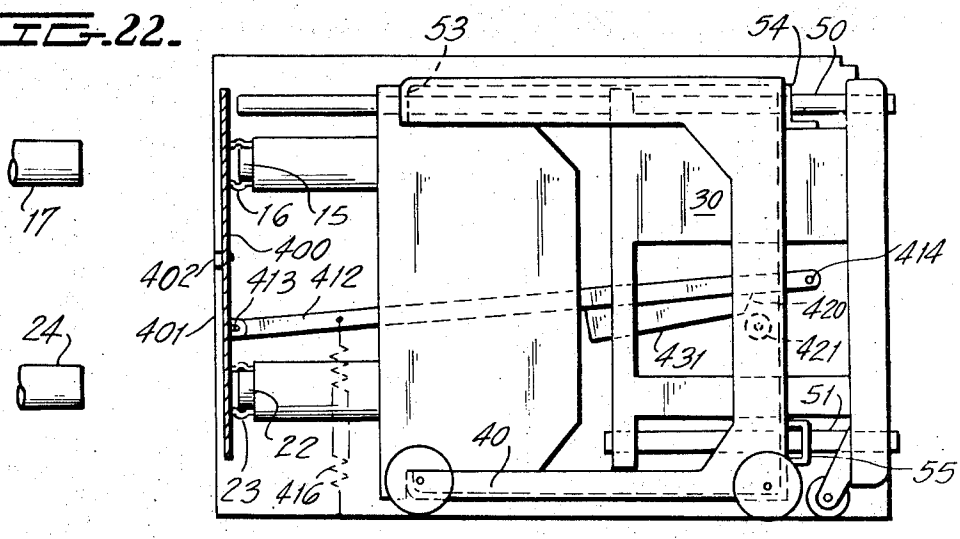


FIG. 23

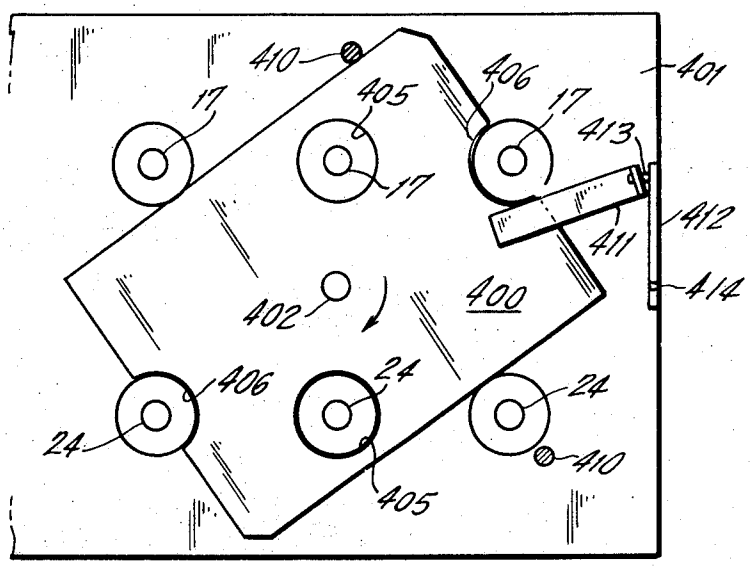
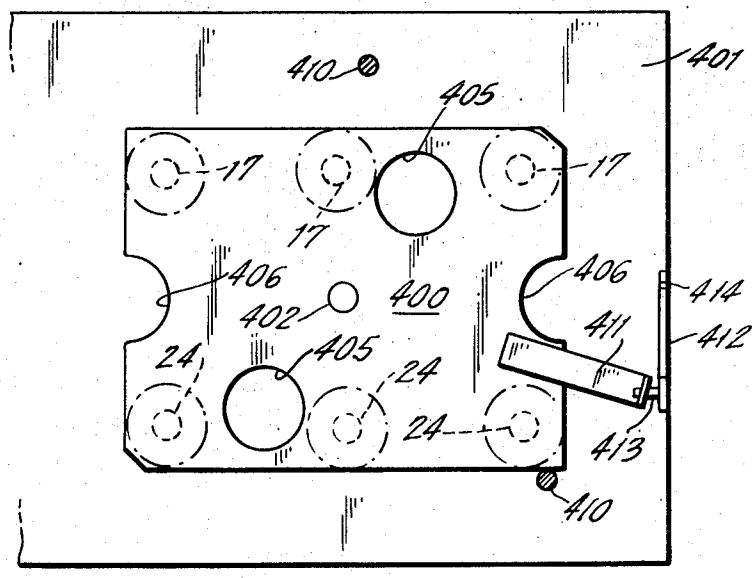

410
17
405
406
17
401
413
17
412
411
414
402
400
406
24
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410
405

FIG. 24


410
405
401
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405
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24
413
410

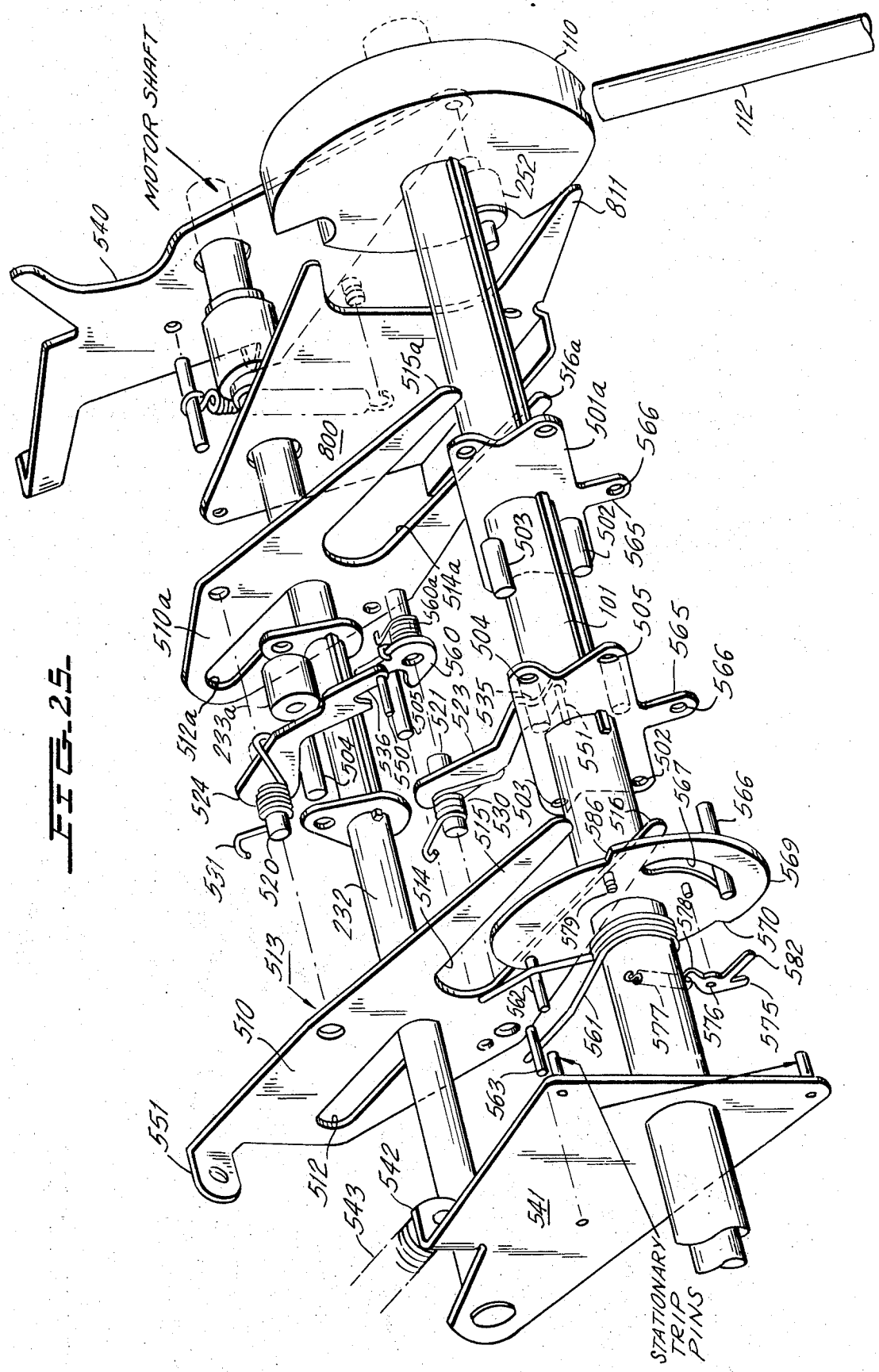


FIG. 25

FIG. 26

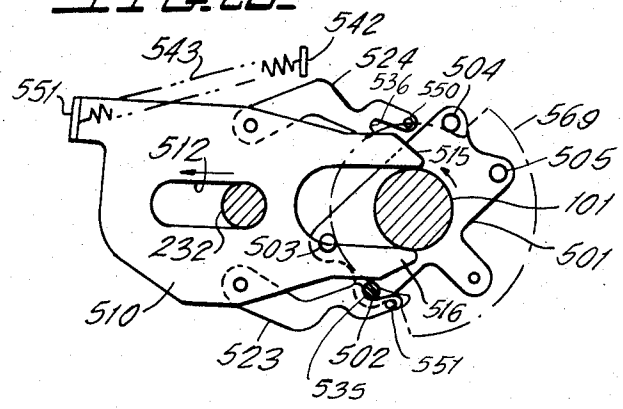


FIG. 33

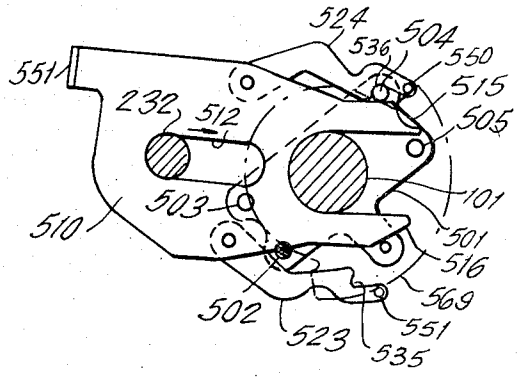


FIG. 27

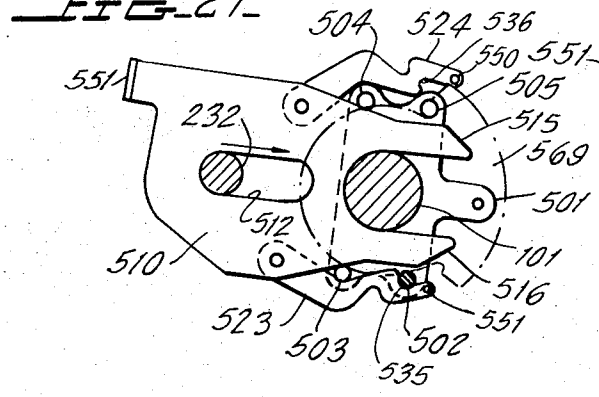


FIG. 32

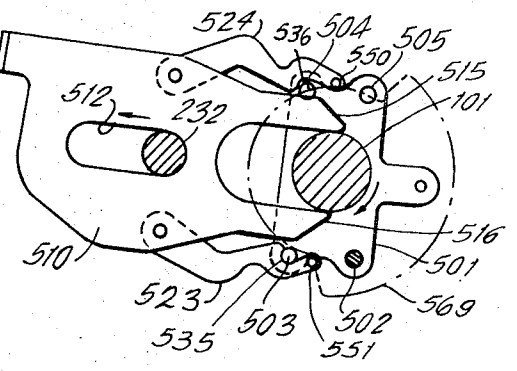


FIG. 28

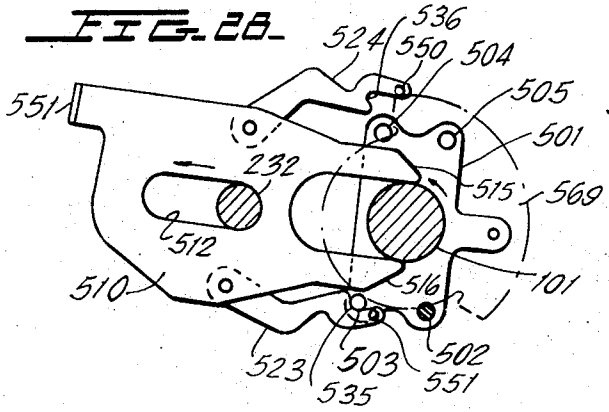


FIG. 31

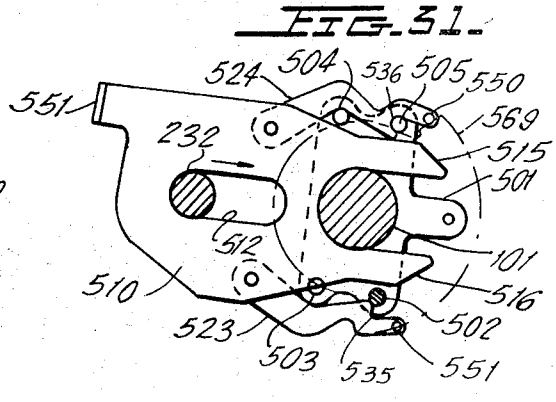


FIG. 29

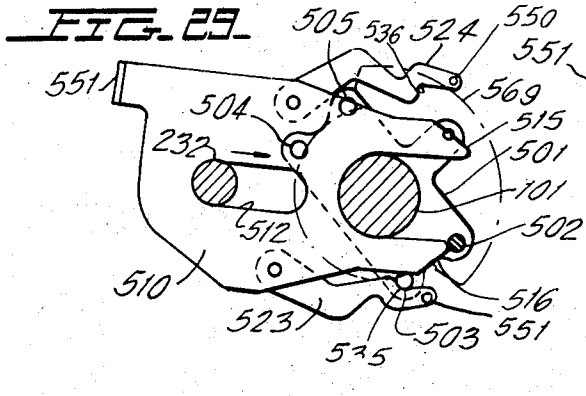


FIG. 30

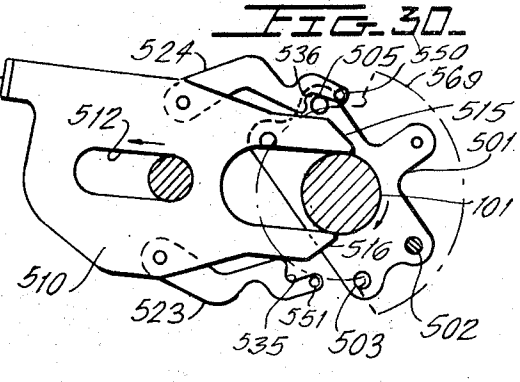


FIG. 34

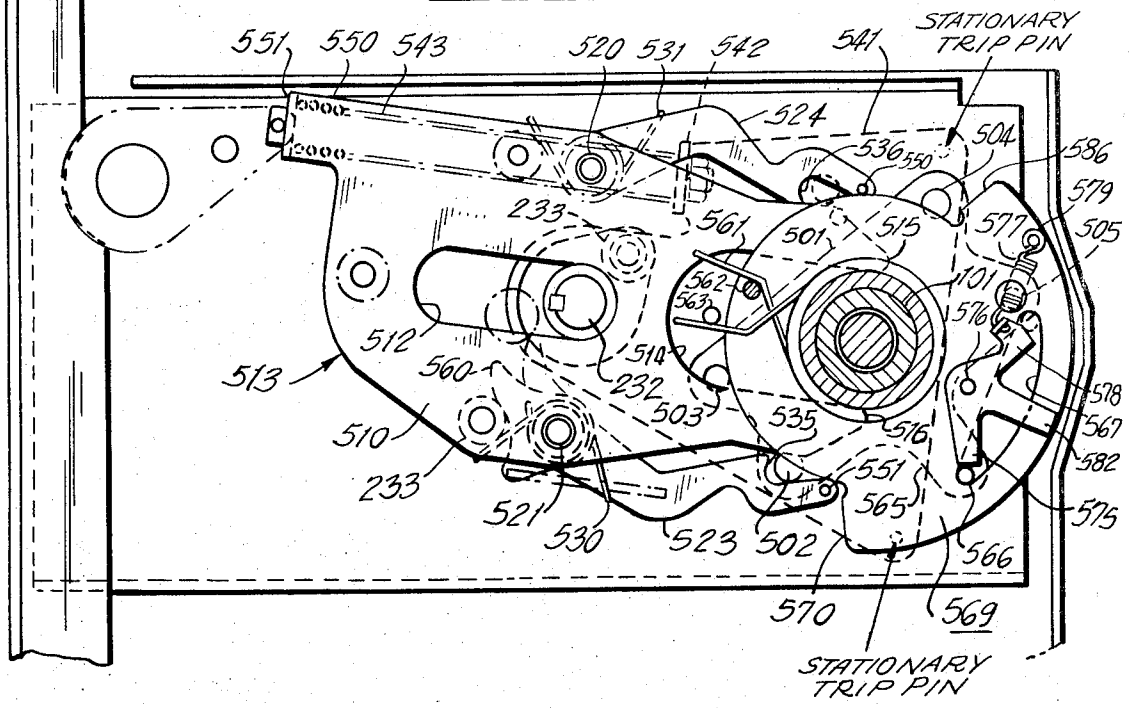
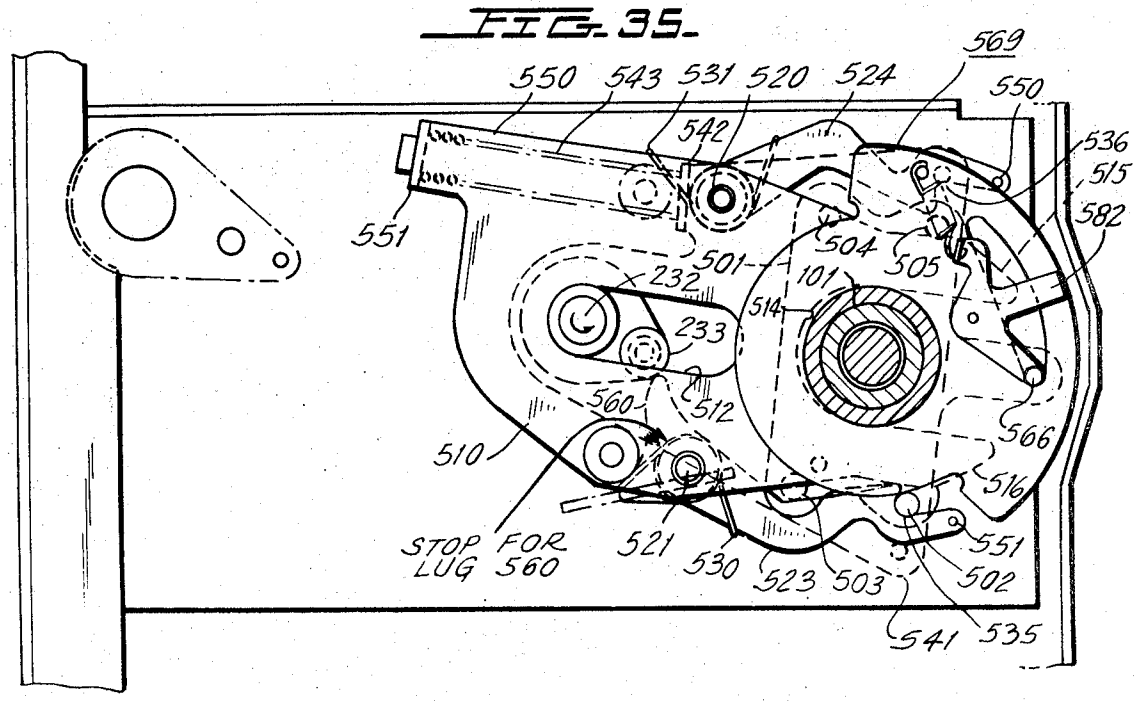

551
550
543
520
531
542
541
STATIONARY TRIP PIN
524
504
536
550
586
579
233
561
501
515
577
505
562
563
101
576
512
560
514
232
513
503
535
516
578
567
510
233
551
582
521
530
523
502
565
575
566
570
569
STATIONARY TRIP PIN

FIG. 35


569
550
543
531
520
524
550
542
536
515
551
582
501
504
505
232
101
514
233
560
512
566
510
516
STOP FOR LUG 560
521
530
523
503
551
502
541
535

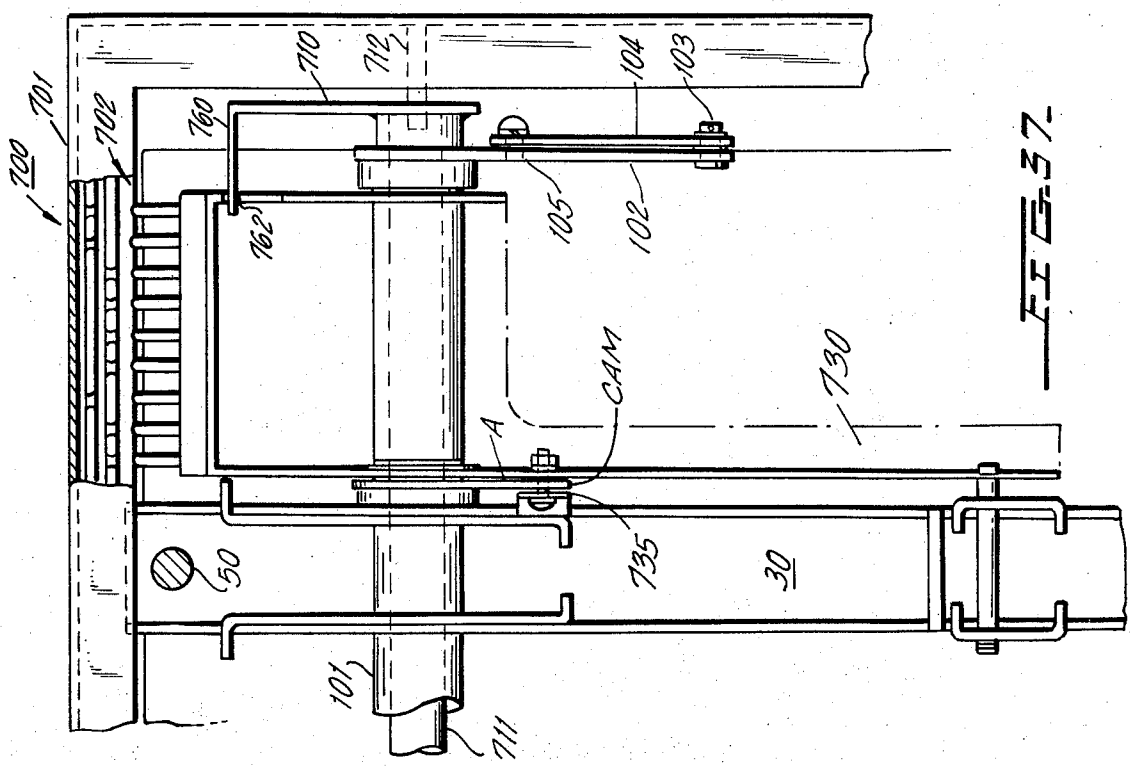

700
701
702
760
710
712
104
103
105
102
162
CAM
A
730
735
50
30
101
711

FIG. 37

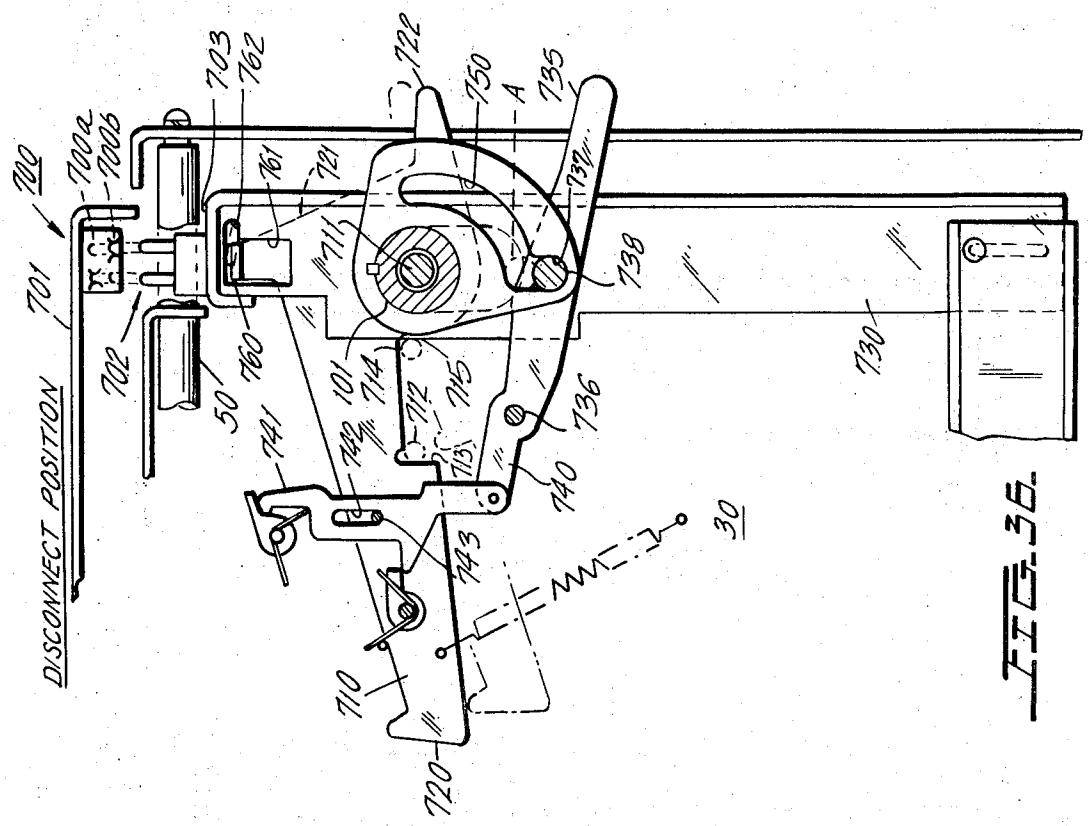

700
700a
700b
701
DISCONNECT POSITION
702
703
762
722
750
A
735
761
721
738
711
138
760
50
101
714
712
715
136
741
742
713
140
730
143
30
710
720

FIG. 36

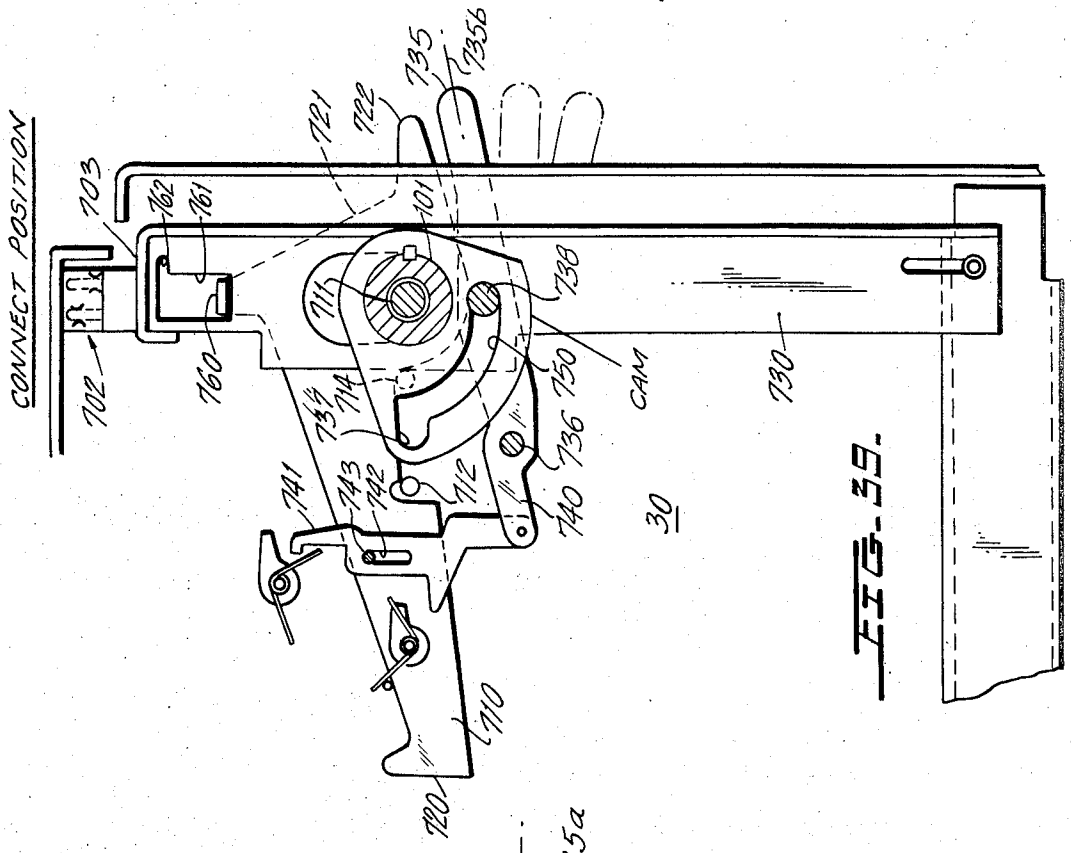

CONNECT POSITION
703
762
761
721
722
735
735a
101
738
702
160
711
714
750
CAM
730
741
743
742
712
736
740
30
710
720

FIG. 3B.

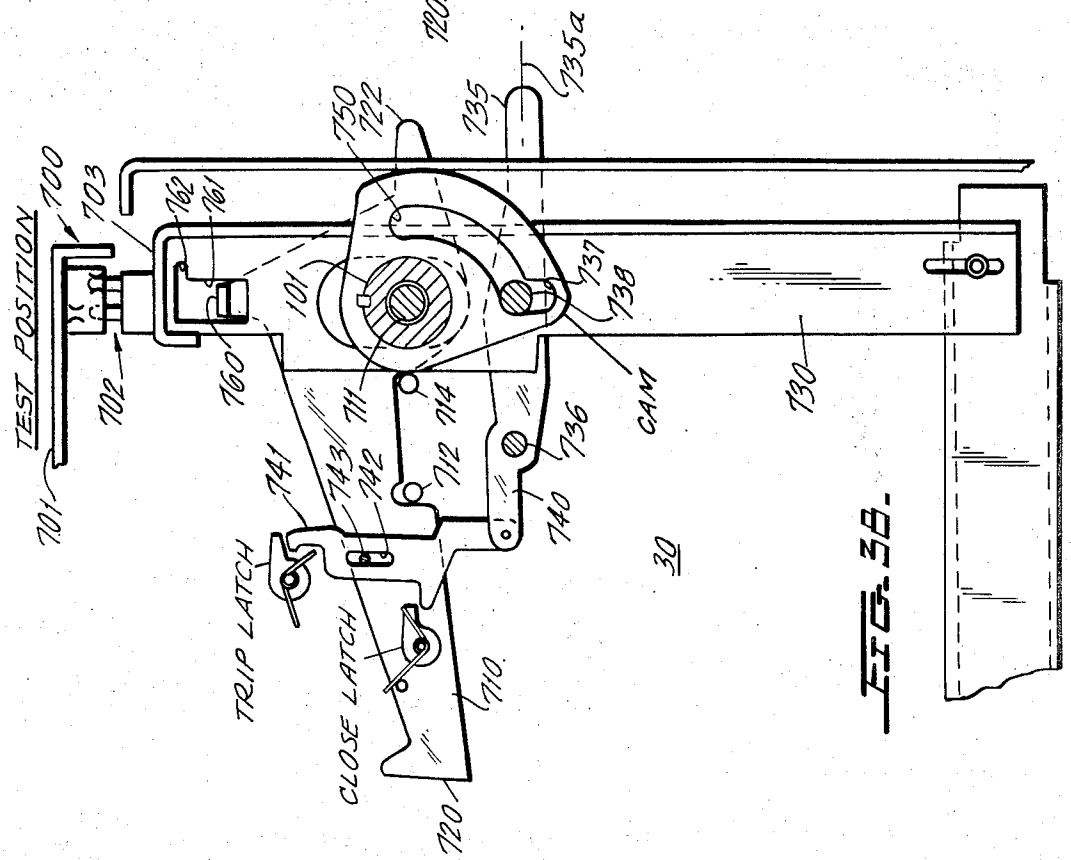

TEST POSITION
700
703
762
761
750
722
735
735a
101
737
738
702
160
711
714
CAM
730
741
743
742
712
736
740
30
710
720
701
TRIP LATCH
CLOSE LATCH

FIG. 3A.

FIG. 40.

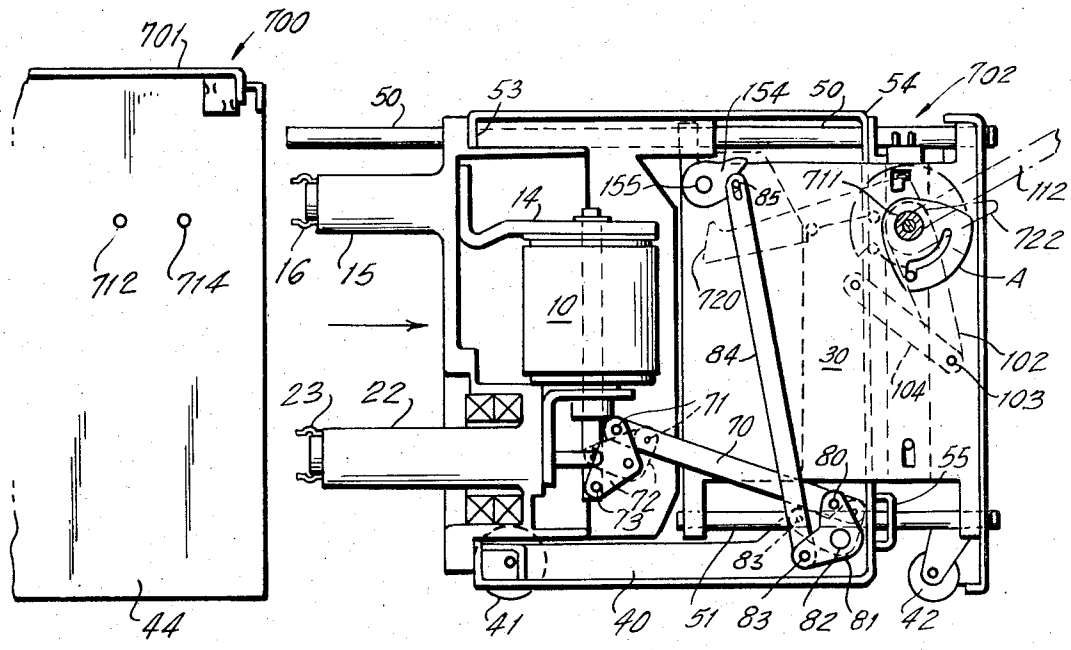
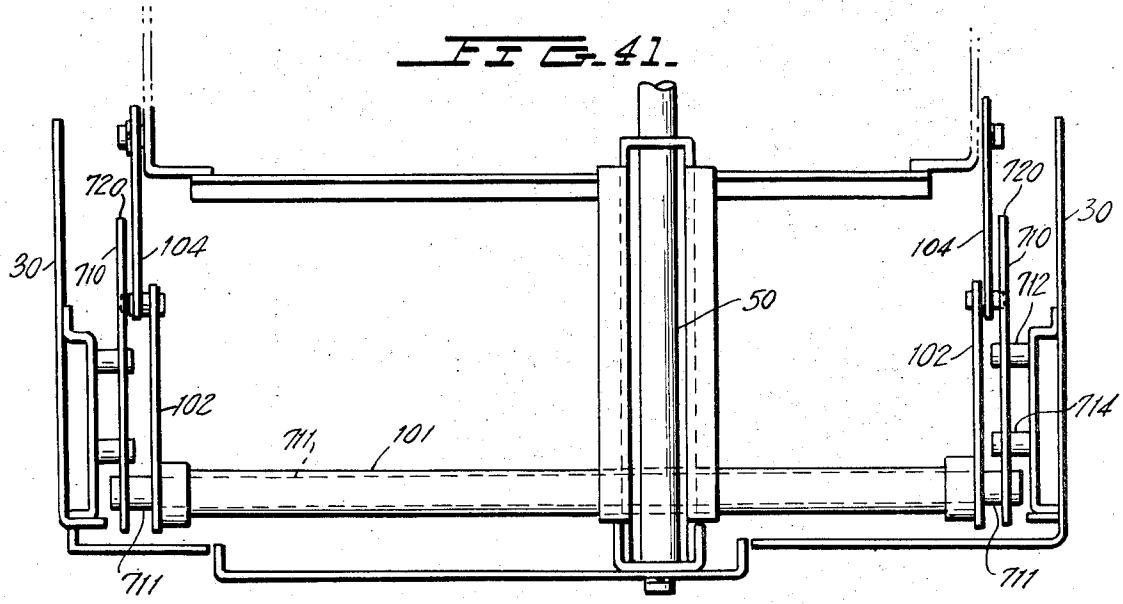

701
700
712
714
50
53
154
50
54
702
155
85
711
112
722
A
14
16
15
10
720
84
30
102
104
103
23
22
71
70
80
55
72
73
83
44
41
40
51
83
82
81
42

FIG. 41.


720
30
710
104
50
102
711
101
720
104
710
30
712
102
714
711
711

DRAW OUT CIRCUIT BREAKER AND COMPARTMENT INTERLOCK AND SECONDARY CONTACT ACTUATION

The present invention relates to telescoping withdrawal switchgear and circuit breakers for minimum size compartments and more particularly relates to a miniature high voltage circuit breaker for utilization in a compartment in which the interrupters and operating mechanism will completely utilize the available compartment space. For this purpose the operating mechanism and the current conducting mechanism are so arranged that when it is desired to withdraw the current conducting mechanism from a connected to a test position the section of the unit which carries the current conducting mechanism will telescope with respect to and around the operating mechanism thereby making it possible to reduce the size of the entire switching or circuit breaker mechanism and therefore to reduce the size of the compartment and of course to reduce the size of the entire switchboard and installation.

By the construction and novel elements hereinafter described it is possible to arrange a 15KV line breaker so that it may be completely housed in cubicle having dimensions 28 inches high, 37 inches deep and 36 inches wide for a three pole circuit breaker.

In addition, the present invention relates to modular switchgear which is so arranged that the various parts and elements thereof may be interconnected in a switchboard in selected arrangements and combinations.

Essentially the circuit breaker structure is arranged so that it may be inserted and withdrawn from the compartment as a whole and is therefore mounted on appropriate rolling or wheel devices. The circuit breaker structure itself is mounted on two platforms which may telescope or slide with respect to each other. One portion of the circuit breaker structure including the contact elements and the current carrying element are mounted on a truck which is separated from the mounting for the operating elements. The mounting for the operating elements is so arranged that the truck carrying the contact members and current carrying members may telescope with respect thereto and thereby, when disconnected, approach the operating parts closely.

Since the current carrying elements of the circuit breaker structure, on their own truck, are disconnected from the bus in the manner hereinafter described when the truck carrying the same is moved toward the operating section and telescopes therewith, electrical clearance in this disconnected position is not necessary between the circuit breaker current carrying elements and the operating parts.

When the circuit breaker current carrying elements are fully racked into connected position, appropriate electrical clearance is provided between the circuit breaker contacts and current carrying elements on the one hand and the operating parts on the other hand so that no danger to the operator exists.

A further object of this invention is, in a miniature high voltage circuit breaker, to provide a spring charging system for charging the spring which closes the contacts of the interrupter and thereby provide a stored energy mechanism in which the closing springs are charged in one continuous effort by the charging motor. This is done without the noisy additional elements of pawl and ratchet drives and without the complication of release clutches of any kind between the motor and springs. Existing ratchet and pawl systems are noisy in charging and are noisy on closing of the interrupter when the spring crank arms go past bottom dead center onto the so-called bonus angle from which they reverse and slam the ratchet back onto the pawls. This so-called bonus angle represents excess spring energy not used in closing the breaker which often limits the life of the mechanism by this abuse of the ratchet; in such cases if the ratchet wheel, when it reverses, catches one of the still moving charging pawls, it reverses the charging pawl abruptly and with it the motor gear train and armature. This can result in motor gear and bearing damage. Ratchet systems are also noisy when the closing springs go past top dead center on charging and fall with considerable impact on the prop latch. This prop latch impact is also a substantial factor in the endurance of the mechanism. Such ratchets, pawls and crank arms are also comparatively expensive to machine. The single stroke charging system of the present invention eliminates all of the above mentioned noise impact motor abuse and production cost faults of the ratchet and pawl systems.

A further object of the present invention is the provision of simplified means for motorized racking of the interrupter elements of the circuit breaker from a connected to a disconnected position whereby the energization of a motor will, through appropriate linkages during such energization, effect the racking operation. Such linkages and connections being so arranged so that in the fully connected and fully disconnected condition of the interrupter elements with the bus or other contacts in the compartment, the linkages and connectors will be disengaged.

Another object of the present invention includes the simplified arrangement of connections between the vacuum interrupter and the operating mechanism therefor so that this connection will maintain its integrity whether or not the circuit interrupter elements are telescoped with the operating mechanism and whereby current transfer between the vacuum interrupter contacts and the current conducting leads is simplified.

Another object of the present invention is provision of an interlock between the circuit breaker truck and the compartment so that the truck cannot enter the compartment except in the withdrawn position of the interrupter elements, and cannot leave the compartment unless the interrupter elements are in that same condition, and whereas secondary or auxiliary contacts may be controlled in accordance with the inserted or test position of the circuit interrupter elements; also wherein the movement of the interlock which permits full withdrawal from the compartment of the entire circuit breaker structure necessitates complete withdrawal from contact arrangement from second or auxiliary contacts.

Still another object of the present invention is the provision of shutter or closure means in the compartment for opening or closing access to the stationary conductors leading to the buses, in accordance with the racked in or racked out condition of the circuit interrupter elements; a simplified cam operated lever being provided for operating the said shutter in accordance with the operation of the telescoping circuit interrupter carrying carriage.

The foregoing and other objects of this invention will become apparent in the following description and drawings in which:

FIG. 1 is a side view partly in section and partly broken away of the novel miniature high voltage circuit breaker with the contact members and current carrying members fully racked into operative position showing the relative positioning and placement of the various parts of the entire circuit breaker mechanism.

FIG. 2 is a view corresponding to that of FIG. 1 showing the same structure in the same racked in position of FIG. 1 with certain of the details omitted so that the telescoping operation, which may more readily be seen in FIGS. 3 and 4, may be understood.

FIG. 3 is a schematic side view showing the manner in which the circuit breaker contact and current carrying elements of the miniature high voltage circuit breaker mounted on their own truck may be integrated, controlled and positioned with respect to the frame which carries the operating mechanism.

FIG. 4 is a view corresponding to that of FIG. 2 showing the racked out position of the circuit breaker contact and current carrying elements, demonstrating the manner in which the truck carrying these elements may telescope with respect to the frame which carries the operating mechanism.

FIG. 5 is a side view partly in cross-section of the mechanism for operating the circuit breaker contacts of the circuit breaker of FIGS. 1 to 4 with the springs charged and the breaker closed.

FIG. 6 is an enlarged view of a portion of the operating mechanism showing the manual racking and interlocking.

FIG. 7 is a top plan view, partly in section of the operating mechanism showing the manual and electrical racking.

FIG. 8 is an expanded schematic view of the manual and electrical racking mechanism including also elements set forth in later figures comprising not only racking mechanism, but also motorized racking mechanism, interrupter operating mechanism, auxiliary contact operation and latching of the truck in the compartment.

FIG. 9 is an expanded schematic view showing the operating elements of FIGS. 5 and 7 for closing and opening the circuit breaker interrupter contacts.

FIG. 10 is a front view of the escutcheon plate at the front of the circuit breaker mechanism showing the various elements which are used in connection with the operation of the circuit breaker.

FIG. 11 is a further view of the operating mechanism of the circuit breaker showing the relationship of the electrical control features including the motor, the motor cut-off switch, the closing solenoid and the tripping solenoid.

FIG. 12 is a side view of the interrupter contact closing and opening mechanism with the springs discharged, the circuit breaker open and in trip free condition.

FIG. 13 is a detail of the motor switch actuating structure for operating the spring charging mechanism of the interrupter contacts.

FIG. 14 is a vertical plan view of parts of the operating mechanism and their relationship to the escutcheon plate of FIG. 10.

FIG. 15 is a top view of the operating mechanism of FIG. 5.

FIGS. 16*a*, 16*b*, 16*c*, 16*d* are successive schematic views of the operation of the interrupter contacts from the condition in which the circuit breaker is open with the closing springs charged through discharge of the closing springs to close the interrupter contacts to recharge of the closing springs.

FIG. 17 is a more detailed view partly in cross-section, partly in phantom, of the interrupter of FIG. 1.

FIG. 18 is a view taken on line 18—18 of FIG. 17 looking in the direction of the arrows.

FIG. 19 is a view taken on line 19—19 of FIG. 17 looking in the direction of the arrows.

FIG. 20 shows the miniature high voltage circuit breaker with the operating elements on frame 40 racked into fully operative current controlling condition corresponding to the position of FIG. 1.

FIG. 21 shows the same structure with the operative elements on frame 40 partly racked out and partly telescoped with the operating mechanism.

FIG. 22 shows the circuit breaker on the moving frame 40 fully racked out in a fully telescoped position corresponding to the position of FIG. 4.

FIG. 23 is a view taken from line 23 of FIG. 20 showing the shutter mounted in the open position so that there is access from the movable disconnect into the stationary disconnect and would therefore correspond to the position which is obtainable in FIG. 20.

FIG. 24 is a view similar to that of FIG. 23 taken from line 24 of FIG. 20 showing the shutter mounted in the closed position, in a position which corresponds to FIG. 22.

FIG. 25 is an expanded view in perspective of the operating element of the motorized and manual portions of the racking arrangement.

FIG. 26 is a diagrammatic view showing the motorized operating elements in the connected or racked in position of the circuit breaker.

FIG. 27 is a similar diagrammatic view showing the initiation of the racking out operation.

FIG. 28 is a similar view showing a further step in the racking out operation.

FIG. 29 is a similar view showing the completion of the racking out operation for the circuit breaker elements to the test position.

FIG. 30 is a similar diagrammatic view showing the motorized operating elements in the racked out or test position of the circuit breaker.

FIG. 31 is a similar diagrammatic view showing the initiation of the racking operation.

FIG. 32 is a side view partly in cross-section of the operating element of the motorized racking operation of FIGS. 25 to 31 showing a continuation of the racking-in operation.

FIG. 33 is a view similar to that of FIG. 32 showing the completion of the racking-in operation to the connected position. The components then reset to the positions shown in FIG. 26.

FIG. 34 is a side view partly in cross-section of the operating elements of the motorized racking operation of FIGS. 25 to 33, showing a position corresponding to the diagrammatically illustrated position of FIG. 26.

FIG. 35 is a view similar to that of FIG. 36 showing, however, a position of the elements corresponding to that of FIG. 27.

FIG. 36 is a side view partly in section showing the secondary contact interlock and truck to compartment interlock.

FIG. 37 is a front view of the structure of FIG. 34.

FIGS. 38 and 39 are views corresponding to that of FIG. 36 showing different positions of the interlock elements thereof.

FIG. 40 is a side view in section showing the entire composite circuit breaker apparatus withdrawn from the compartment.

FIG. 41 is a top view of the forward end of the truck mounted circuit breaker structure of FIG. 38.

Referring first to FIGS. 1, 2 and 4, the circuit breaker structure is a vacuum type of circuit breaker now well known in the art in which a vacuum-tight housing 11 encloses and supports a stationary contact 12 and a moving contact 13. The connections to the interrupter 10 are specifically described in connection with FIGS. 17, 18 and 19. It is sufficient for the present to note that stationary contact 12 is electrically connected to the rigid connector 14 which in turn is connected in any suitable manner as by the nut 12a to upper or load back disconnect contact 15. The upper back disconnect 15 is provided with suitable contact fingers 16 in a manner now well known in the art when the circuit breaker structure is in the position shown in FIG. 1 to electrically engage the stationary back disconnect contact 17 in the compartment the said back disconnect contact 17 being connected to a load bus.

The movable contact 13 is a plunger type contact electrically connected to the conductive support 284 by the means described in connection with FIGS. 17, 18 and 19; the support 21 is connected to the lower disconnect contact 22 which is similar to the upper back disconnect contact 15; the contacts 23 of the lower back disconnect contact 22 are engageable with the lower stationary back disconnect contact 24 which is connected to the line bus. The circuit is then made from back disconnect contact 17 to the circuit breaker upper back disconnect contact 15 stationary contact 12 in the vacuum housing 11 then to the movable contact 13, the lower disconnect contact 22, the contacts 23 and the lower stationary disconnect contact 24. While in the view of FIGS. 2 and 4 a single circuit breaker is shown, it is obvious that the circuit breaker may be set up and in the present embodiment is intended to be set up as a three pole circuit breaker in which the operating mechanism carrying frame 30 will, through the connecting link 84, hereinafter described, and the jack shaft 82 which is common to and runs through all of the three poles of the breaker structure thereby operating the three poles simultaneously.

Each of the poles is provided with the structure thus far described including the vacuum interrupter 10 and the back disconnect structures 15 and 22. The three pole circuit breaker arrangement including vacuum interrupters 10 are carried on the frame 40 which is truck mounted on wheels 41, 42 at the front and back of the frame so that they may roll; thus the frame 40 as a whole may roll with respect to frame 30 which carries the operating mechanism.

The circuit breaker back disconnect contacts of the breakers 10 are racked out with the frame 40 to disconnect the upper and lower back disconnect contacts 15 and 22, when the frame is moved to the position shown in FIG. 4.

Telescoping Withdrawal Circuit Breaker

The frame 40, as may readily be seen from FIG. 4, telescopes with respect to the frame 30 of the operating mechanism. The frame 30 is fixed in position by hooks 710 engaging appropriate elements 712, 714 on the opposite side walls 44 of the compartment as will be hereinafter described in connection with FIGS. 34 to 37 and 8 so that during the racking operation from the connected position of FIG. 1 to the disconnect position of FIG. 4 the operating mechanism on the frame 30 is for all practical purposes to be regarded as integrated with the compartment and switchboard in which the compartment is located.

Since the frame 30 is thus fixed, the circuit breaker structure on the moving frame 40 moves with respect to the frame 30 and hence with respect to the compartment wall 44. It is guided in this movement by the slide arrangement which is more clearly seen in FIG. 3 but appears in FIGS. 1 to 4; that is the frame 30 carries the upper side 50 (see also FIGS. 5, 8, 12, 14, 20, 21, 22, 38, 39) and the lower side rod 51. The frame 40 carrying the circuit breaker is provided with the slide member 53 at the upper rear portion of the frame and the slide member 54 at the upper front of the frame 40 which slides on the upper slide bar 50 carried by the operating mechanism frame 30. The lower portion of the circuit breaker frame 40 is provided with a slide 55 which slides on the lower guide bar 51 on the frame 30.

It may thus be seen that when the racking mechanism is operated the circuit breaker structure on frame 40 may be moved from the position of FIG. 1 to the position of FIG. 4 telescoping with respect to the operating mechanism of frame 30.

Since, in the telescoped position of FIG. 4 the circuit breaker back disconnect contacts 15 and 22 are fully disconnected there is no need at this position of the circuit breaker mechanism to isolate the operating mechanism, there being no danger of any flashover to the operating mechanism. This is especially so since the stationary back conductors 17 and 24 remain in their original position within the stationary insulated bushings 60 and 61 on the back wall 62 of the compartment and covered by the shutter 400 (of FIGS. 20 to 24).

The mechanical connection for the operating mechanism on frame 30 to the truck mounted interrupter elements on frame 40 in order to operate the circuit interrupter 10 is made through the insulated operating link 70 which engages pin 71 on the bell crank lever 72 on pivot 73. The bell crank lever 72 at the end opposite the pin 71 is provided with the pins 74 which engage the clevis 75 of the extension 76 of the moving contact 13 of the interrupter 10. The specific operation of the interrupter 10 by bell crank lever 72 is described in connection with FIGS. 17, 18 and 19.

Consequently the movement of the link 70 to the right with respect to FIG. 1 will rotate the bell crank lever 72 to raise the moving contact 13 into engagement with stationary contact 12 and the movement of the link 70 to the left will operate the bell crank lever 72 to open the contacts 13. The operating link 70 may be centrally located to operate the center pole or may be provided in duplicate on each side to be operated by bell crank levers 81 (hereinafter described) keyed to a single jack shaft 82 which is common to all the poles of the circuit breaker.

The end of the operating link 70 opposite its connection to the bell crank lever 72 is connected at pin 80 to bell crank lever 81 which is keyed to jack shaft 82 on frame 40. The opposite end of the bell crank lever is connected by pin 83 to the link 84 which is the driving

link in the operating mechanism for operating the circuit breaker. The driving link **84** in the operating mechanism frame is connected at its upper end **85** so that it may react appropriately to the closing spring **120** (FIG. **5**) and respond to the latch system as hereinafter described in connection with FIGS. **5, 9** and related figures.

The moving contact plunger **13-76** is biased toward the stationary contact **12** in the closed position by the compression spring **90** captured between the upper portion of the clevis **75** on the external portion of the moving contact plunger **76** and the base **91** of the moving contact plunger **13.** Vacuum interrupter **10** contains a bellows **93** which is connected to the plunger **13** within the interrupter housing **11** in order to maintain the vacuum despite the fact that the plunger **13-76** must slide in and out of the housing. This is more specifically described in connection with FIGS. **17, 18** and **19.**

When, therefore, the link **84** is permitted to rise it rotates the bell crank lever **81** thereby pulling the link **70** to the right, rotating the bell crank lever **72** clockwise and moving the contact plunger **13** up to the closed position where it engages the stationary interrupter contact **12.** When the link **84** is released so that it no longer retains the contact in the closed position, then the opening compression spring **82***a* drives the bell crank **81** down to open the contacts, rotating the bell crank lever **72** counterclockwise, pushing the link **70** to the left, rotating the bell crank lever **81** counterclockwise and pulling down the operating link **84.**

Racking Into and Out of Telescoping Position to Disconnect and Connect the Back Contacts

As pointed out above, the operation of the link **84** to close the contact **13** and the release of the link **84** to permit the contact **13** to open with respect to stationary contact **12** are more specifically described in connection with FIG. **5.** In FIGS. **1, 2** and **4** the racking shaft **101** may be seen. The racking shaft is a through shaft in the operating mechanism frame **30.** The racking shaft **101** is provided on each side thereof with a crank **102** keyed to shaft **101** and connected by the pin **103** to the link **104** which is connected to the pin **105** on the interrupter frame **40.** The crank **102** and link **104** are in toggle relationship.

The two racking positions of the swinging link **84,** FIG. **1,** are symmetrically arranged so that the closing mechanism will operate the interrupter contacts equally when the circuit breaker is in the connected position or in the test position. This is necessary so that the operation of the circuit breaker while in the test position may be checked with appropriate assurance that its subsequent operation when racked in will be the same.

When the racking shaft is rotated counterclockwise from the position of FIG. **2** to the position of FIG. **4,** the crank **102** and link **104** on each side move to the closed toggle position shown in FIG. **4** thereby resulting in the racking out of the interrupter carrying frame **40.** When the racking shaft **101** is rotated clockwise from the position of FIG. **4** to the test position of FIG. **2** then the interrupter carrying frame **40** is moved also from the position of FIG. **4** to the position of FIGS. **1** and **2** into the fully connected position. The racking shaft is provided with a handle receiving member **110** keyed thereto, having an opening **111** therein to receive a removable handle **112.** Therefore the racking shaft **101** may be rotated to move the interrupters from the position of FIGS. **1** and **2** to the position of FIG. **4** by inserting the handle **112** in the opening **111** of the handle member **110** and lifting the handle as shown by comparison of FIGS. **2** and **4.** Similarly the circuit breaker interrupter elements may be racked into connected position by a reverse operation in which the handle **112** is inserted in the opening **111** of the handle member **110** and the handle **112** lowered from the position of FIG. **4** to the position of FIGS. **1** and **2** (See also FIG. **9**).

By this means therefore a full telescoping arrangement is provided for the truck elements of the circuit interrupter and back disconnect contacts mounted on the truck **40** so that they may approach the operating mechanism and overlap and surround elements of the frame **30.**

The only operative connection between the operating mechanism on frame **30** and the interrupter elements on frame **40** is the link **84** which operates the interrupter elements. The link **84** in turn operates as previously described on the three links **70** which are housed in the interrupter mechanism frame **40.**

As will be seen from a comparison of FIGS. **1** and **2** on one hand and FIG. **4** on the other hand, the link **84** is free to swing alongside the operating mechanism. Thus, the interrupter on frame **40** may cooperate with any type of operating mechanism on frame **30** and vice versa in accordance with the modular concept above disclosed.

Telescoping Arrangement and Modular Concept

It should be borne in mind that, for this purpose, the ability of the driving link **84** on the operating mechanism to swing as shown from the position of FIGS. **1** and **2** to the position of FIG. **4** permits the telescoping arrangement to occur. By isolating this link **84,** any interrupter device on frame **40** which will respond to the movement of the driving link to close may be substituted for the interrupter on frame **40,** and any operating mechanism utilizing a swinging link (or a link which may shift its position) while still being operatively connected through bell crank lever **81** to an interrupter contact drive link, such as link **70,** may be substituted for the operating mechanism shown. This makes possible the modular arrangement in which various types of interrupters may be used in connection with various types of operating mechanisms.

The opening spring is part of and associated directly with the frame; the closing operation as well as the latch arrangement which resists the opening spring and the controls for the latch are in the operating mechanism on the telescoping frame. Hence, the telescoping and modular arrangements are both made possible.

A specific operating system which achieves the foregoing functions will now be described:

Spring Closing Device for the Interrupter, Spring Charging Means Therefor and Latch and Trip Structures in the Operating Mechanism

Reference is first made to the diagrammatic and highly schematic views of FIGS. **16***a*, **16***b*, **16***c*, **16***d* which illustrate the principle but do not show the actual structure (this structure is more fully explained in connection with FIG. **9** and related Figures).

FIG. 16*a* shows the circuit condition of the closing springs with the circuit breaker open but the closing springs charged. The closing spring **120** has been compressed by the spring charging link **121.** The roller **130** is resting on the latch **131.** Since the roller **130** is carried by the charging link **121,** it supports the closing spring **120** in compressed condition. Roller **130** rides on the bell crank lever **132** which rotates on pin **133.** The spring **120** has been operated to the charged position by the counterclockwise rotation of bell crank lever **132.** The said bell crank lever **132** also constitutes a cam member with varying cam surfaces; it is rotated counterclockwise for this charging operation by link **135** connected thereto by pin **136.** Link **135** is pulled upward by the spring **137.** The charging motor **138** drives the crank **139** clockwise carrying the roller **140.** When the roller **140** has entered the notch **141** of the drive link **135,** it pulls this link down thereby rotating the bell crank cam lever **132** counterclockwise and thereby effecting the charging operation. When the spring charging operation is completed, the latch **131** which is spring biased counterclockwise on the stationary mounting pin **145** moves under the roller **130** to support the spring in charged position thereby moving away from the motor limit-switch **146** and opening the circuit to the motor **138.** The motor then coasts to a stop to the position where the roller **140** on driving crank **139** is at the position of FIG. 16*a*, ready for the next charging operation.

The top of bell crank lever **132** is a cam, and as will be seen, a roller **150** on link **151** is supported between the cam surface of link **152** and the top cam surface of crank lever **132.** Link **150** is connected at pin **153** to crank arm **154** on the jack shaft **155** (see also FIG. 2) which operates the operating link **84** of the circuit breaker. The circuit breaker at this point is open but the roller **150** on the end of link **151** is fixed in position between the cam link **152** and the top of the cam surface of the bell crank lever cam **132.** The cam lever **152** is fixed in position by the trip latch **160.**

Both the closing latch **131** and the trip latch **160,** on its pivot shaft **160***a* (FIGS. **16, 5, 9** and **12**) may be operated by manual means hereinafter described or by remote control means as well as, in the case of the trip latch **160,** by an appropriate overcurrent means.

Since the cam lever **152** is fixed in position by the latch **160,** now when the latch **131** is removed from its supporting position on the roller **150** of spring arm **121** which holds the spring **120** compressed, the spring arm **121** may now be driven to the left by the spring **120.** The roller **150** then rotates the bell crank lever **132** clockwise and because of the cam surface, pushes the roller **150** from the position shown in FIG. 16*a* to the position shown in FIG. 16*b* where the roller **150** engages the detent **170** in the cam latch arm **152.**

This causes a rotation of the closing crank **154,** the jack shaft **155** and consequently an upwardly directed force on the operating lever **84** which causes the circuit breaker to close.

Referring now to FIG. 16*c*, it will be seen that the forces on the link **151** against the detent **170** of latch link **152** are in a direction such that the roller **150** is detented in position by the latch link **152** which in turn is held by the trip latch **160.** Consequently when the interrupter is closed, even though the compression spring is operated from the discharged position of FIG. 16*c* to the charged position of FIG. 16*c* and the cam bell crank lever **132** is no longer in supporting position for the roller **150,** the roller **150** is nevertheless held latched in position by the combination of latch lever **152** and latch **160.** Therefore, the opening spring **82***a* for the circuit breaker acting through bell crank lever **81,** link **84** andd the jack shaft **82** cannot operate since it is ultimately stopped by the engagement of roller **162** with the latch **160.** This maintains the link **84** in position and the circuit breaker closed.

The circuit breaker therefore remains closed until it is otherwise tripped as hereinafter described while nevertheless the spring charging cycle may now proceed from the discharge position of FIG. 16*b* to the charged condition of FIG. 16*c*.

With the charging spring in compressed position ready to close or in uncompressed condition after having completed the closing operation, the circuit breaker is nevertheless trip free since on the occurrence of any overload condition the removal of latch **160** by motion clockwise around its mounting pin **160a** will permit the latch link **150** to rotate clockwise and thereby permit the latch roller **162** to leave the detent **170** permitting the jack shaft **155** to rotate to the position shown in FIG. 16*a*, thereby permitting the operating link **84,** link **70** and their associated bell crank levers to rotate in response to the force of the opening spring **82***a* of FIG. **1** which pulls the plunger contact **13** in the interrupter **10** down to open position.

Consequently the circuit breaker is trip free at any point during the closing operation, during the charging of the spring and during discharge of the spring.

This provides a single stroke charging action; a single motion of the motor driven crank serves to charge the closing spring.

In order to absorb excess energy of the spring when it discharges to close the circuit breaker, an appropriate dash pot **180** is provided.

As above mentioned, the foregoing description is purely schematic and with respect to the schematic drawings 16*a–d*, the actual structure is shown in FIGS. **5, 9, 12** in various positions of operation with some of the details appearing in FIGS. **13, 14** and **15.** FIG. **9** is an over-all expanded view in perspective. FIG. **5** shows the position of the elements with the circuit breaker contacts in the closed position. FIG. **12** shows the position of the elements with the circuit breaker contacts in the open position. The compression spring **120** on its base **120***a* is connected so that the spring rod **121** is urged upwardly. The upward force of the spring on spring rod **121** is resisted by the latch **131** on latch roller **200** on operating cam **201.** Operating cam **201** is connected to the spring rod **121** by pin **202,** link **203** and pin **204** which also connects the spring rod **121** to the bell crank cam **132.** When the latch **131** is removed from its blocking position on roller **200** then the bell crank operating cam **201** hereinafter described may freely rotate about its pivot **205** as spring rod **121** may now rise. This results in a counterclockwise rotation of bell crank lever cam **132** on its pivot **133.** Cam pin **150** on the upper end of the first toggle link **210** is held in the position shown in FIG. **5** while cam lever **201** is correspondingly rotated on its pivot **205.** The pin **150** is connected to latch toggle **151** comprising toggle links **210, 211,** The end of toggle link **211** is connected to the operating crank **154** of the shaft **155** to operate the circuit breaker contacts to closed position when the

crank arm **154** is turned counterclockwise by pulling up the operating link **84.**

As the pin **150** at the end of link **210** of toggle **151** is moved upwardly by the detent element **213** of bell crank lever cam **132** the toggle **151** is pushed upwardly, that is the center pin **220** of toggle **151** is guided by the connecting link **210'** attached to the trip roller carrier **152,** the circuit breaker contacts reach the closed position; the upward push on toggle link **211** causes the crank **154** and the shaft **155** to rotate in a counterclockwise direction to the position of FIG. **5** thereby pulling the operating link **84** up and thus operating the interrupter contacts **13** toward the closed position in engagement with contact **12.** The toggle is then supported in its closed position by the trip latch **160.** Thereafter, the closing spring may be recharged as shown in FIG. **5** even with the contacts closed. The racking release lever **811** drives pin **506** (See FIG. **9**) to collapse the toggle as hereinafter described.

FIG. **12** shows the condition of the parts with the circuit breaker contacts open, the operating crank **154** and the operating link **84** in the down position with the spring now discharged; the toggle **151** is now broken thereby permitting the circuit breaker to trip by the latch **160;** the trip free position of th circuit breaker being shown.

In order to charge the spring, closing cam **201** must be rotated counterclockwise about its pin **205.** This results in driving the link **203** from the position shown in FIG. **12** back to the position shown in FIG. **5** and since the closing spring rod **121** is connected to the cammed lever **132,** thereby fixing its position, this must necessarily result in the downward movement of the link **203** and spring charging rod **121** from the position of FIG. **12** to the position of FIG. **5** until the latch **131** engages the latch roller **200** on the moving cam lever **201.**

The cam lever may be rotated by a motor connected to the pinion **230** which drives the gear **231,** in turn driving the shaft **232** which carries the crank **129** and cam roller **233.**

As will be seen by a comparison of FIGS. **5** and **12** the rotation of the cam roller **233** against the inner surface **234** of cam **201** will cause the cam **201** to rotate about its pivot **205,** thereby charging the spring **120** by moving down the spring arm **121.** At the completion of the charging operation, the cam roller **233** coasts to the position of FIG. **12** where it is free from both arms of the cam lever **201.** At this point the cam roller coasts into the spring loaded overtravel stop which brings it to a halt and resets it to the position shown in FIG. **12** where it is ready for a recharging signal. The roller **233** cannot then get past this stop until the springs **120** are discharged and the cam **201** lifts this stop out of the way as shown in FIG. **12.** Lifting this stop actuates the motor switch FIG. **9** and the motor will start recharging the springs. The stop and thereby the motor switch are held by engaged by the concentric part of plates **129** until the plates **129** have reached the fully charged position of FIG. **5.** When this position is reached the overtravel stop drops down off the concentric part of plates **129** as shown in FIG. **5** and the motor switch cuts off the motor which then begins to coast again until the roller **233** again hits the overtravel stop.

This manner of stopping the cam roller **233** and its arm and thereby stopping the motor so that the cam roller may not coast to an interfering position and will remain in the correct position for another charging operation is an essential element of the single stroke charging system.

The roller **233** cannot be stopped immediately after it has charged the spring; it must be allowed to coast and decelerate and then be stopped by the spring loaded overtravel stop (FIG. **12**) that has dropped down into the path of travel of the roller, cutting off the motor switch while roller **233** is still approximately 180° away from its final stop position.

The spring-loaded stop (FIG. **12**) must be moved out of the way of roller **233** before the motor starts either for spring charging or racking.

The stop (FIG. **12**) is lifted out of the way by the discharge of the closing springs (FIG. **12**) or by release of the racking release lever (FIG. **6**). Lifting this spring loaded stop starts the motor (FIG. **9**). The spring loaded stop is then held up as the springs are charged by the outer edge of the cam roller carrying plates (FIG. **9**), which also act as a timing cam, until the charged position of FIG. **5** is reached and the spring loaded stop can drop down to shut off the motor and block roller **233** as it coasts toward the stop.

The cam lever **201** may also be rotated manually in order to charge the spring manually. Since the motor operated charging roller **233** is in the position shown in FIG. **12** in the fully charged or in the uncharged position of the spring, the cam lever **201** may be rotated about its pivot **205** by a distance equal to that between the cam lobes **240** and **241.**

The manual means for charging the spring comprises the shaft **250** mounted across the front of the frame **30** which carries the operating mechanism **251** and a cam roller **252.** When the operating mechanism **281** is rotated clockwise from the position shown in FIG. **12,** cam roller **252** moves from the solid line position shown in FIG. **5** to the dotted line position **253** shown in FIG. **5** and rotates the cam **201** to operate the closing spring operating link **121** exactly in the same manner as previously described in connection with FIG. **5** and the motor mechanism for charging the spring.

This manual operation is obtained by arranging the crank wheel **251** freely on the shaft **250** so that it has an opening **255** in which the operating handle **256** may be placed. The dash pot **180** previously described in connection with FIG. **16***a* is shown at FIGS. **5** and **12.** In this case, the dash pot **180** is connected by the link **270** to a pin **271** on the cam lever **132** which is, of course, connected to the spring operating rod **121** and serves to absorb the shock and the excess energy of the operation of the spring.

The escutcheon plate of FIG. **10** shows the access opening for handle **256** to charge the closing springs.

Interrupter Structure and Current Transfer

FIGS. **17, 18** and **19** show the novel portions of the miniature high voltage circuit breaker as it relates to the interrupter **10** itself which includes the stationary contact **12,** the moving contact **13.** As previously pointed out, the moving contact has a bellows **93** connected to a sealing sleeve **280** carried thereby. The bellows **93** is connected at the bottom wall **281** of the vacuum interrupter housing by a vacuum type seal therewith so that the movement of the movable contact plunger **13** through th opening **282** in the bottom wall will not result in contamination of the vacuum condition within the housing **11** of the vacuum interrupter

10. The vacuum interrupter 10 is supported by an annular insulator 183 and is secured to the rigid connector strap 284 which, in turn, is connected to the lower back disconnect contact 22. The moving contact plunger 13 is secured in any suitable manner as by, for instance, screw threads 290 to an exterior plunger 291. The strap 284 is provided with an opening 292 through which the exterior plunger 291 may pass and the periphery of this opening is provided with spring contact elements 295 arranged annularly of the contact plunger extension 291, so that effective contact can at all times be made between the moving contact plunger 13 and the connecting strap 284. An extension 301 of the plunger is provided with a ring 302 secured thereto and another ring 303 which together form the clevis 75 previously referred to which is slidably mounted on plunger extension 291. Plunger 13 and extensions 291 and 301 move as a unit. Clevis 75 slides along this unit to compress spring 90. Only contacts 295 transfer current to the moving plunger extension 291. Annular contact spring 320 acts as a current transfer pressure spring engaging and squeezing contact 295 against plunger extension 291. Extension 291 is threaded into and hence a part of moving contact plunger 13.

The operating pin previously described in connection with FIG. 1 engages the clevis on both sides; the operating bell crank lever is basically a two piece member with the pin 74 projecting from each side thereof so that when the circuit breaker is to be closed upward movement of the pin 74 will operate the clevis 75. Raising the clevis 75 will compress the spring 90. As previously described the arm 70 which operates the bell crank lever 72, which in turn operates the pins 74 which engage the clevis, is latched in position through its connection bell through crank lever 81 to operating link 84 which in turn is connected to elements which engage the latch (see also FIG. 19).

Consequently when the plunger 13 is raised to the position shown in FIG. 17, the circuit breaker is closed. On release of the holding force which is transmitted to the link 70 and bell crank lever 72, the opening spring 82A (FIG. 1) will now drive the plunger 13 down to the open position. The stationary contact 12 is supported in the upper wall 30 of the housing 11 of the interrupter and there connected to the rigid connection trap 14 which is, in turn, connected to the movable back disconnect contact 15. The garter spring 320 maintains contact pressure between contacts 295 and the plunger assembly 13-291-301. Spring 90 maintains contact pressure between contacts 12 and 13 when the circuit breaker is closed.

By the means herein described, the minimum number of current transfer joints are used to minimize heating. The straight line guiding of the moving contact 13 prevents damage to the bellows 93 and insures full seating of the internal contact surface in the vacuum interrupter. The contact pressure spring 90 is placed as close as possible to the gap between contacts 12 and 13 with a minimum amount of added material between the springs and the contact gap. This spares the stationary housing 11 for the vacuum interrupter and especially the stationary contact extra abuse from the inertia of material of any kind added between the contact pressure springs and the contact gap. Such material wouldd otherwise be brought to an abrupt halt by the stationary vacuum interrupter contact on closing. The rigidity of the mounting and actuating assembly minimizes contact bounce on closing and rebound on opening.

The vacuum housing 11 is mounted to the copper conductor 284 which in turn is bolted to the incoming lower disconnect 22. The stationary contact 12 is bolted to the outgoing copper conductor 14 which is connected to the upper disconnect 15. The moving contact plunger 13 has a threaded external end on which is mounted the copper bushing 291 which is then clamped by the washer, the long bushing, and the long bolt which enters a tapped hole in the external end of the moving plunger 13. The floating bushing with the actuation groove or clevis 75 forces the copper bushing and the moving contact 13 upward through the captive contact pressure spring 90. The floating bushing is held assembled by the limit washer. The moving contact and spring assembly are guided by the widely spaced bearings 321 inside the housing 11 and the lower stationary bearing 322 which is secured to the frame.

Shutter for Stationary Disconnects in Compartment

In order not only to facilitate the operation of the device, but to make absolutely certain that the bus is not available when the interrupter and its elements are racked out to the test position, there is provided a shutter 400 against the back wall 401 of the compartment. Thus, shutter is arranged to block access to the stationary back connection studs 17 and 24 when the interrupter is disconnected. (See FIGS. 20 to 24).

The shutter 400 is mounted as previously described on the back wall 401 of the compartment being pivotal on a stud 402 carried by the back wall of the compartment. The shutter 400 is provided with openings 405 and notches 406, 406 which as shown in the open position of the shutter FIG. 23 corresponding to that of FIG. 20, there is full access to the back disconnects 17 and 22. Obviously, the showing in FIGS. 23 and 24 are for a three-pole circuit breaker arrangement with the upper disconnects and lower disconnects 17 and 22 respectively being each repeated so that there are three of each. It will be obvious that when the shutter 400 is in the position shown in FIG. 24 which corresponds to the position of FIG. 22, all of the disconnects 17 and 22 are blocked. When the shutter is rotated approximately 60° in a counterclockwise direction, then the notches 406, 406 register with the lower left and upper righthand disconnects; the openings 405, 405 register with the upper and lower middle disconnects and the upper lefthand corner and lower righthand corner of the shutter clear the upper left and lower righthand disconnects.

The back wall is provided with stop members 410 which locate the shutter in the closed and open positions. The shutter is provided on the right side with respect to FIGS. 23 and 24 with an extension 411 rigidly connected thereto. The extension 411 is connected to the operating lever 412 by pin 413 so that when the lever 412 is raised, the shutter is moved to the open position of FIG. 23. When the lever 412 is lowered, the shutter is moved to the shut-off position of FIG. 24. The lever 412 at the end opposite its connection to pin 413 is pivotally mounted on pin 414 secured to the right side wall of the housing of the compartment (FIGS. 23 and 24). A tension spring 416 is connected between the bottom of the compartment and the lever 412 biasing the lever to a downward position. The operating lever 412, since it is therefore biased down is

biased toward the shutter closed position of FIG. 24, so that unless the circuit interrupter is racked in, the shutter will be moved to the closed or shut-off position. The operating lever 412 is provided with a cam surface 420 which operates against a pin 421 mounted on the frame 40 of the circuit interrupter. In the position shown in FIGS. 22 and 24, the pin 421 is clear of the cam 420 on the lever 412. Consequently, the spring 416 rotates the shutter to the down or closed position about the pivot 402. As the circuit breaker is racked in from the position of FIG. 22 to the position of FIG. 21, the pin 421 moves against the cam surface 420 thereby raising the lever 412 and rotating the shutter from the position shown in FIG. 24 to the position shown in FIG. 23. Cam surface 420 is an extremely short cam surface with a steep angle so that the initial movement toward the insert position from the position of FIG. 22 toward the position of FIG. 21 will promptly raise the shutter in time for the disconnect contact elements 16 and 23 to enter the openings into which the connection studs 17 and 24 project. Thereafter the pin 421, by riding under the secondary cam element 431 will, as shown in FIGS. 21 and 20, as well as FIG. 23, maintain the shutter in the open or access position.

By this means, therefore, it is seen that as the interrupting elements are racked out, the shutter will be moved into closed position and just as the circuit breaker interrupter elements begin to be racked in and before the moving contact elements 16 and 23 begin to enter the bushings 430, the shutter will be moved out of closed position.

The initial travel of the interrupter section toward connected position will therefore serve to move the shutter from the closed to the open position.

Since the moving contacts 16 and 23 are slightly more than an inch and a half away from the shutter in the racked out position of FIGS. 22 and 24, the cam surface 420 must be so arranged that it will operate in the first one and a half inch of travel of the frame 40; this is the reason for the steepness of the slope of the cam surface 420. However, it should be noted that the shutter is a balanced member with only the spring 416 and the weight of the lever 412 providing a force opposing the movement of the pin 424 against the cam surface 420. Therefore, this initial movement of the relatively much heavier circuit interrupter element will not be impeded by the need for moving the shutter from the closed position of FIG. 24 to the open position of FIG. 23.

Motorized Racking Arrangement

The racking arrangement, that is, the operation of shaft 101 in order to operate the toggle 102, 103, 104 to rack the circuit breaker in and out has been described generally in connection with FIGS. 1, 2 and 4. It is shown in detail in the expanded view of FIG. 25. It is explained diagrammatically in sequence in FIGS. 26, 27, 28, 29, 30, 31, 32, and 33. The entire operation may also be understood from the complete expanded view of FIG. 8.

FIG. 26 shows the racked in position of the elements. FIG. 27 shows the initiation of the racking-out operation. FIG. 28 shows a further step in the racking-out operation. FIG. 29 shows the completion of the racking-out operation for the circuit breaker elements to the test position. FIG. 30 shows the racked out position of the elements. FIG. 31 shows the initiation of the racking-in operation. FIG. 32 shows a further step in the racking-in operation; and FIG. 33 shows the completion of the racking-in operation to the connected position.

Referring specifically to FIGS. 25 to 33 (but see also FIGS. 8 and 34), the racking shaft 101 which may be manually operated by the racking handle 112 of FIGS. 1, 2 and 4 is provided with a drive plate consisting of a pair of parallel and similar plates 501, 501*a*, which are keyed to the racking shaft 101 and also interconnected by the four corner pins 502, 503, 504, 505 which extend between them. It will be obvious therefore that when the plate 501 is rotated counterclockwise from the connected position of FIG. 26 to the disconnect or test position of FIG. 30, the racking shaft 101 will correspondingly be rotated and the toggle 102, 103, 104 of FIGS. 1, 2 and 4 will be moved toward collapsed position to effect a racking out of the interrupter elements of the circuit breaker.

Correspondingly, when the racking plate 501, 501*a* is rotated in a clockwise direction from the position of FIG. 30 through the positions of FIGS. 31, 32, 33, back to the position of FIG. 26, the toggle will be extended and the interrupter elements of the circuit breaker will be racked in to the connected position.

The same motor which charges the closing spring (described in connection with FIGS. 5, 12 and 15) is used for the racking operation, it being obvious that once the spring has been charged, the operation of the motor shaft 232 by pinion 230 (FIG. 5) will no longer affect the operation of the closing spring 120 of FIG. 5.

The means for operating the racking plate 501, 501*a* includes the slide 510 of FIGS. 25 to 33. The slide 510 is arranged for movement back and forth on the motor shaft 232 which is received in the horizontal slot 512 of slide 510 and slot 512a of slide 510*a*. The forward end 513 of the slide is supported by the open slots 514 and 514*a* defined by the extensions 515, 515*a* and 516, 516*a* of the slide 510 and sliding on the racking shaft 101, which in this case serves only as a means for supporting and guiding the slide 510 and does not control its operation.

The slide 510 consists of two similar plates 510 and 510a which are appropriately connected together primarily by the mounting pins 520, 521 for the lower operating fingers 523 and the upper operating fingers 524. The fingers 523 and 524 are mounted on the pins 520 and 521 between the plates so that they may rotate on the pins under the guidance of the apparatus as hereinafter described.

The lower fingers 523 are provided with the biasing spring 530 around pin 521 to drive the fingers upwardly. The fingers 524 are provided with the biasing spring 531 around the pin 520 to drive the fingers 524 in a downward position. The fingers 523 and 524 are provided respectively with detents 535 and 536; detent 535 may engage the lower pins 502, 503 of the racking plate and detent 536 on the upper finger 524 may engage the pins 504 and 505 of the racking plate 501, 501a. Stationary plates 540, 541 are supported by the shafts 101 and 232.

Plate 541 is provided with a reentrant support 542 for supporting the spring return element 543 and providing a bearing surface therefor: That is, when the slide 510 is moved to the right, the compression spring 543 in the housing 550 on slide 510 is compressed by

the end **551** of the housing **550** which moves with the plates forming the slide **510**, the said spring being compressed against the stationary element **542** of the stationary plate **541**. Therefore, when the driving force on the plate slide **510** is released, the spring will return the plate slide.

It will thus be seen, particularly from FIGS. **26, 27** and **28**, that the slide **510** moves to the right with respect to said figures under control of motor driven roller **233**. Then, on release of the driving force, the spring **543** returns the slide **510** back to the position of FIG. **28** where the slide **510** is located and positioned by the righthand end of the slots **512, 512***a* engaging the shaft **232**.

The pin **521** of the slide **510, 510***a* which supports the lower finger **523** also carries a rotatable lug **560** directed rearwardly thereof. The roller **233** driven by the motor as shown in FIG. **33** engages the trailing end of the lug **560** to drive the slide **510** from the position of FIG. **26** to the position of FIG. **27**. The lug is spring biased by spring **560***a* to the position shown in FIG. **34**. However, when the slide reaches the advanced position, as for instance that of FIG. **33**, the continuation of movement of the roller **233** will clear the lug **560** and permit it to move to the left with slide **510**. Lug **560** is made rotatable to permit engagement of the motorized racking feature only when desired by the movement of the lower flange on lever **811** of FIG. **6**. This initiates a racking operation only when desired by raising the lug **560** into the path of roller **233**. This is necessary since the roller **233** moves whenever the motor is running, as, for instance, in the spring charging operation.

For the purpose of ensuring exact movement of the slide **510**, the positioning thereof at the forward end of its stroke is therefore positively controlled by the travel of the roller **233** pushing lug **560** clockwise against its stop (FIG. **33**).

It will be obvious from an examination of FIGS. **26, 27, 28** and **29** that the movement from the connected to the test or racked-out position requires two back and forth movements of the slide **510**. In both of these movements, the upper fingers **524** are disengaged from and do not contact the pins **504, 505** of the racking plate **501, 501***a*. This is controlled by cam means hereinafter described. During such movement, the detents **535** of the lower fingers **523** successively contact and move first the pin **502** of the racking plate **501**. Thio is clearly shown in FIGS. **26, 27, 28** and **29**.

When the motor is operated to move the slide **510** to the right, the detent **535** of finger **523** on the slide **510** engages first the pin **502**. The movement of the slide to the position of FIG. **27**, where it is stopped by the roller **233** leaving the lug **560**, serves to rotate the racking plate **501** and the racking shaft **101** through an angle which is half the rotation required of the racking shaft **101** to perform the racking operation. At this point, the continued rotation of the driving roller **233** disengages it from the driving lug **560** of the slide and the spring **543**, which has been compressed during this operation, is now free to return the slide **510** to its original position as illustrated in FIG. **28**. Thereafter, on the next movement of the slide **510** from the position of FIG. **28** to the position of FIG. **29**, the detent **535** of the lower finger engages the pin **503**, and on the movement of the slide **510** under the influence of the motor driven roller **233**, moves the slide from the position of FIG. **28** to the position of FIG. **29**, thereby performing the second half of the angle of rotation necessary to rotate the racking shaft **101** to the full racked-out position corresponding to FIG. **4**. With the circuit interrupter now racked out the next initiation of the motorized racking sequence will result in the detent **536** of the upper finger **524** engaging pin **505** to drive the racking plate **501** and the shaft **101** from the position of FIG. **31** to the position of FIG. **31** which is half of the angle of rotation needed to rack in the circuit interrupter. The slide **510** will then be released, as previously described, to return to the driving position whereupon on the next operation of the slide **510**, it will engage the pin **504** of racking plate **501** to rotate the racking shaft **101** back to the racked in or connected position shown in FIG. **26**.

It should be noted that separate motor-driven rollers **233** and **233***a* are used respectively for spring charging and for racking.

The racking is initiated by operation of lever **811** (FIG. **6**) which rotates lug **560** into the path of travel of roller **233**. Lever **811** can be moved only after the springs are charged and the breaker is open (FIG. **6**); the lever **811** must be moved to restart the motor.

The same drive motor is used for spring charging and for racking. The lug **560** is, in effect, the clutch which effects the connection between the motor and racking mechanism. The operation of charging and racking cannot be performed simultaneously and is prevented by lug **560** (FIG. **6**). The same limit switch **146** (FIG. **9**) is used for both operations.

As previously described, the fingers **523** and **524** must be so arranged that the finger **524** will be disengaged from driving operation with pins **504, 504** of the racking plate **501** during the movement from the connected position of FIG. **26** to the racked-out or test position of FIG. **29**. Similarly, fingers **523** and their detents **535** must be disengaged from pins **502** and **503** during the movement of the breaker from the test position of FIG. **29** through positions of FIGS. **30** and **31**, back to the connected position of FIG. **26**. For this purpose, camming pin **550** is provided at the lead end of finger **524** remote from its pivot, and camming pin **551** is similarly provided at the lead end of the lower finger **523**, remote from its pivot. The detents **536** and **535** of the fingers **524** and **523**, as previously pointed out, engage their respective pins **502-3-4-5** between the plates **501, 501***a*. Pin **550** of the upper finger **524** extends beyond the finger **524** so that with the racking plate in the position shown in FIG. **26**, the pin **550** of the upper finger **524** first strikes the side of racking plate **501**, thereby lifting the finger up so that the detent **536** is initially out of the path of the pins **504, 505** (FIG. **26**). Similarly, when racking in, the pin **551** of the lower finger **523** when the racking plate **501** is in the position of FIG. **30**, first strikes the side of the racking plate, FIG. **30**, so that the finger is lifted down and away, so that in subsequent movement through the positions of FIGS. **30** and **31**, back to the position of FIG. **26**, the lower finger **523** will have no effect on and will not come into contact with the pins **503, 502**.

These camming pins **550** and **551** therefore defeat the operation of the springs **550, 531** which drive the fingers toward operating position so that only the finger which is to perform the operation may engage its respective pins.

It will be obvious that the trailing, left-hand side of the racking plate **501, 501***a* may be appropriately curved and shaped to guide the pin **550** or **551** to initi-

ate the movement of the associated finger **524, 523** out of operative position. As a supplement to this shaping, there is provided a camming wheel **569** which is loosely mounted on the racking shaft **101** and is under the control of the pin carried in openings **566** of extensions **565** of racking plates **501, 501***a*, the latch **582** and spring **561**, depending on the location of the plates **501** (FIG. **34**).

Wheel **569** is provided with a centering spring **561** which surrounds the racking shaft **101** and engages a pin **562** on wheel **569** and a stationary pin **563** (supported on plate **541**). The racking plates **501, 501***a* are provided with an extension **565** which supports the pin **566** between them, the said pin **566** riding in the slot **567** of the cam wheel **569.** When the finger **524** has completed its movement driving the pins **504, 505** from the position of FIG. **30** through the position of FIG. **31,** back to the position of FIG. **26,** the cam wheel **569** has rotated with plates **501** driven by pin **566** pushing against latch **582** (FIGS. **33, 34**) which is mounted on cam **560**; the finger **524** has been free to operate the pins **504** and **505,** while the finger **523,** during the forward movement toward the right, with respct to FIG. **30,** of the slide **510,** is in a position where the pin **551** will first ride down the side of the racking plate **501** adjacent the pin **503,** and then ride down the camming surface **570** of the cam plate **569** and thus be lifted clear of the pins **502, 503** of the racking plate **501.**

The cam wheel **569** is maintained in this position by the leg **578** of latch **582** which is rotatably mounted on the pivot **576** on the cam wheel **569.** The latch is also provided with a tension spring **577** engaging the leg **578** thereof and the pin **579** also mounted on the cam wheel **569.** The latch leg **578,** driven by pin **566** has served to maintain the cam wheel **569** in the position shown in FIG. **30** in relation to plates **501.** Thus, the centering spring **561** is tensioned, tending to drive the cam plate counterclockwise to the alternate position where it will cause the pin **550** on finger **524** to rise up out of operative position, but is prevented from doing so by the latch arrangement.

As the racking plate **501** completes its rotation from the position of FIG. **30** through FIG. **31,** back to the position of FIG. **33,** the lower stationary trip pin mounted on plate **541** strikes the tail **582** of the latch and disengages the latch, whereupon the centering spring **561** now moves the cam wheel **569** to the alternate position indicated in FIGS. **26** and **34.** The opposite leg **578** of the latch is now in engagement with the pin **566** as shown in FIG. **34.** Racking toward the disconnect position will result in the pin **566** pushing the leg **575** and with it the cam **569** in a counterclockwise direction until latch **582** is released by the upper stationary pin (FIG. **34**).

With the camming wheel **569** now in the alternate position indicated by the dotted lines **584** (FIG. **37**) the movement of the slide **511** to operate the racking mechanism will result in movement from the connected position of FIG. **26** to the full disconnect of FIG. **29,** with the finger **523** engaging successively the pins **503** and **502** as shown in FIGS. **27, 28** and **29,** while the pin **550** on the upper finger **524** will first ride up the upper rear side of the plate **501, 501***a* and then on the camming surface **586** of the cam wheel **569.**

By this means a simplified motor-driven operation is provided for the racking shaft **101** shown in FIGS. **1, 2** and **4.** This motor operative means does not interfere with the manual operation as shown by means of the handle **112** and handle receiver **110** on the racking shaft **101.**

In operation, switch **146** (FIG. **9**) is closed to start the motor which drives the rollers **233** (and **233***a*) and the lug **560** is rotated into the path of roller **233***a*. The operation, as far as the motor and the slide **510** are concerned, is then the simple operation of driving the slide **510** from the position of FIG. **26,** which is the connected position, to rotate the shaft **101** through half the angle needed for racking-out to the position of FIG. **27.** The roller **233** then leaves the driven lug **560,** comes around once more to pick up the slide **510** which has been returned by the compression spring **543.** The roller then picks up the lug **560** and drives the slide **510** from the position of FIG. **28** to the position of FIG. **29,** completing the rotation of the racking shaft **101** through the angle needed to move the interrupter mechanism from the operative or racked-in position to the test position. The motor is then stopped by the switch **146** when the racking release lever **811** (FIG. **6**) drops into the proper index notch on wheel **110.** The closing latch (FIG. **6**) is then unblocked so that the springs can close the breaker and the trip latch is permitted to reset. If the springs close the breaker at this time, the motor is again started by the same switch, through actuation of the same spring loaded overtravel stop as shown in FIG. **12,** being lifted by the plates **241.**

Thereafter, when racking-in is to occur from the test position of FIG. **30** through to the position of FIGS. **31, 32** and **33** to the connected position of FIG. **26,** the motor is energized once more and the motor driven roller **233** then operates the slide from the position of FIG. **30** to the position of FIG. **31.** The slide then returns once more to a position shown in FIG. **32** and the further operation of the motor drives the racking shaft from the position of FIG. **32** back to the position of FIGS. **33** and **26.** Again, the motor is stopped at this point, with the interrupter fully racked-in.

The various indication devices available to the operator are shown in the escutcheon plate of FIG. **10.** It should be noted that in FIG. **6,** the clockwise motion of lever **811** that initiates the electrical racking, and that unlocks the racking shaft **101,** can be accomplished by manually depressing the protruding end of lever **811,** momentarily, or this lever can be operated from a remote location by including a small solenoid, not shown, which will pull this lever down.

Secondary Contact Actuation and Compartment Interlock

Referring to FIGS. **36–41,** the stationary elements of the secondary contacts at **700** are mounted on the top wall **701** of the compartment or housing. The m'vable elements **702** of the secondary contacts are mounted on support **703** carried by the frame **30** of the operating mechanism. As previously pointed out in connection with FIGS. **1** to **4,** the operating mechanism, with the interrupter frame **40** in racked-out position, may be trucked out of the compartment. However, the operating mechanism must be connected to and integrated with the compartment mechanically, so that while the circuit breaker is being racked from connected into disconnected position, no part of the mechanism may be moved from the compartment. Also, the operating mechanism must be so integrated with the compartment that when the interrupter elements are in test po-

sition, the operating mechanism remains integrated with the compartment and is incapable of movement with respect thereto.

Only after the interrupter element of the circuit breaker has been racked to the disconnect position, and only after all of the movable contact elements **702** of the secondary contacts have been removed from engagement with the stationary contact elements **700** in the compartment, may the entire unit be removed from the compartment.

FIGS. **36** and **37** show these integrating and interlock elements with all of the elements in the disconnect or test position of the circuit interrupter. When the operating mechanism is located in the compartment, a hook **710** rotatably mounted on the shaft **711**, carried by the main frame **30** of the operating mechanism, engages the stationary pin **712** on the side wall of the compartment, that is, the section **713** of the hook engaging the pin **712**, prevents removal of the operating mechanism from the compartment. An additional pin **714** is provided on the compartment. Section **715** of the hook engages this additional pin and determines the limit of inward movement of the operating mechanism into the compartment. Thus, the pins **712** and **714**, cooperating with the surfaces **713** and **715** of the hook, accurately position the operating mechanism in the compartment. It should be pointed out that the parts are so arranged that when the entire unit is withdrawn from the compartment, the hook **710** is in the position shown in FIG. **36**. This position of the hook would obtain if an attempt were made to insert the structure in the compartment when the circuit breaker interrupter mechanism happens to be in the connected position, the hook **710** is so arranged that it is locked in the position shown in FIG. **36** when the interrupter elements are in any position other than the disconnect position shown.

Therefore, since the entire mechanism must be prevented from entering the compartment with the circuit breaker interrupter elements in any condition other than the disconnected position, which could result in a dangerous condition and possible damage to the operator, the hook **710** is locked down by the operating mechanism as hereinafter described when the circuit breaker is in any condition other than the disconnected position. When the circuit breaker structure is outside the compartment, and an attempt is made to insert the same in the compartment, the surface **720** of the hook **710** will engage the pin **714** nearest the entry to the compartment and block the full entry of the structure. A pair of hooks **710** are provided, one on each side, cooperating with similar pins **712** and **714** on each side wall of the compartment. The hooks are connected to and operate together on shaft **711**, being keyed thereto. Shaft **711** is provided with a crank arm **721** keyed thereto, and an extension **722** of the crank arm **721** may be depressed to raise the hook. Again, this can only be done as above pointed out, with the interrupter elements in the disconnected position, and the movable secondary contacts **702** removed from their engagement with the stationary secondary contacts **700**.

A slide **730** is provided to operate the movable secondary contacts **702**. This slide **730** is so arranged that certain of the secondary contacts **700***a* may be disconnected, the slide moving to a half position when the circuit breaker is moved from the fully connected to the disconnect position.

Thereafter, the slide **730** may be moved down further to separate the movable contacts **700***a* from stationary contacts **700***b* in order to enable the circuit breaker to be completely removed from the compartment.

The slide is operated by a lever **735**, which is rotatably mounted on pin **736** carried by the frame of the operating mechanism. The lever **735** is provided with an opening **737** which engages the pin **738** on the slide. The opening **737** is sufficiently larger than the pin **738** so that the rotary movement of the lever **735** may be translated into vertical movement of the slide **730**.

It will be obvious that with the lever **735** in the position shown in FIG. **36**, the slide has been moved to a position where the movable secondary contacts **702** are fully disengaged from the stationary secondary contacts **700**. When the lever **735** is moved to the position **735***a*, that is, the disconnect or test position, then the movable contacts **702** have been raised to an intermediate position where certain of the stationary contacts **700***b* are engaged. From the test position of FIG. **38** to the connected position of FIG. **39**, the contacts **702** are raised by the clockwise motion of the racking shaft **101** (as previously described). The racking shaft **101** has, keyed to it, a cam plate which lies between the slide **730** and the lever **735**, and actuates the pin **738**, which is mounted on the slide. Thus, the pin and the slide can be actuated between the test and connected positions, only by rotation of the racking shaft **101** and not by manual actuation of the lever **735**. Between the test and connected positions therefore, the lever **735** is serving only as a pointer to indicate the racking position. (see FIG. **10**). The contacts **700***b* can be moved manually by lever **735** through position **735***b* only between the test and disconnected positions (FIGS. **38** and **36**) by virtue of the cam on shaft **101** presenting a vertical travel slot **737** in these positions. Also, with lever **735** and pin **738** in the disconnected position (FIG. **36**), it is clear that the racking shaft **101** and the cam cannot be rotated, since the pin **738** is down in the vertical travel **737** of slot **750** of the cam. This prevents rotating the racking shaft toward the connected position without first raising the contacts **700***a* to the test position of FIG. **38**; nothing can therefore get out of phase. The lever **735** is held by suitable detents in the disconnected or test positions (FIG. **10**), so that it will not wander between these positions.

The lower **735** is a bell crank lever having an extension **740** engaging the vertical slide **741** which has a slot **742** enabling it to be guided on the pin **743**. Any attempt to move the lever **735** from the test position of FIG. **38** (**735***a*) to the full disconnect position to enable the circuit breaker to be pulled out, will result as the lever **735** moves through position **735***b* (FIG. **39**) in the raising of the slide **741** to operate the trip latch of the breaker and the closing latch, which obviously are rotated. This is done so that the breaker can be withdrawn from the compartment only when the closing and opening springs are in a disarmed condition. The control is such that when the circuit breaker interrupter elements are fully racked in, the lever **735** and the slide **730** are locked in a full up position with all of the contacts **700–702** engaged. When the circuit breaker in the compartment is moved to the test position, the slide has been moved to an intermediate position where certain of the moving contacts **702** engage the contacts **700***b*.

When the operation is completed to the test position, FIG. **38**, and it is now desired to remove the circuit breaker from the compartment, the hook **710** cannot be raised for this purpose unless the slide is in the full down position shown. This position for blocking the hook is clear on FIG. **38**. The hook **710** has an extension **760** which enters the slot **761** of the slide **730** and is prevented by the sides of the slot **761** from being rotated to disengagement from the pin **712**. When the slide **730** and its associated contacts are in the full down or disconnected position, FIG. **36**, the extension **760** may enter the notch **762** of the slide thereby permitting the hook to be raised by depressing the finger **722**. The slide cannot be moved to this full down position unless the interrupter elements are in the full test position, and the hook therefore cannot be raised unless both events occur, that is, the interrupter elements are in the full test position and the secondary contacts **702-700** are fully disconnected (FIG. **36**).

An examination of FIG. **10**, the escutcheon plate, will facilitate a recapitulation of the various operations:

The manual racking is accomplished at position **800** where the hole **111** in the racking wheel **110**, mounted on the racking shaft **101** of FIGS. **1**, **2** and **4**, is covered by a sliding cover **801**. The cover **801** is provided with a switch, not shown, which disconnects the motor. The tab **801** is lifted to clear the hole **111** for insertion of the racking handle. It will be obvious that the position shown is one for the fully racked-in position of the circuit interrupter, the handle inserted in the hole **111** is lifted for the rack-out position.

Electrical racking for operating the motor is accomplished by moving down the switch handle **811** which starts the motor. Means may be provided to operate the handle **811** remotely by a solenoid. The manual charging handle **256** of FIG. **5** is inserted in the opening **255**. A downward movement of the handle in the opening **255** will move this opening **255** and the charging wheel **251** down to charge the closing springs. The operating mechanism for controlling the disconnects and the handle **735** appears at the right-hand side of the escutcheon plate of FIG. **10**, indicating the three positions. The position shown in FIG. **10** is the connected position of the interrupter elements. The manual close button **810** releases the latch **131** of FIG. **5**. Remote control operation may be provided by appropriate electrical and selenoid connections for operating the manual close button (FIG. **10**). The padlock arrangement **820** is used for locking the circuit breaker racking mechanism to maintain the breaker in a selected position. The manual trip button **812** operates the latch **160** and may, of course, be remote controlled (FIG. **10**).

Projection **830** on padlocking lever blocks movement of lever **735** between test and disconnect when padlock lever is moved to the right to insert padlock. Motion of this lever also moves release lever assembly on which it is mounted. This means that the racking release lever **811** is again blocked, as described below.

Thus, in conjunction with the cam positioning of lever **735** (FIG. **39**) the breaker can be positively padlocked in any racking position, connect, test or disconnect.

Projection **831** blocks motion of lever **735** between test and disconnected positions unless release lever below is pulled to the right.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appended claims.

I claim:

1. In draw out switchgear having a housing;
said housing having a substantially open side and a wall parallel to and opposite said open side;
said switchgear having a first frame and a second frame reciprocally mounted with respect to said first frame;
said second frame carrying circuit interrupter elements and back connection contacts;
complementary connectors for said back connection contacts in said wall of said housing; said back connection contacts being engageable and disengageable with said complementary contacts;
said switchgear being introduceable into said housing through said open side;
means for securing said first frame with respect to said housing;
said second frame being movable with respect to said first frame, when said first frame is secured, between a position in which said back connection contacts engage said complementary contacts and a position in which they are disengaged;
said first frame being locked in position in said housing in any position of said second frame with respect to said first frame other than the disengaged position of said back connection contacts with respect to said complementary contacts;
said securing means comprising a hook rotatably carried on said first frame and lying in a plane parallel to the path of movement of said switchgear through said open side of said housing;
a detent on said hook;
a projection in said housing engaging said detent when said switchgear is fully introduced into said housing;
means for locking said hook into a position in which its end will abut said projection and prevent full introduction of the switchgear into said housing when the second frame is in any position with regard to said first frame other than the position of said second frame in which said back connection contacts are withdrawn with said second frame toward said first frame.

2. The draw out switchgear of claim **1**, having also secondary contacts comprising stationary contact members carried by said housing and movable contact members carried by said first frame;
means for actuating said movable secondary contacts between engagement and disengagement position;
and an interlock for said movable secondary contact members;
said interlock engaging said actuating means for said secondary contacts and blocking said actuating means from operating selected secondary contacts from disengaging said stationary secondary contacts when the second frame is in a position in said housing in which the back disconnect contacts engage their complementary contacts;
said interlock in addition blocking said hook from movement to a position in which said detent may disengage said projection, when the second frame is in a position with respect to the first frame with the back disconnect contacts fully disengaged,

while the remainder of the secondary contacts are engaged.

3. The draw out switchgear of claim **2** in which:

said movable secondary contacts are mounted on a slide carried by said first frame;

said stationary contacts comprising a first set of stationary contacts and a second set of stationary contacts on the housing off-set with respect to each other;

movement of said slide from a first full disconnect position to a second partially connected position engaging said movable contacts with one said set of said stationary secondary contacts;

movement of the slide to a third position engaging the movable contacts with both sets of stationary contacts.

4. The draw out switchgear of claim **3** in which:

a projection extends from said hook into a recess in said slide; the engagement of said hook projection with said recess preventing rotation of said hook;

the said hook projection being disengaged from said recess when said slide is in said first full disconnect position of all the said secondary contacts.

5. The draw out switchgear of claim **4** having:

means for operating said circuit interrupter elements including a trip member; said trip member being positioned to initiate the operation of said current interrupter elements to switchgear open position;

a connection from said slide to said trip member;

said connection operating said trip member on initiation of movement of said slide toward a position in which said secondary contacts are disengaged.

6. The draw out switchgear of claim **5** in which said connection maintains said trip member in position to cause said circuit interrupter elements to remain in switchgear open position while said slide is in disconnected position.

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