

Jan. 6, 1959

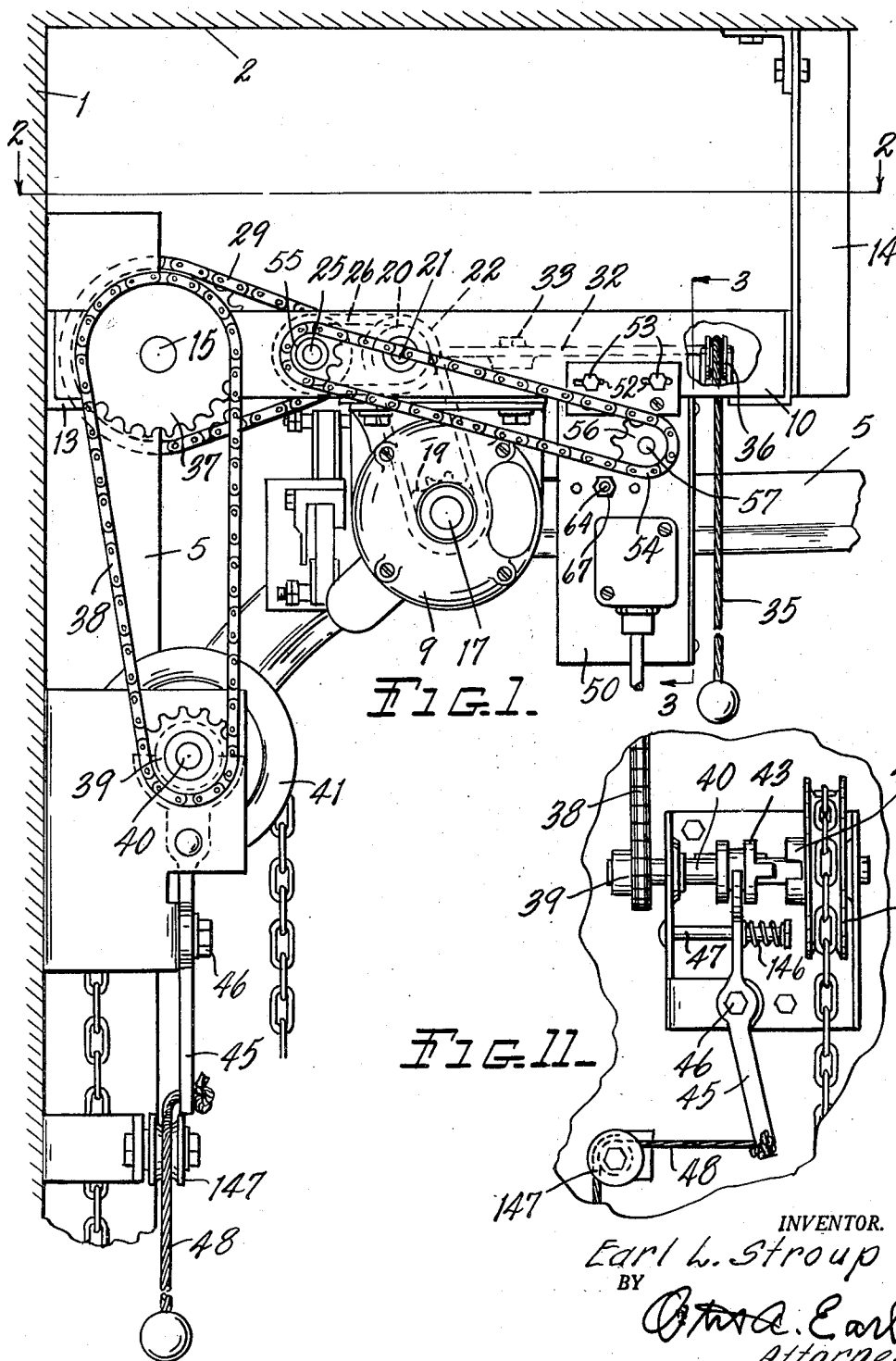
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DOOR CONTROL OPERATOR AND LIMIT SWITCH MECHANISM

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4 Sheets-Sheet 1



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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

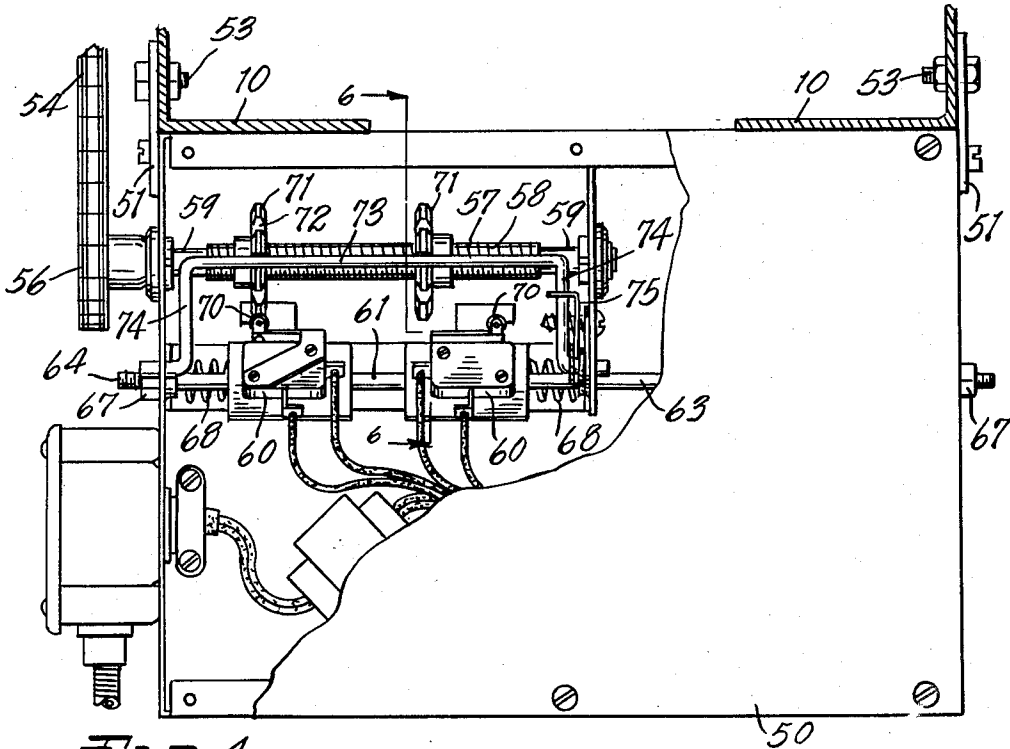


FIG. 4.

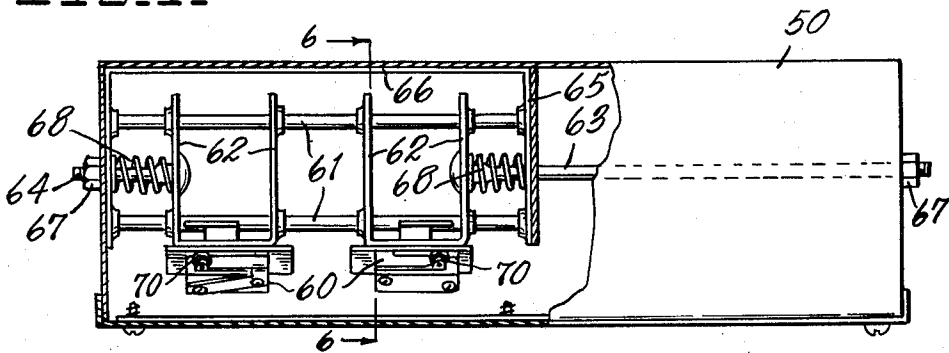


FIG. 5.

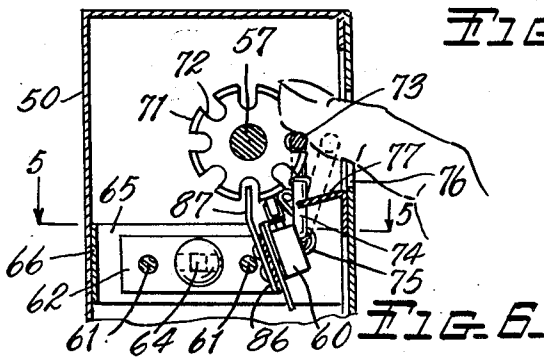


FIG. 6.

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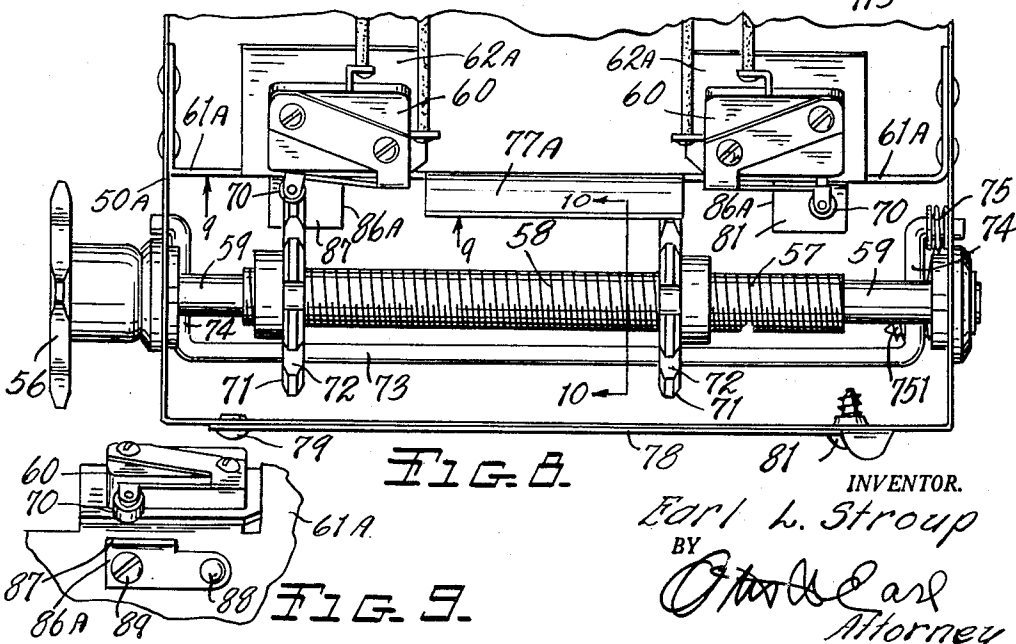
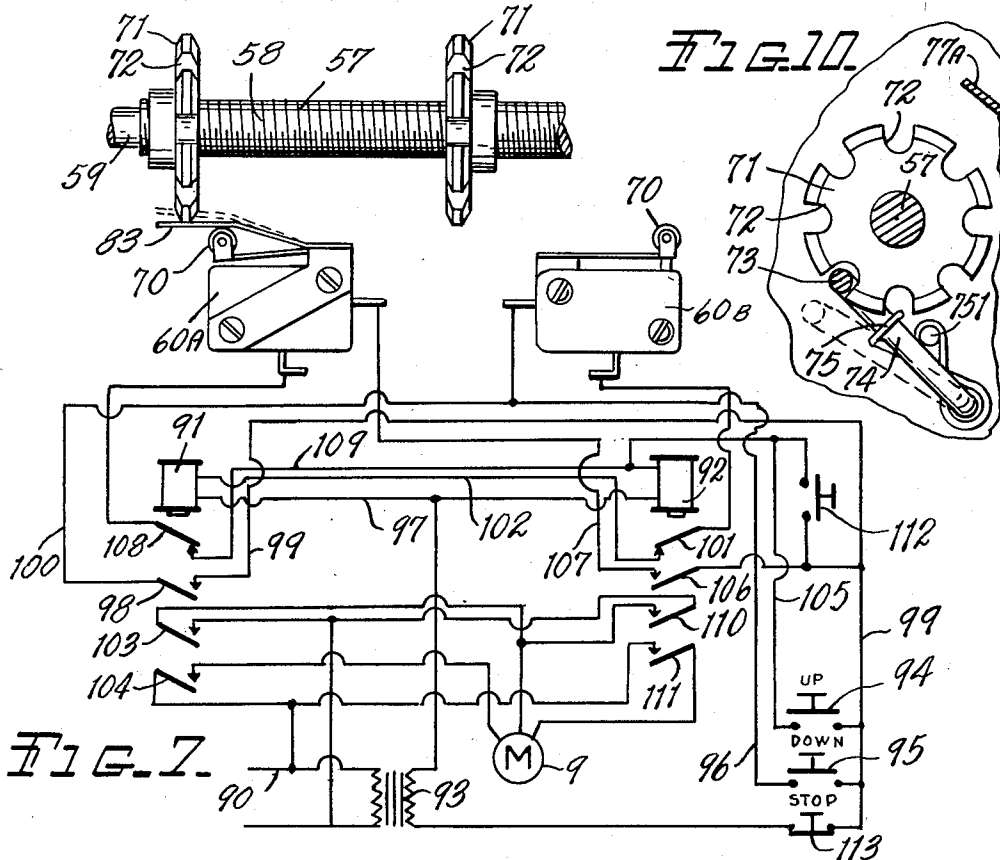
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DOOR CONTROL OPERATOR AND LIMIT SWITCH MECHANISM

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4 Sheets-Sheet 4



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DOOR CONTROL OPERATOR AND LIMIT SWITCH MECHANISM

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Application September 13, 1956, Serial No. 609,574

8 Claims. (Cl. 200—47)

This invention relates to operating mechanism for reciprocatingly mounted parts such, for example as upwardly acting doors and to the limit or travel control switch therefor.

The main objects of this invention are:

First, to provide a switch assembly for reciprocatingly mounted parts such, for example, as upwardly acting doors which may be quickly and easily adjusted to a particular installation to control the travel of the door.

Second, to provide an operating mechanism powered by a reversible motor with a limit switch mechanism which is capable of a relatively wide range of adjustment to adapt the same to variations in installing conditions.

Third, to provide an operating mechanism of this character in which, in the event of failure of current, automatic control may be disconnected by means of a clutch to permit manual control and the automatic control restored without the parts being readjusted other than by shifting of manually controlled clutches.

Fourth, to provide an assembly of the class described including limit switch tappets driven by a threaded reversely driven shaft in which the shaft and tappets are so related that parts are not broken in the event of failure of a switch.

Fifth, to provide a switch control mechanism of the type described in which a longer travel than that for which the limit switch is set may be had, for example, to increase the lift of a door to meet particular conditions.

Sixth, to provide a control mechanism having these advantages which is not likely to become inoperative or damaged in normal use thereof, the more delicate of the operating parts being effectively housed.

Objects relating to details and economies of the invention will appear from the description to follow. The invention is defined and pointed out in the claims.

A preferred embodiment of the control assembly and two forms of limit switch structure of the invention are illustrated in the accompanying drawings, in which:

Fig. 1 is a side elevational view of an operating or control mechanism embodying my invention, parts being shown conventionally and parts being broken away for convenience in illustration.

Fig. 2 is a fragmentary plan view on a line corresponding to line 2—2 of Fig. 1.

Fig. 3 is a fragmentary elevational view on a line corresponding to line 3—3 of Fig. 1.

Fig. 4 is an enlarged view illustrating details of a first form of the limit switch mechanism, the front wall of the housing therefor being partially broken away.

Fig. 5 is a fragmentary view of certain parts of the limit switch mechanism, the housing thereof being sectioned on a line corresponding to line 5—5 of Fig. 6.

Fig. 6 is a fragmentary view in section on a line corresponding to line 6—6 of Figs. 4 and 5 illustrating the details of the switch control mechanism and the manner of performing certain manipulations or adjustments thereof, an operators fingers being indicated by dotted lines.

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Fig. 7 is a composite view illustrating the limit switch operating tappets and an electrical circuit for the switches and the motor controlled thereby.

Fig. 8 is a fragmentary view of a modified form of limit switch assembly.

Fig. 9 is a fragmentary elevational view taken along the line 9—9 in Fig. 8 and illustrating details of structure to prevent accidental rotation and mal-adjustment of the switch operating traveling nuts when they are in proper registering engagement with the limit switches.

Fig. 10 is a fragmentary cross sectional view taken along the plane of the line 10—10 in Fig. 8 and illustrating structure for preventing wear and drag on the traveling nuts and their operating screw.

Fig. 11 is an inside elevational view of the manual drive clutch for operating the door when the motor drive is interrupted for any reason.

In the accompanying drawings I have illustrated my invention as embodied in a motor powered operator for an upwardly acting door utilizing an electrically reversible electric motor. While my invention is particularly desirable for that use I desire to point out that certain features thereof are adapted and desirable for use in various other relations where reciprocatingly movable parts are involved and where it is desirable to automatically control the normal operation thereof and where it is desirable to vary the length of the stroke of the actuated part.

In the accompanying drawing 1 represents a wall and 2 the ceiling of a building or the like. 3 represents a door of the upwardly acting type which is provided with rollers 4 engaging the tracks 5. The shaft 6 is provided with drums 7 for the cables 8 which are attached to the door.

The track comprises an upright or vertical section and a horizontal section. The shaft 6 is commonly provided with a counterbalance spring not illustrated.

As doors of this general type are known in the art I have not illustrated the details thereof. Also, certain other parts are shown conventionally as the details form no part of this invention, for example, the motor 9. The motor 9 is of the electrically reversible type.

In the embodiment illustrated the motor and various operating parts are supported by a frame consisting of the horizontally disposed side members 10 of angle section disposed to face upwardly and inwardly and connected by suitable cross pieces 11 and 12 and the supporting bracket 13 which is secured to the wall 1. Hangers 14 depending from the ceiling are provided for the outer end of the frame.

The shaft 6 is connected to the motor driven shaft 15 by the coupling 16, as is best shown in Fig. 2. The shaft 15 is connected to the motor shaft 17 through a train of shafts, sprockets and chains designed to secure certain results which will become apparent as the description proceeds.

This driving train comprises the sprocket 19 on the motor shaft 17, the sprocket 20 on the shaft 21 and the connecting chain 22. It will be noted that the sprockets 19 and 20 are of the same diameter. The shaft 21 is provided with a sprocket 23 connected to the sprocket 24 on the shaft 25 by the sprocket chain 26. The sprockets 23 and 24 are also of the same diameter. The shaft 25 is provided with a sprocket 27 connected to the sprocket 28 on the driven shaft 15 which, as stated, is connected to the shaft 6 to be operated, the sprockets 27 and 28 are connected by the sprocket chain 29. The sprocket 28 is of substantially larger diameter than the sprocket 27 which results in reduction of speed between the motor and the driven shaft.

The shafts are supported in suitable bearings provided on the frame parts, the bearings are not specifically re-

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ferred to. The sprocket 23 on the shaft 21 is rotatable thereon and is provided with a clutch member 30 with which the clutch member 31 coacts, the clutch member 31 being splined to the shaft. This clutch is normally in engaged position, the clutch lever 32 pivoted at 33 being urged to clutch engaging position by the spring 34.

The clutch release cable 35 is connected to the lever 32 and passed over the guide pulley 36 to depend in position to be grasped by the operator. The purpose of this is to disengage the motor from the mechanism described in the event of failure of current or the like so that the door may be manually operated. To that end the driven shaft 15 is provided with a sprocket 37 connected by the sprocket chain 38 to a sprocket 39 on the shaft 40 which is provided with a chain pulley 41. The chain pulley 41 is drivingly connected to the shaft 40 by means of the clutch member 43 splined to the shaft 40 to be manually shifted into engagement with the jaw clutch member 44 on the chain pulley 41.

The clutch shaft lever 45 is pivoted at 46 to engage the clutch member 43 and is normally held in disengaged position by means of the spring 146 on the supporting rod 47, see Fig. 7. The cable 48 attached to the lever 45 is passed over the guide pulley 147 and depends to position to be conveniently grasped, see Figs. 1 and 7. It will be understood that the clutch 31 is disengaged from the coacting clutch member 30 on the sprocket 33 before the operator attempts to manually manipulate the door.

An important feature of my invention is the motor control limit switch mechanism. This limit switch mechanism is inclosed in a housing designated generally by the numeral 50 mounted on the supporting frame at the outer side of the motor by means of the hangers or brackets 51. The hangers or brackets have longitudinal slots 52 therein receiving the attaching bolts 53 so that the housing may be adjusted as a tightener for the sprocket chain 54 connecting the sprocket 55 on the shaft 25 to the sprocket wheel 56 on the threaded shaft 57. The sprockets 55 and 56 that drive the limit switch mechanism 50 are operated from the same shaft driving train 15, 25 as the door shaft 6 ahead of the motor clutch 31 so the limit switch mechanism stays in its adjusted position as will be described whether the door is operated manually or by the motor.

As stated, the motor 9 is of the electrically reversible type so that the shaft 57 is reversibly driven. The shaft 57 is provided with a threaded portion 58 which is conventionally illustrated in the drawing. There are portions 59 at each end of the threaded portion 58 of less diameter than the threaded portion.

The control switches designated generally by the numeral 60 are mounted on parallel rod like ways 61, the switches being provided with arm like slides 62 engaging the ways, see Fig. 5. These slides 62 are adjustable on the way by means of the threaded rods 63 and 64 arranged through the arms 65 of the way mounting bracket 66 and through the opposed end walls of the housing 50. Nuts 67 are provided on the projecting ends of the rods 63 and 64 for providing fine or vernier positioning adjustment of the switches. The coil springs 68 are disposed on these switch adjusting rods between the switch slides and the arms of the mounting bracket and serve to yieldably hold the switch slides and also frictionally hold the nuts against the housing walls through which the rods are arranged. The rods 63 and 64 are conveniently made of carriage bolts having squared ends non-rotatably engaged in the slides.

The switches are provided with tappet contact members 70 positioned to be engaged by the tappets 71 on the reversibly driven shaft 57. These tappets 71 are threaded upon the shaft 57 to be simultaneously driven thereby but may be independently adjusted relative to each other. The tappets are provided with uniformly spaced peripheral slots 72 to be engaged by the rod like

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detent 73 which holds the tappets against rotation on the shaft while permitting translation thereof axially of the shaft by the rotation of the shaft.

The detent 73 is provided with arms 74 pivotally engaging the end walls of the housing so that the detent may be swung to disengaged position as indicated by dotted lines in Fig. 6 to permit independent adjustment of the tappet, the spring 75 yieldingly urges the detent into tappet engaging position.

To permit this adjustment the housing is provided with an opening 76 opposite the shaft 57 so that the operator may engage the detent to retract it and individually adjust the tappets. A guard 77 is provided below the opening and projects inwardly toward the switches to prevent the operator contacting the switch or "hot" wiring thereof. As appears more clearly in Fig. 10 the screw 751 that anchors the spring 75 to the housing wall acts as a stop to engage the arm 74 and prevent the detent 73 from seating in the bottom of the slots 72.

The opening 76 is provided with a closure 78 pivotally mounted at 79 so that it may be swung to open position as shown in Fig. 3. The closure member 78 has an opening 80 engageable with the headed stud 81 for keeping the closure in closed position. The details of the switches are not illustrated as they form no part of this invention.

The switches are suitably connected to the motor by wiring best illustrated in Fig. 7 which will be described in greater detail presently.

As stated, the assembly illustrated is particularly designed for use in connection with upwardly acting doors and such doors vary in height and in installing conditions vary greatly and require variations in the travel or movement of the door from closed to fully opened position. The tappets may be readily adjusted to meet these varying conditions. However, in some installations it is desirable for normal operation to set the tappets to open the door to a predetermined height less than the full possible opening and to further open the door for particular requirements beyond the opening resulting from the set open limit switch. For example the apparatus may be set to open the door to accommodate trucks of a predetermined height range. However, it may be desired to open the door for a truck of greater height and to that end the switch member 70 is provided with an arm extension 83, see Fig. 8. To permit this higher opening of the door an operator holds the push button indicated at 94 until the door has reached the desired height. As the door is opened and closed at the same speed this permits the adjustment of the tappets so that the opening movement of the door is automatically stopped at a predetermined height less than its full opening stroke but may be opened further should occasion require. This results in the substantial saving of opening and closing time or what would be required if the tappets were set to operate the door with its maximum stroke. The shorter opening and closing time saves heat in the winter time.

It should be pointed out that the sprocket 22 on the shaft 21 is connected to the shaft by means of the friction drive conventionally indicated at 85 and comprises a friction disc and thrust spring 86, see Fig. 2.

The modified form of switch mounting illustrated in Fig. 8 can be substituted where desired for the switch mechanism shown in Figs. 4, 5 and 6. In this modified form of mounting the housing 50A has a U-shaped mounting bracket 61A secured therein in place of the rod like ways 61. The switches 60 are fixedly mounted on flanges 62A on the bracket 61A. A forwardly turned guard flange 77A on the bracket 61A performs the function of the guard 77 in Fig. 6 of preventing the operators finger from striking the electrical connections of the switches. The adjustment of the opening and closing limits of the door controlled by the switches is controlled solely by adjustment of the tappets 71 on the threaded shaft 57 which are the same as in the first form of the switch

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mechanism. The same access door 78 permits entry to the tappets 71 and the tappet locking detent rod 73. The screw 751 that anchors the spring 75 to the side of the housing also prevents the detent rod from dragging on the bottom of the slot 72 in which it is engaged.

In both forms of the switch mechanism provision is made for preventing accidental or unintentional movement of the switch actuating tappets 71 relative to the threaded shaft 57 as the tappets are being adjusted. Normally the detent rod 73 prevents rotation of the tappet members 71 but when the detent rod is pulled away from the tappets to adjust one of them the other tappet remains in contact with its associated limit switch contact without any restraining force from the detent rod.

The tappet 71 that is in contact with a switch contact member 70 should not be adjusted as it might move beyond the contact member and be difficult to reengage with it. However, inexpert persons might mistakenly attempt to adjust both tappets 71 and to prevent improper adjustment angled lock plates 86A are secured to the switch bracket 61A in Figs. 8 and 9. Similar lock plates 86 are secured to the back sides of the switches 75 in Fig. 6. These locked plates 86 and 86A have forwardly projecting flanges 87 that enter into one of the slots 72 in the tappet members when the tappet members approach either of the switches 60. The lock plates being fixed relative to the rotatable tappets prevent accidental rotation of the tappets while they are in registry with the switch contact members. The lock plates 86a are pivoted at 88 and releasably held in position by screws 89 so they can be dropped to inoperative position should a malfunction of the switch require major readjustment of the tappets. Lock plates 86 are fixed as the switch brackets 62 can be moved if necessary.

The electrical circuit by means of which the limit switches 60 regulate the movement of the door opening and closing mechanism is shown in Fig. 7 and it will be understood that this circuit and the connections shown therein are applicable to both forms of the limit switch mechanism. A source of electrical energy is indicated at 90 and the motor for reversely operating the door is indicated at 9. The limit switch which may be designated as the open limit switch is indicated at 60A and the down or closed limit switch is indicated at 60B. A pair of solenoid operated switch assemblies having operating solenoids 91 and 92 are arranged to open and close a plurality of switches as will be described. A transformer 93 energized from the power source 90 provides low voltage current for the control circuits while portions of the solenoid operated switches interrupt and control the relatively high voltage current to the motor.

Considering the circuit and switch mechanism in a position corresponding to the open position of the door all elements of the circuit will be as illustrated in Fig. 7 with the limit switch 60A open and the limit switch 60B closed. The manually operable up control switch 94 and down control switch 95 will similarly be open and the system will be at rest. Closing the down control switch 95 energizes the conductor 96 to the solenoid 91 with a return circuit through the conductor 97 to the transformer. Energization of the solenoid 91 closes the switch 98 and completes a holding circuit through the conductors 99 and 100 to the closed down limit switch 60A and from there through the solenoid switch 101 and conductor 102 back to the solenoid 91 so the manual down control button 95 can be released. Energizing of the solenoid 91 also closes the high voltage switches 103 and 104 which connect the electrically reversible motor 9 to the power source 90 to lower or close the door as will be understood.

When the door reaches the lower limit of its closing motion the tappet 71 engages the operating contact member 70 of the down limit switch 60B to open that switch. Opening of the closed limit switch breaks the holding circuit to the solenoid 91 and automatically disconnects the motor from the power source to stop the door.

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When the door is down or closed the limit switch 60B will be open as noted and the up or open limit switch 60A will be closed. Closing the manually operable up control switch 94 energizes the conductor 105 and through it the solenoid 92. Energization of the solenoid 92 closes the switch 106 completing a holding circuit from the conductor 99 to the conductor 107 and limit switch 60A which is closed as noted. The circuit continues through the switch 108 that is closed in the deenergized condition of the solenoid 91 to the conductor 109 and the solenoid 92 so the up control button can be released. Energization of the solenoid 92 closes the high voltage switches 110 and 111 to energize the motor 9 to raise or open the door. When the door reaches its upper limit of travel as determined by the tappet 71 the limit switch 60A is opened breaking the circuit to the solenoid 92 and automatically stopping the door.

Reference has been made to the member 83 overlying and extending beyond the contact member 70 of the up limit switch 60A. As stated, this member 83 permits raising or opening motion of the door beyond the normal upper limit of the door when desired. The circuit means for accomplishing this operation consists of the manual control switch 112 which will energize the previously mentioned conductor 105 to the solenoid 92 to energize the solenoid and close the switches 110 and 111 regardless of the open condition of the limit switch 60A. The door will thus continue to raise as long as the button 112 is held closed. The member 83 on the switch 60A prevents the tappet 71 from snapping over the switch control member 70 and becoming jammed when the door is next lowered.

An emergency stop switch 113 is provided to break the energizing circuit to both solenoids to stop either upward or downward motion of the door should that be necessary.

As stated I have illustrated my invention as embodied in an upwardly acting door. It is desired, however, to point out that the invention is readily adapted for use in other relations. However, I have not attempted to illustrate or describe such other adaptations as it is believed this disclosure will enable those skilled in the art to embody or adapt my invention as may be desired.

Having thus described the invention, what is claimed as new and is desired to be secured by Letters Patent is:

1. A control switch mechanism for an electrically reversible motor comprising a housing, parallel slideways within said housing, a pair of switches provided with laterally spaced arm-like slides mounted on said ways to support the switches for independent adjustment longitudinally of the ways, a threaded reversibly driven shaft disposed within said housing in parallel relation to said slideways, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, said tappets being independently adjustable on said shaft and having uniformly spaced peripheral notches, an elongated detent swingably mounted in said housing for engagement with aligned notches of said tappets, a spring anchored to a wall of said housing and biasing said detent into said notches, a screw anchoring the spring and positioned to engage a portion of the detent to hold the detent in spaced relation to the bottoms of the notches, and holding plates mounted on said switch slides engageable in a notch of a tappet engaged with the switch, the length of said detent exceeding that of the threaded portion of the shaft, said shaft having unthreaded portions at the ends thereof of less diameter than that of the threaded portion so that a tappet is automatically disengaged from the threaded portion of the shaft in the event of failure of a switch, said housing being provided with an opening through which said detent may be manually disengaged and the tappets individually adjusted on said shaft.

2. A control switch mechanism for an electrically reversible motor comprising a housing, parallel slideways within said housing, a pair of switches provided with

laterally spaced arm-like slides mounted on said ways to support the switches for independent adjustment longitudinally of the ways, a threaded reversibly driven shaft disposed within said housing in parallel relation to said slideways, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, said tappets being independently adjustable on said shaft and having uniformly spaced peripheral notches, a spring biased elongated detent swingably mounted in said housing for engagement with aligned notches of said tappets, said housing being provided with an opening through which said detent may be manually disengaged and the tappets individually adjusted on said shaft, and holding plates on said switch slides engageable in a notch of the tappet engaged with the switch.

3. A control switch mechanism for an electrically reversible motor comprising a housing, parallel slideways within said housing, a pair of switches provided with laterally spaced arm-like slides mounted on said ways to support the switches for independent adjustment longitudinally of the ways, threaded adjusting rods connected to said slides and projecting through opposite side walls of the housing and provided with adjusting nuts on their projecting ends, biasing springs for said slides opposed to said adjusting nuts, a threaded reversibly driven shaft disposed within said housing in parallel relation to said slideways, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, said tappets being independently adjustable on said shaft and having uniformly spaced peripheral notches, and a spring biased elongated detent swingably mounted in said housing for engagement with aligned notches of said tappets, said housing being provided with an opening through which said detent may be manually disengaged and the tappets individually adjusted on said shaft.

4. A control switch mechanism for an electrically reversible motor comprising a housing, a switch slideway within said housing, switches mounted on said slideway for independent adjustment, threaded adjusting rods connected to said switches and projecting through opposite side walls of the housing and provided with adjusting nuts on their projecting ends, a threaded reversibly driven shaft disposed within said housing, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, said tappets being independently adjustable on said shaft, and an elongated detent releasably engageable with said tappets to prevent rotation thereof while permitting the translation thereof by said shaft, the length of the detent exceeding that of the threaded portion of the shaft, said shaft having unthreaded portions at the ends thereof of less diameter than that of the threaded portion so that the tappet is automatically disengaged from the threaded portion of the shaft in the event of continued rotation of the shaft in one direction beyond the switch point, the housing being provided with an opening through which said detent may be mechanically disengaged and the tappets individually adjusted on said shaft.

5. A control switch mechanism for an electrically reversible motor comprising a housing, a switch slideway within said housing, switches mounted on said slideway for independent adjustment, threaded adjusting rods connected to said switches and projecting through opposite

side walls of the housing and provided with adjusting nuts on their projecting ends, a threaded reversibly driven shaft disposed within said housing, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, said tappets being independently adjustable on said shaft, and an elongated detent releasably engageable with said tappets to prevent rotation thereof while permitting the translation thereof by said shaft.

6. A control switch mechanism comprising a threaded reversibly driven shaft, switches mounted for independent adjustment longitudinally of the shaft, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, said tappets being independently adjustable on said shaft and having uniformly spaced notches, a spring biased elongated swingably mounted detent engageable with aligned notches of said tappets, the length of said detent exceeding that of the threaded portion of the shaft, said shaft having unthreaded portions at the ends thereof of less diameter than that of the threaded portion so that a tappet is automatically disengaged from the threaded portion of the shaft in the event of failure of a switch.

7. A control switch mechanism for an electrically reversible motor comprising a threaded reversibly driven shaft, switches mounted for independent adjustment in a plane parallel to the axis of the shaft, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, an elongated detent releasably engageable with said tappets to prevent rotative movement thereof on said shaft while permitting movement axially of the shaft, the length of the detent exceeding that of the threaded portion of the shaft, said shaft having unthreaded portions at the ends thereof of less diameter than that of the threaded portions so that the tappet is automatically disengaged from the threaded portion of the shaft in the event of continued rotation of the shaft after the predetermined limit has been reached.

8. A control switch assembly for an electrically reversible motor a threaded shaft reversibly driven by said motor, switches spaced longitudinally relative to the axis of the shaft, switch tappets having threaded engagement with said shaft to be simultaneously driven thereby, one of said switches having an elongated tappet engaging member, a manual control switch operatively associated with the switch having the elongated tappet engaging member, an elongated detent releasably engageable with said tappets and when engaged therewith providing relative movement thereof on said shaft and when disengaged permitting individual adjustment of the tappets, the length of the detent exceeding that of the threaded portion of the shaft, said shaft having an unthreaded portion at the end thereof adjacent the switch having the extended tappet engaging member so that the tappet is automatically disengaged from the threaded portion of the shaft in the event the manual switch is held in closed position beyond the feed stroke of the tappet.

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