

Nov. 25, 1952

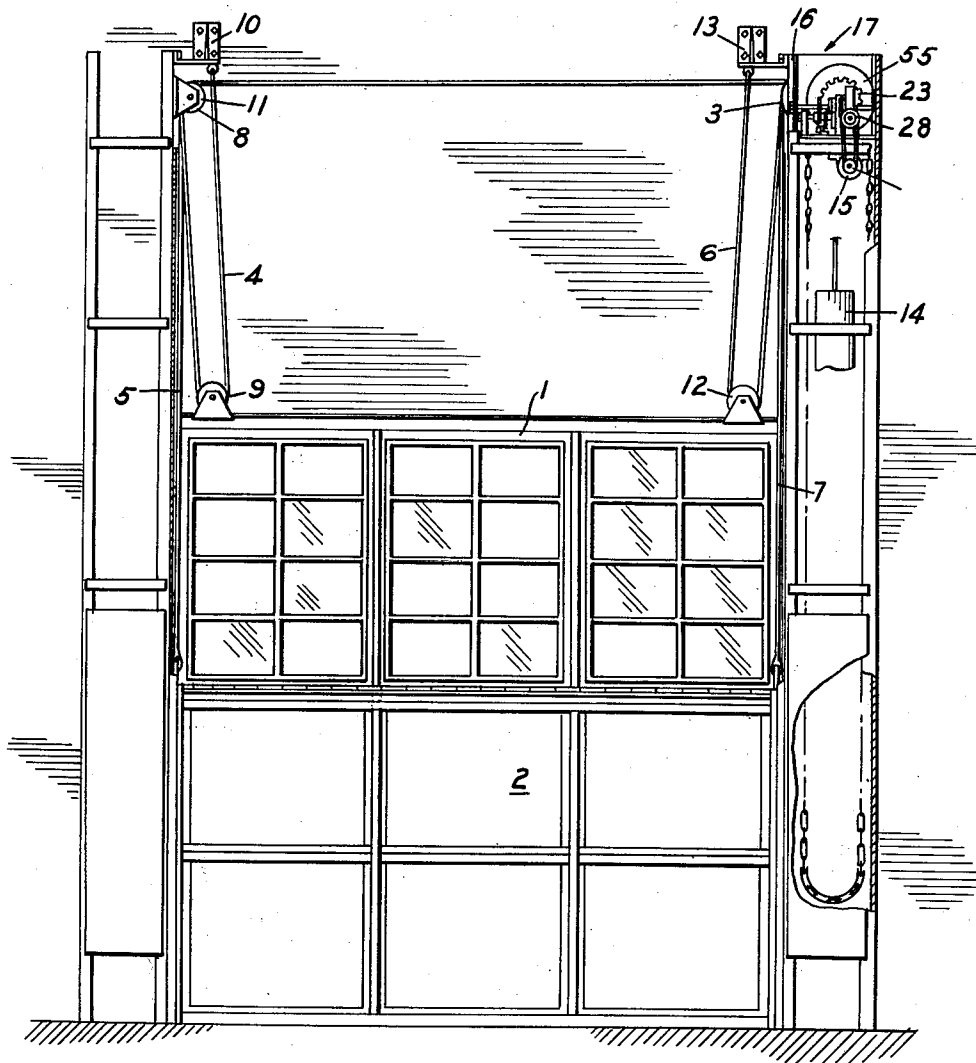
C. S. DAVIDSON
DOOR OPERATING DEVICE

2,619,345

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5 Sheets-Sheet 1

FIG. 1



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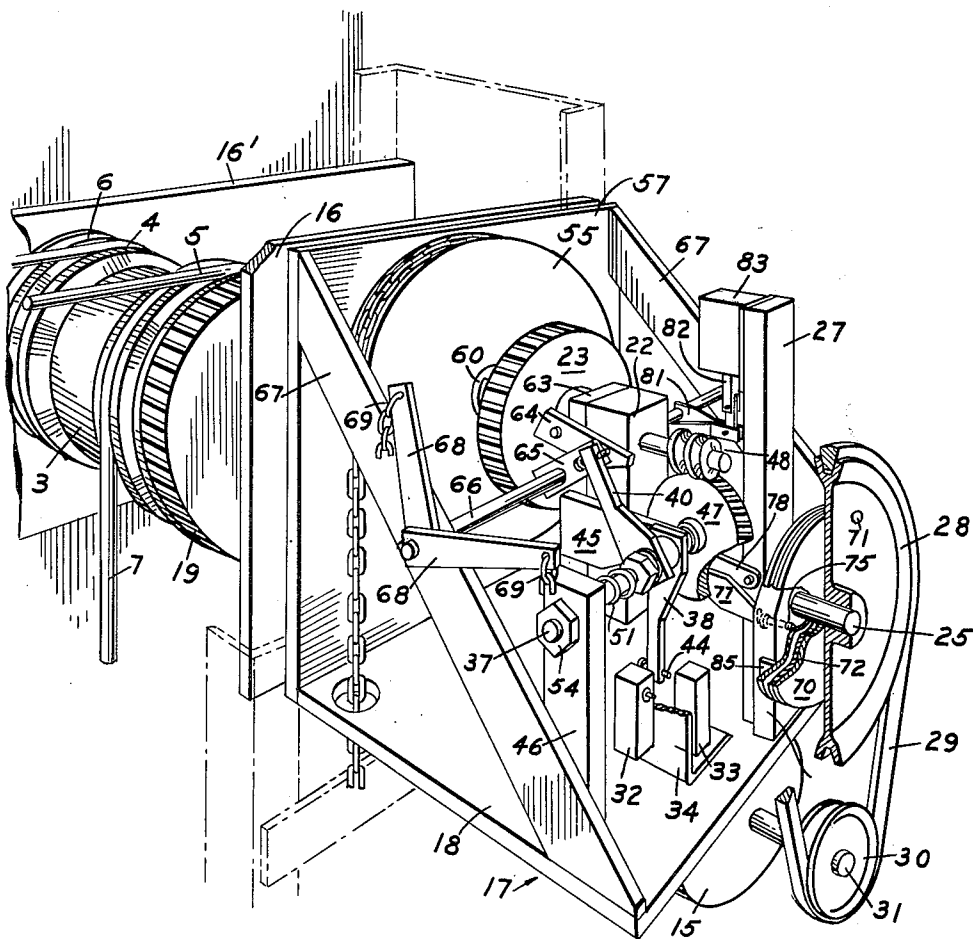
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FIG. 2



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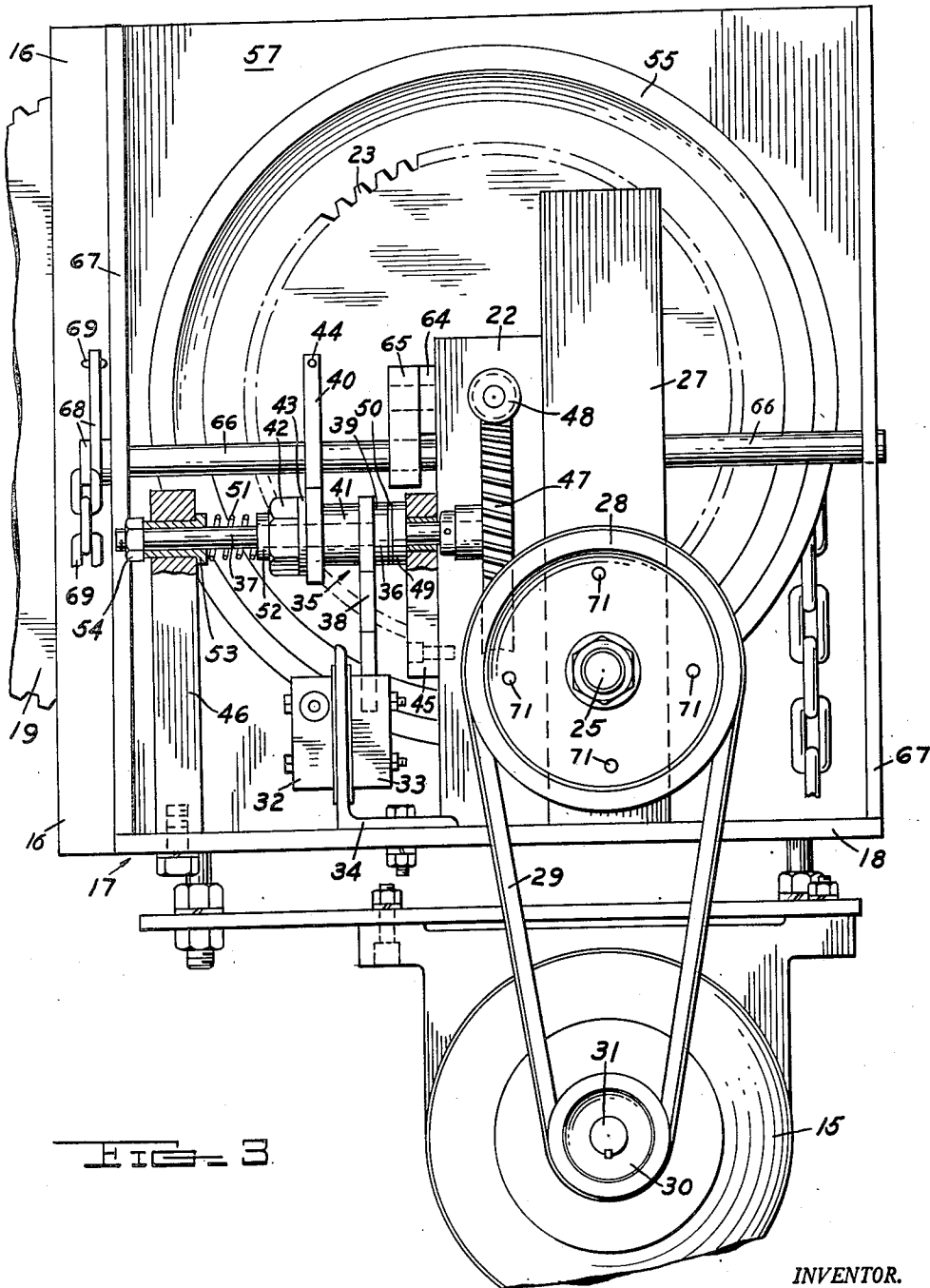
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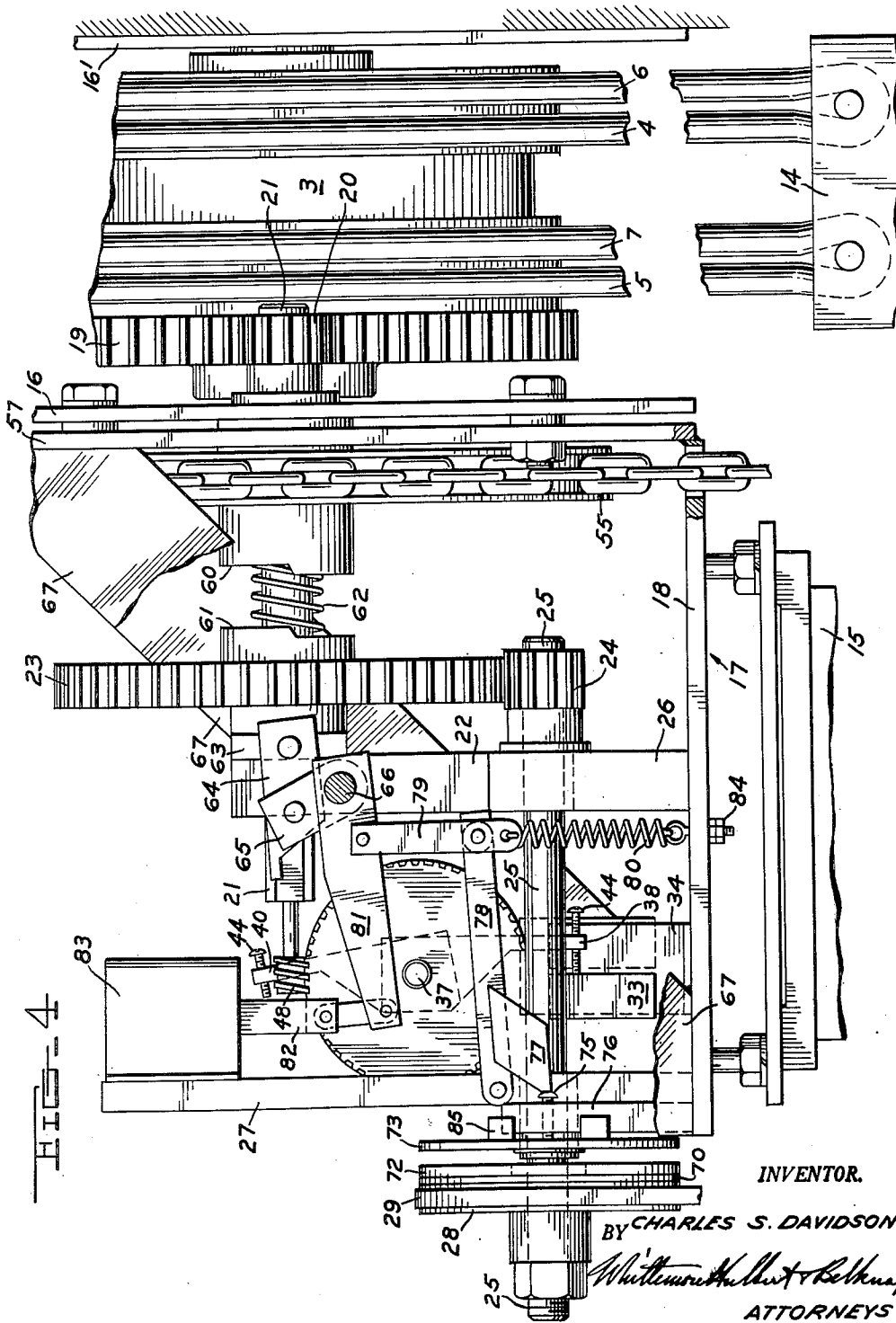
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UNITED STATES PATENT OFFICE

2,619,345

DOOR OPERATING DEVICE

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Application February 26, 1949, Serial No. 78,607

10 Claims. (Cl. 268—59)

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The invention relates to door operating devices and refers more particularly to devices for operating industrial doors.

The invention has for one of its objects to provide an improved power operating device for a door in which the operative connection between the door and the power means permits relative movement of the connecting parts, the device having limit switch means for controlling the operation of the power means driven by the power means in a manner to compensate for the relative movement of the connecting parts.

The invention has for another object to provide an improved power operating device for a cable actuated door in which the cable is driven by a drum having slip driving engagement with the cable, the device having limit switch means for controlling the operation of the power means yieldably driven by the power means to compensate for slip of the cable on the drum.

The invention has for a further object to provide an improved power operating device in which the means for actuating the limit switch means is driven by the power means so that if the door is blocked while the power means is in operation the limit switch means will still function to avoid sever damage which might result from protracted operation of the power means.

The invention has for still another object to provide an improved door operating device having power means operatively connected to the door to operate the same, manually operable means adapted to be operatively connected to the door, in the event that it is not desired to use the power means or the power means is inoperative, and a brake which is normally applied when the power means is not in operation, this brake being constructed to facilitate breaking the operative connection between the power means and the door and making the operative connection between the manually operable means and the door.

With these and other objects in view the invention resides in the novel features of construction and combinations and arrangements of parts as more fully hereinafter set forth.

In the drawings:

Figure 1 is an inside elevation of a dual door with an operating device embodying the invention;

Figure 2 is a perspective view with parts broken away, and diagrammatically illustrated, of the operating device;

Figures 3, 4 and 5 are respectively an end view, a side view and a top plan view of the operating device.

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As illustrated in the drawings, the door operating device is employed to raise and lower to open and closed positions an industrial door of the vertical lift type, although it is apparent that this device may be used for moving to open and closed positions industrial doors of other types such as the horizontally movable and combined vertically and horizontally movable types.

The door is of conventional construction comprising the upper and lower leaves 1 and 2 respectively, adapted to be raised and lowered by the conventional arrangement of cables extending over the drum 3 of the door operating device which is mounted on the framing at one side of and above the door opening. The cable arrangement comprises the cables 4 and 5 operatively connected to the ends of the upper and lower leaves 1 and 2 respectively remote from the drum 3 and the cables 6 and 7 operatively connected to the ends of the upper and lower leaves 1 and 2 respectively closest to the drum 3. The cable 4 extends over the sheave 8 secured to the framing above the door opening and remote from the drum 3 and then extends downwardly around the sheave 9 secured to the top bar of the upper door leaf 1 and then upwardly to the anchor 10 also mounted on the framing above the door opening. The cable 5 extends over the sheave 11 carried by the mounting for the sheave 8 and then downwardly and has its lower end connected to the top bar of the lower door leaf 2. The cable 6 extends downwardly from the drum 3 around the sheave 12 secured to the upper bar of the upper door leaf 1 and then upwardly to the anchor 13 which latter is mounted on the framing carrying the door operating device above the door opening. The cable 7 extends downwardly from the drum 3 and has its end secured to the upper bar of the lower door leaf 2. Each cable extends in an individual groove in the drum 3 through an arc of approximately 90° and has a depending portion which is secured to the counterweight 14 for counterbalancing the door. With this conventional construction, the drum 3 has a yieldable frictional or slip driving engagement with the cables 4, 5, 6 and 7.

The door operating device has the electric motor 15 which is adapted to be operatively connected by gearing to the drum 3. The support for the drum, electric motor and gearing comprises the side plates 16 and 16' mounted on the framing and the bracket 17 mounted on the side plate 16. The drum is located between the side plates and journaled on a shaft extending between and mounted on the side plates and the

electric motor is located below and carried by the bottom plate 18 of the bracket. 19 is a gear secured to the drum and 20 is a pinion meshing with the gear 19 and secured to one end of the shaft 21 which is journaled in the side plate 16 and the post 22 which latter is mounted on and extends upwardly from the bottom plate 18. 23 is a gear non-rotatably secured to and slidable longitudinally of the shaft 21, the portion of the shaft engageable by the gear being of polygonal cross section and the hole in the hub of the gear being correspondingly shaped so that the hub has a sliding fit with the polygonal shaft portion. 24 is a pinion in mesh with the gear 23 and secured to the end of the shaft 25 which is journaled in the posts 26 and 27 which latter are mounted on and extend upwardly from the bottom plate 18. 28 is a pulley secured to the outer end of the shaft 25 beyond the bracket and operatively connected to the electric motor 15 by the belt 29 which extends over the pulley 30 secured to one end of the shaft 31 of the electric motor.

For controlling the electric motor and more particularly breaking the electric circuit to the electric motor at the upper and lower limits of travel of the door at which time it is in open and closed position respectively, I have provided the micro limit switches 32 and 33 mounted on the bracket 34 supported by and secured to the bottom plate 18. These limit switches are of conventional construction. I have also provided the limit switch operating device 35 which comprises the bushing 36 journaled on the shaft 37, the lever 38 sleeved on the bushing and abutting the shoulder formed by the head 39 of the bushing and the lever 40 also sleeved on the bushing and spaced from the lever 38 by the spacer sleeve 41 encircling the bushing. The levers 38 and 40 are held from angular movement relative to each other and the bushing 36 by the nut 42 threaded on the end of the bushing remote from its head and the spring washer 43 between the nut and the adjacent lever. The levers have adjustably secured to their free ends the screws 44 which are adapted upon angular movement of the levers to engage the actuating plungers of the limit switches. The shaft 37 extends at right angles to the shaft 21 and is journaled in the plate 45 secured to the post 22 and the post 46 mounted on and extending upwardly from the bottom plate 18. This shaft is driven by the worm wheel 47 secured to the shaft 37 and the worm 48 meshing with the worm wheel and secured to the shaft 21. The limit switch operating device is yieldably frictionally driven by means of a friction clutch, one part of which is formed by the end portion of the head 39 of the bushing and the other part of which is formed by the head 49 fixed to the shaft 37 with the facing 50 of friction material therebetween and preferably secured to the end portion of the head 39. 51 is a coil spring encircling the shaft 37 and abutting the washer 52 which in turn abuts the nut 42 and the head of the bushing 53 extending through the post 46. This spring is placed under compression by the nut 54 threaded on the shaft 37 and abutting the bushing 53, the construction being such that the parts of the friction clutch are resiliently held in engagement with each other under force which may be varied by adjustment of the nut 54.

For the purpose of manually operating the door, I have provided the hand chain wheel 55 which is disconnected from the drum 3 during the power operation of the operating device and is adapted to be operatively connected to the drum

upon breaking the operative connection between the electric motor 15 and the drum. This hand chain wheel is journaled on the bearing 56 which encircles the shaft 21 and extends through the upright plate 57 of the bracket 17 and is secured to the adjacent side plate 16. The hand chain wheel is held from longitudinal movement on its bearing by forming the hub of the hand chain wheel with the annular groove 58 and providing the plate 59 extending into the groove and mounted on the upright plate 57. The opposed ends of the hubs of the hand chain wheel 55 and the gear 23 are formed with the cooperating clutch jaw teeth 60 and 61 respectively which are adapted to mesh upon movement of the gear toward the hand chain wheel after the gear has become disengaged from the pinion 24. This movement is opposed by the coil spring 62 encircling the shaft 21 and abutting the hub of the gear 23 and the bearing 56. The gear 23 is movable longitudinally of the shaft 21 by the shifting collar 63 pivotally connected at diametrically opposite sides to the links 64 which are pivotally connected to the links 65 secured to the shaft 66. The shaft 66 is journaled in the post 22 and diagonal plates 67 extending between the bottom plate 18 and upright plate 57 of the bracket. The end of this shaft beyond the bracket has secured thereto the angularly arranged levers 68, to the free ends of which are secured the chains 69 which extend downwardly toward the floor a sufficient distance for actuation by the operator. The pivots connecting the links 64 and 65 are adapted to be positioned off center when the clutch jaw teeth of the end chain wheel 54 and gear 22 are in mesh thereby holding the parts in this position against the force exerted by the spring 62.

I have also provided a disk brake which is automatically released when the electric circuit to the electric motor is made and automatically applied when this electric circuit is broken. This brake comprises the disk 70 freely encircling the shaft 25 and non-rotatably secured to the pulley 28 by means of the annular series of rivets 71. The disk has secured thereto the brake lining 72. The brake also comprises the disk 73 slidable longitudinally of the shaft 25. 75 are pins at diametrically opposite sides of the shaft 25 and longitudinally slidable in the plate 76 secured to and forming part of the post 27. These pins abut the disk 73 and are adapted to be moved longitudinally to force the disk 73 into engagement with the brake lining 72 by the abutments 77 secured to the levers 78 which are pivotally mounted on the post 27. The free ends of the levers are pivotally connected to the links 79, the lower ends of which are connected to the coil springs 80 and the upper ends of which are connected to the levers 81. These levers are pivotally connected at one end to the shaft 66 and at the other end to the single core 82 of the solenoid 83 which is mounted on the post 27. The coil springs 80 are adjustably connected to the bottom plate 18 by the eye bolts 84. The wiring connecting the coil of the solenoid 83 and the electric motor 15 to the electric power line is such that, when the push button for making the electric circuit including the electric motor 15 is operated, the electric circuit including the coil of the solenoid 15 is also completed so that the disk brake is released, the solenoid 15 overcoming the coil springs 80. Also when the electric circuit to the electric motor 15 is broken the electric circuit to the coil of the solenoid 83 is broken and

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the coil springs 80 then function to apply the disk brake.

For the purpose of facilitating the disengagement of the gear 23 from the pinion 24 when moving the gear to engage its jaw teeth 61 with the jaw teeth 60 of the hand chain wheel 55, the axially movable disk 73 has a limited angular movement. This angular movement is limited by the lugs 85 secured to and extending chordwise of the disk and engageable with the edges of the plate 76, the particular edge depending upon the direction of rotation.

With the above construction, the electric motor 15 drives the drum 3 through intermediate reduction gearing, the drum having slip driving engagement with the cables connected to the door. The electric motor also drives the device 35 for operating the micro limit switches 32 and 33 through part of the intermediate gearing and other reduction gearing. The levers 38 and 40 of the limit switch operating device are fixedly angularly positioned relative to each other at an angle depending on the height of the door opening and the screws 44 are adjusted in the levers and the limit switches are positioned so that upon rotation of the electric motor rotor in one direction and rotation of the drum in one direction for a predetermined amount, one of the screws engages and actuates one of the limit switches. Also, upon rotation of the electric motor rotor and the drum in opposite directions for a predetermined amount, the other of the screws engages and actuates the other of the limit switches. The limit switches are constructed with a minimum of overtravel allowance (no overtravel as nearly as possible) so that upon engagement of a screw with a limit switch the latter exerts a pressure upon the screw and its lever resisting rotation of the limit switch operating device and overcoming the friction between the parts of the friction clutch for driving the limit switch operating device, compelling the parts to slip relative to each other in an amount equal to the coast or overtravel of the door by reason of the relative angular movement of the brake disks. This action positions the lever of the limit switch operating device with respect to the final position of the door, the operation being the same for both levers of the limit switch operating device in the opposite directions of travel of the door.

In actual practice, the limit switch operating device 35 is angularly positioned by manual operation of the door through the chain hand wheel 55 and the screws 44 are adjusted so that the limit switches 32 and 33 are operated to stop the electric motor 15 before actual contact of the door with the sill or soffit, any stretch in the cables being taken into account so that the door in its final position is either fully closed or open.

It will thus be seen that the door operating device provides complete control of the severity of impact of the door at each of its limits of travel.

The construction is also such that if the door is blocked mechanically as by an obstruction in the door opening, such as a truck or by jammed mechanism, the proper limit switch will be operated when the drum has slipped with respect to the cables a sufficient amount, thereby avoiding severe damage which might result from protracted operation of the electric motor.

Also with the above construction, the disk brake comprising the disk elements 70, 72 and 73, is normally applied when the electric motor

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15 is not in operation, the mechanism for applying the disk brake comprising the pins 75 abutting the disk 73, the levers 78 having the abutments 77 engaging the pins, the links 79 and the coil springs 80. The frictional resistance to rotation of the disk 73 exerted by the pins 75 is relatively small and appreciably less than the frictional resistance to rotation of the disk 73 exerted by the brake lining 72 and disk 70. With the electric motor in operation, the disk brake is released by the solenoid 83 which is energized at the same time as the electric motor, this solenoid acting through its core 82 and the levers 81 on the links 79 to swing the levers 78 in the releasing direction.

By providing the disk 73 with the lugs 85 engageable with the edges of the plate 76 recoil of the cables is used to relieve the pressure between the teeth of the pinion 24 and gear 23 so that the latter may be more easily moved axially out of engagement with the pinion into interlocking engagement with the hand chain wheel 55. Assuming the electric motor to be operating and the brake to be released, it will be seen that upon operation of one of the limit switches that the brake is automatically applied and one of the lugs 84 is forced tightly against the plate 75. However, by reason of momentum of the rotor, the drum is momentarily driven beyond the point of equilibrium to either relieve or increase the tension of the cables connected to the door depending upon whether the door is closed or open. After the rotor rotation stops, the equilibrium is re-established, the cables being permitted to recoil so that slight movement in the reverse direction of the disk 73 occurs. This slight movement is sufficient to relieve the friction between the meshing teeth of the pinion 24 and gear 23 but is not great enough to force the opposite sides of the teeth of the pinion and gear into tight engagement. As a result the axial movement of the gear 23 out of engagement with the pinion 24 is facilitated to provide for coupling the hand chain wheel with the drum.

What I claim as my invention is:

1. An operating device for a cable actuated door balanced by a counterweight connected to the cable, comprising a drum having slip driving engagement with the cable, an electric motor, a pulley operatively connected to said electric motor, gearing for operatively connecting said drum to said pulley, said gearing having a pinion operatively connected to said pulley, a shaft operatively connected to said drum and a gear non-rotatably mounted on and movable longitudinally of said shaft from a position in mesh with said pinion to a position out of mesh with said pinion, a manually operable chain wheel encircling said shaft, said gear and chain wheel having clutch teeth engageable with each other when said gear is out of mesh with said pinion, a disk brake comprising a brake disk connected to said pulley and a cooperating brake disk movable toward and away from said first mentioned brake disk, spring means for exerting pressure on said cooperating brake disk to apply the disk brake when said electric motor is de-energized, a solenoid for relieving said cooperating brake disk from the pressure of said spring means to release said disk brake when said electric motor is energized, a stationary abutment and a lug on said cooperating brake disk movable into firm engagement with said stationary abutment upon de-energization of said electric motor and movable out of firm engagement with said abutment dur-

ing recoil of the cable thereby decreasing the pressure exerted by the teeth of said pinion upon the teeth of said gear and decreasing the frictional resistance to movement of said gear out of mesh with said pinion.

2. An operating device for a cable actuated door comprising a drum in driving engagement with the cable, power means, a brake disk driven by said power means, means for driving said drum from said power means comprising a pinion rotatable with said brake disk, a shaft operatively connected to said drum and a gear non-rotatably mounted on and movable longitudinally of said shaft from a position in mesh with said pinion to a position out of mesh with said pinion, a manually operable chain wheel, cooperating clutch means on said gear and chain wheel engageable with each other when said gear is out of mesh with said pinion, a second brake disk movable toward and away from said first mentioned brake disk, spring means for exerting pressure on said second brake disk to hold the same in operative relation to said first mentioned brake disk when said power means is out of operation, the frictional resistance to rotation of said second brake disk resulting from the pressure applied by said spring means being less than the frictional resistance between said brake disks to relative rotation thereof, a solenoid for relieving said second brake disk from the pressure of said spring means when said power means is in operation, a stationary abutment and lug means on said second brake disk movable into firm engagement with said stationary abutment when said power means is out of operation and movable out of firm engagement with said abutment during recoil of the cable thereby decreasing the pressure exerted by the teeth of said pinion upon the teeth of said gear and decreasing the frictional resistance to movement of said gear out of mesh with said pinion.

3. An operating device having a cable actuated door comprising a drum in driving engagement with the cable, power means, a rotatable brake member driven by said power means, means for driving said drum from said power means comprising a pinion rotatable with said rotatable brake member, a shaft operatively connected to said drum, and a gear non-rotatably mounted on and movable longitudinally of said shaft from a position in mesh with said pinion to a position out of mesh with said pinion, a manually operable chain wheel, cooperating clutch means on said gear and chain wheel engageable with each other when said gear is out of mesh with said pinion, a brake member cooperable with said rotatable brake member, means for moving said second brake member into operative relation with said rotatable brake member when said power means is out of operation, the frictional resistance to rotation of said second brake member resulting from the pressure applied by said moving means being less than the frictional resistance between said brake members to relative rotation thereof, a stationary abutment and lug means on said second brake member movable into firm engagement with said stationary abutment when said power means is out of operation and movable out of firm engagement with said abutment during recoil of the cable thereby decreasing the pressure exerted by the teeth of said pinion upon the teeth of said gear and decreasing the frictional resistance to movement of said gear out of mesh with said pinion.

4. An operating device for a cable actuated door

comprising a drum in driving engagement with the cable, power means, means for driving said drum from said power means comprising a pinion, a shaft operatively connected to said drum and a gear non-rotatable on and movable longitudinally of said shaft from a position in mesh with said pinion to a position out of mesh with said pinion, a manually operable chain wheel, cooperating clutch means on said gear and chain wheel engageable with each other when said gear is out of mesh with said pinion, and a brake between said power means and pinion comprising cooperating brake members, one of said brake members having limited angular movement.

5. An operating device for a cable actuated door comprising a drum in driving engagement with the cable, power means, means for driving said drum from said power means comprising a pinion, a shaft operatively connected to said drum and a gear non-rotatable on and movable longitudinally of said shaft from a position in mesh with said pinion to a position out of mesh with said pinion, a manually operable chain wheel, cooperating clutch means on said gear and chain wheel engageable with each other when said gear is out of mesh with said pinion, and a brake between said power means and pinion comprising a rotatable brake member driven by said power means and a cooperating brake member having limited angular movement.

6. An operating device for a cable actuated door balanced by a counterweight connected to the cable, comprising a drum having slip driving engagement with the cable, power means for positively driving said drum, limit switch means for controlling the operation of said power means and an actuating device for said limit switch means, comprising contact means engageable with said limit switch means and a friction clutch between said contact means and power means for driving said contact means from said power means, one of said limit switch means and said limit switch actuating device being limited in its movement in a direction actuating said limit switch means to compel the parts of said clutch to slip relative to each other in an amount to compensate for the coast of the door.

7. An operating device for a cable actuated door balanced by a counterweight connected to the cable comprising a drum having slip driving engagement with the cable, an electric motor for positively driving said drum in opposite directions, limit switches for controlling the operation of said electric motor, angularly movable levers engageable with said limit switches for operating the same, and a friction clutch operatively connecting said electric motor and levers for angularly moving said levers from said electric motor, said limit switches having limited overtravel allowance and compelling relative movement of the parts of said friction clutch and adjustment of said levers with respect to the final position of the door.

8. An operating device for a cable actuated door comprising a drum having slip driving engagement with the cable, an electric motor, gearing for operatively connecting said drum positively to said electric motor, limit switches for controlling the operation of said electric motor and an actuating device for said limit switches comprising levers movable angularly in unison with each other for operating said limit switches and a friction clutch between said gearing and levers for driving said levers from said gearing, said limit switches having limited overtravel

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allowance and compelling the parts of said clutch to slip relative to each other.

9. An operating device for a cable actuated door balanced by a counterweight connected to the cable comprising a drum having slip driving engagement with the cable, power means for positively driving said drum, limit switch means for controlling the operation of said power means and an actuating device for said limit switch means comprising lever means engageable with said limit switch means, a friction clutch between said lever means and power means for driving said lever means from said power means, one of said limit switch means and said lever means having a limited movement to compel the parts of said friction clutch to slip relative to each other.

10. An operating device for a cable actuated door balanced by a counterweight connected to the cable comprising a drum having slip driving engagement with the cable, power means for positively driving said drum, limit switches for controlling the operation of said power means, contact members engageable with said limit

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switches for operating the same and a friction clutch driven by said power means for moving said contact members into engagement with said limit switches, said limit switches having a limited overtravel allowance and compelling relative movement of the parts of said friction clutch and adjustment of said contact members relative to said power means in accordance with the coast of the door.

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