Dec. 15, 1931. J. E. BANCROFT 1,836,059

DOOR OPERATING MECHANISM

Filed Oct. 12, 1928

Fig. 1

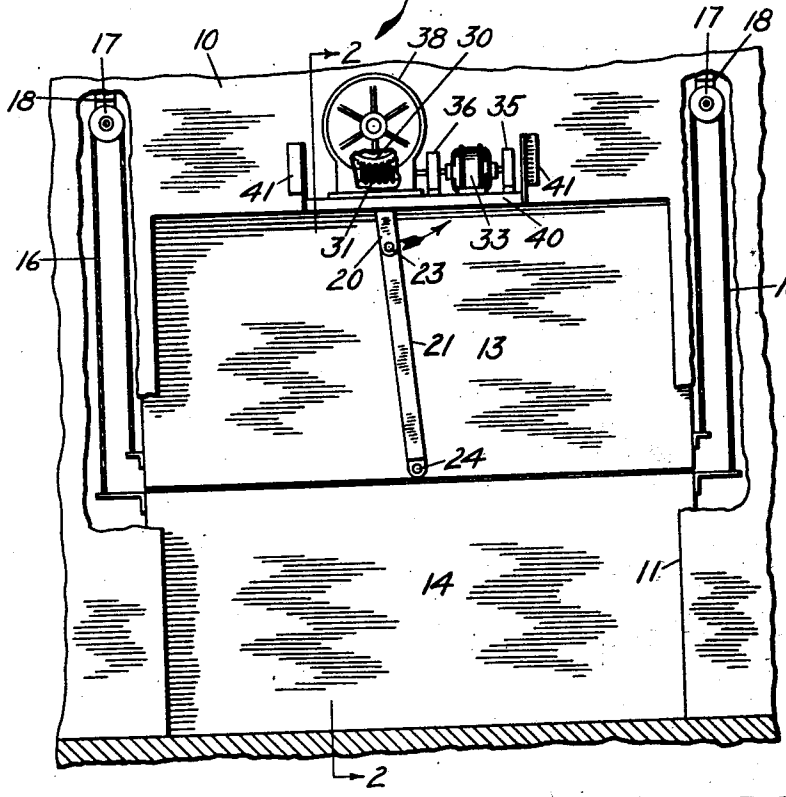
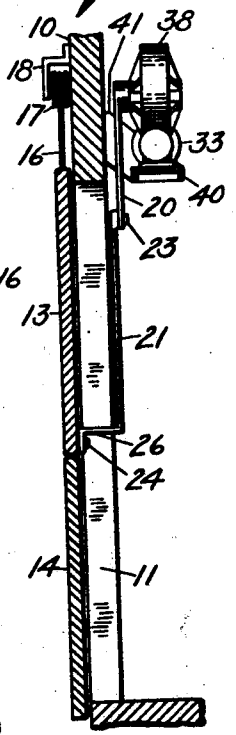


Fig. 2



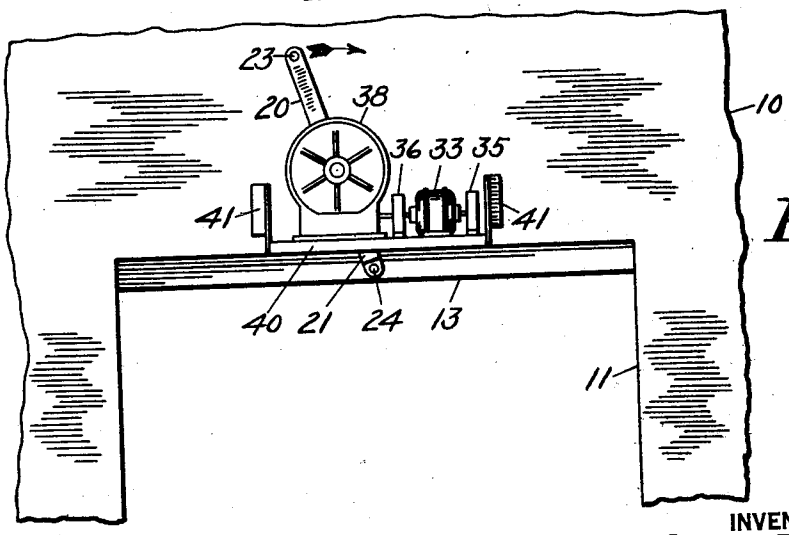


Fig. 3

WITNESS

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UNITED STATES PATENT OFFICE

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DOOR OPERATING MECHANISM

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This invention relates to door operating mechanisms, and more particularly to power driven apparatus arranged to open and close doors of the slidable type.

Doors of this type are in common use in connection with freight elevator shafts, where the service is unusually severe. The doors are usually of heavy construction, and hand operation has proven unsatisfactory in most instances. Such power operators as have heretofore been used have been subject to various disadvantages. Some of these devices cause excessive slamming of the doors at the end of their travel, which produces undesirable noise and increases the cost of maintenance of the entire equipment. Others tend to twist the doors and cause them to bind in the guides. Still others are expensive and complicated, and are difficult to install in connection with existing doors.

It is accordingly the main object of my invention to overcome these difficulties and to provide a power driven mechanism which will operate slidable doors swiftly and smoothly without undue friction or noise.

It is a further object of my invention to provide a door operator which will be simple and inexpensive to manufacture, and which can be connected to existing installations of sliding doors without altering the doors or their supporting structure.

With these and other objects in view, as will be apparent to those skilled in the art, my invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawings illustrating one embodiment of my invention, and in which like reference numerals indicate like parts.

Fig. 1 is a front elevation of an installation in connection with doors of the vertically slidable counter-balanced type, the doors being shown in the closed position and certain parts being broken away for clearness of illustration;

Fig. 2 is a cross section on the line 2—2 of Fig. 1, and

Fig. 3 is a front elevation showing the position of the mechanism when the doors are open.

The embodiment illustrated in the drawings comprises a vertical wall 10 provided with a rectangular opening 11 therethrough, and a pair of doors 13 and 14 mounted on one side of the wall adjacent to the opening. Door 13 is arranged above door 14, and both doors are slidable vertically in guides (not shown). The doors are connected at each end by means of flexible members, such as the cables 16 which pass over sheaves 17 mounted on brackets 18 on the wall. The cables support the weight of the doors, so that each door acts as a counter-weight for the other, and the doors are preferably made of substantially equal weight. It will be apparent that whenever one door is moved up or down, the other door will move in the opposite direction. Counter-balanced doors of this type are frequently used to provide access to freight elevator shafts, and many installations are opened and closed hundreds of times a day. Hand operation of such heavy doors is slow and laborious.

In order to actuate the doors by power I provide a power driven crank 20 and a connecting rod 21. One end of the connecting rod is pivoted at 23 to the crank, and the other end is pivoted at 24 to one of the doors and preferably to the upper door 13 as illustrated. The crank 20 may be mounted above the opening 11 on the opposite side of the wall from the doors, and is preferably arranged for rotation about an axis perpendicular to the wall. In order to minimize the tendency to twist the doors and cause them to bind in the guides, I locate the pivoted connection 24 on the vertical center line of the door 13 and near the lower edge thereof. The connecting rod may have an offset portion 26 at its lower end (Fig 2.) so as to avoid interference between the connecting rod and the wall when the doors are open.

Since it is desirable to avoid all shock in the starting and stopping of the doors, I so proportion the various parts that the crank 20 will be in one dead center position when the doors are open and in the other dead center position when the doors are closed. In other words, for each extreme position of

the doors, a line through the points 23 and 24 will intersect the axis of the crank.

I prefer to rotate the crank in one direction to open the doors and in the reverse direction to close them, and to mount the crank with its axis offset from the vertical center line of the doors in a direction opposite to the direction toward which the crank extends during the major part of its travel. For example, from Figs. 1 and 2 it will be apparent that crank 20 will extend to the right during the major part of its travel from one extreme position to the other, and the axis of the crank is located to the left of the door center line. This construction applies force to the upper door in a substantially vertical direction and reduces the tendency to twist the doors.

Various means for driving the crank may be used within the scope of my invention, but in the preferred embodiment illustrated the crank is mounted on the shaft of a worm gear 30 which meshes with a worm 31 (Fig. 1). The worm is driven by a reversible electric motor 33 directly connected thereto. The motor is suitably connected to a source of electric power, and a limit switch 35 and brake 36 are preferably utilized to stop the motor automatically as the doors reach either extreme position. The limit switch and brake are merely indicated diagrammatically in the drawings, since they form no part of the present invention, and various suitable constructions are well known to those skilled in this art.

The worm and worm gear may be enclosed in a casing 38 which is mounted together with the motor on a horizontal support 40. This support is spaced from the wall as shown in Fig. 2, and attached thereto by a bracket 41 at each end. The crank is mounted between the worm gear and the wall, and the connecting rod is pivoted to the crank on that side thereof which faces the wall. This construction permits the connecting rod to move very close to the wall, so that the operating force is applied as nearly in line with the door as possible.

The operation of my invention will now be apparent from the above disclosure. Assuming the doors to be in the closed position shown in Fig. 1, the motor 33 is started and acts through the worm and gear to rotate the crank 20 in the direction of the arrow in Fig. 1. The crank was originally on dead center, and the connecting rod therefore starts the door gradually upward. The door rapidly gains speed, reaches a maximum near the half way point, and then slows down to a gradual stop as the crank reaches the other dead center position. During this time the lower door of course is moving downwardly at the same velocity. To close the doors, the motor is reversed to drive the crank in the direction of the arrow in Fig. 2. During the closing movement, the doors approximate simple harmonic motion, the same as during the opening movement.

The invention is inexpensive to build, and its installation requires substantially no alteration of the existing structure. It provides swift and silent door operation with a minimum of power consumption.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. An operating mechanism for a vertically slidable door comprising a power driven crank mounted above the door and rotatable about a fixed axis, and a connecting rod which is pivoted at one end to the crank and at the other end to the door, said parts being so constructed and arranged that the crank is substantially at one dead center position when the door is closed and substantially at the other dead center position when the door is open.

2. An operating mechanism for a vertically slidable door comprising a crank mounted for rotation about an axis substantially perpendicular to the plane of the door, a connecting rod which is pivoted at one end to the crank and at the other end to the door at a point substantially on the vertical center line of the door, and power means to rotate the crank in one direction to open the door and in the opposite direction to close the door, said crank being mounted with its axis offset from the vertical center line of the door in a direction opposite to the direction toward which the crank extends during the major part of its travel.

3. An operating mechanism for a vertically slidable door comprising a crank mounted for rotation about an axis substantially perpendicular to the plane of the door, a connecting rod which is pivoted at one end to the crank and at the other end to the door at a point substantially on the vertical center line of the door, said parts being so constructed and arranged that the crank is substantially at one dead center position when the door is closed and substantially at the other dead center position when the door is open, and power means to rotate the crank in one direction to open the door and in the opposite direction to close the door, said crank being mounted with its axis offset from the vertical center line of the door in a direction opposite to the direction toward which the crank extends during the major part of its travel.

4. A closure comprising a pair of vertically slidable doors of substantially equal weight and arranged one above the other, means including a flexible member connecting the doors and so arranged that each door acts as a counterweight for the other, a crank mounted for rotation about an axis substantially perpendicular to the plane of the doors, power means connected to the crank to rotate

the same, and a connecting rod which is pivoted at one end to the crank and at the other end to the upper door.

5. A closure comprising a pair of vertically slidable doors of substantially equal weight and arranged one above the other, means including a flexible member connecting the doors and so arranged that each door acts as a counterweight for the other, a crank mounted above the doors and rotatable about an axis substantially perpendicular to the plane of the doors, power means connected to the crank to rotate the same, and a connecting rod which is pivoted at one end to the crank and at the other end to the upper door at a point substantially on the vertical center line of the door and near the lower edge thereof.

6. A closure comprising a vertically slidable door, a crank mounted above the door and rotatable about an axis substantially perpendicular to the plane of the door, power means connected to the crank to rotate the same, and a connecting rod which is pivoted at one end to the crank and at the other end to the door at a point substantially on the vertical center line of the door and near the lower edge thereof, said crank and connecting rod being so arranged that the crank will be on one dead center when the door is closed and on the other dead center when the door is open.

7. A closure comprising a pair of vertically slidable doors mounted on one side of a wall having an opening therethrough, said doors being located one above the other, connections between the doors so arranged that each door acts as a counterweight for the other, a crank mounted on the other side of the wall above the opening and arranged for rotation about an axis substantially perpendicular to the plane of the doors, a motor connected to rotate the crank, and a connecting rod which is pivoted at one end to the crank and at the other end to the upper door.

8. A closure comprising a vertically slidable door mounted on one side of a wall having an opening therethrough, a support mounted above the opening on the other side of the wall and spaced therefrom, a worm gear on said support and arranged for rotation about an axis perpendicular to the wall, a worm in mesh with said worm gear, a motor connected to drive said worm, a crank located between the worm gear and the wall, connections between the crank and the worm gear whereby they both rotate together, and a connecting rod which is pivoted at one end to the crank and at the other end to the lower part of said door.

9. A closure comprising a pair of vertically slidable doors mounted on one side of a wall having an opening therethrough, said doors being located one above the other, connections between the doors so arranged that each door acts as a counterweight for the other, a support mounted above the opening on the other side of the wall and spaced therefrom, a worm gear on said support and arranged for rotation about an axis perpendicular to the wall, a worm in mesh with said worm gear, a motor connected to drive said worm, a crank between the worm gear and wall, connections between the crank and the worm gear whereby they both rotate together, and a connecting rod which is pivoted at one end to the crank on that side of the crank which faces the wall and at the other end to the upper door at a point substantially on the vertical center line of the door and near the lower edge thereof, said parts being so constructed and arranged that the crank will be on one dead center when the doors are closed and on the other dead center when the doors are open.

Signed at Detroit, Michigan, this 8th day of October, 1928.

JAMES E. BANCROFT.