March 6, 1928. 1,661,719

R. M. EDWARDS ET AL

DOOR MECHANISM

Filed Aug. 13, 1927

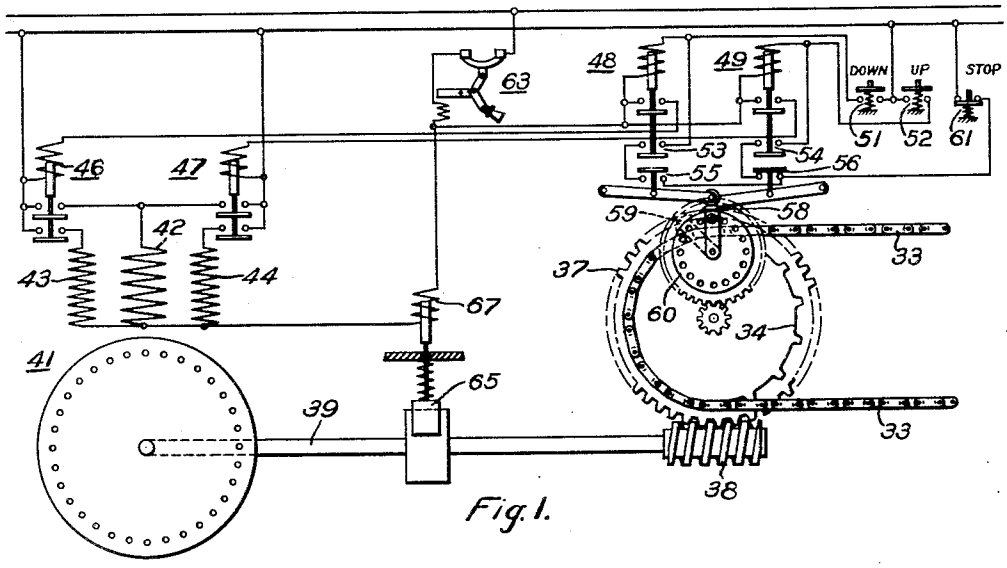


Fig. 1.

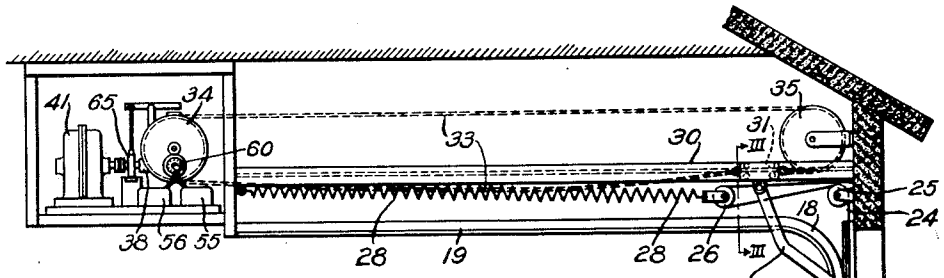


Fig. 2.

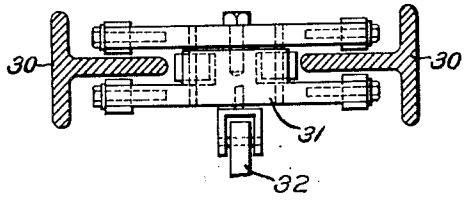


Fig. 3.

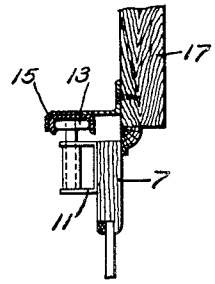
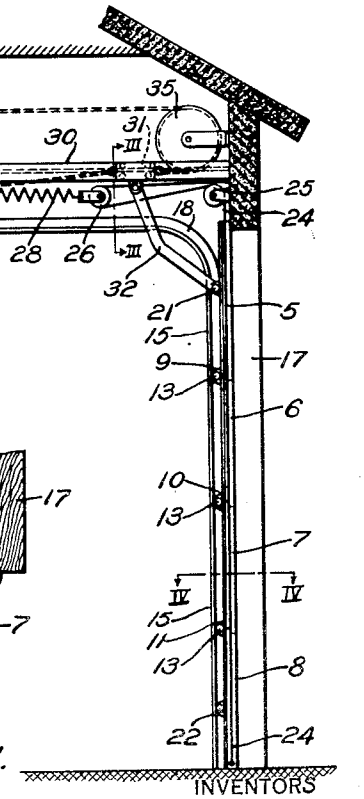


Fig. 4.



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UNITED STATES PATENT OFFICE.

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DOOR MECHANISM.

Application filed August 13, 1927. Serial No. 212,622.

Our invention relates to automatic door-operating mechanism, and it has particular relation to such mechanism as applied to an overhead door of the type having hinged panels guided, at their ends, in a track which disposes the door in a horizontal position overhead, when the door is opened.

The principal object of our invention is to provide a thoroughly safe and reliable mechanism which utilizes only a small-size electric motor to operate the same.

A further object of our invention is to provide mechanism whereby a reversible single-phase induction motor may safely be utilized.

A still further object of our invention is to provide means whereby the motor may attain a good start before exerting a significant torque on the door-operating mechanism.

With the foregoing and other objects in view, which will be understood as the description proceeds, our invention consists in the combinations and parts described and claimed in the following specification, and illustrated in the accompanying drawing, wherein

Fig. 1 is a diagrammatic view of circuits and apparatus embodying an electrical control and driving connections embodying our invention,

Fig. 2 is a side elevational view illustrating the entire assembly,

Fig. 3 is a cross-sectional view on the line III—III of Fig. 2, and

Fig. 4 is a cross-sectional view on the line IV—IV of Fig. 2.

The overhead door is constructed of a plurality of panels, as indicated at 5, 6, 7 and 8, which are hinged together, one above another, by offset hinges, as indicated at 9, 10 and 11. The hinge pintles are extended to support rollers 13 which run in tracks or guides 15 extending up along both sides of the door-opening in the front wall 17 of the garage or other building in which the door is installed. The door guides 15 make a quarter-circle bend 18 near the top of the door and extend back in a substantially horizontal direction overhead, as indicated at 19. One or both of the top and bottom panels 5 and 8 may be provided with additional guide rollers 21 and 22, respectively, at points removed from the hinges 9 and 11.

The door is preferably counterbalanced so that it will remain in any position. Any well-known means may be provided to this end, such as a chain 24, connected to the lower panel 8 at each side edge of the door, said chain extending up to a fixed pulley 25 at the top of the door, whence it passes horizontally to a spring-supported pulley 26, and forward again to a point of attachment near the head of the door frame A spring 28 pulls backwardly on the movable pulley 26 and effects the exact counterbalancing action which is desired.

The door-operating mechanism of our invention relates particularly to an overhead door of the type just described. One form of embodiment thereof is shown, in the drawing, as comprising a pair of substantially horizontal T-irons 30 slightly spaced from each other to provide a runway for a small trolley or carriage 31 which is movable to the front and the rear immediately above the overhead position of the door. The carriage 31 is connected to the top panel 5 of the door by means of a rod or link member 32 which is pivoted at both ends, whereby the door may be pulled or pushed, to open and close the same.

Movement is imparted to the carriage 31 by means of an endless chain 33 which passes over a driving wheel 34 in the rear and an idler wheel 35 at the front. The driving wheel 34 is driven by means of a non-reversible gear mechanism comprising a worm wheel 37 (Fig. 1) which meshes with a worm 38 on the shaft 39 of an electric motor 41, which is preferably a single-phase induction motor having a main primary winding 42 and two teaser windings 43 and 44 for starting in either the forward or the reverse direction.

The motor is controlled by a suitable push-button control system, which may comprise two double-pole main-circuit relays 46 and 47 for energizing either the main winding 42 and the forward teaser winding 43, or the main winding 42 and the reversing teaser winding 44. The main-circuit relays 46 and 47 are energized by any suitable means, such as two control relays 48 and 49, respectively, which are actuated to closed position by means of forward and reverse push buttons 51 and 52, respectively. When either of the control relays 48 or 49 is closed, an auxiliary contactor 53 or 54, as the case may be, com-

pletes a holding circuit to keep the relay closed until the holding circuit is broken by a limit switch 55 or 56, respectively, which is actuated by one of two cams 58 or 59 carried by a slowly moving wheel 60 geared to the driving wheel 34.

The motor may be stopped at any point by depressing an emergency-stop push button 61 which open-circuits the holding circuits of the control relays 48 and 49. The motor will also be stopped, in case the overhead door meets with an obstruction, by means of an overload circuit breaker 63 which is adjusted to just barely permit the motor to develop sufficient torque to operate the door, thereby limiting the pressure that can be brought to bear on any obstruction such as an automobile (not shown) in the doorway. The opening of the circuit-breaker 63 also de-energizes all of the relays, so that the reclosing of the breaker will not cause the motor to re-start until the desired push button 51 or 52 is subsequently depressed.

When the motor is de-energized, it is immediately brought to rest by means of a spring-pressed brake 65, which is automatically released by means of a series solenoid 67 in the motor circuit, when the motor is started in either direction. The brake not only prevents the motor from continuing to rotate after the door has come into contact with an obstruction, which would increase the crushing force exerted by the door on the obstruction, but it also makes possible the operation of the emergency-stop button 61, followed immediately by the reversing push button 52, in case the operator should see an obstruction in the way of the descending door. If the brake were not provided, with a single-phase induction motor, which is the most practical form of motor, an excited operator, attempting to quickly reverse the motor, might operate the reversing button while the motor is still turning in the forward direction, in which case, the motor would continue to operate in the forward direction without reversing. It is no small part of our invention to prevent such an accident by providing an automatic brake 65 which instantly stops the motor before the reversing button 52 can possibly be depressed after the depression of the stop button 61.

In operation, the small trolley or carriage 31 rolls smoothly, and without binding, along the T-bar runways 30, pushing or pulling the door along with it. The carriage and its runway are particularly necessary when the door is in its closed position, as shown in the drawing, as then a horizontal backward pull by the chain 33 on the carriage causes the connecting link 32 to pull obliquely upwardly on the door, thereby raising it and starting its upward movement. If the carriage were not provided, the chain 33 being then connected directly to the top panel of the door, no amount of backward pulling on the chain would raise the door, as there would be no vertical component to the pulling force on the door.

It is quite desirable, in operation, to provide a yielding driving connection, or lost-motion device, between the motor and the door, so that the motor may make one or more revolutions before encountering much opposing torque, thereby enormously reducing the starting-torque requirements. In our present embodiment of the invention, the lost-motion connection is obtained by means of the slack in the chain 33. It will be noted in Fig. 2, for example, that when the door is closed, the bottom chain is slack, so that when the motor is started in the reverse direction, to raise the door by pulling back on the carriage 31, the slack in the chain must be taken up before the motor begins to pull hard on the carriage, and the high-reduction gearing between the motor shaft 39 and the driving wheel 34 makes it necessary for the motor to turn several revolutions before taking up this slack.

It will be noted, further, that the non-reversible gear drive consisting of the worm 38 and worm wheel 37 causes the door to be positively locked in any position in which the door is stopped.

While we have described our invention in a preferred form of embodiment, we desire it to be understood that such embodiment is illustrative only, and that many changes may be made without departing from the essential spirit of our invention. We desire, therefore, that the appended claims shall be given the broadest construction consistent with their wording and the prior art.

We claim as our invention:

1. The combination comprising a closure member having hinged panels, guide rollers attached to the ends of the panels, a track for said guide rollers, said track having a central curved portion and two substantially straight ends corresponding to the open and closed positions of said closure member, respectively, a substantially straight runway disposed substantially parallel to but offset from, the straight end of the track in which said closure member is in its open position, a carriage movably mounted on said runway, and inclined link connecting said carriage to one of the panels of said closure member, and independent means for moving said carriage along its runway.

2. The combination comprising a closure member having hinged panels, guide rollers attached to the ends of the panels, a track for said guide rollers, said track having a central curved portion and two substantially

straight ends corresponding to the open and closed positions of said closure member, respectively, a substantially straight runway disposed substantially parallel to, but offset from, the straight end of the track in which said closure member is in its open position, a carriage movably mounted on said runway, an inclined link connecting said carriage to one of the panels of said closure member, pulleys at the ends of said runway, an endless flexible tension member passing over said pulleys and connected to said carriage, and means for driving one of said pulleys.

3. An overhead door assembly, comprising the combination, with the door having hinged panels, a track for guiding the ends of said panels from a vertical position in which the door is closed to a substantially horizontal overhead position in which the door is open, and counterbalancing means for approximately counterbalancing the door in any position, of mechanism for opening and closing said door, comprising a substantially straight runway disposed substantially parallel to, but slightly above, the closed position of the door, a carriage movably mounted on said runway, an inclined link connecting said carriage to the top panel of the door, pulleys at the ends of said runway, an endless flexible tension member passing over said pulleys and connected to said carriage, and means including a non-reversible gear mechanism for driving one of said pulleys.

4. An overhead door assembly, comprising the combination, with the door having hinged panels, a track for guiding the ends of said panels from a vertical position in which the door is closed to a substantially horizontal overhead position in which the door is open, and counterbalancing means for approximately counterbalancing the door in any position, whereby approximately the same force is required to move the door in either direction at any point in its travel, of mechanism for opening and closing said door, comprising a substantially straight runway disposed substantially parallel to, but slightly above, the closed position of the door, a carriage movably mounted on said runway, an inclined link connecting said carriage to the top panel of the door, pulleys at the ends of said runway, an endless flexible tension member passing over said pulleys and connected to said carriage, a prime mover for driving one of said pulleys in either direction, at the will of the operator, and automatic means for quickly stopping said prime mover when the door requires an abnormally large force to move it at any point in its travel.

5. An overhead door assembly, comprising the combination, with the door having hinged panels, a track for guiding the ends of said panels from a vertical position in which the door is closed to a substantially horizontal overhead position in which the door is open, of mechanism for opening and closing said door, comprising a substantially straight runway disposed substantially parallel to, but slightly above, the closed position of the door, a carriage movably mounted on said runway, an inclined link connecting said carriage to the top panel of the door, pulleys at the ends of said runway, an endless flexible tension member passing over said pulleys and connected to said carriage, a single-phase induction motor operatively connected to one of said pulleys, a normally applied brake applied to said motor, means responsive to the energization of said motor for releasing said brake, and means, under the control of the operator, for starting, stopping and reversing said motor, said brake being operative to stop said motor before said reversing means can normally be actuated by the operator after the actuation of said stopping means.

6. An overhead door assembly, comprising the combination, with the door having hinged panels, a track for guiding the ends of said panels from a vertical position in which the door is closed to a substantially horizontal overhead position in which the door is open, and counterbalancing means for approximately counterbalancing the door in any position, of mechanism for opening and closing said door, comprising a substantially straight runway disposed substantially parallel to, but slightly above, the closed position of the door, a carriage movably mounted on said runway, an inclined link connecting said carriage to the top panel of the door, a prime mover of relatively high speed, and a driving connection including a lost-motion device for operatively connecting said prime mover to said carriage to move the latter in either direction, said lost-motion device enabling the prime mover to attain a good start before exerting a significant torque on said carriage upon starting in either direction.

In testimony whereof, we have hereunto subscribed our names this 8th day of August, 1927.

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