March 24, 1959 R. M. G. PHILLIPS 2,879,058

DOOR OPERATOR

Filed Sept. 16, 1953 3 Sheets-Sheet 1

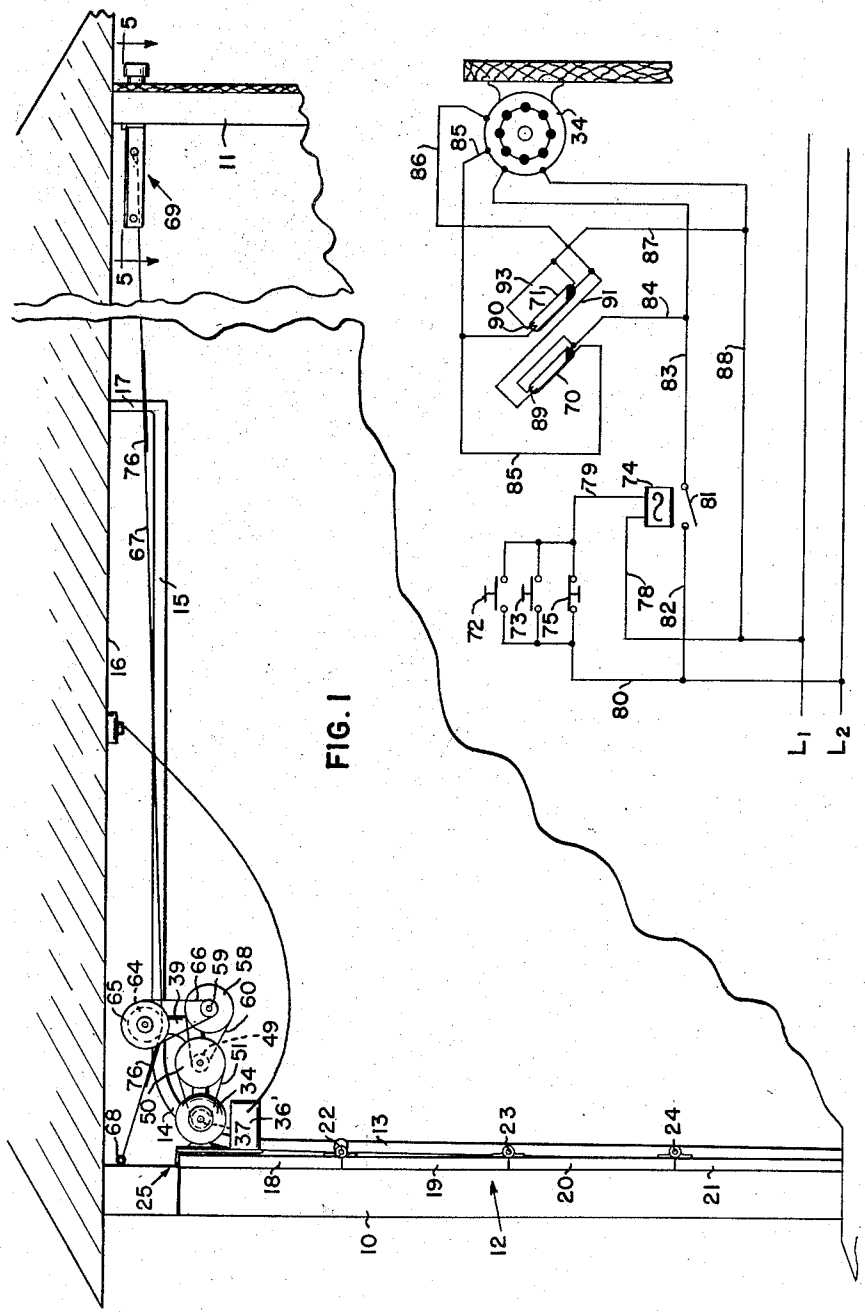


FIG. 1

FIG. 7

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DOOR OPERATOR

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3 Sheets-Sheet 2

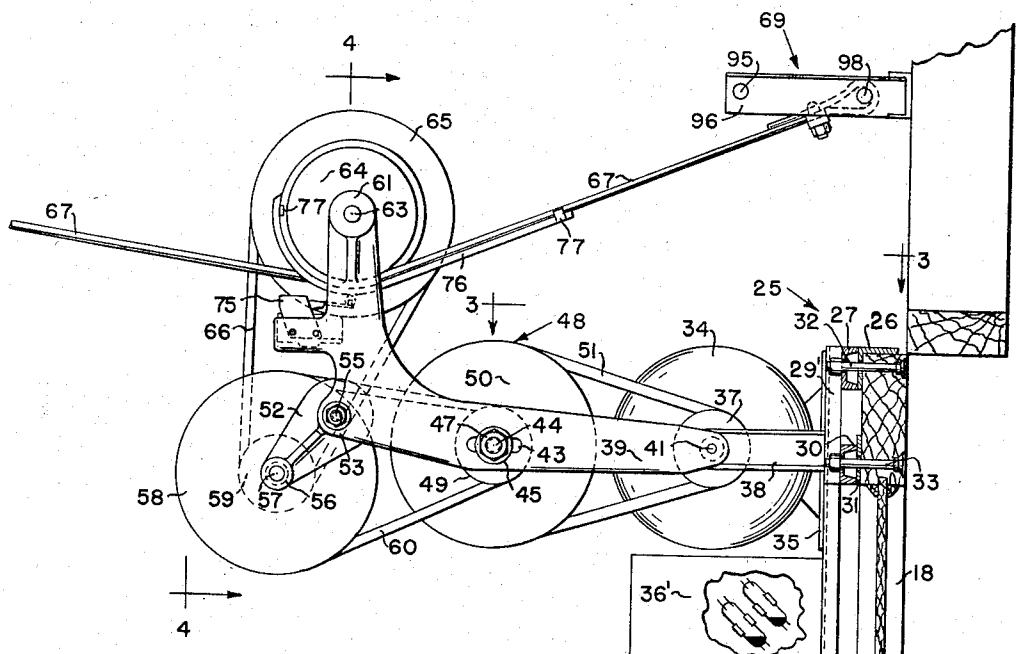


FIG. 2

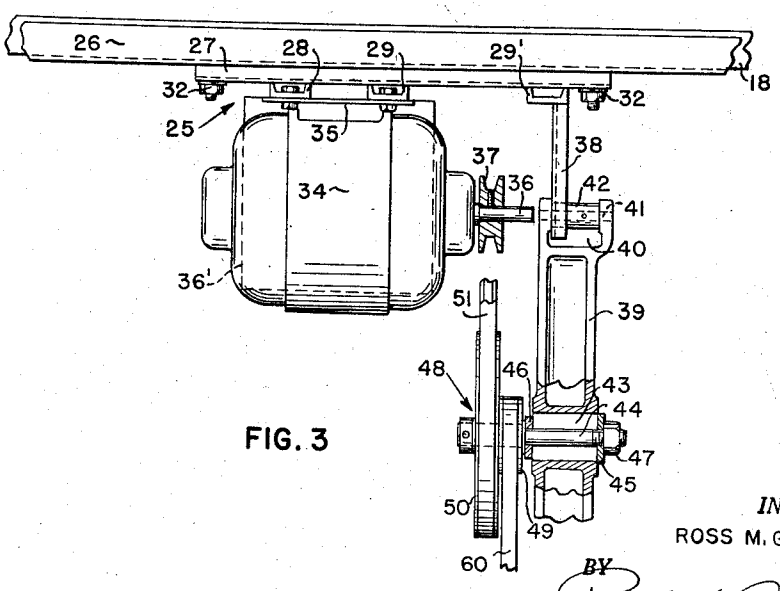


FIG. 3

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DOOR OPERATOR

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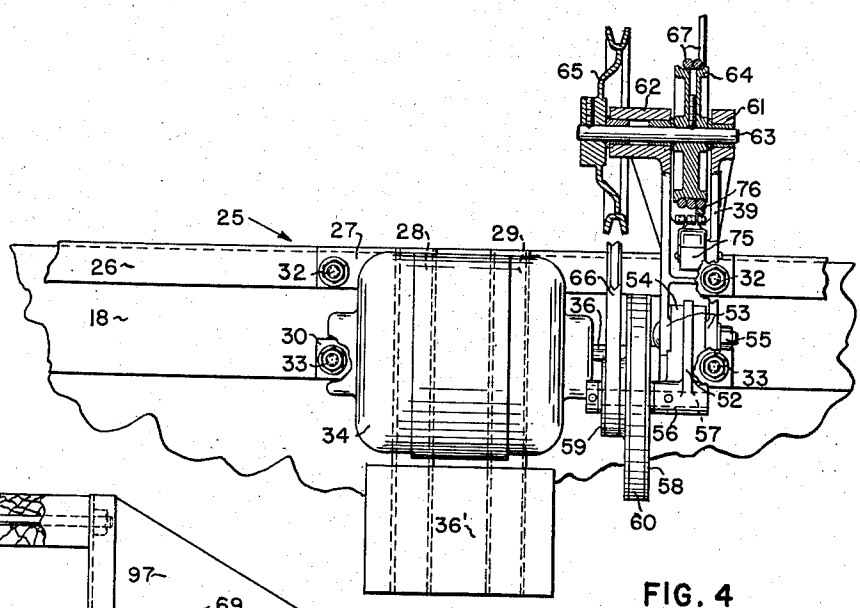


FIG. 4

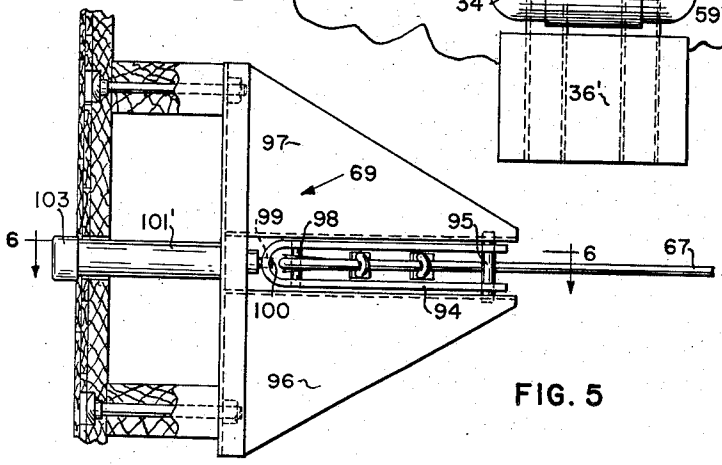


FIG. 5

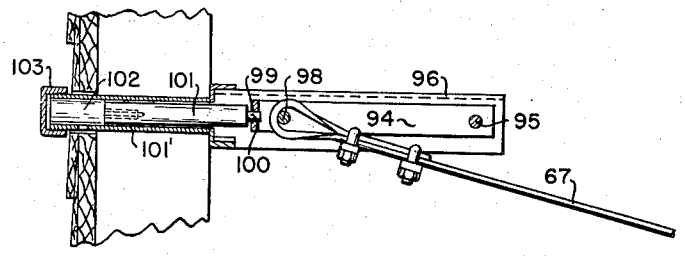


FIG. 6

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United States Patent Office 2,879,058 Patented Mar. 24, 1959

2,879,058

DOOR OPERATOR

Ross M. G. Phillips, Sandy Hook, Conn.

Application September 16, 1953, Serial No. 380,468
14 Claims. (Cl. 268—59)

The present invention relates to door operators and particularly to a new and improved door operator for the well-known overhead type of garage door.

There are many types of garage door operators on the market today, but they universally embody relatively complicated structures requiring expensive installations in order to render them operative. Prior-known door operators of the type referred to include various types of auxiliary carriage mechanisms that may run on separate tracks or on the tracks normally employed for the overhead door. These mechanisms are usually connected to the top of the door by some type of draw bar means.

The principal object of this invention is to provide a simple, rugged and inexpensive door operator requiring a minimum structure for installation purposes.

Other objects of the invention include the provision of a door operator in which the electric motor and speed reducing mechanism including the traction element are mounted rigidly to the top of the door, as distinguished from being mounted on a separate carriage mechanism that is connected to the top of the door by draw bar means; the provision of such a door operator that can be readily rendered ineffective from the outside of the garage in the event of power failure whereby the door can be opened manually; the provision of such a door operator including a reversible electric motor rigidly attached to said door and provided with a control circuit that is rendered effective to reverse the polarity of the motor by the action of the door moving from a closed position to an open position; the provision of such a door operator requiring a minimum of installation mechanism to effect its application to commonly-employed overhead doors.

The above, as well as other objects of the invention will become apparent from the following specification and accompanying drawings in which:

Figure 1 is a sectional elevational view through a garage having an overhead door to which the principles of this invention have been applied;

Fig. 2 is an enlarged elevational view of a portion of the structure shown in Fig. 1, but looking at the side thereof opposite that shown in Fig. 1;

Fig. 3 is a plan view, partly in section, taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is an elevational view taken substantially along line 4—4 of Fig. 2;

Fig. 5 is a plan view taken substantially along line 5—5 of Fig. 1; and

Fig. 6 is a sectional elevational view taken substantially along line 6—6 of Fig. 5; and

Fig. 7 is a wiring diagram of certain of the components forming the invention.

While the principles of the invention may be applied to any type of overhead door, they are shown and will be described as applied to a garage having a front wall 10 and a rear wall 11. A sectional overhead door 12 is shown in its closed position—closing the usual car entrance opening in the front wall 10 of the garage. Although the door 12 is shown as a sectionally-hinged door, it may with equal facility be of unitary construction of the type that is moved from closed to open position by a kinematic linkage or such that is provided with rollers that run in a track. The usual door track including a substantially vertical portion 13 is mounted along the vertical wall 10 within the garage, and it is

connected to a curved portion 14 joining the vertical portion 13 to a horizontal portion 15 spaced a determined distance from, and anchored to the garage ceiling 16 by a bracket 17.

The door 12 of the embodiment disclosed is provided with sections 18, 19, 20 and 21. These sections are hinged together in the usual manner and rollers 22, 23 and 24 are attached to the sections in a manner to ride within the track portions 13, 14 and 15.

Attention is directed to Figs. 2, 3 and 4, in which a bracket 25 is shown as rigidly attached to the top section 18 of the door 12. The bracket 25 comprises an angle iron 26 to the one leg of which a channel iron 27 is welded. Additional channel irons 28 and 29 are welded or otherwise fastened to channel iron 27 at right angles thereto. Still another channel iron 30 is welded or otherwise fastened to the channels 28 and 29 in spaced parallel relation to channel 27. Pads 31 are fixed to channel 30 of a thickness equal to that of the leg of angle 26 to which channel 27 is welded. The bracket 25 is mounted on the top section of the door 12 such that the leg of angle 26 other than that to which the channel 27 is welded rests along the top edge of the top section 18, and is fixed to the top section 18 by through bolts 32 and 33. A single phase induction reversing motor 34 having a capacitor starter and a base 35 is bolted to the channel irons 28 and 29 as shown in Fig. 3. The motor 34 is provided with an output shaft 36 to which is keyed a V-pulley 37 for a purpose to be described later.

The channel irons 28 and 29 extend downwardly (Figs. 2 and 4) to a point substantially below the motor 34 and support a housing 36' adapted to hold a portion of the control mechanism to be described later.

Attention is directed to Fig. 3, in which is shown another channel iron 29' that is welded to the channel irons 27 and 30 to the right of the motor 34 (Fig. 3), and an additional channel iron 38 is welded to the channel iron 29' in a manner to extend outwardly from the top section 18 of door 12 beyond the shaft 36 to a point where the centerline of the output shaft 36 of the motor 34 passes through a portion of channel iron 38. A bracket 39 is adapted pivotally to be mounted on the channel iron 38 on an axis that is coextensive with the axis of rotation of the shaft 36. The bracket 39 is provided with a bifurcated portion 40 through which a pivot pin 41 extends. The pivot pin 41 also extends through a drilled hole in line with the centerline of the shaft 36 and extending through the channel 38, as well as a boss 42 welded to the channel 38. This provides an adequate bearing on channel 38 to pivotally support the bracket 39.

The bracket 39 is of generally L-shaped construction and includes an elongated slot 43 for receiving an axle 44 that is adjustably held in a predetermined position within the elongated slot 43 by washers 45 and 46 resting on the outer edges of the bracket 39 and rigidly held thereto by a nut 47. The axle 44 supports a reduction V-pulley assembly 48 including a relatively small V-pulley 49 and a relatively large V-pulley 50. The relatively large V-pulley 50 is mounted in the plane including the V-pulley 37 on the motor shaft 36, and the V-belt 51 extends between these two pulleys. Obviously, by one's adjusting the axle 44 within the slot 43, proper tension of the belt 51 can be effected to provide a suitable drive from the motor to the pulley 50. Inasmuch as the relatively small pulley 49 is integrally attached to the relatively large pulley 50, the power transmitted to the pulley 50 is automatically transferred to the relatively small pulley 49, forming part of the speed reduction gearing of the present invention.

Referring to Figs. 2 and 4, a bracket 52 is pivotally

mounted on the bracket 39 at the point between the angularly-disposed legs of its L-shaped construction. This is accomplished by the provision of a bifurcated portion 53 (Fig. 4) of the arm 39 adapted to receive a boss 54 of the bracket 52. A pivot pin 55 extends through the legs of bifurcated portion 53 and through the boss 54 providing a pivotal connection for the bracket 52. The free end of the bracket 52 is provided with a boss 56 adapted to receive an axle 57 that supports another pair of reduction pulleys 58 and 59. The pulley 58 is of relatively large diameter, while the pulley 59 is of relatively small diameter and the two are integrally attached to each other. A V-belt 60 extends between the relatively small pulley 49 of the unit 48 and the relatively large pulley 58.

Referring to Figs. 2 and 4, the L-shaped bracket 39 is so arranged that in its operating position, its one leg extends vertically upwardly above the motor 34 and is provided with a bifurcated portion having aligned bosses 61 and 62 forming part thereof. An axle 63 extends through the bosses 61 and 62 and supports between them a drum 64 to be described later. The outer end of the axle 63 has fixed to it a V-pulley 65 in line with the relatively small pulley 59 previously described. A V-belt 66 extends between the relatively small pulley 59 and the pulley 65, and from an inspection of the drawings, it is quite evident that the drum 64 is caused to rotate at a relatively slow speed compared to that of the motor 34 and with a correspondingly high torque.

The drum 64 is of such width as to accommodate several windings of a cable 67 that is rigidly attached to one of the walls of the garage by an eye 68 and to the other wall of the garage by a mechanism 69 to be described later. The construction and arrangement of the speed reduction unit of the power operator are such that its weight tends to cause it to pivot about the pin 41, thereby insuring an adequate traction effect between the cable 67 and the drum 64. It is also quite evident that rotation of the motor 34 in one direction will cause the drum 64 to roll along the cable 67 in one direction, thereby causing the door 12 to be opened; and, when the motor 34 is rotated in the opposite direction, the drum 64 will roll along the cable 67 in the opposite direction to effect closing of the door 12.

An electrical circuit is provided for controlling the operation of the reversing motor 34. Attention is directed to Fig. 7, in which the circuit is shown as including a pair of single-pole, double-throw mercury switches 70 and 71 that are mounted at a 45° angle relatively to the vertical and supported by the housing 36' on the top section 18 of the door 12. Normally-open contacts 72 and 73 are connected in parallel relation with a solenoid-operated switch 74. The switches 72 and 73 may be located on the inside and outside of the garage, respectively, and the one on the outside of the garage could with facility be operated by a key to prevent unauthorized use of the door operator.

A normally-closed switch 75 (Figs. 2, 4 and 7) is mounted on the L-shaped bracket 39 in position to be opened by a dog 76 adjustably attached to the cable 67. The dog 76 is in the form of a relatively elongated member provided with clips 77 that can effectively secure the dog 76 to the line 67 at any desirable point. There are two such dogs 76 located on the cable 67—one adjacent the door opening in the front wall 10 of the garage; and one located on the cable 67 adjacent the bracket 17.

With the door 12 in its closed position, switches 70 and 71 in the position shown in Fig. 7, switches 72, 73 open, and switch 75 held open by the dog 76 attached to the cable 67, closing of either switch 72 or 73 causes current to flow from line L_1 through a conductor 78, thence through solenoid 74, a conductor 79, thence through the switch 72 or 73 that has been closed, thence through a conductor 80 to line L_2. This circuit energizes the solenoid 74, causing a normally-open switch 81 to close, whereupon a current flows from line L_2 through a conductor 82, closed switch 81, a conductor 83, thence through a conductor 84, the contacts within mercury switch 70 that are connected by the mercury being in the lower portion thereof, thence through a conductor 85 to the motor 34, thence through a conductor 86 from the motor 34 to the leads immersed within the mercury in the mercury switch 71, thence through a conductor 87 to a conductor 88, leading to line L_1. This circuit causes the energization of the motor 34 in a manner to effect its rotation, causing counterclockwise rotation of the drum 64 (Fig. 2), thereby causing the drum and its associated mechanism including the motor 34 which is rigidly attached to the top of the door 12, to move leftwardly (Fig. 2), or rightwardly (Fig. 1), which action causes the door 12 to be elevated such that the top section and the succeeding sections follow the track portions 13, 14 and 15 to a horizontal position adjacent the ceiling 16. As the top section 18 moves to a horizontal position, the mercury switches 70 and 71 accordingly turn through 90°, whereupon the electrodes 89 and 90 of the respective mercury switches 70 and 71 are immersed in the bath of mercury of the respective switches. While such action will cause current to flow from line L_2 through conductor 82, the closed switch 81, conductor 83, conductor 84, through the electrodes 89, thence through a conductor 91, thence through conductor 86 to the motor 34, thence from the motor 34 through conductor 85, electrodes 90 in the mercury switch 71, thence through a line 93, thence through conductor 87, conductor 88 to line L_1, which flow of current is a reversal from that previously described, the motor 34 will not reverse its direction of rotation due to the fact that the usual starting winding will remain unaffected since it is disconnected as a result of the action of the conventional centrifugal switch mechanism in such motors. Accordingly, the motor 34 will not reverse until it has first stopped and has been re-started by closing one of the switches 72 or 73. In other words, the motor 34 continues to rotate in a manner to cause counterclockwise rotation of the drum 64 even after the mercury switches 70 and 71 have been reversed until the motor has completely stopped. This latter stopping of the motor 34 does not occur until the drum 64 reaches the dog 76 located on the cable 67 adjacent the bracket 17 at the rear of the garage. When this occurs, the dog 76 near the bracket 17 opens the normally-closed switch 75, thereby de-energizing the solenoid 74 and, consequently, causes the normally-open switch 81 to open, whereupon the motor 34 stops. When the motor 34 has stopped, with the garage door in its open position, subsequent starting of the motor 34 by closing of either of switches 72 or 73 causes the motor 34 to rotate in a reverse direction to cause the drum 64 to rotate in a clockwise direction. Accordingly, the drum 64 and its associated structure including the motor 34 move rightwardly along the cable 67 (Fig. 2), or leftwardly (Fig. 1) until the door 12 has been moved to its vertically-closed position. As the door 12 moves into its vertically-closed position, the mercury switches 70 and 71 are again reversed to their initial position, whereupon the motor 34 is conditioned to cause the drum 64 to rotate in a counterclockwise direction the next time either of the switches 72 or 73 is closed.

From the foregoing it is evident that the mercury reversing switches make and break under low current conditions since their reversal occurs only after the motor 34 is rotating at full speed.

In the event of power failure it is quite evident that the friction between the cable 67 and the drum 64 will prevent manual opening of the door 12. Accordingly, the present invention contemplates the employment of a unique connecting mechanism 69 that supports the cable 67 at one end of the garage. The mechanism 69 is shown in Fig. 1 as being connected to the rear of the garage, and in Fig. 2, it is shown as being connected to the front of the garage. Obviously, the mechanism 69 may be

located at either the front or back of the garage without departing from the principles of the invention. Attention is directed to Figs. 5 and 6, in which the connection **69** includes a U-shaped bracket member **94** that is pivotally mounted on a pin **95** rigidly secured in angle brackets **96** and **97** that are in turn rigidly mounted on the one wall of the garage near the ceiling **16**. The cable **67** is rigidly attached to a pintle pin **98** located at the end of the U-shaped member **94** remote from the pivot pin **95**. The end of the U-shaped member **94** opposite the pin **95** is also provided with an opening **99** adapted to receive a plunger **100** that extends from a locking member **101**. The locking member **101** is rigidly mounted within a sleeve **101'** that passes through the wall of the garage and extends to the exterior thereof. The locking member **101** includes a portion **102** provided with a key insert. The portion **102** is quite similar to the conventional file cabinet lock, the unlocking of which causes it to spring outwardly and which, when pressed inwardly, effectively locks. The portion **102** is fixed to the plunger **101**, and a protective cap **103** is provided for covering the portion **102** extending exteriorly of the garage to prevent ice forming on it. The construction and arrangement of the parts are such that by one's inserting a key within the portion **102** and turning it releases the portion **102** so that it moves outwardly sufficiently to permit an operator to grasp it and forcibly extract the plunger **100** from the hole **99** within the end of the U-shaped member **94**. When this occurs, the force on the cable **67** by the drum **64** and its associated mechanism immediately causes the U-shaped member **94** to pivot about the pin **95** in a counterclockwise direction (Fig. 6), thereby slackening the cable **67** to such a point that the traction between it and the drum **64** is eliminated, whereupon the door **12** can manually be raised. It is quite evident that U-shaped member **94** can be re-set by one's pivoting it in a clockwise direction (Fig. 6) about the pivot **95** to a point where the members **101** and **102** can be forced inwardly such that the plunger **100** cooperates with the hole within the U-shaped member **94**.

Although the various features of the invention have been shown and described as applied to one embodiment of the invention, it is evident that certain features may be used without others without departing from the principles of the invention.

What is claimed is:

1. In an overhead door construction, a door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; a non-hinged rigid frame member bolted to said door; means for opening and closing said door including a reversible electric motor having a base mounted on, and rigidly bolted to said frame member; a speed transmission unit pivotally mounted on said frame member; means for tractionally cooperating with said speed transmission unit to cause said door to move from a vertically-closed position to a horizontally-open position; and means for energizing and de-energizing said electric motor.

2. In an overhead type of door construction, a door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; a rigid frame member bolted to the top of said door; a reversible electric motor including a base rigidly fixed to said frame structure; a speed reduction unit pivotally mounted on said rigid frame structure on an axis coaxial with the axis of rotation of said reversible electric motor; means adapted tractionally to cooperate with said speed-reduction unit to cause said door to move from a vertically-closed position to a horizontally-open position; and means for energizing and de-energizing said electric motor.

3. In an overhead type of door construction, means for guiding said door from a vertically-closed position to a horizontally-open position; power-operated actuator means for opening and closing said door including a rigid frame structure fixed to the top of said door; a reversible electric motor having a base adapted rigidly to be fixed to said rigid frame member; a bracket pivotally mounted on said rigid frame structure on an axis coaxial with the axis of rotation of said reversible electric motor; a plurality of stepped V-pulley assemblies mounted on said bracket; V-belts connecting all of said pulleys in a manner to produce successive reductions of speed from one set of stepped V-pulleys to the other; a combined V-pulley and drum mounted on said bracket of said speed reduction unit; a V-belt drive from one of said stepped V-pulley assemblies to the V-pulley attached to said drum; a cable in traction engagement with said drum; and means for energizing and de-energizing said electric motor.

4. In an overhead type of door construction, a door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; means for opening and closing said door including a reversible electric motor mounted on, and rigidly attached to said door; a speed reduction unit mounted on said door; a drum forming part of said speed reduction unit; a cable adapted tractionally to cooperate with said drum; a dog attached to said cable; means for energizing said electric motor; and means movable with said speed reduction unit and cooperable with said dog for de-energizing said electric motor.

5. In a garage, an overhead type of door; means for guiding said door from a vertically-closed position to a horizontally-open position; power-operated actuator means for opening and closing said door including a rigid frame structure bolted to the top of said door; a reversible electric motor including a base rigidly attached to said rigid frame structure; a speed reducer unit pivotally mounted to said rigid frame on an axis coextensive with the axis of rotation of said electric motor; a drum forming part of said speed reduction unit; a cable adapted tractionally to cooperate with said drum; means for energizing and de-energizing said electric motor; and pivotally-mounted means adapted to be pivoted from one operative position to another operative position each time said door is operated to recondition said motor to cause it to rotate in the correct direction for the next successive movement of said door.

6. In a garage, an overhead type of door; means for guiding said door from a vertically-closed position to a horizontally-open position; power-operated actuator means for opening and closing said door including a reversible electric motor mounted on and rigidly attached to said door; a speed reduction unit mounted on said door; traction means adapted to cooperate with said speed-reduction unit; dog means adjustably attached to said traction means; a circuit for controlling the operation of said reversible electric motor including a pair of single-pole, double-throw mercury switches mounted on said door in a position to connect the electrodes at opposite ends of said switches when said door is in its two positions of rest; a normally-closed switch mounted on said speed reducing unit and adapted to be opened by the dog means on said traction means; and means for energizing said circuit from the outside as well as the inside of said garage.

7. In a garage, an overhead type of door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; means for opening and closing said door including a reversible electric motor; a speed reduction unit driven by said reversible electric motor; a cable for tractionally cooperating with said speed-reduction unit to effect the opening and closing of said door; means for maintaining

said cable under tension and means for temporarily relieving the tension of said cable to thereby render said traction means inoperative in the event of failure of power, whereby said door can manually be opened.

8. In a garage, an overhead type of door; means for guiding said door from a vertically-closed position to a horizontally-open position; power-operated actuator means for opening and closing said door including a reversible electric motor mounted on and rigidly attached to said door; a speed reduction unit mounted on said door; a drum forming part of said speed reduction unit; a cable adapted tractionally to cooperate with said drum; means for energizing and de-energizing said electric motor; toggle means connected to said cable for maintaining said cable under tension; and means operable from the outside of said garage for releasing said toggle means in the event power fails, whereby said door can be manually opened.

9. In a garage, an overhead type of door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; means for opening and closing said door including a reversible electric motor; a speed reduction unit adapted to be operated by said reversible electric motor; a cable adapted tractionally to cooperate with said speed reduction unit; pivotally-mounted bell-crank supporting means for one end of said cable; and key means operable from the exterior of said garage for tripping said pivotally-mounted bell-crank supporting-means, whereby said cable is slackened and said door is adapted manually to be opened.

10. In a garage, an overhead type of door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; means for opening and closing said door including a reversible electric motor mounted on and rigidly attached to said door; a speed reduction unit mounted on said door; a drum forming part of said speed reduction unit; a cable adapted tractionally to cooperate with said drum; means for energizing and de-energizing said electric motor; means within the circuit of said electric motor, responsive to the rest positions of said door for reconditioning said motor to cause it to rotate in a direction to move the door in the correct direction for each succeeding operation thereof; and toggle means forming one support for said cable and adapted to be released upon actuation of releasing mechanism mounted on the exterior of said garage and cooperable with said toggle-means.

11. In a garage having a ceiling, an overhead type of door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; means for opening and closing said door including a reversible electric motor mounted on and rigidly attached to said door; a speed reduction unit mounted on said door; a drum forming part of said speed reduction unit; a cable adapted tractionally to cooperate with said drum; means for supporting said cable in spaced parallel relationship with said ceiling; means for energizing and de-energizing said electric motor; means within the circuit of said electric motor, responsive to the rest positions of said door for reconditioning said motor to cause it to rotate in a direction to move the door in the correct direction for its next successive operation; pivotally-mounted means for supporting one end of said cable; re-settable means for maintaining said pivotally-mounted means in a position to maintain said cable in taut condition; and means rendered effective from the exterior of said garage and cooperable with said re-settable means for releasing said pivotally-mounted cable supporting means, whereby the tautness of said cable is removed, and said door is adapted manually to be opened.

12. In a garage having a ceiling, on overhead type of door; means for guiding said door from a vertically-closed position to a horizontally-open position; power-operated actuator means for opening and closing said door including a reversible electric motor mounted on and rigidly attached to said door; a speed reduction unit mounted on said door; a drum forming part of said speed reduction unit; a cable mounted in slightly spaced parallel relationship relatively to said ceiling, and adapted tractionally to cooperate with said drum; means for energizing and de-energizing said electric motor; a pair of single-pole, double-throw mercury switches forming part of the energizing and de-energizing means and adapted to be rendered effective to recondition said motor for the reversal thereof upon the actuation of said door from its one position to its other position; pivotally-mounted means adapted to support one end of said cable in taut condition; means adapted to release said pivotally-mounted cable supporting means; and key-operated means on the exterior of said garage adapted to render said releasing mechanism effective.

13. In a garage, an overhead type of door; means for guiding said door from a vertically-closed position to a horizontally-open position; power-operated actuator means for opening and closing said door including a reversible electric motor mounted on and rigidly attached to said door; a speed reduction unit mounted on said door; traction means forming part of said reduction unit; cable means adapted tractionally to cooperate with said traction means; adjustable dog means mounted on said cable means; means for energizing and de-energizing said electric motor including means adapted to be rendered effective from the exterior or the interior of said garage; a normally closed switch mounted on said speed reduction means and adapted to be opened by said dog means on said cable means; a pair of single-pole, double-throw mercury switches mounted on said door in a manner to cause current to flow through said circuit to said reversing motor to cause it to rotate in one direction when said door is in its vertically-closed position, and to be actuated by the opening of said door to recondition said reversing motor whereby it will rotate in a reverse direction upon the next successive operation of said energizing means.

14. In an overhead type of door construction, a door; vertically-disposed track means joined to horizontally-disposed track means for guiding said door from a vertically-closed position to a horizontally-open overhead position; a rigid frame member bolted to said door; a reversible electric motor including a base rigidly fixed to said frame member; a transmission unit including a rotatable power input pivotally mounted on said rigid frame structure in cooperating position relatively to said reversible electric motor; means adapted tractionally to cooperate with said transmission unit to cause said door to move from a vertically-closed position to a horizontally-open position; and means for energizing and de-energizing said electric motor.

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