May 5, 1953 B. RITTER 2,637,550

OVERHEAD DOOR ACTUATOR

Filed Nov. 10, 1947 2 SHEETS—SHEET 1

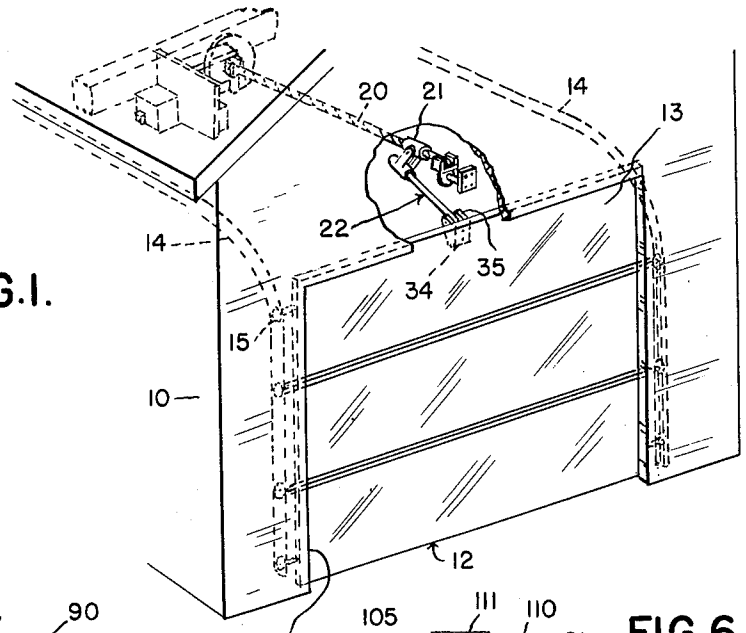


FIG.1.

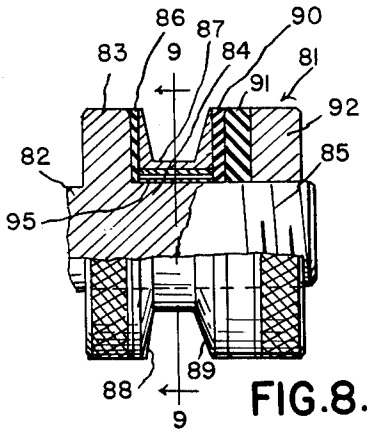


FIG.8.

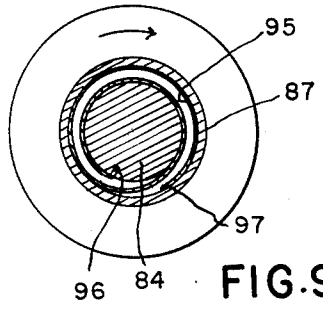


FIG.9.

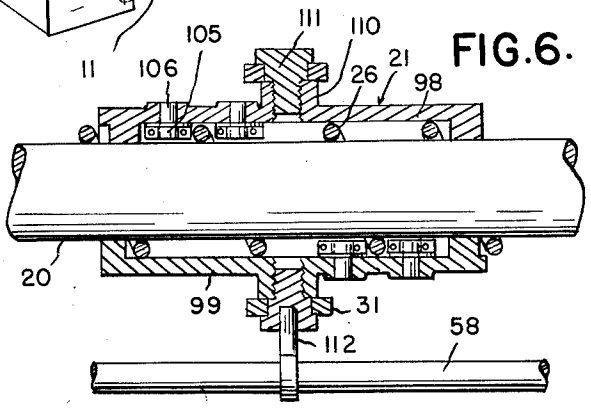


FIG.6.

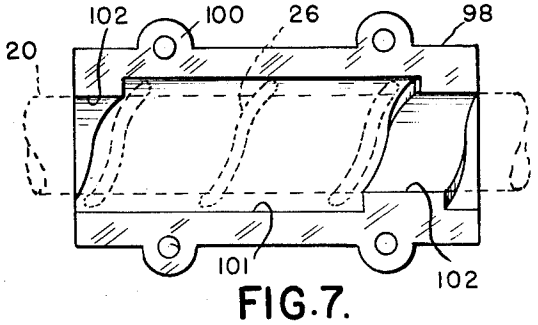


FIG.7.

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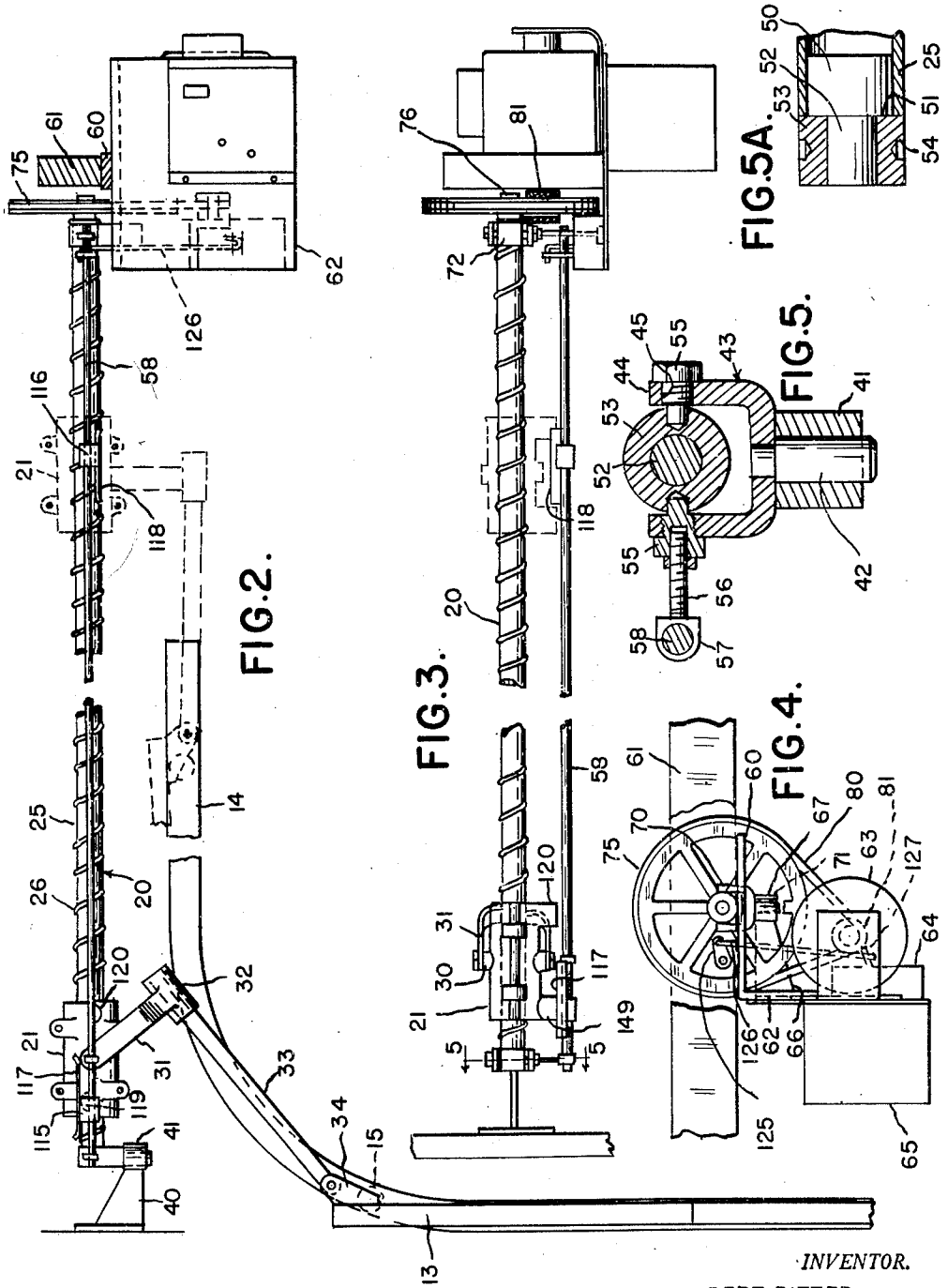


FIG.2.

FIG.3.

FIG.5.

FIG.5A.

FIG.4.

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OVERHEAD DOOR ACTUATOR

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7 Claims. (Cl. 268—59)

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The present invention relates to an overhead garage door operator and is illustrated in conjunction with an articulated or sectional door adapted to be moved from a lower vertical position to an upper horizontal position adjacent the ceiling of the garage by movement along tracks provided adjacent the edges of the door. However, the invention is not limited to use with a door of this type and in certain aspects may find application as operating means for quite different devices.

It is an object of the present invention to provide an overhead door operator characterized by the simplicity of the construction, the elimination of parts as compared with prior structures, the economy of manufacture and the efficiency of operation.

More particularly, it is an object of the present invention to provide an overhead door operator including an improved and simplified feed screw.

It is a further object of the present invention to provide an overhead door operator characterized by the flexibility of its mounting whereby the operator may be attached to structural members of the garage which may be out of true and will nevertheless operate efficiently when so mounted.

It is a further object of the present invention to provide an overhead door operator comprising a traveling nut mounted on a feed screw, the nut being firmly connected to a portion of the door by means which serve the additional function of preventing rotation of the nut during rotation of the feed screw.

It is a further object of the present invention to provide an improved overhead door operator including safety means preventing injury to persons standing in the way of movement of the door.

It is a further object of the present invention to provide an improved nut and feed screw combination which may be constructed by a simple method completely avoiding prior expensive machining operations.

More specifically, it is a feature of the present invention to provide an improved feed screw comprising a wire or similar element wound in helical disposition about an elongated rod or tube and secured thereto only adjacent the ends thereof.

It is a further feature of the present invention to provide for cooperation with the feed screw described above, a traveling nut comprising a casing having mounted therein one or more pairs of bearings adapted to engage opposite sides of the thread on the feed screw.

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It is a further feature of the present invention to provide a clutch comprising adjustable friction means for effecting one-way driving connection in combination with additional means for effecting positive drive in the other direction.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a fragmentary perspective view of a portion of a garage showing an overhead door provided with the improved operating means of the present invention;

Figure 2 is a transverse section taken from the side of the door showing the operating mechanism in detail;

Figure 3 is a plan view of the operating mechanism illustrated in Fig. 1;

Figure 4 is a side view of the motor drive for the improved operating mechanism;

Figure 5 is an enlarged fragmentary section on the line 5—5 of Figure 3;

Figure 5A is a fragmentary longitudinal section through one end of the feed screw 20;

Figure 6 is a horizontal section through the traveling nut illustrating its cooperation with the improved feed screw;

Figure 7 is a view of one-half of the nut structure designed to show its bearing on the shaft of the feed screw;

Figure 8 is a side elevation, partly in section, of a driving clutch; and

Figure 9 is a section on the line 9—9 of Figure 8.

Referring now to Figure 1, there is illustrated generally at 10 a garage having a door opening 11 in which is mounted a sectional garage door indicated generally at 12 comprising individual sections, the uppermost section 13 of which is connected to the operating mechanism described herein. Located within the garage and adjacent the edges of the door 12 are tracks 14 along which the door moves, rollers 15 being mounted along the edges of the door for the purpose of guiding the door along the trackways.

This type of garage door is well known and as furnished to the trade may include suitable counterbalancing mechanism to reduce the effort necessary to raise and lower the door manually. Where such counterbalancing mechanism is provided it may be retained so as to reduce the load on the automatic operating mechanism forming the subject matter of the present invention.

Briefly described in conjunction with Figure 1,

the operating mechanism comprises a feed screw 20 having a traveling nut 21 mounted thereon, the nut being connected to the upper section 13 of the door through linkage indicated generally at 22. Motor means are provided for effecting reverse rotation of the screw 20 and thereby causing the nut 21 to move forwardly or rearwardly thereon, thus lowering or raising the garage door. Suitable automatically operated circuit-controlling means are provided for interrupting operation of the motor as the door reaches fully open or fully closed position.

Referring more specifically now to Figures 2, 3 and following, the door actuating mechanism comprises an elongated tube, rod or shaft 25 which is provided with a thread 26 formed by winding a wire tightly about the shaft 25 from adjacent one end thereof to the other and securing the wire adjacent its ends to the shaft as by welding or brazing. It is found that the thread 26 thus formed hugs the shaft 25 tightly and that there is no longitudinal slip of the thread along the shaft as loads are applied thereto. It is therefore possible to produce long threaded elements having a thread of long lead in a very economical and efficient manner. The wire 26 may if desired be of circular cross section or if preferred it may be of a generally quadrilateral cross section. It is found that in winding the wire 26 about the shaft 25, some deformation of a wire of square cross section occurs so that if it is desired to provide a wire thread whose cross section in the completed article is square, it is necessary to employ a slightly rhomboidal wire whose proportions are selected such that upon winding upon a particular shaft the deformation or change in the shape of cross section of the wire results in the provision of a wire or thread of square cross section on the completed article. The traveling nut 21 which cooperates with the feed screw 20 is provided at its opposite sides with projecting ears 30 to which is pivoted a yoke 31 terminating in a sleeve portion 32. Interconnecting the sleeve portion 32 and the top section 13 of the door is a link 33 which is pivoted to a bracket 34 located adjacent the upper end of the door. As best seen in Figure 2, the connection between the nut 21 and the upper section 13 of the door is such that upon initiation of movement of the door from closed to open position, a substantial upward component of force acting on the door is provided, whereas after a portion of the door is moved along the horizontal portion of the track 14 the pull of the traveling nut 21 and associated mechanism is substantially horizontal.

As best seen in Figure 1, the bracket 34 comprises a pair of forwardly projecting arms 35 which firmly support the link 33. In addition, the yoke 31 includes a pair of arms pivoted at opposite sides to the nut 21. The result of the construction just described is that the nut is retained quite firmly against rotation solely by its interconnection with the top of the door, thus obviating the necessity of additional means for preventing rotation of the nut as the feed screw 20 is rotated.

Flexible means are provided for supporting the feed screw 20 and associated mechanism. As best seen in Figure 2, the forward end of the screw 20 is supported by means of a bracket 40 secured to the front wall of the garage above the door opening, the bracket extending rearwardly from the garage and terminating in a sleeve 41. As best seen in Figure 5, the sleeve 41 receives a pin 42 secured to a yoke member 43 having two arms 44 each of which is provided with a threaded opening 45 adjacent its upper end. The shaft 25, for reasons of economy and to conserve weight, is preferably hollow and adjacent its ends is provided with a plug 50 welded or otherwise secured therein as indicated at 51, the plug having a reduced portion 52 extending outwardly beyond the end of the tube 25. Surrounding the reduced portion 52 of the plug 50 is an end bearing sleeve 53 provided with pivot recesses 54. The arms 44 of the bracket 43 are connected to the bearing sleeve 53 by means of screws 55. One of the screws 55, as indicated to the left in Figure 5, is itself tapped to receive a supporting bolt or screw 56 having a supporting portion 57 rotatably supporting a trip rod 58 whose purpose will later be described.

The construction just described permits mounting of the forward end of the screw 20 at the forward end of the garage, the flexibility provided by the pivot connections permitting attachment of the bracket 40 to a surface which may be substantially out of line.

A similar construction is provided for supporting the rear end of the screw 20 in that it also provides for flexibility to permit mounting on surfaces which are out of true. This construction comprises an angle piece 60 best seen in Figure 4 which is attached by screws or otherwise to the underside of a portion of the garage, such for example as a rafter 61. Secured to the vertical leg of the angle piece 60, as best seen in Figure 4, is a supporting plate 62 on which is mounted a drive motor 63, a reversing and control switch 64 and if desired suitable remote control receiving means 65 by means of which the door may be opened and closed by means of a radio signal, supersonic signal or the like.

Extending forwardly from the plate 62 is a supporting bracket 66 terminating in a sleeve 67, the bracket 66 and sleeve 67 being a counterpart of the bracket 40 and sleeve 41 employed for supporting the opposite end of the screw 20. A bifurcated yoke 70 which is in all respects similar to the bracket 43 is rotatably supported in the sleeve 67 by a pin 71. Set screws similar to the screws 55 illustrated in Figure 3 pass through threaded openings in the ends of the arms of the yoke 70 and are received in recesses of a bearing sleeve 72 similar to the sleeve 53.

Secured to the end of the screw 20 last referred to is a drive pulley 75 which may conveniently be keyed or otherwise secured to an extending portion 76 of the plug which supports the bearing sleeve 72.

The motor 63 drives the pulley 75 through the medium of a belt 80 driven from a clutch sheave 81 which is illustrated in detail in Figures 8 and 9. The sheave 81, as illustrated in these figures, comprises a driver 82 driven by the motor and provided with a radially extending flange 83. Beyond the flange 83 the driver 82 has a portion 84 of reduced diameter, the outer end portion being threaded as indicated at 85. Sleeved upon the reduced portion 84 is a friction ring 86, an annular sheave portion 87 provided with two radially extending flanged bearing portions 88 and 89 and a second friction ring 90. The internal diameter of the sheave 87 is substantially larger than the reduced portion 84 of the driver to receive a one-way drive element later to be described. Also sleeved upon the reduced portion 84 outwardly from the second friction ring 90 is a resilient element 91 which is herein illustrated as formed of compressible rubber. Be-

yond the resilient element 91 is a nut 92 threaded to the threaded portion 85 of the driver. As will be readily apparent from an inspection of Figure 8, rotation of the nut 92 varies the compression of the resilient element 91 and accordingly varies the pressure between friction rings 86 and 90 and the sheave element 87. Accordingly, by the mechanism thus far described means are provided for effecting a friction drive of the sheave 87 which permits slippage between the sheave 87 and driver 82 when a predetermined resistance to rotation is encountered.

In addition to the mechanism thus far described, there is positioned in the annular space between the internal diameter of the sheave 87 and the reduced portion 84 of the driver, a spirally wound flat spring 95 which is illustrated in Figure 9 as having one end turned in and received within a slot formed in the reduced portion 84 of the driver as indicated at 96, the outer end 97 of the spring being free within the space. This spring serves to provide a positive driving force in one direction of rotation but will slip if rotation is reversed. Thus, for example, if the driver is rotated in the direction of the arrow in Figure 9 friction between the outer end 97 of the spring and the inner surface of the sheave 87 tends to expand the spring and provides a firm interlock between the parts. As the direction of rotation is reversed friction between the spring and the inner surface of the sheave 87 tends to wind up the spring so as to reduce its diameter and the sheave 87 slips substantially freely on the driver.

The purpose of the clutch just described is to prevent injury to a person standing in the way of movement of the door. Upward movement of the door cannot injure an individual and accordingly the one-way clutch is arranged so that it has positive driving connections when turning in a direction to raise the door. This is found desirable since it is the raising movement of the door that requires the greatest force. However, downward movement of the door could conceivably injure a person standing in the way of movement and accordingly the clutch is arranged so that the driving connection established by the spirally wound flat spring is ineffective to transmit torque upon rotation in a direction which results in closing movement of the door. In order to insure that sufficient force is available to close the door, the nut 92 may be adjusted so that sufficient friction is provided between the friction disks 86 and 90 and the sheave 87 to insure movement of the door in closing direction unless it encounters an obstacle.

Referring now to Figures 6 and 7, there is illustrated in detail the construction of the traveling nut 21 which follows the thread of the driving screw 20. This nut is preferably formed in two halves 98 and 99 adapted to be bolted or otherwise secured together by ears 100. The interior of each of the halves is hollowed out centrally as indicated at 101 to provide clearance for the thread 26 of the nut 21. However, adjacent the ends each of the castings is formed with a land or bearing portion 102 adapted to provide firm support of the nut 21 on the screw 20. The land portions 102 are helically shaped to follow the helical formation of the thread 26, as is apparent in Figure 7.

Rollers 105 are provided in pairs at the interior of the nut 21, these rollers being illustrated in Figure 6 as supported by pins 106 having a press fit in openings suitably formed in the walls of the

nut 21. As illustrated in Figure 6, two pairs of rollers 105 are provided although the specific number of pairs of rollers is immaterial. Thus, for example, if the nut is designed for a relatively light load a single pair will be sufficient. On the other hand, two such pairs are desirable in many cases in order to provide for a balancing of forces between the nut and screw. Finally, if a relatively heavy load is to be sustained it may be desirable to provide several pairs of rollers.

Each of the rollers of a pair should be positioned such that it engages one side of the thread 26 closely adjacent to the other roller of the pair. Preferably rollers of a pair are positioned so that the line joining their axes extends perpendicular to the helix of the thread.

Each of the members 98 and 99 is provided with an internally threaded boss 110 adapted to receive a stud 111 which serves as a pivot mounting for the arms of the yoke 31. Furthermore, one of the studs 111 is tapped to receive an eye bolt 112, the eye of which slides upon the trip rod 58.

In order to effect automatic actuation of the motor 63 the trip rod 58 is provided with operating arms 115 and 116 which carry resilient elements 117 and 118, respectively, which operate as cam followers. The traveling nut 21 is provided with a pair of cams 119 and 120, respectively. As the nut 21 moves to the right as seen in Figure 2, the cam 120 engages the cam follower 118 and rotates the trip rod 58. The trip rod 58 at its inner end carries an actuating arm 125, best seen in Figure 4. The arm 125 is connected by a link 126 to a switch lever 127. Opposite travel of the nut results in reverse rotation of the trip rod 58 caused by engagement between the cam 119 and the cam follower 117. In the event that remote control signal apparatus is employed the cam operation of the switch 127 results in stopping the motor 63 and preparing the circuit for reverse operation upon receiving the next signal.

The drawings and the foregoing specification constitute a description of the improved overhead door actuator in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. In an overhead garage door operator for moving a door between open and closed position, a threaded shaft and traveling nut mounted on said shaft, means for connecting said nut to said door to raise and lower said door when said nut is moved longitudinally along said shaft, a motor for rotating said shaft, a clutch having adjustable friction devices for transmitting power to rotate the shaft in one direction, and a one-way drive device for transmitting power to rotate said shaft in the opposite direction, said one-way drive element and clutch comprising a driving shaft part, a driven sleeve part received over said shaft part, a second nut mounted on said driving shaft part, a resilient element disposed between said parts, said nut serving to compress said element between said parts and a spirally wound ribbon spring secured at one end to one of said parts, the other end of said spring being free.

2. In an overhead garage door operator for moving a door between a closed and open position a threaded shaft supported above the door, a traveling nut threadably mounted on said shaft, a link pivotally connected to said nut and to said door adjacent the upper edge thereof,

said link constituting the only connection between said nut and said door, a motor for rotating said shaft, said nut being moved along said shaft to move said door when said shaft is rotated, and drive means for transmitting power from said motor to said shaft, said drive means including a driver member rotated by said motor, a driven member connected to rotate the shaft, a compressible resilient element disposed to transmit rotation between said driver and driven members to rotate said shaft and move said door from open to closed position, said resilient element slipping relative to said members to stop the rotation of said shaft when a predetermined force is applied to said door, and an interlock element mounted between said driver and driven members and adapted to positively rotate said driven member when said driver member is rotated in one direction and, hence, rotate said shaft in a direction to move said door toward the open position and adapted to permit slippage between said members when said driver member is rotated in the other direction.

3. In an overhead garage door operator a single shaft, a wire tightly wrapped around said shaft and anchored thereto to form a helical thread thereon, a traveling nut on said shaft, said nut having a hollowed-out body, a plurality of pairs of rollers pivotally mounted within the hollowed-out body of said nut adjacent said shaft, the axes of said rollers being disposed perpendicular to the axis of the shaft, each roller of each pair engaging an opposite side of said wire to move said nut along said shaft when the shaft is rotated, an arm connecting said nut and door, said arm holding said nut against rotation with said shaft and forming the sole means for opening and closing said door, and motor means for reversibly rotating said shaft.

4. In an overhead garage door operator, a single shaft, a wire tightly wrapped around said shaft and anchored thereto to form a helical thread thereon, a traveling nut on said shaft, said traveling nut having a hollowed-out body, bearing surfaces at each end of said nut contacting said shaft, a first roller rotatably mounted within said hollowed-out body and having its axis disposed perpendicular to the axis of said shaft, a second roller rotatably mounted within said hollowed-out body and having its axis perpendicular to the axis of the shaft, said rollers engaging opposite sides of said wire to move said nut along said shaft when the shaft is rotated, an arm connecting said nut and door, said arm holding said nut against rotation with said shaft and forming the sole means for opening and closing said door, and motor means for reversibly rotating said shaft.

5. In an overhead garage door operator, a single threaded shaft and traveling nut, an arm connecting said nut and door, said arm holding said nut against rotation with said shaft and forming the sole means for opening and closing said door, a pair of brackets mounted above said door, a bifurcated yoke mounted on each bracket and pivotally connected to said shaft, said shaft being disposed within said yokes, a pulley connected to one end of said shaft, a motor for rotating said shaft, a belt connected between said motor and said pulley, and mounting means for said motor.

6. In an overhead garage door operator for moving a door between a vertical closed position and a horizontal open position, a single threaded shaft disposed above said door, a traveling nut mounted on said shaft, an arm connecting said nut and door, said arm holding said nut against rotation with said shaft and forming the sole means for opening and closing said door, a first bifurcated yoke mounted adjacent one end of said shaft, a first sleeve member pivotally secured within said first yoke, said one end of said shaft being rotatably supported within said first sleeve, a second bifurcated yoke mounted adjacent the other end of said shaft, a second sleeve pivotally mounted within said second yoke, the other end of said shaft being rotatably carried within said second sleeve, a pulley mounted on said other end of said shaft and adapted to rotate therewith, a motor for driving said shaft, and a belt connected between said motor and said pulley.

7. In an overhead garage door operator for moving a door between a vertical closed position and a horizontal open position, a single shaft disposed above the door, a wire tightly wrapped around said shaft and anchored thereto to form a helical thread thereon, a traveling nut on said shaft said traveling nut having a hollowed-out body, bearing surfaces at each end of said nut contacting said shaft, a first roller rotatably mounted within said hollowed-out body, a second roller rotatably mounted within said hollowed-out body, said rollers having their axes disposed perpendicular to the axis of the shaft, said rollers engaging opposite sides of said wire to move said nut along said shaft when the shaft is rotated, an arm connecting said nut and door, said arm holding said nut against rotation with said shaft and forming the sole means for opening and closing said door, a motor for rotating said shaft, and drive means transmitting power from said motor to said shaft, said drive means including a driver member rotated by said motor, a driven member connected to rotate said shaft, a compressed resilient element disposed to transmit rotation between said members thereby to rotate said shaft and move said door from open to closed position, said resilient element slipping relative to said members to stop the rotation of said shaft when a predetermined force is applied to said door, and a locking element connected between said members to positively rotate said driven member when said driver member is rotated in one direction and, hence, rotate said shaft in a direction to move said door toward the open position and adapted to permit slippage between said members when said driver is rotated in the other direction.

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