

April 22, 1969

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3,439,727

GARAGE DOOR OPERATOR

Filed Oct. 27, 1966

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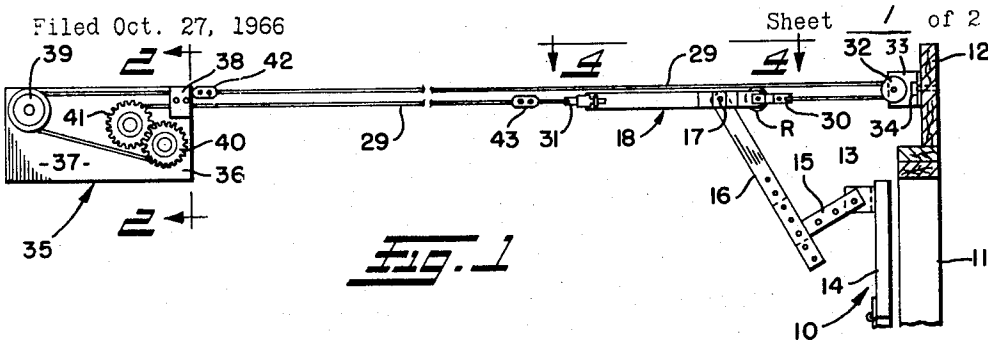


Fig. 1

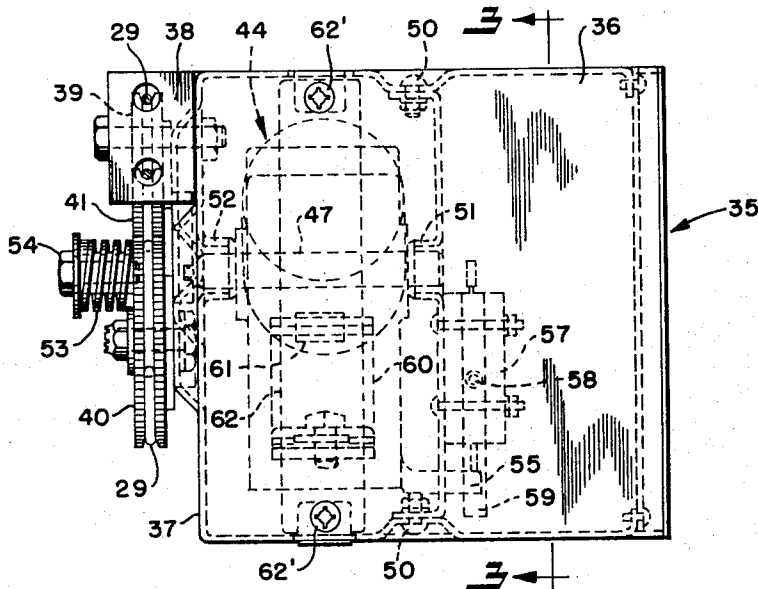


Fig. 2

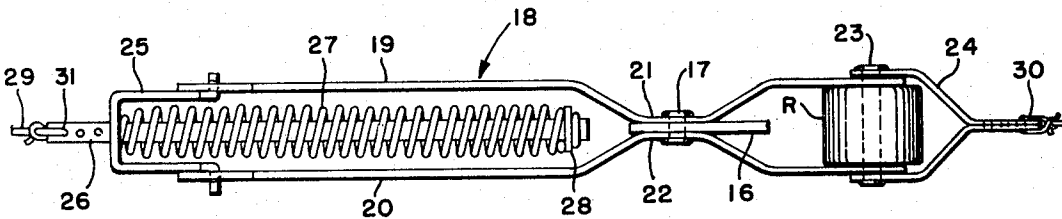


Fig. 4

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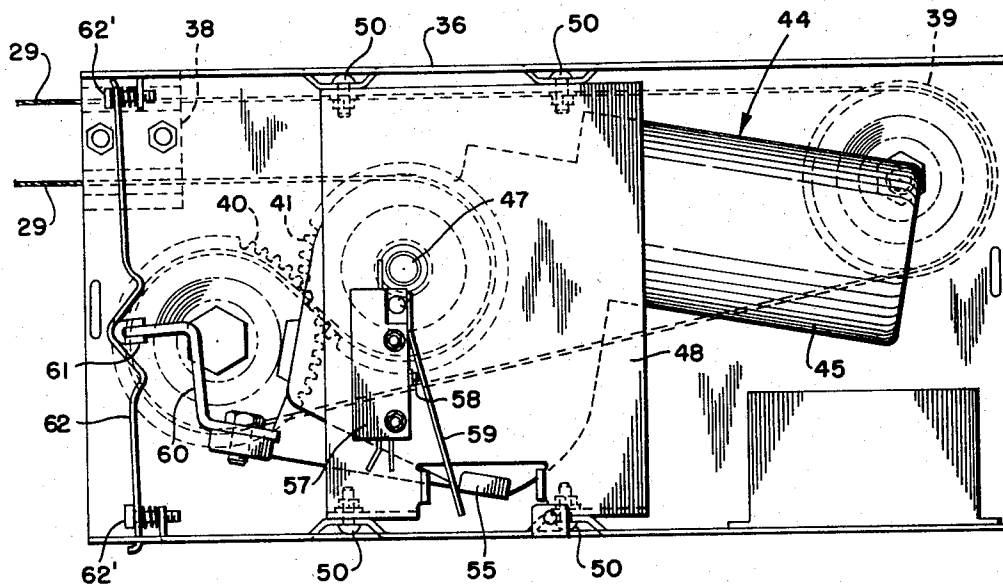
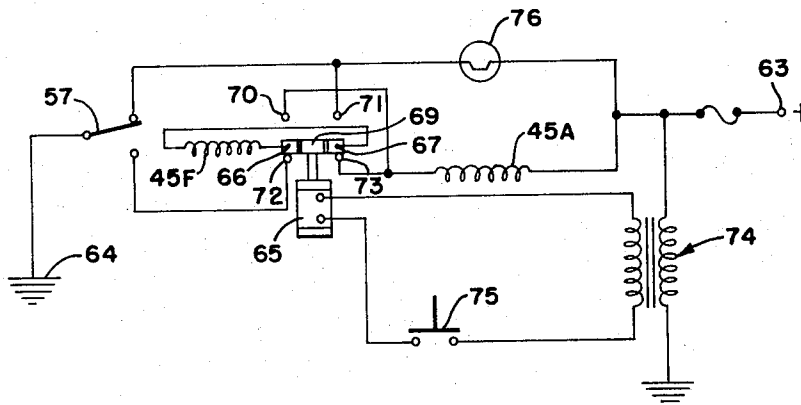


Fig. 3



ES.5

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GARAGE DOOR OPERATOR

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8 Claims

ABSTRACT OF THE DISCLOSURE

A continuous cable for operating the door carries travel stops and extends around gearing driven by a pivotally mounted reversible electric motor drive. The travel stops on the cable engage a fixed stop respectively at the ends of the normal travel of the door to produce increased tension in the cable which causes the motor drive to rock on its mounting and actuate a reversing switch for the drive.

This invention relates as indicated to apparatus for powered operation of garage doors and the like and, more particularly to an electric motor drive mechanism for effecting the movement of the door or comparable structure.

As will appear more clearly hereinbelow, this improved drive mechanism is not critically related to any particular type of door construction and will be considered with a typical overhead garage door as a convenient and well-known illustrative environment which does not require detailed disclosure. The absence of such a design relation in or, in other words, the wide utility of the mechanism, is one of the objectives of the invention, along with economy of form and operation of the mechanism and the ease with which it can be installed, for example, again in conventional garage structure.

It is also an object of the invention to provide such operating mechanism in which the door is driven by the electric motor through an improved gear and cable configuration which will remain efficient and reliably operative over very long periods of use, the arrangement in part being designed and effective to minimize wear on the cable.

It is a further object to provide an improved switching action for accomplishing the usual control of the drive motor at the limits selected for the cable movement in both directions corresponding to the two positions of adjustment between which the door is moved.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation of operating mechanism in accordance with the present invention as applied to an overhead garage door, the latter being conventional and shown fragmented;

FIG. 2 is an end view of the motor section of this mechanism, the plane of the view being indicated by the line 2—2 in FIG. 1;

FIG. 3 is a vertical sectional view the plane of which is indicated by the line 3—3 in FIG. 2 and occurs just within one wall of the enclosure of the motor section;

FIG. 4 is a top plan view of a coupling to which the ends of the cable are connected; and

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FIG. 5 is a simplified wiring diagram of the motor control circuit.

Referring now to the drawings in detail, the garage door structure as illustrated partially in FIG. 1 comprises a multipanel door designated generally by reference numeral 10 and depicted in the vertical or closed condition. A portion of the garage framing about the opening is also shown as including a vertical side section 11 and a header 12. The installation will be further understood to include suitable tracks engaged by rollers at the sides of the door and extending horizontally beneath the ceiling to support the door in its raised or opened condition, with a torsion spring or the equivalent for balancing, all according to conventional design and not herein illustrated.

A bracket 13 is attached to the top panel 14 of the door centrally and preferably closely adjacent the interior top edge as shown. An angle 15 is bolted at one end to the bracket 13 and to an arm 16 at selectively registered openings in the two pieces each of which is provided with a multiplicity of such openings so that the lengths of the angle and arm from their point of connection can be adjusted. This type of adjustable attachment of the arm 16 to the door bracket 13 is desirable for accommodation to different door designs; for example, garage doors are known with channels attached for strengthening across the inner top edge, and the noted angular adjustable attachment of the arm permits the latter to be sufficiently displaced inwardly relative to such a channel so as not to interfere with the latter.

The other end of the arm 16 is pivotally connected by a pin 17 to a cable link assembly designated generally by reference numeral 18. This assembly comprises, as most clearly shown in FIG. 4, two cable links 19, 20 having intermediate sections which are correspondingly bent inwardly to form close spaced sections 21, 22 for supporting the pin 17 on which the arm is pivoted. At one end of the assembly, the links support a further transverse pin 23 to which the arms of a yoke 24 are externally attached and on which a roller R, preferably made of nylon, is supported for rotation between the links 19, 20. A centrally apertured clevis 25 is included in the assembly to bridge between the other ends of the links, with a spring rod 26 extending through the apertures of the clevis and, within the assembly, supporting a coil spring 27 between the clevis and a retainer 28 adjacent the inner end of the rod.

A length of cable 29 is fastened at one end 30 to the yoke 24 of the link assembly and extends continuously to a connection at its other end 31 with the outer end of the spring rod 26 of this assembly. In its such extent, the cable is reeved over a pulley 32 mounted on a bracket 33 attached to the inside of the header 12 by a lag screw 34, and the cable then extends inwardly horizontally in an upper course to an electric motor drive unit designated generally by reference numeral 35. This unit comprises a casing or enclosure 36 having certain components exposed at one vertical side 37, the enclosure being adapted to be suitably attached to a ceiling structure, not shown, within the garage. The noted exposed components include a stop block 38, preferably made of nylon, mounted at the upper forward corner of the enclosure side 37 and having two horizontal passages through which the upper and lower courses of the cable length respectively extend. The upper course of the cable thus extends through the upper passage of the block 38 and continues to the rear of the enclosure 36 where it is reeved over a second pulley 39 and continues forwardly at a slight downward angle to meshed gears 40, 41. The first gear 40 is driven by the second gear 41 as will be more fully explained below. The single length of the cable is warped about the gear 40 and then reversely over the drive gear 41 from which it continues through the lower passage of the stop block 38

to its further end connection 31 with the spring rod of the cable link assembly 18. First and second cable stops 42 and 43, respectively are secured at selected points on the cable 29, for example, by set screws, with the first 42 in the upper course and at the fixed stop block 38 when the door is in the down or closed condition as shown and the second 43 in the lower course near the cable connection 31 to the spring rod. As will also appear more fully below, these stops are cooperable with the fixed block respectively at the conditions of the mechanism which correspond to the open and closed conditions of the door.

A conventional and commercially available electric drive assembly designated generally by reference numeral 44 is housed within the enclosure 36 and comprises in unitary combination an electric motor 45 and a reduction gear section. This unit is pivotally supported on the axis of the output shaft 47 between the side 37 of the enclosure and a spaced vertical plate 48 attached at top and bottom as shown at 50 to the top and bottom walls of the enclosure. This plate 48 and the side wall 37 are thus formed with inner collars 51, 52 holding bearings at registered openings which engage and rotatably support the casing of the motor drive unit 44 about the work shaft 47. The latter is connected to the external drive gear 41, preferably through a friction clutch, also conventional, and including a clutch spring 53 and pin 54 for loading of the clutch in known manner.

The casing of the motor unit 44 includes a laterally projecting lug 55 which, as best shown in FIG. 3, projects through a clearance recess 56 provided in the bottom edge of the vertical support plate 48 to the opposite side of the latter. An electric switch 57 is mounted on this side of the plate 48 and has a plunger 58 and an operating lever 59 which extends into contact with the casing lug 55. The casing also carries a wiper arm 60 to the end of which a wiper 61, preferably of nylon, is attached, with this wiper shown engaging a leaf spring 62 in a rebent portion thereof. Again with reference to FIG. 3, it will be readily apparent that the spring 62 through the engagement of the wiper exerts a force which tends to hold the motor unit 44 stationary on its pivotal support, and such spring can be adjustable by virtue of the end screw attachments 62' to provide different degrees of biasing as might be desired. This holding force can, however, be overcome and, if the motor unit is pivoted from the neutral condition shown in FIG. 3 in a clockwise direction, the lug 55 will move the switch lever 59 and cause actuation of the switch 57. The switch is thus operated only at the ends of the travel of the lug 55 to each side of the neutral position of the motor.

With the door 10 in the closed condition, as in FIG. 1, and the motor 45 deenergized, the control circuit used and to be described further hereinafter, is such that an applied signal for opening of the door causes the motor to rotate in a first direction which, through the wrapping of the cable 29 about the gears 40, 41 pulls the lower course inwardly, with the consequent lifting of the door. The lower cable stop 43 is so positioned as to abut the fixed block 38 when the door has been fully opened and this engagement arrests further movement of the cable in the same direction. With the drive gear thus locked, the further increment of turning of the shaft causes the motor unit to rock or pivot as set forth above to actuate the switch 57. This switch actuation will be effective to deenergize the motor and terminate the drive. The motor is reversible and, in a subsequent new cycle for closing of the door, the upper course of the cable moves inwardly and carries the other cable stop 42 into comparable arresting engagement with the fixed stop block 38 when the movement is sufficient to effect the full closure of the door. When the reverse drive occurs, the wiper 61 first returns to the bottom neutral position in the rebent part of spring 62, and with the arrest of the cable, the motor unit is further reversely pivoted to move the wiper to

the other side of such rebent portion and actuate the switch 57 to stop the drive.

A circuit which provides the above-described mode of operation is illustrated in FIG. 5 wherein the terminal 63 and ground 64 represent an available source of electric energy, for example, a house supply. The electric drive motor is represented by armature winding 45A and field winding 45F connectible through a solenoid relay 65 and the earlier mentioned control switch 57 across the source for energization. In this simple schematic, the field winding 45F is shown as having its ends 66, 67 connected to the contactor of the solenoid which has an insulating center section 69 to maintain the ends electrically isolated and this contactor is movable selectively into engagement with a first set of contacts 70, 71 and a second set of contacts 72, 73, so that the configuration is that of a double pole double throw switch. The motor unit operated switch 57 will be seen to be of double pole single throw type. The solenoid relay 65 is energized at a lower voltage by a line step-down transformer 74 and its energization is controlled by a push-button switch 75; it will be understood that this last switch 75 can also be made automatically responsive, for example, by any of the commonly used signal broadcasting and receiving systems which provide remote control, for example, from an automobile and the like. It is also conventional to provide a light to illuminate the garage when the system is operative, with such a light shown in this circuit at 76, and a time delay switch can be included to shut off the light if the door remains open beyond a predetermined period.

With the circuit in the condition illustrated, closure of the push-button switch 75 will energize the solenoid 65 and cause the contactor to move against the first set of contacts 70, 71, whereupon current will flow through the armature winding 45A to the end 66 of the field winding 45F and through the latter to drive the motor 45 in a first direction and cause movement of the door, for example, in the opening direction. After the door has moved to the fully open condition, the upper cable stop 42 engages the fixed stop block 38 as described above and this causes the motor unit 44 to pivot and actuate the switch 57 to its second condition of adjustment. This last switch actuation of course interrupts the drive. Upon next closure of the switch 75, the solenoid contactor is returned to the position illustrated in FIG. 5 against the second set of contacts 72, 73, whereupon current flows through the armature winding 45A to the other end 67 of the field winding 45F and through the latter and control switch 57, or in other words, relatively reversely through the field, so that the motor is driven in the opposite direction to effect the closure of the door.

It will also be apparent that the drive will be automatically terminated in the event that the door encounters an obstruction in its movement, since this condition would also result in arrest of the cable and the consequent shifting of the motor unit which actuates the switch 57 and deenergizes the motor.

It will be apparent that the mechanism disclosed can readily utilize rugged and low wearing components, with cable wear reduced as compared to a system which requires multiple wraps about a drive drum or the like because only single wraps are employed. The lag screw 34 attachment of the front pulley bracket 33 to the header 12 permits a degree of cable tension adjustment, and the spring and rod connection of the one end of the cable to the link assembly provides shock absorption which is also obviously desirable. It will be further seen from FIG. 1, that the nylon roller R will permit the runs of the cable 29 to be spaced fairly close together vertically without the danger of wearing interference, with other projecting low friction guides, for example, nylon shoes adjacent the ends of the assembly, also usable for this purpose. There will likely occur in the assembly of the new mechanism some small difference in the diameter

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of the drive and idler gears resulting from manufacturing tolerances, but it has been found that the assembly is self-leveling in that the wear incident to initial run-in will be more pronounced on the gear which is slightly larger and the difference is soon eliminated.

I, therefore, particularly point out and distinctly claim as my invention:

1. Apparatus for operating garage doors and the like, comprising a continuous cable, means carried by said cable for coupling the door thereto, reversible electric motor drive means including an output shaft on which there is a drive gear, a driven gear in mesh with said drive gear, the cable being wrapped relatively reversely on such gears and thereby driven to operate the door, support means for pivotally mounting said motor drive means to rock about said output shaft between two conditions of adjustment as a result of arrest of the drive gear rotation, stop means for limiting travel of the cable in both directions to determine the normal extent of movement of the door, said stop means being operative at each limit of the travel to arrest the cable and hence the rotation of the drive gear, with consequent rocking of the motor drive means, and circuit means for connecting the motor drive means to an electric energy source, said circuit means including switch means actuated by the drive means in the rocking movement thereof and operative when thus actuated to interrupt the energization of the motor drive means.

2. Apparatus as set forth in claim 1, including spring means normally holding the motor drive means against rocking and providing a snap action when sufficient turning force to overcome such holding is exerted on the drive means as a result of the arrest of the drive gear.

3. Apparatus as set forth in claim 1, wherein the cable is arranged with first and second runs, and said stop means comprises fixed stop means and a cable carried stop in each of said runs.

4. Apparatus as set forth in claim 3, wherein the motor

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drive means, the switch means actuated thereby, and said fixed stop means are supported by a unitary mount adapted to be attached to the garage or other structure in which the apparatus is installed.

5. Apparatus as set forth in claim 4, wherein the means carried by the cable for coupling to the door comprises a link assembly to which the ends of the cable are attached, and an angular coupling of adjustable length connected to the link assembly and adapted for attachment to the door.

6. Apparatus as set forth in claim 5, wherein said link assembly in one run of the cable includes guide means with low surface friction projecting therefrom in the direction of the other run of the cable.

7. Apparatus as set forth in claim 5, wherein one end of the cable is connected to said link assembly through shock absorbing and tensioning spring means.

8. Apparatus as set forth in claim 4, wherein the cable runs are determined by a first pulley adapted to be attached to forward structure adjacent the door opening and a second pulley also supported by said unitary mount, the latter being at a relative rearward location.

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U.S. Cl. X.R.

160—193; 49—28, 360