

Jan. 22, 1957

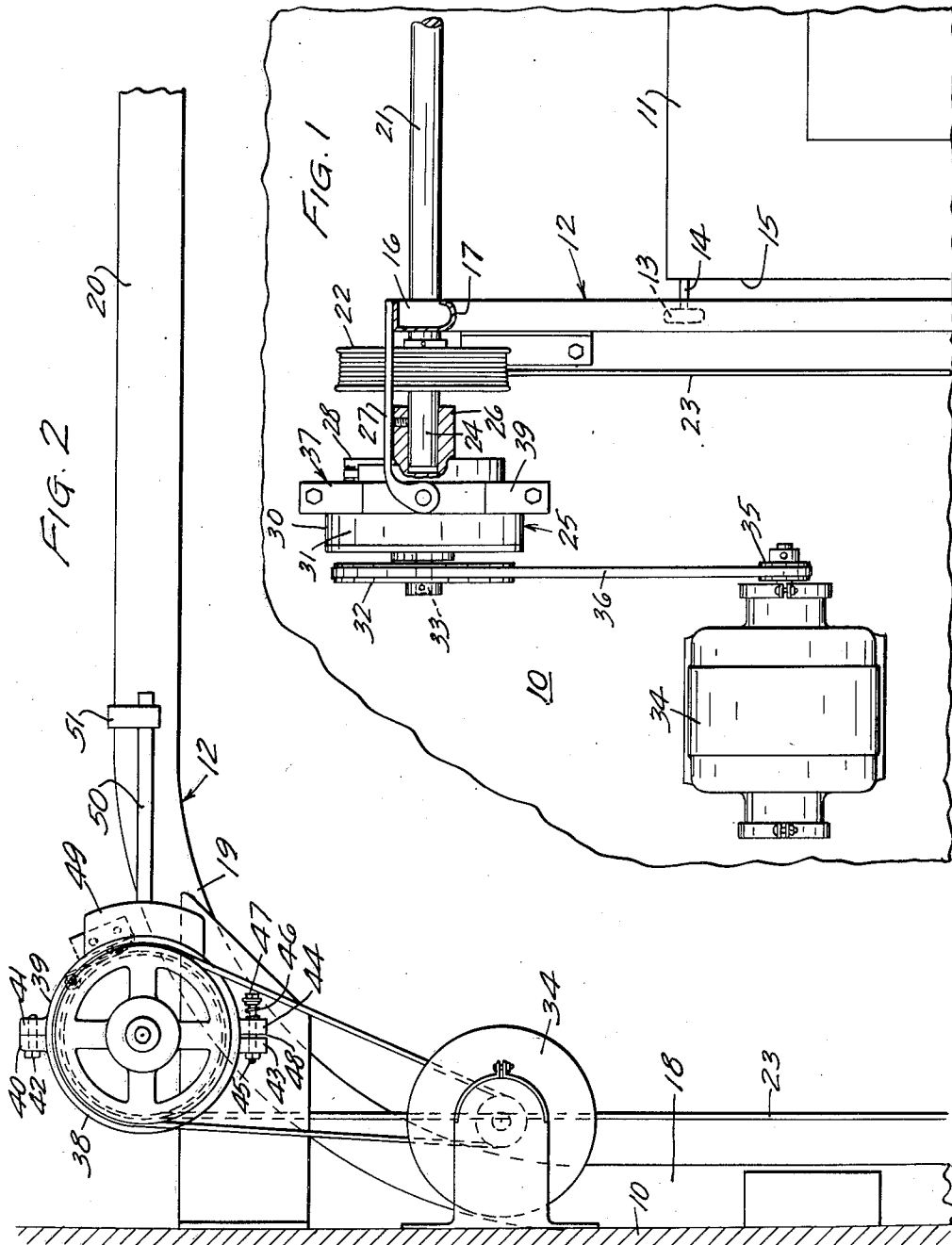
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GARAGE DOOR ACTUATING MECHANISM

Filed April 8, 1955

2 Sheets-Sheet 1



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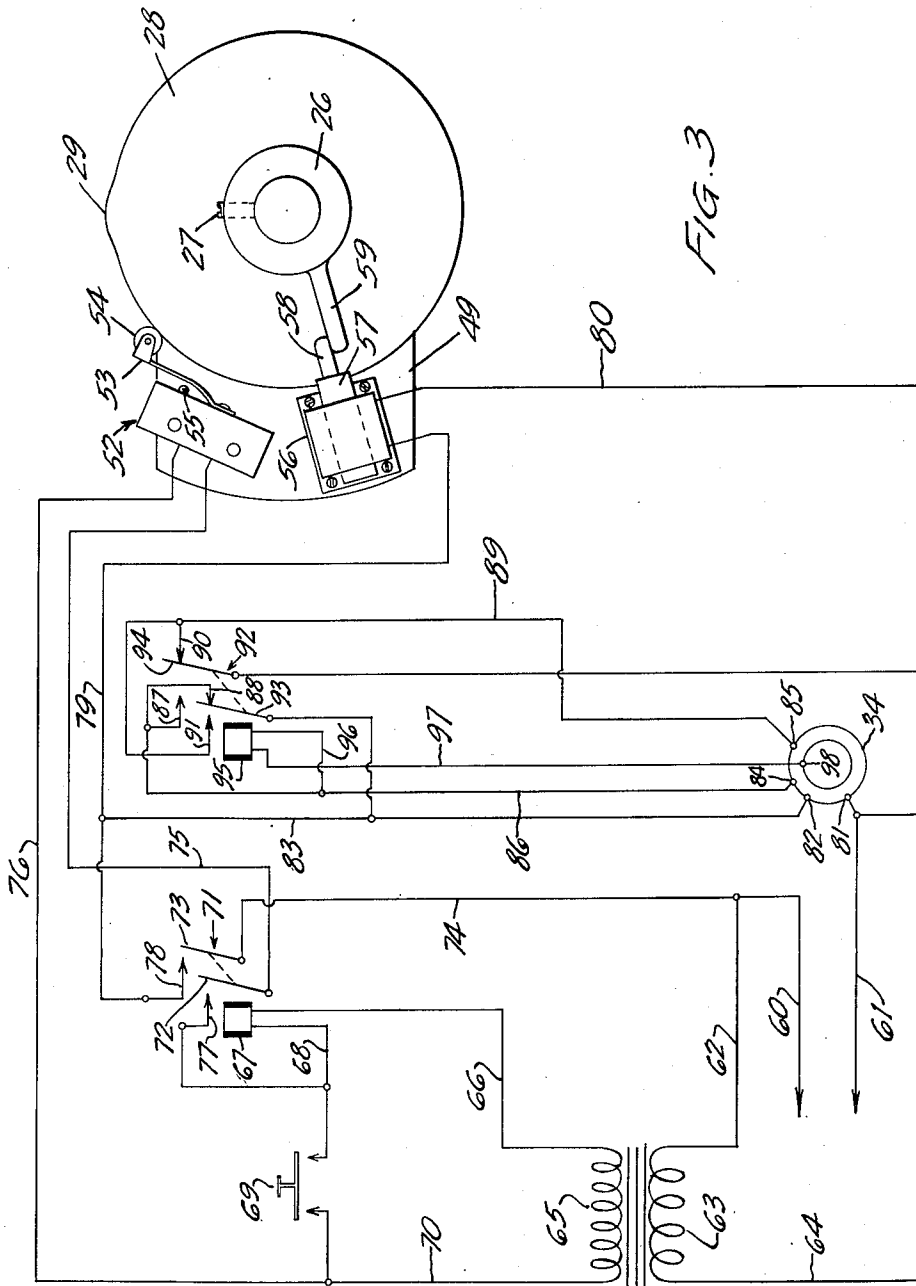


FIG. 3

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GARAGE DOOR ACTUATING MECHANISM

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Application April 8, 1955, Serial No. 500,178

10 Claims. (Cl. 268—59)

This invention relates to a remotely controlled garage door and more particularly to an actuating mechanism for electrical operation thereof.

It is an important object of the invention to provide a very simple device for efficiently opening and closing conventional garage doors.

A number of devices have been proposed for opening and closing garage doors, many of them having chain drives, longitudinal threaded shafts and various interconnecting linkages with the door to be operated. These devices in the main are adequate for the purpose intended but many of them take up so much space within the garage that only a small percentage of the existing conventional garages can accommodate the mechanism. It therefore becomes necessary to construct the garage with the particular mechanism in mind so that sufficient space will be provided for mounting and for operating thereof. It is therefore another object of this invention to provide a novel garage door actuating mechanism which has a compact and simple structure which can easily be adapted as an attachment for a conventional overhead garage door having a torsion bar with balancing stress, or can be constructed as a new and unique combination with a lift or overhead garage door in which a transverse upper shaft is rotatably mounted to raise or lower the door, the mechanism being mounted directly upon the bar or shaft and supported thereby in close coupled arrangement.

As an adjunct of the close coupled arrangement, I have been able to eliminate separate units for driving and reducing speed as well as eliminating separate units for controlling the energizing system. Consequently it is a further object of the invention to provide an electrically powered garage door mechanism in which concentric members in driving connection provide speed reduction as well as control of power for stopping the mechanism when the door has been properly positioned.

It is a still further object of the invention to provide in a unitary mechanism of the class described, an automatic clutch and locking device which will render the operation of the door safe and sure, yet will prevent opening of the door by an unauthorized person.

These and other objects and advantages of the invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

Fig. 1 is a side elevation of an area at the inside of a garage wall at the upper left hand corner of a door, my mechanism being shown in mounted position with respect to the bar, unessential portions being cut away and other portions segmented in vertical section to better show the structure of the parts;

Fig. 2 is an end elevation of my mechanism taken on the line 2—2 of Fig. 1, hidden portions being shown in dotted line and unessential portions being cut away; and

Fig. 3 is a diagrammatic representation of the energizing system for my invention.

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With continued reference to the drawings, and particularly to Figs. 1 and 2, the garage wall structure is indicated generally at 10 and is shown in the area of the garage door 11 which may be of the paneled type which can be raised and lowered on trackways 12 which receive a plurality of rollers 13 which are in turn fastened by means of roller shafts 14 to the side edges 15 of the door panel or panels 11. The trackway 12 is usually of the channel type having an inwardly facing opening 16 and a curved lower edge 17 for guiding the rollers 13 in the upward and downward movement of door 11. The trackways 12 have a straight portion 18 secured to the vertical wall 10, a curved medial portion 19 for changing the direction of the door panels 11 in their upward movement, and another straight portion 20 which is attached to or secured relative with the roof or ceiling of the garage (not shown).

In the particular type of garage door used which I am concerned with, a rotatable shaft 21 is transversely journaled with respect to the trackways 12 so as to provide a balancing effect for the weight of door 11 which remains in vertical suspended relation on the straight portion 18 of the trackway 12. This is generally accomplished through such means as a drum 22 and cable 23 which is secured through a connection (not shown) at a lower position on door 11. A resilient force of progressively increasing value such as a coil spring (not shown) is secured between a fixed mounting and the shaft or torsion bar 21 so that the winding power of drum 22 will increase as the door 11 is lowered on the vertical portion 18 of trackway 12. Conversely as the door 11 is raised and a portion thereof is disposed along the horizontal portion 20 of the trackways 12, lesser force is needed to counterbalance the suspended weight of the door and the force on the torsion bar or shaft 21 is correspondingly less as the requirement diminishes. It is within the contemplation of my invention to supply a shaft 21 or to utilize the ordinary torsion bar of the type of overhead garage doors described and in which the shaft or torsion bar 21 has an outward extension 24 at each side of the trackways 12 as shown in Fig. 1.

My invention adapts itself either to construction in combination with the overhead door, trackways and horizontal actuating bar or shaft, or may be furnished as an accessory which is attachable to the end extension 24 of the conventional torsion bar 21 at either side of the garage wall.

The mechanism for opening and closing the garage door comprises a speed-reducing unit indicated generally at 25 which, in turn, has an output driving connection or hub member 26 attachable to the end extension 24 through such means as set screw 27, as shown in Fig. 1. The hub 26 is rotatable with respect to the other portions of the speed-reducing unit 25. The first of these is a concentric cam wheel 28 having a camming area such as lobe 29, and secured with the outer casing 30, as indicated in Figs. 2 and 3. The outer casing 30 is likewise concentric with respect to the shaft end 24 and is equipped with a clutch surface or drum 31. The third of the rotatable members is the external drive wheel 32 which is secured to an axial input drive shaft 33 connectable to the speed-reducing unit 25 and operable through such means as planetary gears (not shown) to effect the relative rotation of the respective parts. In the assembled and mounted condition, the driving wheel 32 rotates at the higher speed, and the interconnecting hub 26 operates at slower speed. In any type of speed-reducing unit, there are torque forces applied to the casing during use. If the input and output shafts are journaled on transverse or parallel axes, the force is absorbed in the walls of the casing. However, if the respective input and output shafts are coaxial, then the entire casing lies under pure

torque force and, unless restrained against turning, will rotate differentially with respect to the input and output shafts.

It will be noted that the speed-reducing unit 25 is substantially supported by its concentric mounted relationship with the shaft end 24 and, hence, needs no outward additional support for holding the weight of the unit in mounted position. The drive wheel 32 may be rotated by a suitable source of driving power such as the motor 34 having a sheave 35 and belt connection 36, as shown in Figs. 1 and 2. Where space is at a premium, the motor 34 may be mounted either at the left or at the right of the drive belt 36 on wall 10 or may be mounted in either of the respective positions to the ceiling, the driving sheave 35 being aligned with the speed reduction driving wheel 32 as illustrated. The choice of positions and the compact quality of the device permits mounting and attachment to any conventional garage door regardless of how small and cramped the internal spacing may be.

In order to inhibit rotation of the casing 30 of the speed-reducing unit 25, I employ a mounting structure in the form of a torque arm having a slip clutch indicated generally at 37. The clutch may comprise a pair of shoes 38 and 39 which are interconnected at brackets 40 and 41 respectively by means of fastener 42, and at the opposite ends of the shoes 38 and 39 by a pair of brackets 43 and 44 which are fastened by resilient means such as adjustable bolt 45 having a compression spring 46 interposed between the head 47 and bracket 44 to place a predetermined amount of frictional stress between the mounting member 37 and the drum surface 31 of casing 30. The compression of spring 46 may be varied by tightening bolt 45 and thereby placing greater converging force between the individual clutch members 38 and 39. A small gap 48 is maintained between the brackets 43 and 44 so as to permit tightening of the shoes or clutch members 38 and 39, as previously noted.

The clutch portion 39 is secured to a mounting plate 49 which in turn has a rigid torque arm 50 extending inwardly of the wall 10 and preferably in spaced parallel relation with the horizontal portion 20 of trackway 12. A bridging bracket 51 interconnects the trackway 12 with the torque arm 50 as shown in Figs. 1 and 2 so as to prevent rotation of the clutch and mounting element 37 in its engagement with the drum 31 of casing 30.

Referring now to Fig. 3, the mounting plate 49 has secured thereto a microswitch 52 in such a position that the switch arm 53 has its roller element 54 aligned with the cam wheel 28 in rolling contact with the outer periphery. The cam roller 54 when in engagement with the cam lobe 29 will actuate the switch button 55 to de-energize and interrupt the circuit as will be presently described. Also mounted on the mounting plate 49 is a solenoid 56 which has an extendible and retractable core 57 with an outer abutment 58 rigidly connected therewith. The abutment lies adjacent the cam wheel 28 and, in extended position, is in alignment with a lock arm 59 rigidly secured to the hub member 26 and rotatable therewith during operation of the mechanism. When the solenoid 56 is energized, the abutment 58 will be withdrawn to permit the free rotation of lock arm 59.

With reference to the circuit diagram of Fig. 3, the leads to an ordinary source of electrical current are indicated at 60 and 61 respectively, the hot line being the former and the neutral line being the latter. Lead 60 connects with lead 62 which in turn connects with one side of transformer primary 63 and then connects through lead 64 back to the neutral line 61 of the electrical source. The transformer secondary 65 has a lead 66 which connects with solenoid 67 and thence through lead 68 to the starting switch 69 and back through lead 70 to the opposite pole of secondary winding 65. The solenoid 67 operates a double pole, single throw switch 71 having contacts 72 and 73 respectively. Contact 73 interconnects with lead 74 which in turn is connected with the

hot line 60, and the contact 72 is electrically connected with lead 75 which is in series with the microswitch 52 and lead 76 which returns to lead 70 and its connection with the transformer secondary 65. Contact 72 is adapted to close against contact 77 which in turn connects with lead 68, and the switch arm contact 73 is adapted to close against contact 78 which in turn connects with the lead 79. The lead 79 is secured to one terminal of the solenoid 56 and the other lead 80 extends from solenoid 56 back to the neutral lead 61 of the electrical source of energy. The motor 34 has a pair of poles 81 and 82 connected with the running windings, the pole 81 being electrically connected with the neutral line 61 and the pole 82 being connected through conductor 83 with the lead 79.

The starting windings of motor 34 have terminals 84 and 85 respectively, the terminal 84 connecting with lead 86 which in turn terminates in contact 87 and in the parallel contact 88 as shown. The other terminal 85 of the starting windings is secured to conductor 89 which terminates in contact 90 and in the parallel contact 91 as shown. A double pole, double throw reversing relay is shown diagrammatically at 92 and operates between the contacts 88 and 91 as well as 90 and 87. The switch arm 93 connects alternately with contact 88 and then with 91 while the switch arm 94 correspondingly and simultaneously operates between the contacts 90 and 87. Solenoid 95 actuates the reversing relay 92 and has one lead 96 connecting with the conductor 36 and the other lead 97 electrically connected with the contact 98 which is secured to the back side of the centrifugal throw-out switch which operates the conventional motor M and which switch (not shown) connects and interrupts the starting windings between the terminals 84 and 85 as in motors of the conventional type.

In the use and operation of my garage door mechanism, the starting button 69 is momentarily depressed so as to close the circuit with the transformer secondary 65 through leads 66, solenoid 67, lead 68, switch 69 and lead 70. When the solenoid 67 is actuated, the double pole, single throw switch 71 will cause the contacts 72 and 77 as well as contacts 73 and 78 respectively to be closed. When this condition obtains, the solenoid 67 will remain energized even though the starting switch 69 is released since the current will continue to flow from secondary 65 through lead 66, solenoid 67, lead 68, contact 77, switch arm 72, lead 75, microswitch 52, lead 76, lead 70 and back to the secondary 65. At the same time, the solenoid 56 will become energized so as to withdraw the abutment 58 and permit free rotation of hub 26 out of contact of the lock arm 59. This is accomplished through leads 60, 74, switch arm 73, contact 78, lead 79 to solenoid 56, then through conductor 80 and back to the neutral line 61 of the energy source.

Simultaneously with the aforesaid electrical energizing is the starting of the motor through conductor 74 which is in electrical contact with the hot line 60 and which passes through the closed contacts 73—78, thence through conductor 83 to switch arm 93, contact 88, conductor 86 and to terminal 84 of the starting windings, thence through terminal 85, conductor 89, contact 90 and back to the neutral line 61 of the energy source. As is well understood in the conventional electrical motor art, the centrifugal throw-out switch will break the contact in the starting windings between terminals 84 and 85 when sufficient speed has been attained in the motor, and the motor will then continue to run through application of energy from the hot line 60, conductor 74, contacts 73—78, conductor 83, terminal 82, through the running windings and to the other terminal 81, and thence to the neutral line 61 of the energy source.

When the centrifugal throw-out switch has interrupted the current through the starting windings, the same throw-out action will close a circuit between the terminals 85 and 98 so as to energize the solenoid 95 and actuate the reversing relay 92 to condition the switch arms 93 and 94

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for reversing the terminals 84 and 85 upon the next actuation of switch 69. Thus, the motor 34 will be caused to run in the opposite direction the next time it is energized. Thus, if the condition of the reversing relay 92, as illustrated in Fig. 3, caused the motor 34 to wind up the drum 22 and open the door 11, on the next actuation of manual switch 69 the reversing relay 92 would cause switch arms 93 and 94 to lie in contact with the contacts 91 and 87, respectively. In the latter situation, the current flow through the starting windings led from the hot line 60 through conductor 74, contacts 73-78, conductor 83, switch arm 93, contact 91, conductor 89 and to the terminal 85 of the starting windings. The other terminal 83 is then interconnected through the conductor 86, contact 87, switch arm 94 and back to the neutral line 61. Again, when the centrifugal throw-out switch closes the contact 85-98, the solenoid 95 will be energized to condition the reversing relay 92 for the following operation.

Each time the circuit is energized, the solenoid 56 will retract the abutment 58, as previously pointed out, and the speed-reducing unit 25 will be caused to rotate. The driving wheel 32 will rotate at higher speed and the casing 30 will be held in its clutch mounting without rotation while the drive wheel 32 transmits rotative motion to the hub interconnection 26, it being borne in mind that the cam wheel 28 rotates only when casing 30 slips and the hub 26 travels at a speed slower than that of the drive wheel 32. As the torsion bar or shaft 21 rotates in a clockwise direction, as viewed in Fig. 2, the door 11 will be raised. The motor 34 will continue to operate the raising of the door until it has reached its upper limit on the horizontal portion 20 of the trackway 12. When the door 11 has reached its maximum position, the torsion bar 21 will be stopped in its rotation, thereby preventing the rotation of the interconnecting hub 26. At this point, the housing 30 will overcome the frictional resistance of the shoes 38 and 39 and will slip against the predetermined force applied by compression spring 46. The cam wheel 28 will start to turn until the lobe 29 engages the microswitch roller 54 and depresses the button 55, thus interrupting the current through the microswitch. As before noted, the solenoid 67 will then be de-energized and the double pole, single throw switch 71 will be retracted from engagement with the contacts 77 and 78 which will permit the abutment 58 to project outwardly from solenoid 56 and, at the same time, interrupt the running windings of the motor 34. The garage door will then remain in its uppermost position until the manual switch 69 is again depressed.

As previously noted, upon further actuation of the switch 69, the motor will again start in reverse direction, and the housing 30 will not slip at first but will maintain its fixed relationship with the mounting structure 37 until the door is again stopped, whereupon the housing 30 and the cam wheel 28 rotate and cause the lobe 29 to pass around to the microswitch roller 54 and thereby again close the contacts of the microswitch and permit current to flow therethrough. The motor will then continue to rotate in the opposite direction which will unwind the cable 23 from drum 22 in a counterclockwise direction as viewed in Fig. 2, and permit the garage door 11 to be lowered. It is understood, of course, that a double cable 23 may be employed together with pulley mechanism such as to force the travel of door 11 in a downward as well as in an upward direction. Another way of accomplishing the latter is to provide a second drum 22 at the opposite end of torsion bar or shaft 21 with the cable wound in an opposite direction to that on the drum illustrated in Fig. 1, the outer end of cable 23 at the opposite side being attached to an upper position on the door 11 for pulling it downwardly. Again, when the door 11 has been lowered to its closed position, the added torque causes the clutch to slip and allows casing 30 to turn against the friction of shoes 38 and 39,

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thus stopping the rotation of shaft 21 until the cam lobe 29 again contacts the microswitch roller 54 and interrupts the current therethrough, thus stopping the operation of motor 34 and permitting the abutment 58 to project outwardly from the solenoid 56. It will be noted that when the mechanism has stopped, the abutment 58 will lie in the projected path of the radial stop arm 59 and prevent the manual raising of door 11 to a greater distance than the fraction of a rotation of hub 26 which will effect the abutting of stop arm 59 against the solenoid abutment 58.

In the event the door 11, in its downward descent, should strike an object such as a portion of an automobile, the slip clutch 37 will permit the interconnecting hub 26 to stop rotating together with torsion bar or shaft 21 and at the same time permit the cam wheel 28 to continue its rotation until the lobe 29 again encounters the roller wheel 54 of microswitch 52, thus stopping the operation of the entire mechanism.

It will thus be seen that I have devised a simple self-contained unit which, through a simple and cooperative relationship between several concentric portions, will effect raising and lowering of an overhead garage door of the class described in a limited space and with a minimum of expense in the mounting and setting up of the mechanism.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What is claimed is:

1. A mechanism for opening and closing a garage door of the type which is mounted on fixed and spaced parallel trackways along which the door is guided in upward and downward movement, said mechanism comprising, a horizontal shaft rotatably journaled at an upper position with respect to said trackways and door, means secured to said shaft and having interconnection with the door for raising and lowering thereof in response to rotation of the shaft respectively in one direction and then in the other, a speed reduction unit having a casing, an external drive, an external rotative hub connection coupling the drive and said shaft at a lower speed than the drive, and a cam wheel fixedly coupled with the casing for controlling the mechanism in its operation, and a mounting structure adjacent one end of said shaft and fixed with respect to the trackways for holding frictionally said casing and said cam wheel against rotation below a predetermined torque.

2. A mechanism for opening and closing a garage door of the type which is mounted on fixed and spaced parallel trackways along which the door is guided in upward and downward movement, said mechanism comprising, a horizontal shaft rotatably journaled at an upper position with respect to said trackways and door, means secured to said shaft and having interconnection with the door for raising and lowering the door in response to rotation of the shaft respectively in one direction and then in the other, a speed reduction unit having a casing, an external drive, an external rotative hub connection coupling the drive and said shaft at a lower speed than said drive, a cam wheel rotatably coupled with said drive operating at a relatively slower speed than the rotative connection with the shaft, and a mounting structure adjacent an end of said shaft and outwardly fixed with respect to the trackways, said mounting structure gripping and holding frictionally said speed reduction casing against rotation below a predetermined torque.

3. A mechanism for opening and closing a garage door of the type which is mounted on fixed and spaced parallel trackways along which the door is guided in upward and downward movement, said mechanism comprising, a horizontal shaft rotatably journaled at an upper position with respect to said trackways and door, a drum secured to said shaft and having a line windable thereon and

interconnecting with the door for raising and lowering thereof in response to rotation of the shaft respectively in one direction and then in the other, a speed reduction unit having a casing, an external drive, an external rotative hub connection coupling the drive and said shaft at a lower speed than the drive, and a cam wheel rotatably coupled with both the drive and the rotative connection, said drive having a relatively lower speed than said rotative connection with the shaft, a mounting structure adjacent one end of said shaft and outwardly fixed with respect to the trackways, said mounting structure gripping and holding frictionally said speed reduction casing and said cam wheel against rotation below a predetermined torque, driving means for rotating said external drive, and an energizing system for said driving means responsive to said cam wheel for permitting driving and for causing predetermined interruption thereof.

4. The subject matter of claim 3, and locking means interposed between said hub connection and the mounting structure and responsive to de-energizing of the energizing system to prevent free rotation of said shaft.

5. A device for opening and closing doors of the overhead type having a door-operating shaft rotatably journaled marginally of the doorway, said device comprising, a casing, an input shaft journaled in the casing, an output shaft axially aligned with the input shaft and journaled in the casing for rotation responsive to that of the input shaft and at a relatively slower speed, said output shaft having driving connection with said door-operating shaft, and a fixed frictional mount for the casing permitting the casing to rotate about the axis of the input and output shafts when the door-operating shaft is stopped and a predetermined torque is applied to the input shaft.

6. A device for opening and closing doors of the overhead type by means of a door-operating shaft, said device comprising, an axial coupling attachable directly to one end of said door-operating shaft, a speed-reducing mechanism rotatably secured to said axial coupling and substantially suspendible therewith on said shaft, said speed-reducing mechanism having a circular casing differentially coupled therewith and having a concentric circular area, a fixed mount for frictionally retaining the casing at the circular area against turning below a predetermined torque, and a driving connection with the speed-reducing mechanism for imparting rotation to said door-operating shaft.

7. A device for opening and closing doors of the overhead type by means of a door-operating shaft, said device comprising, an axial coupling attachable directly to one end of said shaft, a speed-reducing mechanism rotatably secured to said axial coupling and substantially suspendible therewith on said shaft, said speed-reducing mechanism having a casing differentially coupled therewith, said casing having a circular area in concentric relation with the axial coupling, a driving connection externally mounted with respect to said casing and coaxially aligned with the axial coupling, and a slip clutch concentrically engaged with said circular area and having a fixed torsion arm for preventing rotation of the casing with respect to the slip clutch below a predetermined torque.

8. A device for opening and closing doors in reciprocating sequence, said device comprising, an annular member

having a circumferential clutch surface, an input shaft journaled in axial alignment with the axis of said annular member, an output drive having connection with a door for movement thereof and journaled in axial alignment with the axis of said annular member and responsive to rotation of the input shaft but at a relatively slower speed, and a fixed frictional mount for said annular member at the circumferential clutch surface thereof permitting the annular member to rotate under counter-torque about the common axis of the input shaft and output drive when a predetermined resistance to rotation of the output drive is attained.

9. A mechanism for opening and closing a garage door of the type which is mounted on fixed and spaced parallel trackways along which the door is guided in upward and downward movement, said mechanism comprising, a rotatable door-operating element disposed marginally of the door for raising the door when rotating in one direction and lowering the door when rotating in the opposite direction, an annular friction-mounted member axially aligned with the rotatable door-operating element and rotatable relatively with respect thereto, an input shaft in axial alignment with both said rotatable door-operating element and said annular friction-mounted member, a speed-reducing mechanism drivably interconnecting the input shaft and the rotatable door-operating element and being differentially coupled with the annular friction-mounted member, the latter being caused to rotate against friction about the common axis when a predetermined torque resistance is applied to the rotatable door-operating element.

10. A door opening and closing mechanism comprising, a rotative door-operating element having connection with a door for opening it while rotating in one direction and closing it when rotating in the other direction, a speed-reduction assemblage drivably connected to said rotative element for imparting door-operating rotation thereto, an input shaft operably connected to said speed reduction assemblage and in axial alignment with said rotative door-operating element, said input shaft operating at a higher rate of rotation than the door-operating element, a switch-operating member having a circular clutch face mounted concentrically with both the input shaft and the rotative door-operating element and being differentially coupled therewith whereby to exert torque force on the switch-operating member while transmitting power from the input shaft to the door-opening element, said switch-operating member having means eccentrically located with respect to the axis of its circular clutch face for actuating a switch upon rotative movement thereof, and mounting means frictionally holding the switch-operating member at said circular clutch face areas whereby to permit slippage of the switch-operating member only when the torque force thereon is increased beyond a predetermined value.

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