

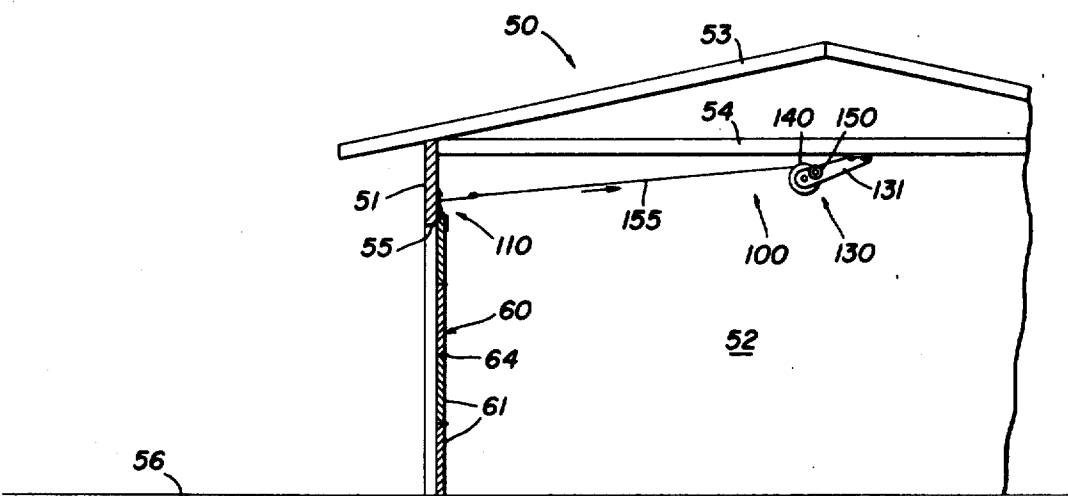
- [54] **DOOR OPERATING MECHANISM**
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[52] U.S. Cl.**160/188, 49/199, 49/280, 292/225**
[51] Int. Cl.**E05F 15/12**
[58] Field of Search.....**49/199, 200, 360, 280; 160/188, 189, 193; 74/89.2; 292/225, 227, 50, DIG. 36; 318/266, 267, 282, 466, 468**
[56] **References Cited**

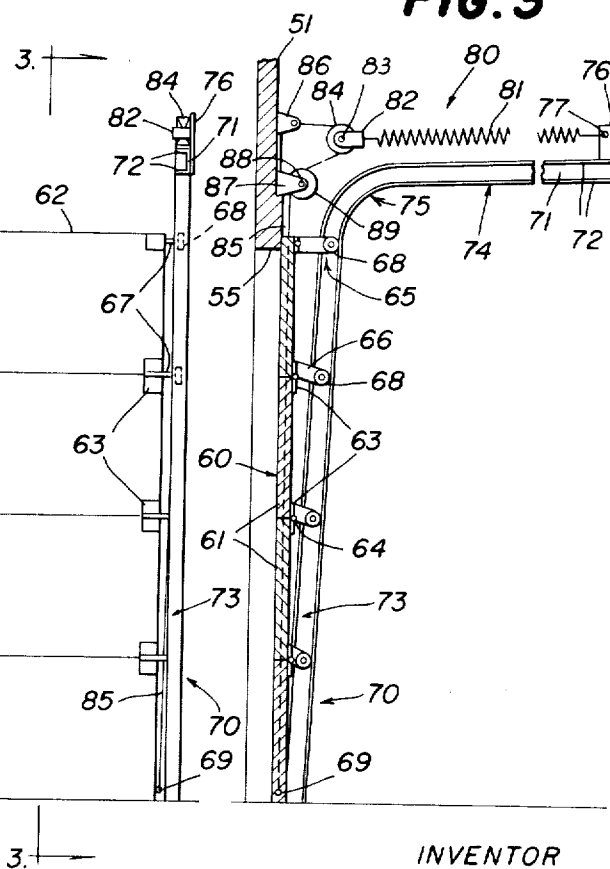
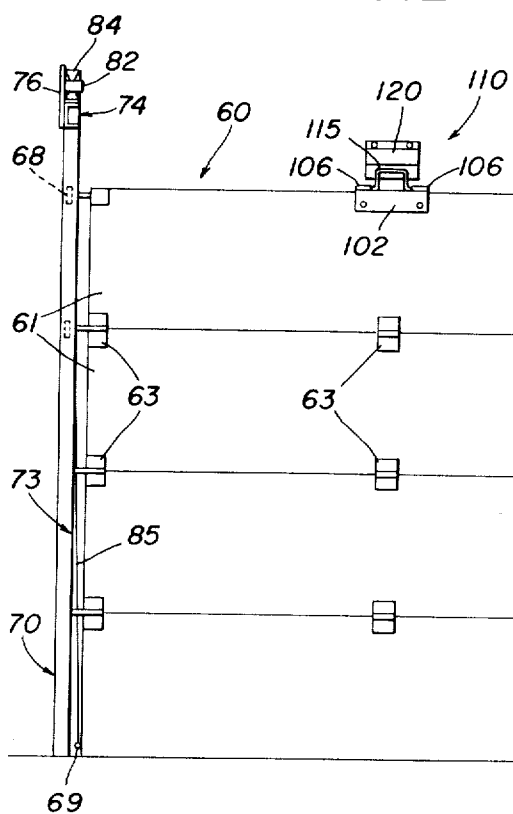
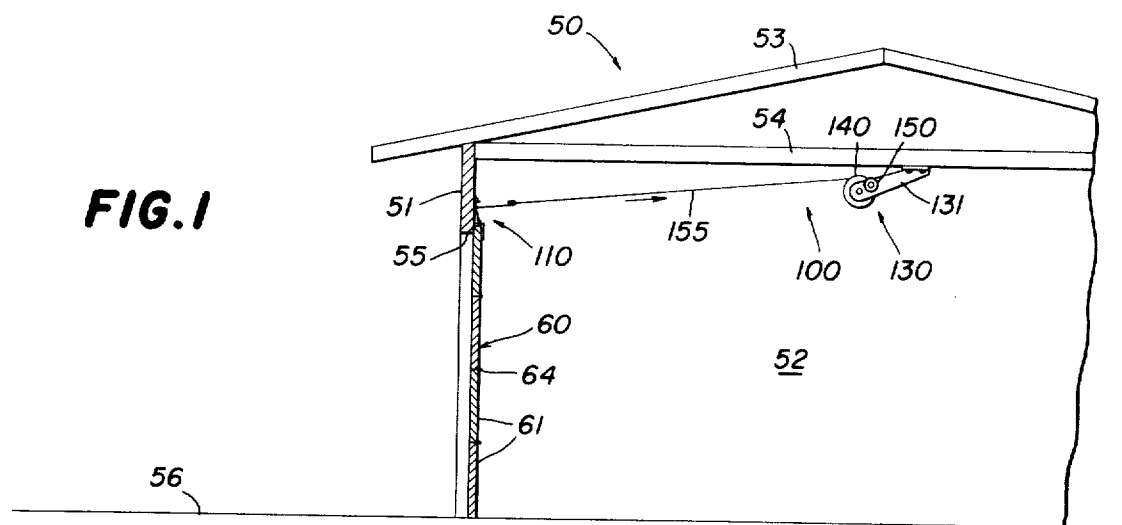
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Primary Examiner—J. Karl Bell
Attorney—Prangley, Clayton, Mullin, Dithmar & Vogel

[57] **ABSTRACT**
An automatic operator for an overhead garage door gravity-biased to a closed position includes a keeper centrally positioned on the garage above the doorway, a pivotally biased latch member secured to the top of the door and spring-biased into a locking configuration wherein it is engageable with the keeper for locking the door in its closed position, a reel mounted in the garage above the top of the door centrally thereof, a cable interconnecting the reel and the latch member, a reversible electric gear head motor coupled to the reel for rotating same in a winding direction to unlock the latch and open the door and in an unwinding direction to permit closing of the door and locking thereof by the latch member, means for actuating the motor, and motor control circuitry including a screw-type limit switch responsive to rotation of the reel for deactuating the motor after opening or closing of the door.

5 Claims, 11 Drawing Figures





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FIG. 4

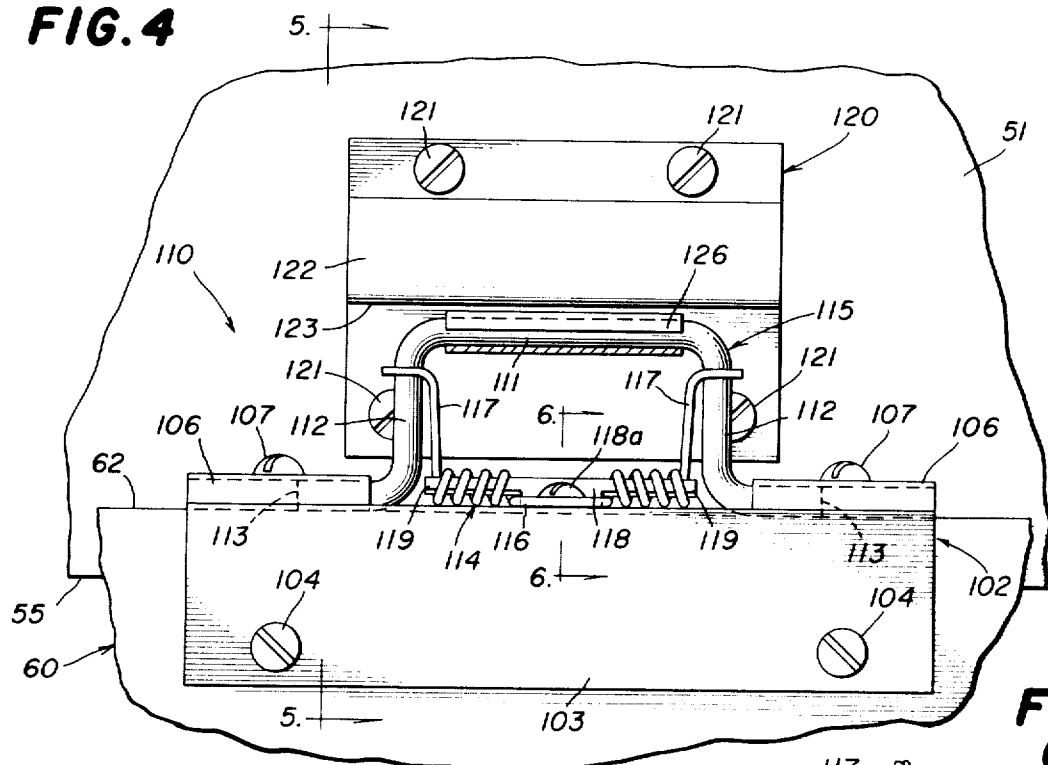


FIG. 6

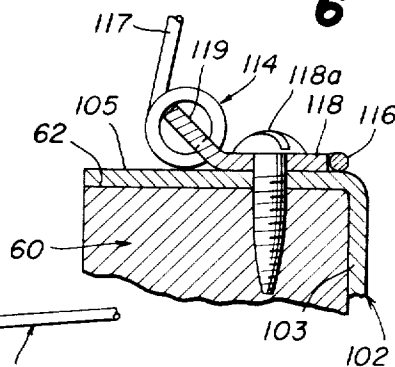


FIG. 5

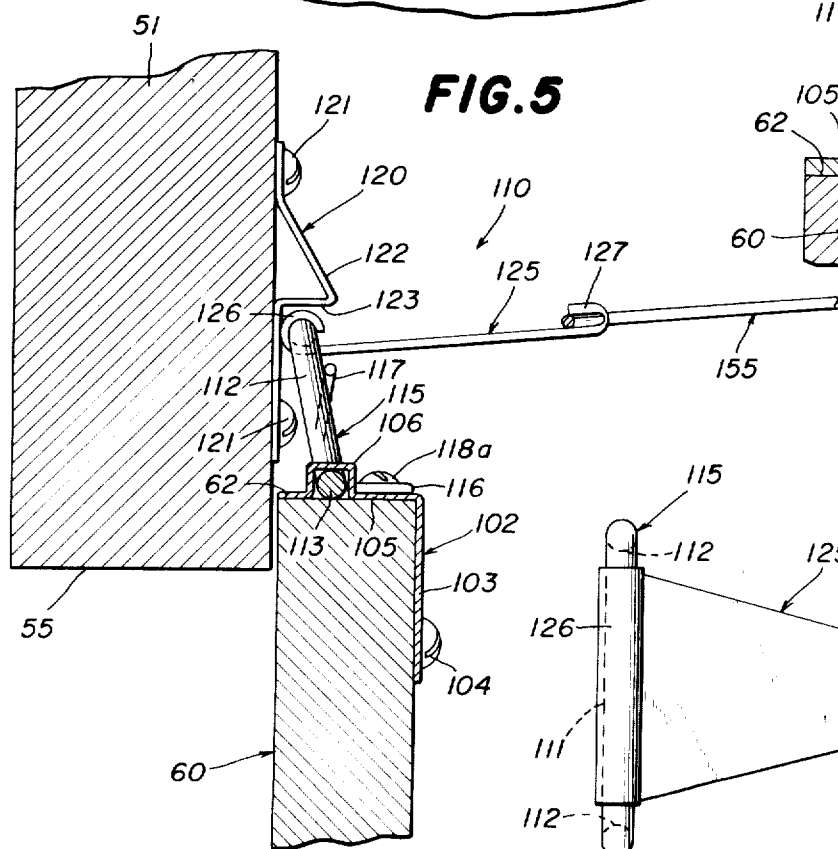


FIG. 7

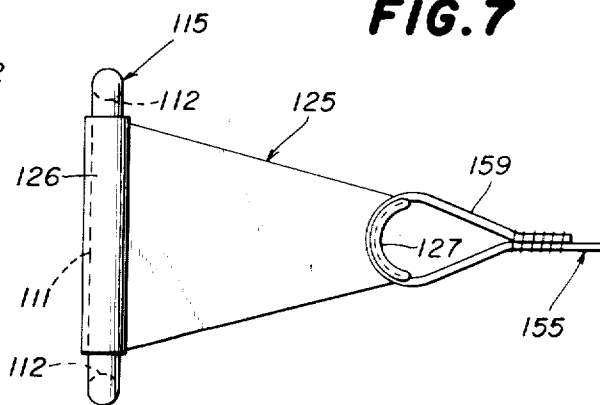


FIG. 8

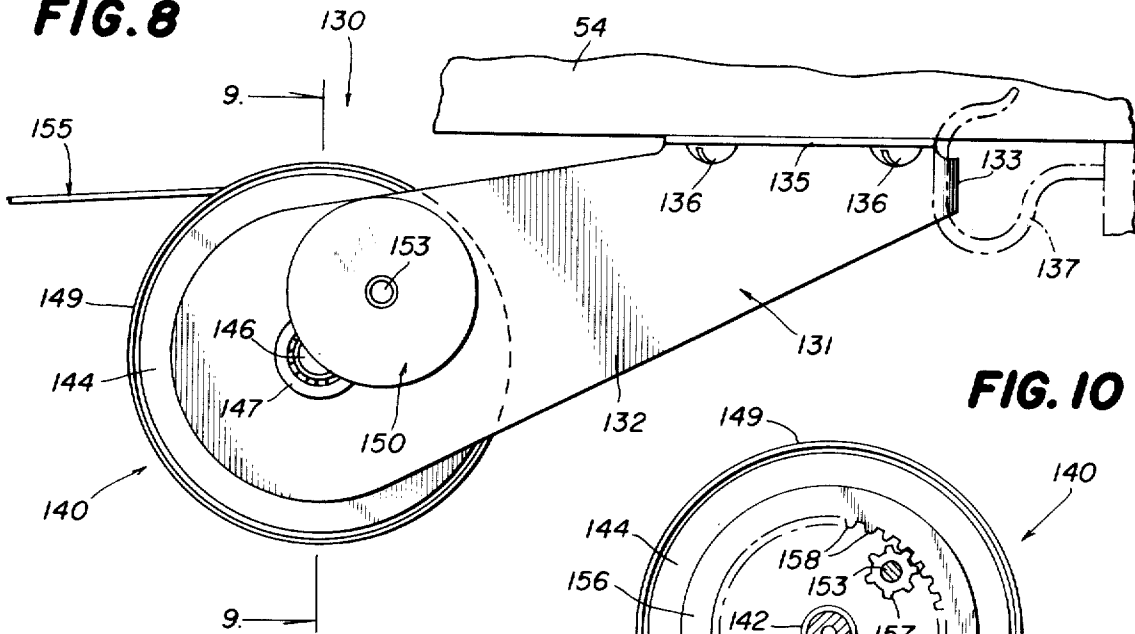


FIG. 10

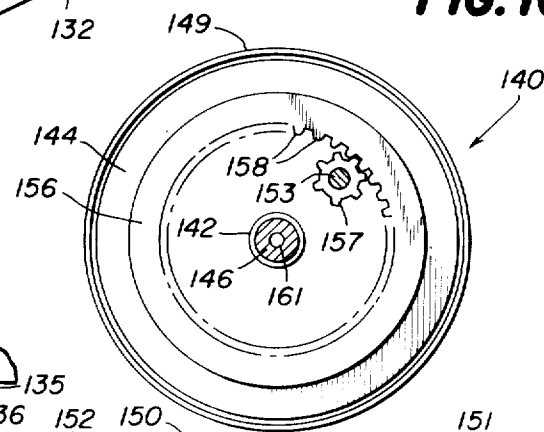


FIG. 9

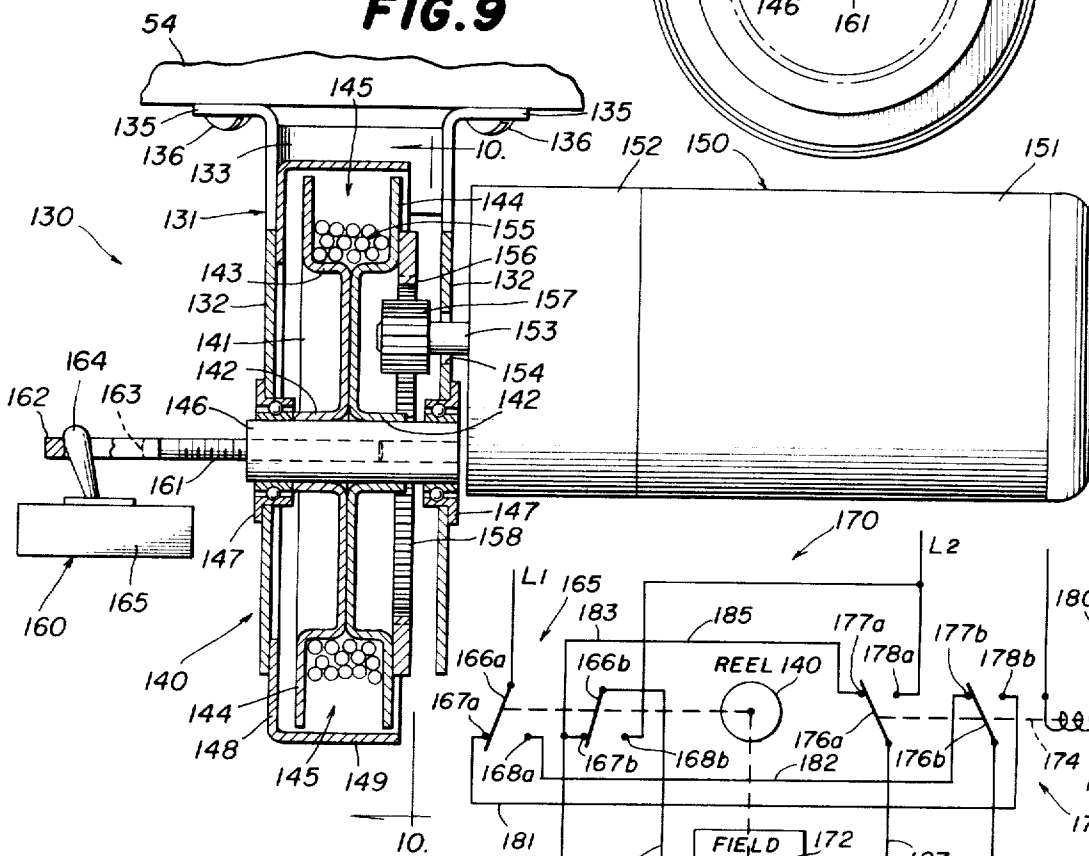
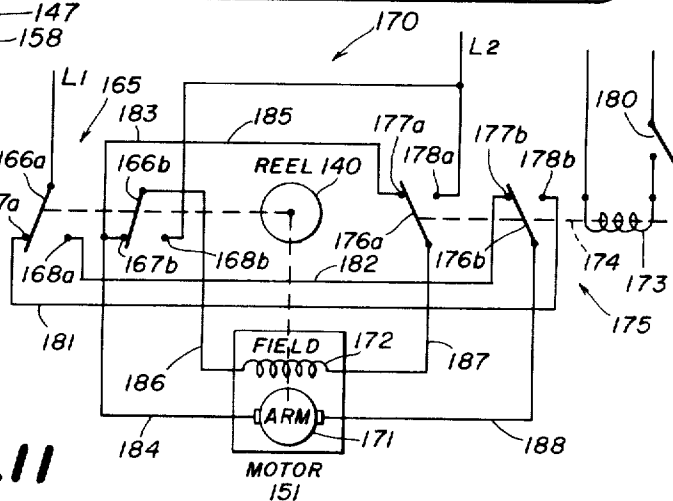


FIG. 11



DOOR OPERATING MECHANISM

This invention is directed to an automatic door operating mechanism of the type useful with overhead doors, such as garage doors and the like.

More particularly, it is a general object of this invention to provide a compact, inexpensive and easily mounted door operating mechanism for effecting automatic operation of overhead garage doors.

It is an important object of the present invention to provide a combination for use with an associated building having a door-receiving opening therein, the combination comprising a door mounted for movement between a first position and a second position with respect to the door-receiving opening and biased toward the first position thereof, a reel mounted on the associated building for rotation in a winding direction and an unwinding direction, a cable coupled at one end thereof to the reel and coupled at the other end thereof to the door, a motor coupled to the reel and having a winding condition means for actuating the motor to the winding and unwinding conditions thereof, and control apparatus directly coupled to the reel and to the motor and responsive to the rotation of the reel through a predetermined angle for automatically de-actuating the motor upon movement of the door from the first position thereof to the second position thereof and upon movement of the door from the second position thereof to the first position thereof, and an unwinding condition, the motor in the winding condition thereof effecting rotation of the reel in the winding direction for winding the cable on the reel thereby to move the door from the first position thereof to the second position thereof, the motor in the unwinding condition thereof effecting rotation of the reel in the unwinding direction for paying out the cable on the reel thereby to permit movement of the door from the second position thereof to the first position thereof, whereby operation of the motor in the winding condition thereof effects automatic movement of the door from the first position thereof to the second position thereof and operation of the motor in the unwinding condition thereof effects automatic movement of the door from the second position thereof to the first position thereof.

In connection with the foregoing objects, it is another object of this invention to provide a combination of the type set forth wherein the first and second positions of the door are respectively closed and open positions, and wherein the first and second configurations of the latch member are respectively locking and unlocking configurations.

It is another object of this invention to provide a combination of the type set forth, wherein the door comprises an overhead door mounted for movement between a substantially vertical closed position and a substantially horizontal open position with respect to the door-receiving opening and biased by gravity toward the closed position thereof, the reel being mounted on the associated building above the upper end of the door in the closed position thereof and centrally with respect thereto, the other end of the cable being coupled to the upper end of the door centrally thereof.

It is another object of this invention to provide a combination of the type set forth, which further includes an internal gear connected to the reel substantially coaxial therewith, the motor being provided with

a rotatably driven output shaft having a pinion gear coupled thereto and disposed in meshing engagement with the internal gear for transferring the rotational motion of the output shaft to the reel.

Yet another object of this invention is to provide a door operating mechanism for use with a door mounted in an associated building having a door-receiving opening therein for movement between a first position and a second position with respect to the door-receiving opening with the door being biased into the first position thereof, the door operating mechanism comprising a latch member mounted on the associated door and movable between a first configuration and a second configuration and biased toward the first configuration thereof, a keeper mounted on the associated building adjacent to the latch member and cooperating therewith when the associated door is in the first position thereof and the latch member is in the first configuration thereof for locking the associated door in the first position thereof, a reel mounted on the associated building for rotation in a winding direction and an unwinding direction, a cable coupled at one end thereof to the reel and coupled at the other end thereof to the latch member, a motor coupled to the reel and having a winding condition and an unwinding condition, means for actuating the motor to the winding and unwinding conditions thereof, and control apparatus directly coupled to the reel and to the motor and responsive to the rotation of the reel through a predetermined angle for automatically de-actuating the motor upon movement of the door from the first position thereof to the second position thereof and upon movement of the door from the second position thereof to the first position thereof, the motor in the winding condition thereof effecting rotation of the reel in the winding direction for winding the cable on the reel to thereby move the latch member from the first configuration thereof to the second configuration thereof and thereafter to move the associated door from the first position thereof to the second position thereof, the motor in the unwinding condition thereof effecting rotation of the reel in the unwinding direction for paying out the cable on the reel thereby to permit movement of the associated door from the second position thereof to the first position thereof and thereafter to permit movement of the latch member from the second configuration thereof to the first configuration thereof, whereby operation of the motor in the winding condition thereof effects automatic movement of the latch member from the first configuration thereof to the second configuration thereof and thereafter effects automatic movement of the associated door from the first position thereof to the second position thereof and operation of the motor in the unwinding condition thereof effects automatic movement of the associated door from the second position thereof to the first position thereof and thereafter effects automatic movement of the latch member from the second configuration thereof to the first configuration thereof.

Another object of this invention is to provide a door operating mechanism of the type set forth, wherein the control apparatus includes only a single limit switch.

Still another object of this invention is to provide a door operating mechanism of the type set forth, wherein the first and second positions of the door are

respectively closed and open positions and wherein the first and second configurations of the latch member are respectively locking and unlocking configurations.

Another object of this invention is to provide a door operating mechanism of the type set forth, which further includes an annular gear having teeth formed internally thereof and being connected to the reel substantially coaxial therewith, the motor being provided with a rotatably driven output shaft having a pinion gear coupled thereto and disposed in meshing engagement with the annular gear for transferring the rotational movement of the output shaft to the reel.

Further features of the invention pertain to the particular arrangement of the parts of the door operating mechanism whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation together with further objects and advantages thereof will best be understood with reference to the following specification taken in connection with the accompanying drawings, in which:

FIG. 1 is a fragmentary side elevational view in partial section of a garage having an overhead sectional door, and illustrating the cooperation the door and the door operating mechanism of the present invention;

FIG. 2 is a rear elevational view of the overhead door of FIG. 1 as viewed from within the garage and showing the latch assembly of the present invention;

FIG. 3 is a view in vertical section taken along the lines 3—3 in FIG. 2 and showing the counterspring assembly for the garage door;

FIG. 4 is an enlarged fragmentary elevational view of the latch assembly of the present invention;

FIG. 5 is a view in vertical section of the latch assembly of this invention taken along the line 5—5 in FIG. 4;

FIG. 6 is a further enlarged fragmentary view in partial section of the torsion spring of the latch assembly of this invention;

FIG. 7 is a top plan view of the cable coupling member of this invention and showing its cooperation with the latch member and the cable;

FIG. 8 is a side elevational view of the drive assembly of the present invention and illustrating the alternative means of mounting same;

FIG. 9 is a view in vertical section taken along the lines 9—9 in FIG. 8;

FIG. 10 is a sectional view of the reel assembly of the present invention taken along the line 10—10 in FIG. 9; and

FIG. 11 is a schematic circuit diagram of the electric control apparatus for the door operating mechanism of the present invention.

Referring now to the drawings, and in particular FIGS. 1 to 3 thereof, there is shown a garage, generally designated by the numeral 50, including a front wall 51, a rear wall (not shown), a pair of upstanding opposed side walls 52 interconnecting the front and rear walls, and a roof 53. Disposed immediately beneath the roof 53 and spanning the area between the front and rear walls and the side walls is a flat ceiling 54. Formed in the front wall 51 of the garage 50 is a door-receiving opening or doorway 55 through which automobiles may be driven on a driveway 56 into the garage 50. The front wall 51 and the doorway 55 therein may have a

width sufficient to accommodate one or more automobiles side-by-side, as desired. Mounted in the garage 50 adjacent to the doorway 55 for movement between open and closed positions with respect thereto, is an overhead garage door, generally designated by the numeral 60. The garage door 60 may be of any of several well-known types, but is preferably a sectional door comprised of a plurality of identically-shaped substantially rectangular sections or panels 61, hingedly interconnected along adjacent edges thereof by a plurality of hinge assemblies 63. Each of the hinge assemblies 63 includes a pair of hinge plates 63a respectively secured to the inner surfaces of a pair of adjacent panels and interconnected by a hinge pin 64, in a well-known manner. Preferably, each two adjacent panels are interconnected by three hinge assemblies 63, one hinge assembly 63 being disposed adjacent to each side edge of the garage door 60 and one hinge assembly 63 being disposed centrally of the garage door 60. However, additional hinge assemblies 63 may be provided as desired or necessary, particularly when the garage door 60 is of a two-car or a three-car width. Preferably, when the door 60 is in the closed position thereof it is arranged substantially vertically, as indicated in FIGS. 1 to 3, with the bottom of the door 60 resting upon the driveway 56 and with the top edge 62 of the garage door 60 being disposed a slight distance above the top of the doorway 55 and along the inside surface of the front wall 51 for completely closing the doorway 55.

Arranged along each side edge of the garage door 60 is a plurality of roller assemblies, generally designated by the numeral 65, each of the roller assemblies 65 including a mounting bracket 66 attached to the inner surface of the garage door 60 and extending rearwardly thereof and being provided at the distal end thereof with a stub shaft 67 having a roller wheel 68 journaled thereon. There are preferably two roller assemblies 65 provided for each of the panels 61, respectively mounted adjacent to the upper side edges thereof. More particularly, each of the roller assemblies 65, with the exception of those associated with the top door section 61, may be associated with one of the hinge assemblies 63 as indicated in the drawings. Respectively connected to the opposite side edges of the door 60 adjacent to the bottom end thereof are a pair of anchor members 69, which may be formed of eyebolts screwed into the opposite side edges of the lowermost door panel 61, for a purpose to be described hereinafter.

Adjacent to the opposite side edges of the doorway 55 of the garage 50 are a pair of tracks, generally designated by the numeral 70 and spaced apart a distance slightly greater than the width of the doorway 55, each of the tracks 70 being substantially channel-shaped in transverse cross section and including a substantially vertically disposed web 71 provided with a pair of generally horizontally extending retaining flanges 72, along the opposite side edges thereof extending inwardly toward the other track 70. The tracks 70 are arranged substantially parallel to each other and in horizontal alignment, each of the tracks 70 includes a substantially vertically extending flight 73 and a substantially horizontally extending flight 74, the flights 73 and 74 being interconnected by an arcuate flight 75. The vertically extending flights 73 of the tracks 70 are

each mounted upon the garage 50 or the driveway 56 by conventional means (not shown), while each of the horizontal flights 74 is preferably suspended from the ceiling 54 by appropriate connecting means (not shown). Extending vertically upwardly from the rear ends of each of the horizontal flights 74 is an anchor member 76 having an eyelet 77 therein for a purpose to be described below. Each of the roller wheels 68 on the roller assemblies 65 is so arranged and dimensioned as to fit between the flanges 72 of the adjacent tracks 70 for rolling engagement therewith. Thus, the roller wheels 68 cooperate with the tracks 70 for guiding the movement of the garage door 60 between the open and closed positions thereof in a well-known manner, the garage door 60 being biased by gravity into the closed position thereof. Preferably, the vertical flights 73 are inclined slightly rearwardly of the garage wall 51 and the horizontal flights 74 are inclined slightly upwardly toward the ceiling 54 of the garage 50, whereby the horizontal flights 74 are respectively disposed at obtuse angles to the vertical flights 73, all to facilitate movement of the garage door 60 between the open and closed positions thereof.

Referring to FIG. 3 of the drawings, there is also provided a pair of counterbalance assemblies, generally designated by the numeral 80, and respectively disposed adjacent to the tracks 70. Each of the counterbalance assemblies 80 includes a tension spring 81 disposed immediately above the horizontal flight 74 of the adjacent track 70 and substantially parallel thereto, the tension spring 81 being connected at one end thereof to the eyelet 77 in the adjacent anchor member 76 and connected at the other end thereof to a clevis 82, the clevis 82 being provided with a shaft 83 having a pulley 84 rotatably mounted thereon. Attached to the inner surface of the front wall 51 of the garage 50 above the doorway 55 and substantially in alignment with the horizontal flight 74 of the associated track 70, is another clevis 87 provided with a shaft 88 having a pulley 89 rotatably mounted thereon. A cable 85 is secured at one end thereof to an anchor member 86 attached to the inner surface of the front wall 51 immediately above the clevis 87, the other end of the cable 85 being threaded around the pulley 84, back over the pulley 89 and then being secured to the eyebolt 69 at the bottom of the adjacent side edge of the garage door 60. The length of the cable 85 is such that, when the garage door 60 is in its closed position, as illustrated in FIG. 3, the pulley 84 is pulled forwardly by the cable 85, thereby stretching the spring 81 and placing it in sufficient tension to substantially counterbalance the force of gravity on the garage door 60. The tension in the spring 81 may be adjusted by adjustment of the length of the cable 85 to any desired degree, but is preferably set so that the garage door 60 may be moved between the open and closed positions thereof by the application of only a very small force.

Referring now also to FIGS. 4 through 10 of the drawings, there is illustrated a door operating mechanism, generally designated by the numeral 100, according to the present invention, the door operating mechanism 100 including a latch assembly 110, a drive assembly 130 and a cable 155 interconnecting the latch assembly 110 on the drive assembly 130. More particularly, the latch assembly 110 includes a mounting

bracket 102 substantially in the form of a right angle bracket and disposed atop the garage door 60 centrally thereof. The mounting bracket 102 includes an attachment flange 103 extending downwardly from the upper edge 62 of the garage door 60 along the inner surface thereof and secured thereto by suitable fasteners such as mounting screws 104. Integral with the attachment flange 103 and extending substantially normal thereto forwardly of the garage 50 is a retainer flange 105 overlying the top surface 62 of the garage door 60 and secured thereto by suitable fasteners such as mounting screws 107. The retainer flange 105 has a pair of raised shoulders 106 formed therein adjacent to the opposite ends thereof and disposed in axial alignment with each other substantially parallel to the attachment flange 103 and cooperating with the top surface 62 of the door 60 to define a pair of retaining channels. A latch member, generally designated by the numeral 115, is also provided, the latch member 115 being in the form of a bail and including a bight 111 and a pair of legs 112, each of the legs 112 having a short prong or foot 113 extending outwardly from the distal end thereof and being received beneath the adjacent one of the raised shoulders 106 on the retainer flange 105. In this manner, the channels formed by the shoulders 106 retain the latch member 115 on the garage door 60 while accommodating pivotal movement of the latch member 115 about the longitudinal axis of the shoulders 106 between a locking configuration wherein the bight 111 is disposed against the inner surface of the front wall 51 (see FIG. 5) and an unlocking configuration (not shown) wherein the bight 111 is disposed away from the front wall 51. The latch assembly 110 is also provided with torsion spring 114 having a median loop 116 intermediate the ends thereof and having a pair of free arms 117 at the opposite ends thereof. A supporting plate 118 is disposed on the upper surface of the retainer flange 105 of the mounting bracket 102 between the shoulders 106 thereof and is secured thereto and to the door 60 by a suitable fastener such as mounting screw 118a. The mounting plate 118 is provided with a pair of arms 119 extending outwardly therefrom toward the opposite ends of the mounting plate 102. In use, the arms 119 of the support plate 118 are disposed axially through the coils of the torsion spring 118, with the median loop 116 lying flat against the upper surface of the retaining flange 105 and with the free arms 117 respectively disposed against the inner or rearward sides of the legs 112 of the latch member 115 for fixedly positioning the torsion spring 114 on the mounting bracket 102 and for biasing the latch member 115 into the locking configuration thereof.

Mounted on the inner surface of the front wall 51 of the garage 50 immediately above the top of the doorway 55 and centrally thereof is a keeper plate, generally designated by the numeral 120. The keeper plate 120 is secured to the front wall 51 of the garage 50 by suitable fasteners such as mounting screws 121 and is provided with a rearwardly extending lip or protrusion 122, having a substantially horizontal abutment surface 123 on the underside thereof. The keeper plate 120 is so positioned on the front wall 51 of the garage 50 that when the garage door 50 is in its closed position and the latch member 115 is in its locking con-

figuration, the bight 111 of the latch member 115 is disposed against the keeper plate 120 only a slight distance below the abutment surface 123, as is clearly illustrated in FIGS. 4 and 5 of the drawings.

The latch assembly 110 is also provided with a coupler 125 comprising a flat, generally triangular plate having the broad end 126 thereof rolled around the bight 111 of the latch member 115 for securing the coupler 125 to the latch member 115. The narrow end of the coupler 125 has a semi-circular channel 127 formed therein for a purpose to be described below.

Referring now to FIGS. 8 through 10 of the drawings, it will be seen that the drive assembly 130 of the door operating mechanism 100 includes a mounting bracket, generally designated by the numeral 131, provided with a pair of flat, parallel plates or arms 132 interconnected at the rear ends thereof by a bight 133. In use, the bracket 131 is disposed toward the rear of the garage 50 with the arms 132 being disposed substantially vertically and sloping downwardly toward the front of the garage 50. The arms 132 are each provided at the upper rear edge thereof with a substantially horizontal outwardly extending attachment flange 135 provided with openings therein for attaching the mounting bracket 131 to the ceiling 54 of the garage 50 as by mounting screws 136. It will be noted that, alternatively, the mounting bracket 131 may be supported in the garage 50 by a hook 137 (indicated in phantom in FIG. 8) looped around the bight 133 and secured by suitable means to the rear wall of the garage 50. Normally, however, the screw-mounted arrangement will be preferred since it affords a more stable mounting of the bracket 131.

Supported by the mounting bracket 131 adjacent to the forward end thereof is a reel assembly, generally designated by the numeral 140, and including a pair of annular plates 141 arranged coaxially with each other and secured together by suitable means such as rivets or spot welding. Each of the plates 141 is provided with an axially extending cylindrical flange 142 along the inner edge thereof, the flanges 142 cooperating to form a hub for the reel 140. Each of the plates 141 is also provided about the periphery thereof with an outwardly extending flange 143 extending outwardly therefrom in the same direction as the axial flange 142 and substantially parallel thereto, each of the flanges 143 being provided along the outer edge thereof with a radially extending flange 144. The radially extending flanges 144 on the plates 141 are spaced apart a predetermined distance and cooperate with each other and with the flanges 143 to define a groove or channel 145 extending circumferentially around the reel 140. Extending axially through the hub of the annular reel 140 and secured thereto is a cylindrical shaft 146, journaled at the opposite ends thereof in a pair of radially flanged ball bearings 147 respectively disposed in complementary openings in the arms 132 in the mounting bracket 131 for accommodating rotational movement of the reel 140.

Mounted on the inner surface of one of the arms 132 of the mounting bracket 131 is an annular cover plate 148 arranged coaxially with the reel 140 and provided around the periphery thereof with an inwardly extending cylindrical flange 149, the flange 149 having a diameter slightly greater than the outer diameter of the

reel 140 and extending across the groove 145 therein in surrounding relationship therewith to provide a cover for the groove 145.

Mounted on the outer surface of the other one of the arms 132 of the mounting bracket 131 by suitable means (not shown) is an electric gearhead motor, generally designated by the numeral 150, and including a motor 151 and a speed-reducing gearhead 152. The motor 150 is preferably of the reversible type and is provided with a rotatably driven output shaft 153 extending through a complementary opening in the adjacent arm 132 of the mounting bracket 131 substantially parallel to the shaft 146 and spaced therefrom, and being coupled at the inner end thereof to a pinion gear 157. Secured to the outer surface of the adjacent one of the radial flanges 144 of the reel 140, as by welding, is an internal gear ring 156 disposed coaxially with the reel 140 and having a set of teeth 158 disposed in meshing engagement with the teeth of the pinion gear 157 for transferring the rotational movement of the motor drive shaft 153 to the reel 140.

The cable 155 is anchored at one end thereof to the reel 140 in the groove 145, the free end of the cable 155 being wound around the reel 140 in the groove 145 and extending therefrom through an outlet opening (not shown) in the flange 149 of the cover plate 148. The cable 155 has a loop 159 formed in the free end thereof which is disposed in use in the channel 127 of the coupler 125. It will be noted that the clearance between the cover plate flange 149 and the periphery of the flanges 144 of the reel 140 is less than the thickness of the cable 155 to prevent the cable 155 from unspooling from the reel 140.

The door operating mechanism 100 is also provided with a limit switch assembly, generally designated by the numeral 160, and including a screw 161 received in a complementary internally threaded opening extending axially through the shaft 146 for threaded engagement therewith. Preferably, the screw 161 extends outwardly from the shaft 146 on the opposite side of the mounting bracket 131 from the gearhead motor 150, and is provided at the outer end thereof with a head 162 having an elongated slot 163 formed therein. Disposed adjacent to the head 162 of the screw 161 is a toggle-type limit switch 165 having a switch lever 164 disposed in the slot 163 in the head 162 of the screw 161. In use, as the reel 140 rotates, the screw 161 will not rotate, but will move axially either inwardly or outwardly of the shaft 146 depending upon the direction of rotation of the reel 140. Thus, at a predetermined point in its axial travel in an outward direction the head 162 of the screw 161 will move the switch lever 164 to a first position (see FIG. 9) for operating the limit switch 165 to a first condition and, at a predetermined point in the inward axial movement of the screw 161, the head 162 will move the switch lever 164 to a second position (not shown) for operating the limit switch 165 to a second condition.

Referring now to FIG. 11 of the drawings, there is shown a schematic circuit diagram of a control circuit 170 for the drive assembly 130 of the present invention. The motor 151 is provided with an armature 171 together with a series field coil (not shown) and a reversing field coil 172, the motor 151 preferably being adapted for operation with 60 Hz, 110 volt, AC electric

power, a suitable source of such electric power (not shown) being provided and having power lines L1 and L2. The control circuit 170 includes the limit switch 165 and a latching relay, generally designated by the numeral 175. The limit switch 165 is a double-pole, double-throw switch and includes a movable contact 166a having a pair of fixed contacts 167a and 168a associated therewith, and a movable contact 166b having a pair of fixed contacts 167b and 168b associated therewith, the movable contact 166a being connected to the power line L1. As indicated above, the movable contacts 166a and 166b of the limit switch 165 are mechanically movable by the action of the screw 161 in response to the rotation of the reel 140, this mechanical linkage being indicated in dashed lines in FIG. 11. The latching relay 175 is also of the double-pole, double-throw variety and includes a coil winding 173 and an armature 174 and a pair of movable contacts 176a and 176b, the movable contact 176a having a pair of fixed contacts 177a and 178a associated therewith, and the movable contact 176b having a pair of fixed contacts 177b and 178b associated therewith. The fixed contact 178a is connected to the power line L2. The terminals of the relay coil 173 are connected to a suitable source of electric power through a switch 180. For example, the coil 173 may be connected across the power lines L1 and L2 or may be provided with a separate power source. The fixed contacts 167a and 168a of the limit switch 165 are respectively connected to the fixed contacts 178b and 177b of the latching relay 175 by conductors 181 and 182. The fixed contact 167b of the limit switch 165 is connected to the fixed contact 177a of the latching relay 175 by a conductor 183, and is also connected to one terminal of the armature 171 of the motor 151 by a conductor 184. The fixed contact 168b of the limit switch 165 is directly connected to the power line L2 by a conductor 185, and the movable contact 166b of the limit switch 165 is connected to one terminal of the field coil 172 of the motor 151 by a conductor 186. The other terminals of the field coil 172 and the armature 171 of the motor 151 are respectively connected to the movable contacts 176a and 176b of the latching relay 175 by conductors 187 and 188.

The operation of the door operating mechanism 100 will not be described in detail. When the garage door 60 is in the closed position thereof indicated in FIGS. 1 to 3, and the latch member 115 is in the locking configuration thereof indicated in FIGS. 2, 4 and 5, the garage door 60 will be securely locked in its closed position. As can be seen from FIG. 3, the movement of the garage door 60 from the closed position to the open position thereof along the tracks 70 requires an initial vertical upward movement of the top panel 61 before the upper one of the rollers 68 will begin to move rearwardly along the arcuate flights 75 and the horizontal flights 74 of the tracks 70. However, since the latch member 115 is held securely against the keeper plate 120 and beneath the abutment surface 123 thereof by the torsion spring 114, the slightest upward movement of the garage door 60 will cause the latch member 115 to engage the abutment surface 123 to prevent any further upward movement of the garage door 60. It will be apparent that for this purpose, the vertical clearance between the bight 111 of the latch member 115 and the

abutment surface 123 of the keeper plate 120 when the garage door 60 is in its closed position should be less than the distance of initial vertical travel of the garage door 60 before it begins its rearward movement along the tracks 70. When the garage door 60 is in its closed position, the movable contacts of the limit switch 165 and the latching relay 175 will be in the positions indicated in FIG. 11.

When it is desired to open the garage door 60, it is necessary only to close the switch 180, which switch may be of the manual push-button or key type, photoelectric controlled, radio controlled or any of several other well known types of switch. Upon closing of the switch 180, a circuit is closed for energizing the relay coil 173 and actuating the movable contacts 176a and 176b into contact with the fixed contacts 178a and 178b respectively, the movable contacts 176a and 176b being latched in this latter position. This actuation of the latching relay 175 will close an energizing circuit for the motor 151 including power line L1, contacts 166a and 167a of limit switch 165, conductor 181, contacts 178b and 176b of latching relay 175, conductor 188, armature 171, conductor 184, contacts 167b and 166b of limit switch 165, conductor 186, field coil 172, conductor 187, contacts 176a and 178a of latching relay 175 and power line L2. Thus energized, the motor 151 will be operated in a winding condition which will effect rotation of the reel 140 in a winding direction (clockwise as viewed in FIGS. 1 and 8) for winding the cable 155 onto the reel 140.

The initial movement of the cable 155 toward the reel 140 will serve to pull the latch member 115 from its locking configuration to an unlocking configuration extending rearwardly of the garage door 60 and clearing the abutment surface 123 of the keeper plate 120, for thereby permitting upward movement of the garage door 60. Further movement of the cable 155 toward the reel 140 will serve to pull the garage door 60 upwardly and rearwardly along the track 70 in an obvious manner. Preferably, the tension in the counterbalance springs 181 will be such that only a slight force is required to move the garage door 60 into its open position, whereby only a relatively small electric motor 151 will be required in the door operating mechanism 100 of this invention. The screw 161 is so set with respect to the hollow shaft 146 of the reel 140 that when the reel 140 has rotated through a sufficient angle to move the door 60 to a completely open position, the screw 161 will have been drawn axially into the shaft 146 a sufficient distance to actuate the limit switch 165 to an off position, thereby moving the movable contacts 166a and 166b thereof into engagement with the fixed contacts 168a and 168b respectively. As can be seen from FIG. 11, this actuation of the limit switch 165 opens the energizing circuit for the motor 151, thereby deactuating the motor 151 and terminating the rotation of the reel 140. At this point, the door 60 will be held in its open position by the internal friction of the gear head 152 or, if necessary, by a brake on the motor drive shaft 153.

When it is desired to close the garage door 60, the switch 180 is again closed, thereby energizing the relay 175 and latching the movable contacts 176a and 176b thereof back into the positions indicated in FIG. 11. This actuation of the latching relay 175 closes a second

energizing circuit for the motor 151 through the power line L1, the contacts 166a and 168a of the limit switch 165, conductor 182, contacts 177b and 176b of latching relay 175, conductor 188, motor armature 171, conductors 184 and 183, contacts 177a and 176a of latching relay 175, conductor 187, motor field coil 172, conductor 186, contacts 166b and 168b of limit switch 165, conductor 185 and power line L2. It will be noted that in this second energizing circuit the electric current flows through the motor field coil 172 in the opposite direction to its flow in the first-described energizing circuit, whereby the motor 151 will be operated in an unwinding condition for effecting rotation of the reel 140 in an unwinding direction (counterclockwise as viewed in FIGS. 1 and 8) for paying out the cable 155 from the reel 140. Thus, since the braking effect of the motor 151 is no longer exerted on the cable 155, the door 160 is permitted to return to its closed position under the urging of gravity. The unwinding of the cable 155 will continue until the door 60 is completely closed and rests upon the driveway 56, and then will continue a slight bit further to permit movement of the latch member 115 back to its locking configuration beneath the abutment surface 123 under the urging of the torsion spring 114. It will be noted that the keeper plate 120 is sufficiently wide to allow for a slightly off-center condition of the door 60 or latch member 115 and still permit the latch member 115 to return to a locking configuration beneath the abutment surface 123. The screw 161 is set with respect to the shaft 146 and the limit switch 165, so that when the reel 140 has rotated through a sufficient angle in the unwinding direction to permit the door 60 to return to its closed position and the latch member 115 to return to its locking configuration, the screw 161 will have moved axially outwardly of the shaft 146 a sufficient distance to actuate the limit switch 165 back to the position indicated in FIG. 11 of the drawings. When thus actuated, the limit switch 165 opens the second energizing circuit for the motor 151 with resultant deactuation of the motor 151 and termination of the rotation of the reel 140. The door 60 is now again securely locked in its closed position and can be opened only by another closing of the switch 180, as described above.

It is an important feature of the present invention that the door operating mechanism 100 is extremely simple and economical, involving no cable or chain loop, no cable or chain head pulley, no door operating arms and no linkages, tensioning devices, locking devices or structures for maintaining loop tension. In addition, the door operating mechanism 100 utilizes an extremely simple switching apparatus. This greatly simplifies the packing and installation of the door operating mechanism 100.

The cable 155 may be formed of any suitable material, such as one-eighth inch polyethylene or polypropylene or nylon rope instead of the usual roller chains or steel cable. Since the counterbalance springs 181 can be set so that a very slight force will be sufficient to open or close the garage door 60 or to stop the door 60 in its movement between the open and closed positions thereof, it is unnecessary to include automatic motor-reversing features in the door operating mechanism 100 of the invention. However, it will be noted that in this arrangement, if the garage door 60

should become stuck or hung-up on some object during its downward travel, the motor 151 will continue running and rotating the reel 140 in its unwinding direction until it is rotated through a sufficient angle to actuate the limit switch 165. Accordingly, the groove 145 in the reel 140 is made of a depth greater than that required to accommodate the wound cable 155 thereon, so as to also accommodate loose loops of the cable 155 when it is unwound but not paid out from the reel 140.

While the door operating mechanism 100 has been illustrated in connection with a sectional, tracked overhead garage door with tension-type counterbalance springs, it will be recognized that the door operating mechanism 100 may also be used with other types of overhead doors. For example, the door operating mechanism 100 may be used with sectional overhead doors having torsion-type balance springs; with flat, single-panel tracked doors; or with flat single-panel trackless doors provided with a stabilizing arm; as well as other types of doors not here mentioned.

From the foregoing, it will be seen that there has been provided a novel door actuating mechanism for an overhead garage door, the door operating mechanism being of extremely simple and economical construction and characterized by ease of installation and operation.

More particularly, there has been provided a door operating mechanism which includes a reel and a cable interconnecting the reel and the garage door, and means for rotating the reel in winding and unwinding directions for opening and closing the garage door.

In addition, there has been provided a novel latch mechanism for locking the garage door in its closed position, the latch mechanism being automatically unlatched when the cable is wound on the reel. There has also been provided a novel mechanical linkage between the drive motor and the reel assembly including a pinion and an internal gear.

Finally, there has been provided a simple and efficient electric control circuit for automatically deactuating and reversing the drive motor after each opening and each closing of the garage door.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. The combination for use with an associated building having a door-receiving opening therein, said combination comprising a door mounted for movement between a closed position and an open position with respect to the door-receiving opening and biased toward the closed position thereof, a reel mounted on the associated building for rotation in a winding direction and an unwinding direction, said reel including a central hub and a peripheral cable channel and a radially extending web interconnecting said hub and said channel and recessed with respect thereto, a cable coupled at one end thereof to said reel and coupled at the other end thereof to said door, an annular gear having teeth formed internally thereof and being fixedly secured to said cable channel substantially coaxial with

said reel, a motor mounted adjacent to said reel and provided with a rotatably driven output shaft and having a winding condition and an unwinding condition, and a pinion gear coupled to said output shaft and projecting inwardly of said annular gear and disposed in meshing engagement therewith for transferring the rotational movement of said output shaft to said reel, the recess in said reel freely accommodating the portion of said pinion gear projecting inwardly of said annular gear to provide a compact coupling between said motor and said reel, said motor in the winding condition thereof effecting rotation of said reel in the winding direction for winding said cable on said reel thereby to move said door from the closed position thereof to the open position thereof, said motor in the unwinding condition thereof effecting rotation of said reel in the unwinding direction for paying out the cable on said reel thereby to permit movement of said door from the open position thereof to the closed position thereof, whereby operation of said motor in the winding condition thereof effects automatic movement of said door from the closed position thereof to the open position thereof and operation of said motor in the unwinding condition thereof effects automatic movement of said door from the open position thereof to the closed position thereof.

2. The combination set forth in claim 1, wherein said motor comprises a reversible electric gear head motor.

3. The combination for use with an associated building having a door-receiving opening therein, said combination comprising a door mounted for movement between a closed position and an open position with respect to the door-receiving opening and biased toward the closed position thereof, a latch member mounted on said door and movable between a locking configuration and an unlocking configuration and biased toward the locking configuration thereof, a keeper mounted on the associated building adjacent to said latch member and cooperating therewith when said door is in the closed position thereof and said latch member is in the locking configuration thereof for locking said door in the closed position thereof, a reel mounted on the associated building for rotation in a winding direction and an unwinding direction, said reel including a central hub and a peripheral cable channel and a radially extending web interconnecting said hub and said channel and recessed with respect thereto, a cable coupled at one end thereof to said reel and coupled at the other end thereof to said latch member, an annular gear having teeth formed internally thereof and being fixedly secured to said cable channel substantially coaxial with said reel, a motor mounted adjacent to said reel and provided with a rotatably driven output shaft and having a winding condition and an unwinding condition, a pinion gear coupled to said output shaft and projecting inwardly of said annular gear and disposed in meshing engagement therewith for transferring the rotational movement of said output shaft to said reel, the recess in said reel freely accommodating the portion of said pinion gear projecting inwardly of said annular gear to provide a compact coupling between said motor and said reel, said motor in the winding condition thereof effecting rotation of said reel in the winding direction for winding said cable on said reel to thereby move said latch member from the

locking configuration thereof to the unlocking configuration thereof and thereafter to move said door from the closed position thereof to the open position thereof, said motor in the unwinding condition thereof effecting rotation of said reel in the unwinding direction for paying out the cable on said reel thereby to permit movement of said door from the open position thereof to the closed position thereof and thereafter to permit movement of said latch member from the unlocking configuration thereof to the locking configuration thereof, means for actuating said motor to the winding and unwinding conditions thereof, and control apparatus directly coupled to said reel and to said motor and responsive to rotation of said reel through a predetermined angle for automatically de-actuating said motor upon movement of said latch member from the locking configuration thereof to the unlocking configuration thereof and subsequent movement of said door from the closed position thereof to the open position thereof and for automatically de-actuating said motor upon movement of said door from the open position thereof to the closed position thereof and subsequent movement of said latch member from the unlocking configuration thereof to the locking configuration thereof, whereby actuation of said motor to the winding condition thereof effects automatic movement of said latch member from the locking configuration thereof to the unlocking configuration thereof and thereafter effects automatic movement of said door from the closed position thereof to the open position thereof with resultant automatic de-actuation of said motor and whereby actuation of said motor to the unwinding condition thereof effects automatic movement of said door from the open position thereof to the closed position thereof and thereafter effects automatic movement of said latch member from the unlocking configuration thereof to the locking configuration thereof with resultant automatic de-actuation of said motor.

4. A door operating mechanism for use with a door mounted in an associated building having a door-receiving opening therein for movement between a closed position and an open position with respect to the door-receiving opening therein for movement between a closed position and an open position with respect to the door-receiving opening with the door being biased into the closed position thereof, said door-operating mechanism comprising a reel mounted on the associated building for rotation in a winding direction and an unwinding direction, said reel including a central hub and a peripheral cable channel and a radially extending web interconnecting said hub and said channel and recessed with respect thereto, a cable coupled at one end thereof to said reel and coupled at the other end thereof to the associated door, an annular gear having teeth formed internally thereof and being fixedly secured to said cable channel substantially coaxial with said reel, a motor mounted adjacent to said reel and provided with a rotatably driven output shaft and having a winding condition and an unwinding condition, and a pinion gear coupled to said output shaft and projecting inwardly of said annular gear and disposed in meshing engagement therewith for transferring the rotational movement of said output shaft to said reel, the recess in said reel freely accommodating the portion of said pinion gear projecting inwardly of said an-

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nular gear to provide a compact coupling between said motor and said reel, said motor in the winding condition thereof effecting rotation of said reel in the winding direction for winding said cable on said reel thereby to move the associated door from the closed position thereof to the open position thereof, said motor in the unwinding condition thereof effecting rotation of said reel in the unwinding direction for paying out the cable on said reel thereby to permit movement of the associated door from the open position thereof to the closed position thereof, whereby operation of said motor in the winding condition thereof effects automatic movement of the associated door from the closed position thereof to the open position thereof and operation of said motor in the unwinding condition thereof effects automatic movement of the associated door from the open position thereof to the closed position thereof.

5. A door-operating mechanism for use with a door mounted in an associated building having a door-receiving opening therein for movement between a closed position and an open position with respect to the door-receiving opening therein for movement between a closed position and an open position with respect to the door-receiving opening with the door being biased into the closed position thereof, said door-operating mechanism comprising a reel having an annular recess formed therein and being mounted on the associated building for rotation in a winding direction and an unwinding direction, a cable coupled at one end thereof to said reel and coupled at the other end thereof to the

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associated door, an annular gear having teeth formed internally thereof and being fixedly secured to said reel about the periphery of said annular recess substantially coaxial with said reel, a motor mounted adjacent to said reel and provided with a rotatably driven output shaft and having a winding condition and an unwinding condition, and a pinion gear coupled to said output shaft and projecting inwardly of said annular gear and disposed in meshing engagement therewith for transferring the rotational movement of said output shaft to said reel, the recess in said reel freely accommodating the portion of said pinion gear projecting inwardly of said annular gear to provide a compact coupling between said motor and said reel, said motor in the winding condition thereof effecting rotation of said reel in the winding direction for winding said cable on said reel thereby to move the associated door from the closed position thereof to the open position thereof, said motor in the unwinding condition thereof effecting rotation of said reel in the unwinding direction for paying out the cable on said reel thereby to permit movement of the associated door from the open position thereof to the closed position thereof, whereby operation of said motor in the winding condition thereof effects automatic movement of the associated door from the closed position thereof to the open position thereof and operation of said motor in the unwinding condition thereof effects automatic movement of the associated door from the open position thereof to the closed position thereof.

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