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R. D. HOUK

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GARAGE DOOR AND OPERATOR

Filed April 30, 1962

4 Sheets-Sheet 1

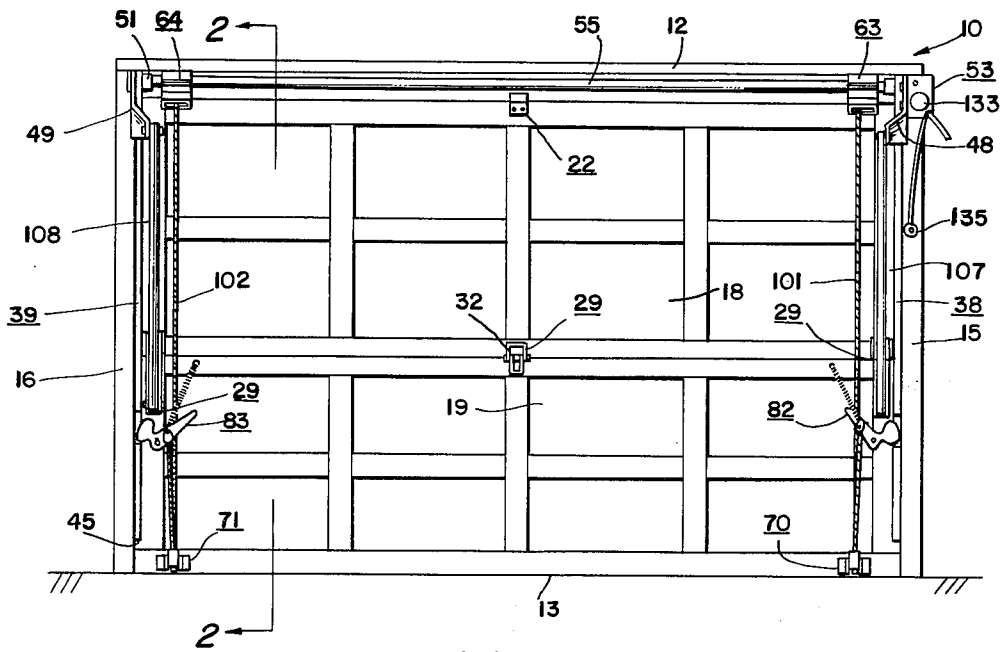


Fig. 1

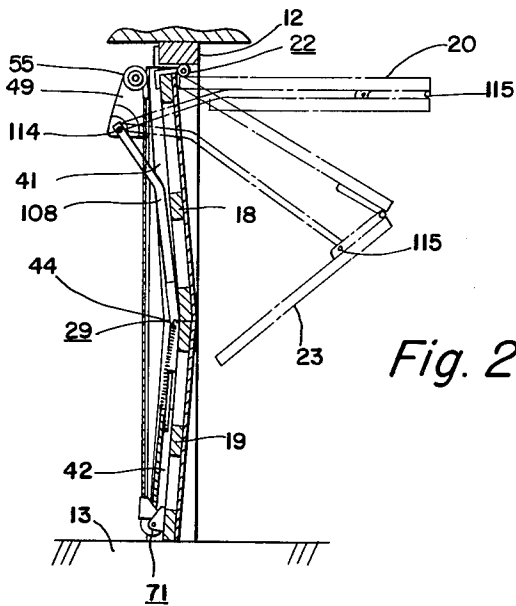


Fig. 2

INVENTOR
Richard D. Houk
BY Woodling, Knost
Changer and Rust
ATTORNEYS

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R. D. HOUK

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4 Sheets-Sheet 2

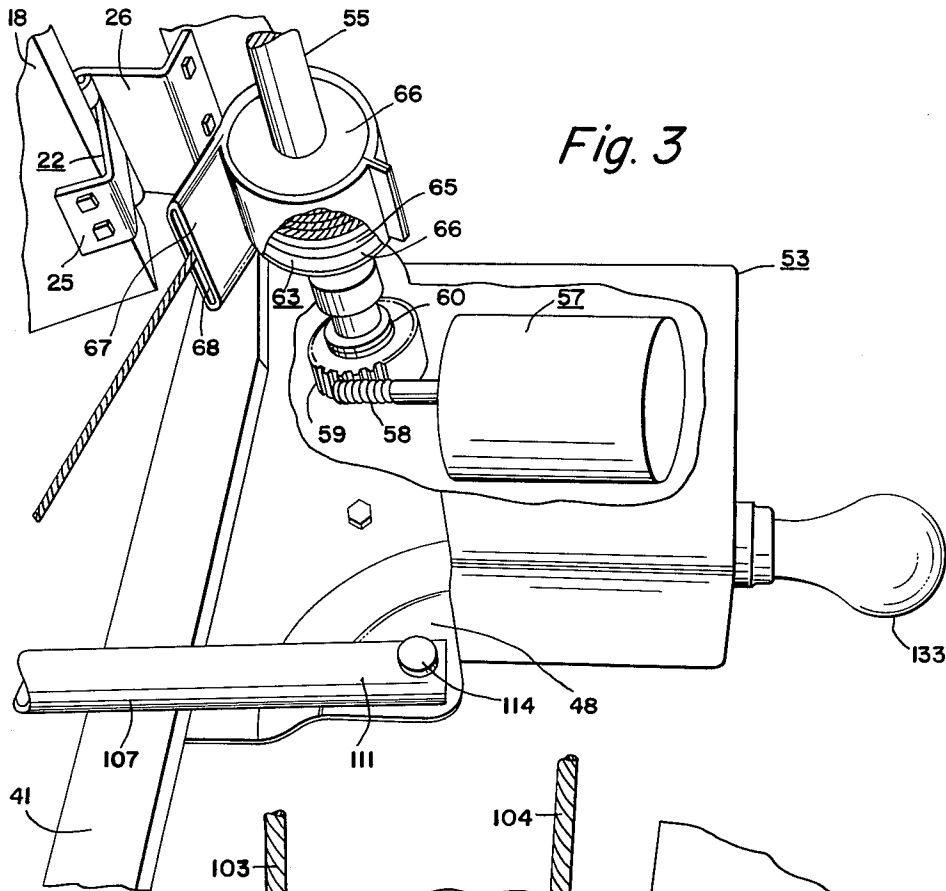
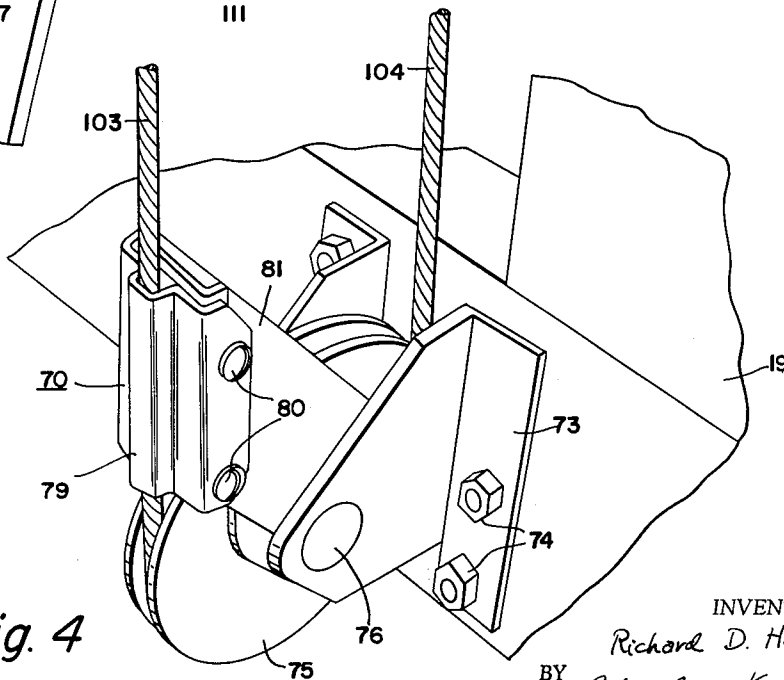


Fig. 4

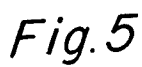


INVENTOR.
Richard D. Houk
BY Woodling, Krost,
Shaner and Rust
ATTORNEYS

Filed April 30, 1962

GARAGE DOOR AND OPERATOR

4 Sheets-Sheet 3



INVENTOR.
Richard D. Houk
BY Woodling, Krost,
Shanger and Rust
ATTORNEYS

Dec. 21, 1965

R. D. HOUK

3,224,492

GARAGE DOOR AND OPERATOR

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4 Sheets-Sheet 4

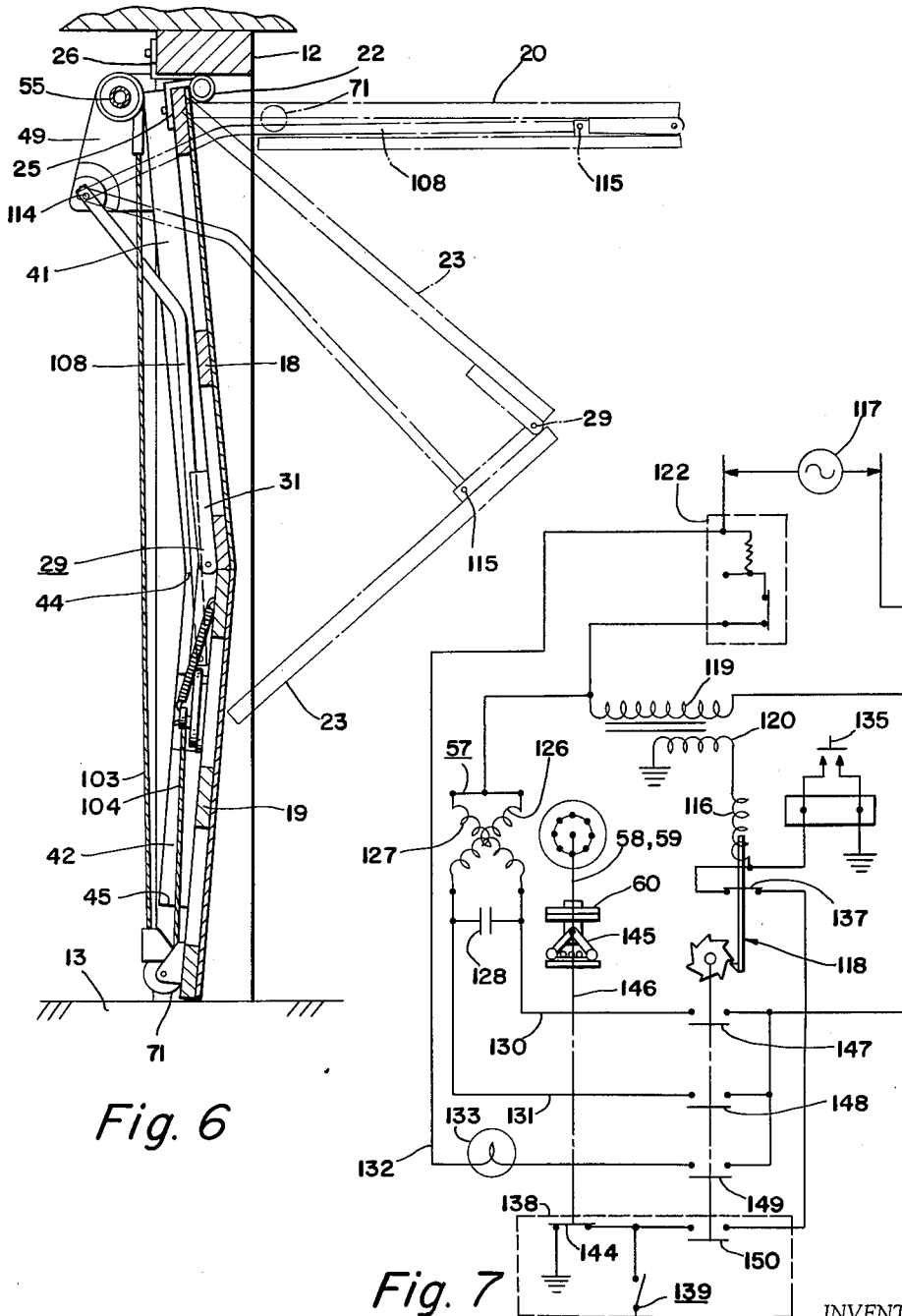


Fig. 6

Fig. 7

INVENTOR.

Richard D. Houk

BY

Woodling, Krost,
Shanger and Rust
ATTORNEYS

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3,224,492

GARAGE DOOR AND OPERATOR

Richard D. Houk, Alliance, Ohio, assignor to Consolidated Electronics Industries Corporation, a corporation of Delaware

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8 Claims. (Cl. 160—189)

The invention relates in general to garage doors and operators and more particularly to an operator and door wherein the door has at least two panels which open in an upward folding manner.

Garage doors of the upward acting type have become increasingly popular and in the last ten to twenty years have far exceeded the use of horizontally swinging garage doors.

Many types of upward acting garage doors have been sold and still more types have been devised. The basic factors for the popularity of upward acting garage doors has been that the door lifts upwardly out of any snow which may be on the ground and thus the annoyance of having snow in front of outwardly swinging garage doors is avoided. A single panel type of door which swings outwardly at the bottom and inwardly at the top into the inside of the garage has been popular in some cases, primarily in the Western part of the United States. Such a door has the disadvantages of requiring considerable room inside the garage for hardware such as pivot arms to control the upward and inward swinging movement of the door. Also, a considerable amount of head room above the door opening is required inside the garage and, still further, a considerable amount of room horizontally inwardly from the top of the door is required within the garage in order to accommodate the door in the open position. This type of door has the advantage of economy of construction, being only a single slab or panel and has fairly good economy of hardware. It has the additional disadvantage of requiring a fairly large opening all the way around the door about $\frac{3}{4}$ " on the two sides and the top, and no door stop can be provided because the door swings both partially inwardly and partially outwardly. Thus, this western type of door is unsatisfactory in the colder climates where snow would drift in around the large opening around the door. Also, the slight outward movement of the door at the bottom during opening movement means it would have to push some snow out of the way and would also drag some snow down under the door during closing.

The aforementioned disadvantages of the single panel door have accounted for the progressively increasing popularity of the overhead sectional door, for example four sections or panels which move upwardly and inside the garage on track guided rollers. The popularity of such door is increasing despite the fact that the completely assembled and installed door is about three times as expensive as the single panel western type door. The expense of the overhead sectional door is caused by the expense of the increased amount and complexity of hardware including the two L-shaped tracks, the ten rollers for a four section door, the many hinges, the counterbalance springs and the complexity of constructing and installing four panels instead of one. Nevertheless, this door has the advantage of lifting directly upwardly out of any snow for easy opening and also moving slightly inwardly away from outside mounted door stops to minimize frictional drag against the door stops. The sectional door also has the disadvantage of requiring a fair amount of head room above the door frame header, for example about one foot to 18", and also requiring a large amount of space within the garage inwardly of the door frame

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header along the ceiling to accommodate the door in the open position.

Accordingly, it is an object of the present invention to provide an upward acting door and operator of sufficiently simple construction and installation so that the door may be provided with a motorized operator for approximately the same cost as the added hardware in an overhead sectional door so that a completely motorized door may be provided for approximately the same cost as an installed overhead sectional door yet with the complete door and operator retaining the advantages of an upward acting door to easily clear any snow on the ground and also to have the advantages of door stops for a tight fitting door in the door frame opening.

An added advantage of the combined door and operator of the present invention is that there is not only economy of hardware but there is economy of space required for the hardware so that a minimum, or in some cases no head room is required above the header, and a minimum of space is required horizontally inwardly from the door header.

Another added advantage of the door of the present invention is that the hardware providing the upward action of the door also supports a majority of the weight of the door during the entire opening and closing movement to thus establish a door construction wherein the motorized operator need never lift more than 50% of the entire weight of the door and thus an ordinary size fractional H.P. motor provides sufficient power to lift the door to open the door in a normal time of ten to fifteen seconds without help from any counterbalance means and thus the entire door and operator may be even more simply and economically constructed and installed.

An object of the present invention is to provide a motorized garage door wherein the majority of the door hardware is eliminated.

Another object of the present invention is to provide a motorized garage door which has an upward opening door whose movement is not restricted by snow or similar material.

Another object of the present invention is to provide a motorized garage door which requires little or no space above the top of the garage door opening.

Another object of the present invention is to provide a motorized garage door which does not require tracks, rollers or counterbalance springs.

Another object of the invention is to provide a combined motorized operator and door with simple hardware for economical fabrication and installation such that the economy of the hardware compensates for the cost of the motor.

Another object of the invention is to provide a combined door and operator with simple door construction and installation to permit ready fabrication of the door at the building site by ordinary carpenter labor.

Another object of the present invention is to provide a motorized garage door which has an upward opening action which initially lifts in and up to avoid snow and the like.

Another object of the present invention is to provide a motorized garage door which has no sliding or rubbing movement relative to the door stops during opening and closing movement to thus minimize frictional drag.

Another object of the present invention is to provide a motorized garage door which requires very little space inside the garage for equipment.

Another object of the present invention is to provide a motorized garage door wherein the motive power means is never required to support more than forty percent of the total weight of the door.

Another object of the present invention is to provide a garage door wherein the door stops are located between the door and the interior of the garage so that wind blows the door more tightly against the stops.

Another object of the invention is to provide an upward acting garage door of simple hardware construction which supports a majority of the weight of the door during the entire opening and closing movements to thus lighten the burden on the motorized operator to preclude the necessity for any counterbalance springs or weights, thus providing further economy to offset the cost of the motor.

Another object of the invention is to provide an upward acting garage door and operator of simple construction which in the door closed position will support the entire weight of the garage door and which only slowly transfers the weight of the door to the motor operator as the door is opened to thus achieve a door requiring only a lower starting torque.

Another object of the present invention is to provide a garage door which includes at least upper and lower panels movable to open position in an upward folding movement and in closed position each panel making an acute angle with the vertical giving a slightly bent appearance to the door.

Another object of the present invention is to provide a motorized garage door which includes at least upper and lower swingably connected panels and a drive shaft or torque bar rotatively driven with cable means connected at one end to the drive shaft and at the other end connected to the lower panel.

Another object of the present invention is to provide a motorized garage door which includes swingably connected panels with a latch mechanism acting between at least one of the panels and a door frame and cable means extending between drive means and the latch mechanism whereby the drive mechanism and cable means first unlocks the latch mechanism and then opens the door. Spring means are provided for the latch mechanism whereby upon closing of the door the spring means accomplishes moving the latch to locked condition.

Another object of the present invention is to provide a motorized garage door which includes a drive means with connection means between the door and drive means whereby upon actuation of the drive means the door is opened and upon closing movement of the door the drive means acts as a brake for the door.

Another object of the present invention is to provide a latch mechanism for a motorized garage door which includes a pivotally mounted latch lever or cam lock and a lock stop or plate with cable means connected to the lever for unlocking the mechanism and spring means acting on the lever for locking the mechanism.

Another object of the present invention is to provide a cable drum and drum guard for use with a drive shaft and cable of a motorized garage door.

Another object of the present invention is to provide a motorized garage door which includes upper and lower swingably connected door panels with the lower panel being shorter than the upper panel and motion directing means acting between the door and door frame to open the door with an upward folding movement of the panels and the lower portion of the lower panel moves upwardly and outwardly of the door frame.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is an elevational view of the garage door and operator constructed under the teachings of the present invention;

FIGURE 2 is a view taken generally along the line 2—2 of FIGURE 1 and showing the opened and closed positions of the door panels as well as an intermediate position;

FIGURE 3 is an enlarged perspective view with some parts broken away of a portion of the garage door and operator shown in the upper right portion of FIGURE 1;

FIGURE 4 is an enlarged perspective view of a cable sheave shown in the lower right portion of FIGURE 1;

FIGURE 5 is an enlarged perspective view of a latch mechanism utilized in locking and unlocking the door and as shown in FIGURE 1 on the right edge of the lower door panel;

FIGURE 6 is a view similar to FIGURE 2 but showing the garage door enlarged; and

FIGURE 7 is a circuit diagram showing the power and control circuit for controlling the opening and closing movements of the garage door.

The present invention relates to a garage door and operator therefor and sometimes referred to as a motorized garage door indicated generally by the reference numeral 10, and this unit is adapted to be located in a generally rectangularly shaped opening in a building structure such as a garage. The opening to the garage may be said to be defined by spaced upper and lower walls 12 and 13, the upper wall sometimes referred to as a header and spaced first and second side walls 15 and 16 respectively, also sometimes referred to as jamb members. The garage door includes upper and lower door panels 18 and 19, respectively, which are movable between open and closed positions. The closed position of the door panels is shown in FIGURE 1 and the full line drawing of FIGURES 2 and 6, the completely open position of the door panels is indicated by the dot-dash position 20 of FIGURES 2 and 6, and the mid-position of the door panels is shown by the dot-dash lines 23.

First hinge means 22 pivotally connect the upper portion of the upper door panel to the header 12. The first hinge means are sometimes referred to as first means for swingably mounting the upper door panel. In the particular embodiment of the motorized garage door shown in the accompanying figures, the first hinge means includes three hinges 24 which includes a portion 25 secured to the top edge of the upper door panel 18, and another portion 26 secured to the header 12. It will be noted from FIGURES 2, 3 and 6 that the pivot center of the hinge is off center or generally in line with the front face of the garage door. If it were not for the off center pivot it would be necessary to cut clearance for the hinges 24 in the header 12.

Second hinge means 29 are provided for pivotally connecting the upper portion of the lower door panel 19 to the lower portion of the upper door panel 18. This second hinge means 29 is sometimes referred to as second means for swingably connecting the upper and lower door panels together. The second hinge means includes two outboard hinges 31 at either side of the door panels and an inboard hinge 32. The outboard hinges include an upper portion 34 and a generally channel shaped lower portion 35. The upper and lower portions 34 and 35 are adapted to pivot about pin 36. It will be noted from the drawings that the pivot point for the second hinge means is located at a place quite close to the inner face of the garage door.

The garage door is provided with first and second door stop members 38 and 39 respectively secured to the first and second jambs 15 and 16, respectively. Each of the door stop members is divided into what may be referred to as upper and lower portions 41 and 42, respectively, and these portions have meeting ends indicated generally at 44 located closely adjacent the second hinge means 29 when the door panels are in their closed position. As will be noted, the door stop members have what may be referred to as a bent appearance and the meeting ends 44 are located slightly outwardly or toward the outside of the garage or other enclosure from a vertical line which might be extended through other parts of the upper and lower portions of the first and second door stop members 38 and 39. It will be noted that the lower portion of

the door stop members terminates at a point 45 a distance from the lower wall or floor 13 and this is to provide clearance for the initial movement of the lower edge of the lower panel upon opening movement of the door and the reverse, namely, the final closing movement of the garage door. The upper panel 18 engages the upper portions 41 of the first and second stop members and the lower door panel 19 engages the lower portions 42 of the first and second door stop members in their closed positions thereby causing the upper and lower door panels at the second hinge means 29 to be spaced slightly outwardly from a vertical line through the first hinge means 22. This gives the garage door the same slightly bent condition which was described hereinabove in conjunction with the door stop members. It may also be said that each of the upper and lower door panels makes an acute angle with a vertical plane when the door panels are in their closed positions.

First and second jamb brackets or plates 48 and 49 respectively are respectively mounted by suitable means on the first and second jambs 15 and 16 respectively. The jamb bracket 49 is provided with bearing means 51 not shown in detail and the jamb bracket 48 serves to mount an actuator 53 sometimes generally referred to as drive means. The jamb brackets 48 and 49 are so constructed that the bearing means and actuator may be mounted interchangeably. The reason for this is that there may not be sufficient clearance in the garage for the actuator to always be mounted on one side or the other, as a result the jamb bracket is so constructed that the actuator may be mounted on either one. As mentioned the bearing means may be mounted on either of the jamb brackets. A torque tube 55 sometimes referred to as a drive shaft is provided which has its left end as viewed in FIGURE 1 rotatively mounted by the bearing means 51 and its other end is rotatively mounted in the actuator 53. An electric motor 57 forms a part of the actuator 53 and drives the torque tube 55 through the medium of a worm gear 58, gear or worm wheel 59, and friction clutch 60 (see FIGURE 3). The gears 58 and 59 constitute speed reduction means and the worm gear 58 provides irreversible power direction means. This is because the worm gear 58 is not capable of being driven by the gear 59 and torque tube 55 because of the weight of the two door panels for example in their raised or open position. On garage doors which are on the order of ten feet and over in width, there are generally provided one or more inboard bearings for the torque tube. These inboard bearings (not shown) prevent the torque tube from whipping because of the length of the same. The inboard bearings are adapted to be mounted in adjustable brackets which in turn would receive their support from the header 12.

First and second cable drums 63 and 64, respectively, are suitably secured to opposite end portions of the torque tube for rotation therewith as generally seen in FIGURE 1. In the embodiment illustrated in the drawings, two cable drums have been illustrated, however, a small enough door might utilize only a single such drum in the center whereas a wider door might utilize more than two. Each of the cable drums 63 and 64 comprises a central cylindrical core surface having grooves 65 formed therein to guide the cable which it is adapted to receive to prevent it from overlapping. The cable drums also comprise two side flanges 66 and about the flanges 66 is positioned a cable drum guard 67. This drum guard has a loose rotational fit with the outer circumference of flanges 66 so as to substantially maintain the position shown for example in FIGURES 1 and 3 with respect to the ground while the cable drum are rotating with the torque tube. Each of the drum guards is provided with an opening 68 which receives cable being wound on the drum. The purpose of the drum guard is to prevent cable from coming off the cable drum in case tension on the cable is lost by raising the door manually. The clearance between

the drum guard and the drum core is such that it must not permit the cable to come out of its groove.

First and second cable sheaves indicated generally by the reference numerals 70 and 71 are mounted on the lower portion of the lower door panel substantially vertically below the respective cable drums 63 and 64. Each of the cable sheaves includes a bracket 73 secured to the door panel by bolts 74 and a circular flanged sheave member 75 is rotatively connected to the bracket by means of a pin 76. A cable sheave guard 79 is provided with each of the cable sheaves 70 and 71 and is secured to a pivot bracket 81 by means of screws 80. The pivot bracket 81 is pivoted on the pin 76 to have a cable opening for the reception of a first run 84 of a cable. The cable opening of the cable sheave guard 79 thus always remains tangent to the sheave 75 as guard 79 pivots on pin 76 and this assures that the cable first run 84 which extends to the sheave member 75 will not leave this sheave in case the tension on the cable is lost.

First and second door lock mechanisms 82 and 83 respectively are located on either side of the lower door panel between the upper and lower portions thereof and generally adjacent the first and second door jambs. The function of the door lock mechanisms is to lock the garage door once it is moved to its closed position and to perform the function of unlocking the door immediately prior to initial opening movement thereof. Each of the door lock mechanisms includes a lever member 85 and a pivot 86 sometimes referred to as pivot means pivotally connects the lever member to the lower door panel. A cam latch member or portion 87 which is formed in this instance integrally with the lever member 85 and is located generally on an opposite side of the pivot 86 as distinguished from the lever member. This cam latch member therefore is movable about the pivot 85 in accordance with the movement of the lever member. As will be seen from the drawings, the cam latch member is adapted to cooperate with a latch plate 89 which is secured on the door jamb by means of screws 90. One portion of the cam latch member indicated by the reference numeral 91 and referred to as the lead portion is located more inwardly from the garage door toward the interior of the garage than a trailing portion 92 of the cam latch member. The construction of the cam latch member 87 assures locking action of the mechanism in the even the closed position of the lower door panel may change because of wind or warpage of the door or similar difficulties. Each of the lock mechanisms also includes a return spring 94 which has first and second end portions. The first end portion of the return spring is secured to the lower door panel 19 above the pivot 86 at 96. A plate 97 is connected to the lever arm by a bolt 98 in such manner that the plate is free to pivot about the bolt. The second or lower end portion of the return spring 94 is secured to the plate 97 through an opening therein as at 99. The locked position of the mechanism 82 in FIGURE 5 is shown in the full line drawing and the dot-dash position indicates the unlocked condition of the mechanism 82 ready for initial opening movement of the door 10. First and second cables 101 and 102 are secured at the upper end to the cable drums 63 and 64, respectively. Each cable has first and second runs 103 and 104, respectively. The first run 103 extends down to the respective sheave 70 or 71 and the second run 104 extends upwardly from the sheave to the respective lever 85 and is anchored at plate 97.

First and second doors arms or central arms 107 and 108, respectively, are provided and each of these door arms has first and second end portions 111 and 112. First pivot members 114 secure the first end portion 111 of the door arms to the respective jamb brackets 48 and 49. It will be noted from FIGURES 1 and 3 that the jamb brackets are offset inwardly toward the door opening at their point of connection with the door arms so as to assure that the door arms miss the first and second

door stops upon opening and closing movement of the door. Second pivot members 115 serve to connect the second end portion 112 of door arms 107 and 108 respectively to the lower door panel by way of their respective connection to the lower portions 35 of the outboard hinges 31. These portions of the outboard hinges are of channel shape and of such width that they receive the end portion 112 of the door arms in the closed condition of the door panels. These control arms 107 and 108 may be considered to be motion directing means for the door panels.

FIGURE 7 shows the power and control circuit for energizing and de-energizing the actuator 53. This circuit includes a 115 volt power source 117 which supplies a coil 116 of power to a ratchet or stepping type relay 118 through a transformer having a primary 119 and secondary 120. An overload protector 122 is located in the circuit from the power source to the primary of the transformer. The electric motor 57 is a capacitor induction type and includes first and second windings 126 and 127 respectively, and a capacitor 128. Electrical circuit means 130 and 131 which are in parallel with each other are provided for energizing the windings of the motor from the power source 117 and another electrical circuit means 132 which includes an electric light 133 is provided which is in parallel with circuits 130 and 131 is also energized from the power source 117. An actuating switch 135 indicated as a push-button switch is provided, and for the purpose of illustration here may also represent the switch which would be actuated by a radio signal from an automobile transmitter, and the circuit which is made by the closing of this switch causes the ratchet type relay 118 to be actuated. The ratchet type relay 118 also includes a normally closed relay position switch 137 actuated by the armature of relay 118 and this switch forms a part of an electrical control circuit 138 and which also includes a cam lock switch 139. The cam lock switch 139 is shown in FIGURE 5 of the drawings and includes a leaf member 140 engageable by a projection 141 on the lever member 85 near and at the locked position of the lock mechanism 82 which causes the leaf like member 140 to engage contact 142 which closes the switch. A torque switch 144 also forms parts of the electrical control circuit 138. The torque switch 144 is controlled by centrifugal members 145 which are driven by the rotor of the electric motor 57 through the medium of the clutch 60. The mechanical connection between the centrifugal members 145 and the torque switch 144 has been indicated by the dot-dash line 146. The ratchet type relay 118 controls the action of selectively actuated contacts 147, 148, 149 and 150 which in turn respectively open or close circuits 130, 131, 132 and the control circuit 138.

The operation of the motorized garage door as disclosed hereinabove is as follows. With the door closed the ratchet type relay is in such position that contacts 147, 148, 149 and 150 are open and switch 139 is closed by the latch lever 85. If it is desired to open the door, the push button actuating switch 135 is pushed thereby causing energization of the ratchet type relay coil 116 through the secondary of the transformer (24 volts in this specific embodiment). This causes actuation of the ratchet type relay, opening contact 137 during energization of relay coil 116 to disable the control circuit 138, and causing contacts 147, 149 and 150 to close whereas contact 148 remains open. This causes the light 133 in circuit 132 to come on and illuminate the garage and causes the winding 127 of the motor to be energized directly from the power source 117 and causes the winding 126 to be energized through the capacitor 128. This causes rotation of the rotor of the motor 57 in the opening direction with subsequent driving of the torque tube or drive shaft 55 through the medium of the worm gear 58, gear 59 and clutch 60. Upon initial acceleration of the rotor of the motor 57, the centrifugal device 145 opens

the torque switch 144 at about one half speed of the motor and initially moves latch lever 85 to open the cam lock switch 139. This is usually within one second for fractional H.P. motors and, thus, a second electrical impulse is not given to the relay coil 116 even though the relay position switch 137 closes upon release of the push button switch 135. This initial taking up of the cables 101 and 102 rotates the lever members 85 of the lock mechanisms 82 and 83 about their respective pivots 86 and at the same time extends the return springs 94. When the pivot 86, bolt 98 and cable sheave are substantially in line, the cables will start to raise the door. If the opening force applied by the cables to the door were applied at the instant the door became unlocked, the door would leap outwardly because of the spring effect in the cables under tension. This is overcome by two actions of the lock mechanism. First the full rotation of the cam latch portion 87 is approximately 100°. The first 30° of rotation unlocks the door and the remaining 70° is lost motion. As the lost motion approaches bottom dead center, that is when the pivot 86, bolt 98 and cable sheave are in line with each other, the opening force is gradually applied to the door. In one specific embodiment, the return springs 94 may have a stress of about 15 lbs. and thus, whenever the cables 101 and 102 supply enough force to overcome this 15 lbs. force, the levers 85 will approach bottom dead center which may be considered a limit position of these levers. Any slight additional pull on the cables begins to open the door and it has been found that only about 20 lbs. total pull on the cables 101 and 102 is sufficient to overcome the force of the springs 94 and commence the door opening movement. This is aided by the fact that the effective toggle of the door panels 18 and 19 has been broken by the slightly bent position established by the door stops 38 and 39. The initial opening movement of the door, because of the motion directing means of the invention, causes the bottom edge of the lower door panel 19 to kick slightly inwardly toward the left as seen in FIGURES 2 and 6 and upwardly. This is permitted because the lower portion 42 of the door stop members does not extend completely to the lower wall 13. This slight inward movement does not continue for long because the lower panel 19 moves bodily outwardly to the mid-position 23 as shown in FIGURE 6. However, this initial inward movement aids in providing clearance relative to any snow which may be on the ground in front of the door.

Continued driving of the drive shaft 55 causes the upper and lower panels to be moved in a folding manner upwardly and outwardly through the dot-dash line position 23 to the fully opened position indicated by the dot-dash line 20, FIGURES 2 and 6. It will be noted in the fully open position that the greater length of the door arms 107 and 108 is received between and parallel to the two panels and the door arms are bent slightly to extend to the pivot connection 114 with the jamb bracket. It will also be noted that the lower door panel is shorter than the upper door panel in the order of five to twenty percent.

When the garage door reaches the completely open position, the door is physically stopped, the clutch 60 slips and the torque switch 144 is caused to be closed by action of the centrifugal members 145 which completes the circuit through the then closed relay position switch 137 to the relay coil 116 by way of the grounded secondary of the transformer which causes the relay to move to its next or door open position at which position contact 149 is closed and contacts 147, 148 and 150 are caused to be opened. The opening of contacts 150 de-energizes relay coil 116. Thus the light 133 remains on and the motor is deenergized. In the open position of the door 10, the worm gear 58 and the gear 59 serve as an irreversible power direction means which prevents

the door from falling closed by the action of gravity without energizing the motor.

Closing action of the door is initiated by pushing the actuating switch 135 which again energizes the coil 116 of the ratchet type relay 118 which causes the same to be moved to a still further position sometimes referred to as a door closing position whereat contacts 148, 149 and 150 are closed and contact 147 is open. In this position the winding 126 of the motor is energized directly from the power source and winding 127 is energized through the capacitor 128 which causes the rotor of the motor to rotate in a closing direction opposite to its rotation in moving the door to its opened position. Again initial motor acceleration opens torque switch 144 and release of push button 135 deenergizes the relay coil 116 to activate control circuit 138 through switch 137. The motor drives the drive shaft 55 in the reverse direction to extend or pay out the cables 101 and 102 from their respective cable drums so that the door moves by gravity from the open position 20 to the closed position shown in the full line drawing of FIGURE 2. The motor 57 is running in the reverse direction but, obviously, it cannot push the door through the means of the cables 101 and 102. Instead, the door closes by gravity with the motor acting as a brake retarding this closing movement. By the use of an essentially constant speed induction motor 57, the closing speed is only slightly greater than the opening speed. As the door comes fully closed, it will be appreciated that there is no longer any weight or force on the cables tending to keep the return springs 94 extended. As the cables pay out, the return springs 94 acting on the lever members 85 cause the cam latch members 87 to rotate into locking engagement with their respective latch plates 89. At the same end of movement the lever arm 85 closes the cam lock switch 139 and energizes the relay coil 116 through the then closed relay position switch 137 which moves the relay contacts to the original position described hereinabove, sometimes referred to as the door closed position. In this position, all of the contacts 147, 148, 149 and 150 move to the open position thereby deenergizing relay coil 116 and stopping the motor and turning off the light 133. The relay position switch 137 is of the type which upon energization of the relay coil 116 which is made by closing switch 135, this relay position switch renders ineffective the control circuit 138 during the time the coil 116 is energized. Hence if the door were accidentally physically blocked against movement, and torque switch 144 did not open after initial energization of motor 57, the relay coil would remain energized through contacts 150 if switch 137 were not connected to disable the control circuit 138 when the relay coil 116 is energized. Also, this relay position switch 137 prevents the sequential action of the relay 118 from getting out of synchronism with the electrical power circuits 130 and 131, even if someone should deliberately hold the push button 135 depressed throughout an entire opening or closing movement of the door 10.

It will be seen from the drawings and the above description that in the closed position of the door the door stops are located between the door and the interior of the garage. This provides a very tight seal door construction and also any wind blowing on the door merely tends to move the door in tighter against the door stops thereby preventing rattling and providing a better seal. The hereinabove construction enables the present door to be manufactured without the necessity of using "T" bars to stiffen the door. In FIGURE 6 it will be noted that the fully open position 20 of the door 10 will result in the cables 101 and 102 extending downwardly and outwardly at an angle to the cable sheaves 70 and 71. This supports the lower edge of the lower panel 19, in combination with the control arms 107 and 108. With wider doors, one or two inboard cable drums and corresponding cable sheaves would be used. Thus, the

lower edge of the door panel 18 is supported not only at the two sides but also at the center or other mid-range points as necessary. Thus, these cables support the entire door panels 18 and 19 without any sagging across the width thereof in the generally horizontal open position. This cable support precludes the necessity for using any "T" bars on the door panels as is customarily necessary with multi-section overhead doors. Such sectional overhead doors have panels which are in a horizontal position when the door is open and for a 16 or 18 foot wide double garage door, this is a long expanse which must be structurally stiffened by the use of "T" bars to prevent sagging of the panels from a horizontal planar position. For a four section door, it is customary to use five such reinforcing "T" bars and in the present invention, such reinforcements are unnecessary, thus simplifying the entire door 10.

It will be appreciated by those skilled in the art from reviewing the present disclosure that one of the many advantages flowing from this construction is the fact that the lower door panel may be trimmed within limits to fit the entire garage door to a given height of opening. It is only necessary that the bottom rail of the panel be of sufficient size to maintain a satisfactory structural capacity. The second hinge means 29 provides in one unitary structure the hinge to hinge together the upper and lower panels 18 and 19 and also precisely positions the second pivot means 115 relative to the pivot of the second hinge means 29. Also, the jamb brackets 48 and 49, since they are mounted at the very top of the side jambs 15 and 16, precisely position the first pivot means 114 relative to the first hinge means 22. This forms a quadrilateral arrangement which is something like a parallelogram arrangement as best seen in the mid-position 23 of FIGURE 6. This quadrilateral of pivot points is that which controls the opening and closing movements of the lower panel 19 relative to the upper panel 18. It will be observed that as the upper panel swings outwardly through approximately 90 degrees, the lower panel 19 swings through an arc of about 180 degrees relative to the upper panel 18. Thus, the lower panel 19 folds and collapses upwardly toward and substantially against the upper panel 18. With this movement of the door precisely controlled by the definitely mutually determined relationship of the four pivot points 22, 29, 114 and 115, the actual length of the lower panel 19 becomes clearly not critical. Thus, the lower panel may be easily trimmed at the site to fit the height of the door frame. Additionally, the door panels 18 and 19 are simple panels to construct and thus may readily be constructed in the field by ordinary carpenter labor as distinguished from specialized carpenter labor or mill work in the factory. Thus, the necessity to fabricate panels to close dimensions at a mill or factory is eliminated and also eliminated is the necessity for shipping such large panels from the factory to the building site. Ordinary framing members and exterior plywood panels, readily available everywhere, may be used at the building site to fabricate the panels 18 and 19. The simple hardware may be readily installed on the door frame and the door stops 38 and 39 may be mounted to provide the slight break of the effective toggle of the door panels. The door panels may be stood in position for fitting, and the bottom of the lower panel 19 may then be trimmed as necessary to fit the door frame.

It will thus be seen that the herein disclosed motorized garage door has an upward opening movement and a reverse closing movement which generally is not restricted by snow or similar material which may be against the door in its closed position. It will be appreciated from viewing FIGURE 2 that little or no space is required above the top of the garage door opening for mounting the structure which motorizes the garage door and for receiving the door panels in their open position. It is also seen that with the present invention the garage door does

not require the use of tracks or rollers. The jamb brackets 48 and 49 are small and compact and thus practically no room within the garage is required horizontally inwardly from the header 12. This is in contradistinction to sectional overhead doors which require 8-10 feet inside the garage as well as 6-18 inches vertical head room inside the garage above the bottom of the door header 12.

As best observed in FIGURE 6, in the door closed position, the first hinge means 22 effectively supports the entire weight of the upper panel 18 and the jamb brackets and control arms plus the upper panel 18 effectively support the entire weight of the lower panel 19. Because of this support of the entire weight of the door panels, only a very slight pull is necessary on the cables 101 and 102 to start the opening movement of the door. As explained above, if the return springs 94 have a stress of about 15 lbs. for example, then only about 20 lbs. total pull is required on the cables to start the door in its opening movement. The maximum pull on the cables is found to be when the door is in its mid-position 23, FIGURE 6, and the pull required decreases as the door reaches the full open position 20. In the full open position, the control arms 107 and 108 act as a form of triangular brace holding the door panels upwardly and outwardly and thus only a small pull is required on the cables 101 and 102. In one particular example of a double size door which weighed 420 lbs., a maximum of only 140 lbs. pull was required on all cables. This was in the middle range of position generally as shown at position 23. Only a small pull in the nature of 20-40 lbs. is required on the cables to hold the door in the full open position, thus it will be seen that the effect of gravity does not put much stress on the cables and thus the irreversible power direction means or worm gear 58 will easily act as a brake to hold the door in the open position. In another example of a door constructed in accordance with the invention, the door panels weighed a total of 385 lbs. and yet the total maximum pull on the cables at any point in the door opening or closing movement was 110 lbs. This is less than 30% of the total weight of the doors and, hence, more than 70% of the weight of the door panels was always carried by the support and control means, namely, the hinge means 22 and first pivot means 114. Thus, the control arms and the mounting thereof which may be considered motion directing means for the door 10 is so designated that a majority of the weight of the door is always carried by the support and control means, and hence, the motor 57 is never required to lift more than 50% of the weight of the door panels and, in actual practice, the lifting force may be as low as 30 or 40%. Because of this unique support and control means or motion directing means and consequent small load on the motor 57, it has been found that the need for any counterbalance means is eliminated. The expense of manufacturing and installing such counterbalance means is thus eliminated. This, together with the marked simplicity of the entire hardware, permits economical manufacturing and installation of the entire motorized door 10 so that the entire motorized door may be manufactured and installed for a price substantially the same as manufacture and installation of a sectional overhead door without a motor operator.

The low starting force or torque of the door 10 of the present invention is another definite advantage. Most garage doors require that the entire weight of the door is lifted at least at some point in the lifting movement, and thus, counterbalance springs or weights are required. Also, such prior art single panel or sectional overhead doors have a large inertia which must be overcome to get the door started in its opening movement. Thus, a motor with large starting torque is required. In the present invention, only a low starting torque is required and thus a more economical motor may be used. Be-

cause of the movement of the upper and lower door panels relative to each other on opening and closing movement, there is little or no sliding movement between the stops and the door panels which in normal instances tends to cut down the efficiency of raising and closing the door. In overhead sectional doors there is a definite sliding movement between the door and the outside door stops before the door can move upwardly and slightly inwardly sufficiently to avoid this frictional contact. In the present invention there is no frictional sliding engagement of the door panels with the door stops and with the lower panel 19 made shorter than the upper panel 18, then the lower edge of the lower panel 19 does not drag on the door stops during opening or closing movement, hence, this frictional drag is eliminated. Wind blowing on the door panels merely forces the door panels more tightly against the door stops for a better seal. Of course, in an overhead sectional door, wind blows the door away from the outside mounted door stops and thus opens the joint to permit wind and snow to enter. It will also be seen that a garage door is provided whereby in its closed position where it may be said to present a slightly bent appearance in that the upper and lower portions of the door each meet a relatively small acute angle with a vertical plane. It will also be appreciated by those skilled in the art that the door lock mechanism of the present invention provides a convenient means for locking and unlocking the door which will still function even when inaccuracies in the door result because of warpage and similar problems.

The first pivot means 114 is positioned approximately a first given vertical distance below the first hinge means 22 and also this first pivot means 114 is positioned approximately said given distance horizontally inwardly from a vertical line through said first hinge means 22. Also the distance between the second hinge means 29 and the second pivot means 115 is substantially said predetermined distance. This establishes the controlled movement of the door panel so that the two doors are generally vertical in the closed position and are substantially collapsed together horizontally in the open position.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A combined garage door and operator for a door frame having a header and a side jamb comprising, in combination, an upper and a lower panel effectively pivoted together on a horizontal line, means swingably connecting the upper edge of the upper panel to the header of the door frame, said upper panel swinging upwardly to open the door, a motor and drive means connected to lift on said door to effect opening of said door, and arm means effectively pivoted to said frame on a line below and inwardly of said swingably connecting means and pivoted to said lower panel to substantially collapse said lower panel against said upper panel substantially at the position where the upper panel becomes generally horizontal in a door-opening movement and together with said swingable connecting means supporting about 60% of the total weight of said door during the entire opening movement such that said motor and drive means lifts a maximum of only about 40% of the total weight of said door during the entire opening movement to thus preclude the necessity for counterbalance means on said door.
2. In combination, an upward acting door and an operator therefor for a door frame,

said door including upper and lower panels,
 first means swinging the upper panel near the upper
 edge thereof to the upper part of a door frame for
 outward swinging movements,
 second means effectively hinging the upper part of the
 lower panel to the lower part of the upper panel,
 control arm means having first and second ends,
 means pivoting the first end of said control arm means
 fixed relative to the door frame at a location a given
 distance below and approximately said given distance
 inwardly of the line of said first swinging means,
 means providing a pivotal connection between the sec-
 ond end of said control arm means and said lower
 panel at a point approximately said given distance
 below said second hinge means to cause said lower
 panel to substantially collapse upwardly toward the
 inner surface of said upper panel as the upper panel
 is swung outwardly to a generally horizontal door
 opening movement,
 said door operator including a motor,
 speed reduction drive means connecting said motor to
 said lower panel,
 said first means and said control arm means being the
 only means supporting a majority of the weight of
 said door such as to place a maximum stress on said
 motor and drive means of less than approximately
 40% of the total weight of the door to thus preclude
 the necessity for any counterbalance means on said
 door and said motor supplies the entire lifting force
 to open said door.
 3. A combination operator and door for a door frame
 having a header and side members, comprising in com-
 bination,
 upper and lower panels,
 first hinge means to hinge the upper part of said upper
 panel relative to said door frame header,
 second hinge means to hinge together said upper and
 lower panels,
 an electric motor and drive means connected to lift
 generally vertically on the lower part of the lower
 panel,
 said upper panel being hinged on said first hinge means
 to swing upwardly and outwardly in a door opening
 movement,
 control arms pivoted relative to said frame side mem-
 bers on a line below and inwardly of said first hinge
 means and pivoted to said lower panel at an inter-
 mediate point between the pivot of said second hinge
 means and the lower edge of said lower panel to
 move same in a controlled movement in a generally
 quadrilateral movement to fold and collapse said
 lower panel upwardly toward said upper panel in
 said opening movement,
 the pivotal connection of the control arms at said in-
 termediate point in combination with said first hinge
 means providing controlled movement to said door
 panels and support of a majority of the weight of
 said door throughout the entire opening movement
 such that said drive means exerts a force less than
 50% of the weight of the door during the entire open-
 ing movement to thus eliminate counterbalance
 means for said door.
 4. A combination operator and door for a door frame,
 comprising in combination,
 upper and lower door panels,
 support and control means for said panels including a
 control arm and first means swingably mounting the
 upper part of said upper panel relative to the upper
 part of said door frame to swing upwardly in a door
 opening movement,
 second means to hinge together said upper and lower
 panels,
 power means connected to move one of said panels in
 said door opening movement,
 said control arm being pivoted for movement relative

to said door frame on a line below and inwardly of
 said first swingably mounting means and having a
 pivotal connection to an intermediate point on said
 lower panel between said second hinge means and
 the lower edge of said lower panel to control move-
 ment of said lower panel to fold and collapse said
 lower panel upwardly toward said upper panel in
 said door opening movement,
 said support and control means supporting substantial-
 ly the entire weight of the door without aid of
 counterbalance means in the closed position of the
 door panels,
 and said support and control means including said
 pivotal connection of said control arm to said inter-
 mediate point establishing that said door panels are
 movable in a controlled door opening movement with
 a majority of the weight of the entire door being
 always supported by said support and control means
 throughout the entire opening movement such that
 said power means exerts a force less than 50% of
 the weight of the door during the entire opening
 movement to thus eliminate counterbalance means
 for said door.
 5. A motorized garage door for disposition in an open-
 ing in a building structure,
 which opening is defined by spaced upper and lower
 walls and spaced first and second side walls includ-
 ing in combination,
 upper and lower door panels movable between open
 and closed positions,
 first means swingably connecting the upper portion of
 said upper door panel to the upper wall,
 second means swingably connecting the upper portion
 of said lower door panel to the lower portion of said
 upper door panel,
 drive means mounted by one of the walls,
 a latch arm pivoted to said lower door panel near said
 second means and cooperating with one of said side
 walls to latch the door closed,
 a cable member acting between said drive means and
 said latch arm,
 a door arm having first and second end portions,
 a first pivot member pivotally connecting said first end
 portion of said door arm to one of the walls,
 a second pivot member pivotally connecting the sec-
 ond end portion of said door arm to said lower door
 panel,
 and means to pull on said cable member to first un-
 latch said latch arm and next to pull said door open
 for actuating said drive means.
 6. In combination, an upward acting door and an op-
 erator therefor for a door frame having a header and
 side jamb members,
 said door including upper and lower panels,
 first means swinging the upper panel near the upper
 edge thereof relative to the door frame header for
 outward swinging movements,
 second means effectively hinging the upper part of the
 lower panel to the lower part of the upper panel,
 a control arm having first and second ends,
 means pivoting the first end of said control arm fixed
 relative to the door frame at a location below and
 inwardly of the line of said first swinging means,
 means providing a pivotal connection between the sec-
 ond end of said control arm and said lower panel
 at a point below said second hinge means to cause
 said lower panel to substantially collapse upwardly
 toward the inner surface of said upper panel as the
 upper panel is swung outwardly to a generally hori-
 zontal door open position,
 a latch arm pivoted to said lower panel,
 spring means engaging said latch arm and urging said
 latch arm toward a latched condition with said door
 frame,
 and drive means including a cable connected to said
 latch arm to pull on same in opposition to said spring

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means to first unlatch said latch arm and second to pull said door upwardly to an opened position.

7. In combination, an upward acting door and an operator therefor for a door frame, said door including upper and lower panels, first means swinging the upper panel near the upper edge thereof relative to the upper part of a door frame for outward swinging movements, second means effectively hinging the upper part of the lower panel to the lower part of the upper panel, a control arm having first and second ends, means pivoting the first end of said control arm fixed relative to the door frame at a location below and inwardly of the line of said first swinging means, means providing a pivotal connection between the second end of said control arm and said lower panel at a point below said second hinge means to cause said lower panel to substantially collapse upwardly toward the inner surface of said upper panel as the upper panel is swung outwardly to a generally horizontal door open position, drive means including a rotatable member positioned inwardly of said first hinge means, a sheave near the lower edge of the lower panel, cable means extending down from said rotatable member and around said sheave and up to a connection to the lower panel, and a sheave guard pivoted on the axis of said sheave to retain said cable means on said sheave despite changing attitudes of said cable means relative to said lower panel and despite any slack in said cable means.

8. In combination, an upward acting door and an operator therefor for a door frame, said door including upper and lower panels, first means swinging the upper panel near the upper edge thereof relative to the upper part of a door frame for outward swinging movements,

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second means effectively hinging the upper part of the lower panel to the lower part of the upper panel, a control arm having first and second ends, means pivoting the first end of said control arm fixed relative to the door frame at a location below and inwardly of the line of said first swinging means, means providing a pivotal connection between the second end of said control arm and said lower panel at a point below said second hinge means to cause said lower panel to substantially collapse upwardly toward the inner surface of said upper panel as the upper panel is swung outwardly to a generally horizontal door open position, drive means including a rotatable member positioned inwardly of said first hinge means, a cable drum on said rotatable member, cable means wound on said cable drum and extending downwardly to a point on said lower panel, and a cable guard rotatably secured on said cable drum and retaining said cable means on said drum despite any slack in said cable means.

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HARRISON R. MOSELEY, *Primary Examiner*.
NORTON ANSHER, *Examiner*.