Nov. 18, 1969 C. L. ESTES 3,478,469

DOOR MOVING MECHANISM

Filed July 2, 1968 3 Sheets-Sheet 1

FIG. 1.

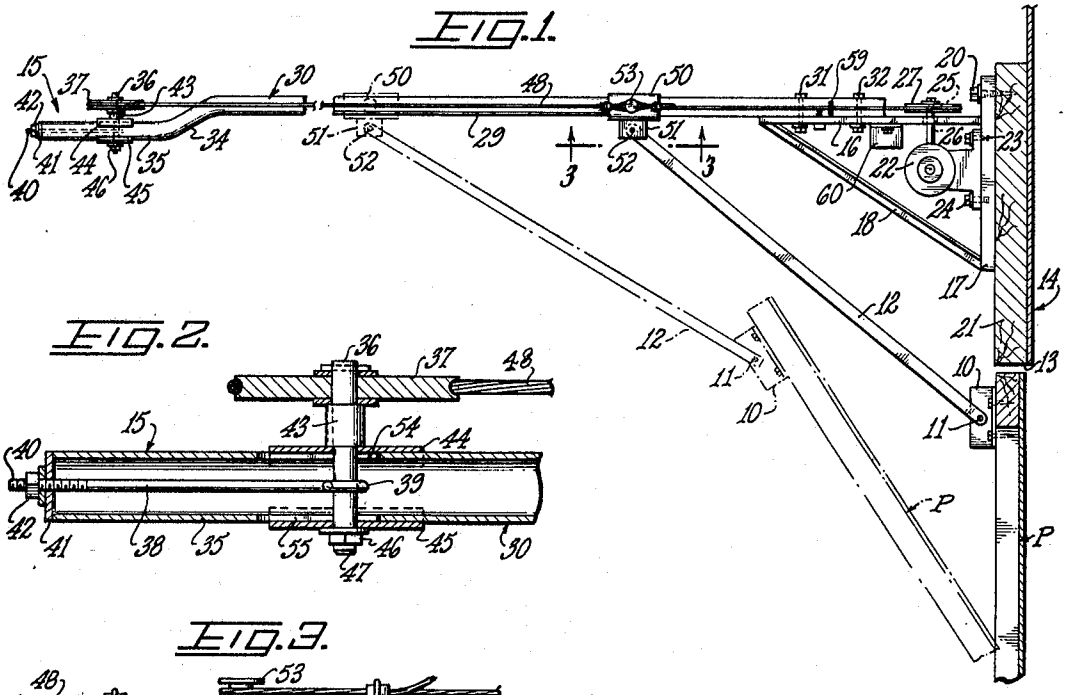


FIG. 2.

FIG. 3.

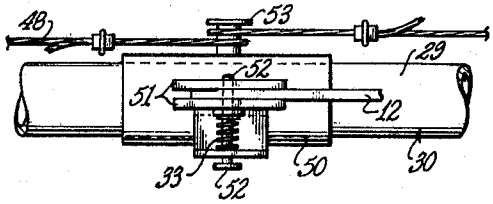


FIG. 4.

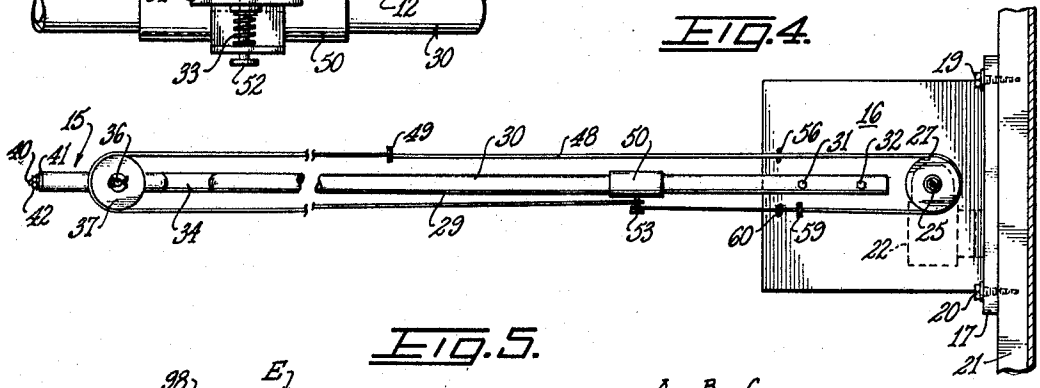
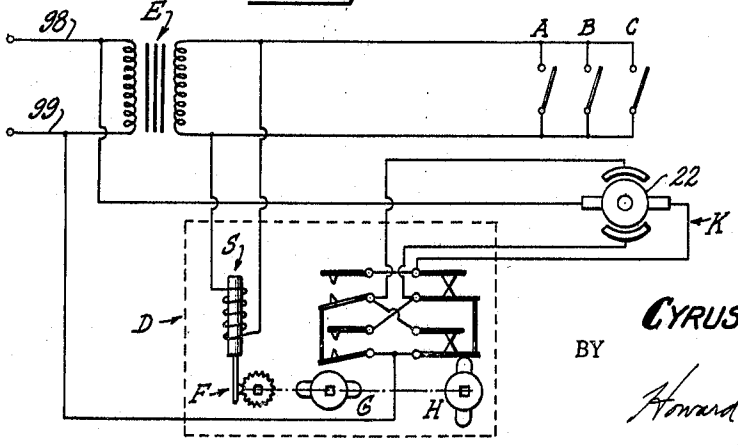


FIG. 5.



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DOOR MOVING MECHANISM

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FIG. 6.

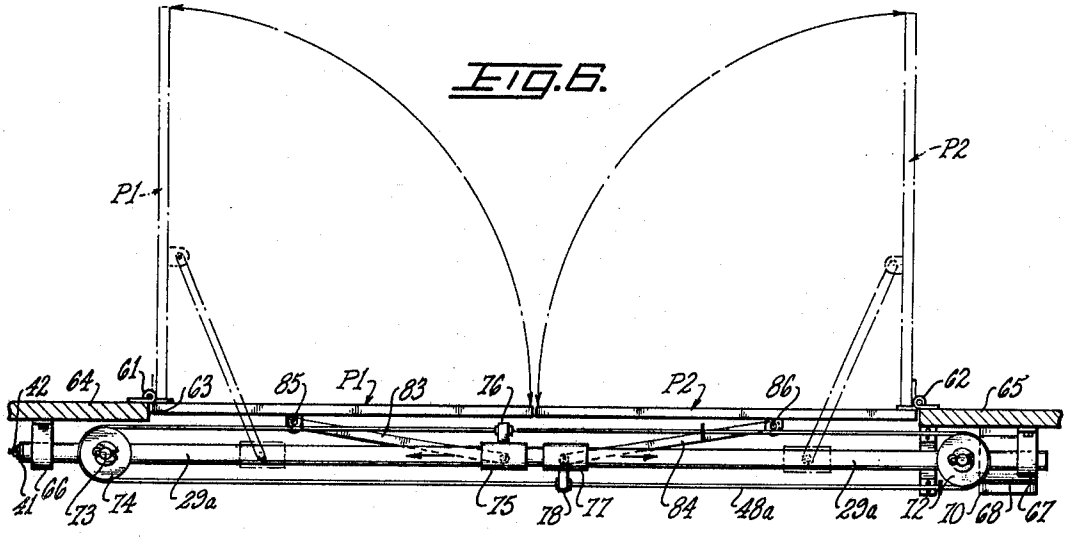


FIG. 7.

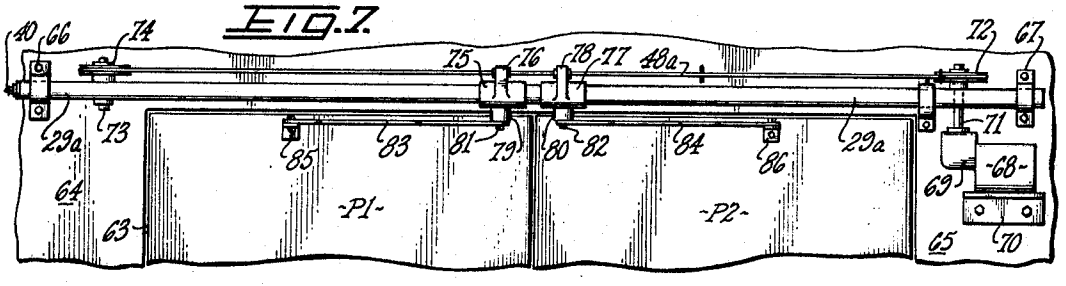


FIG. 8.

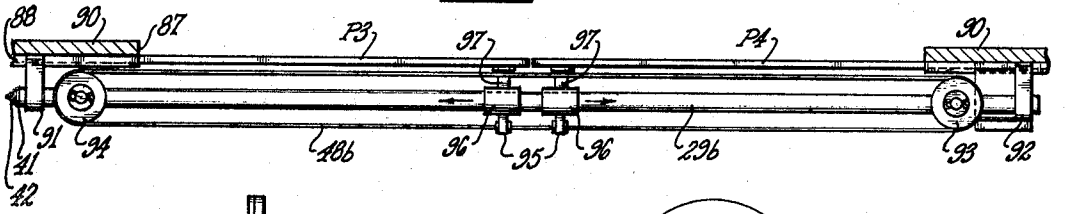


FIG. 9.

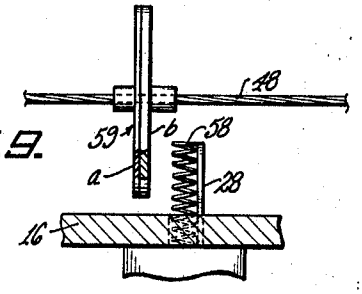
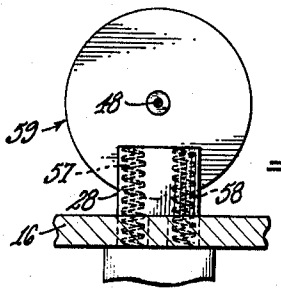


FIG. 10.



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DOOR MOVING MECHANISM

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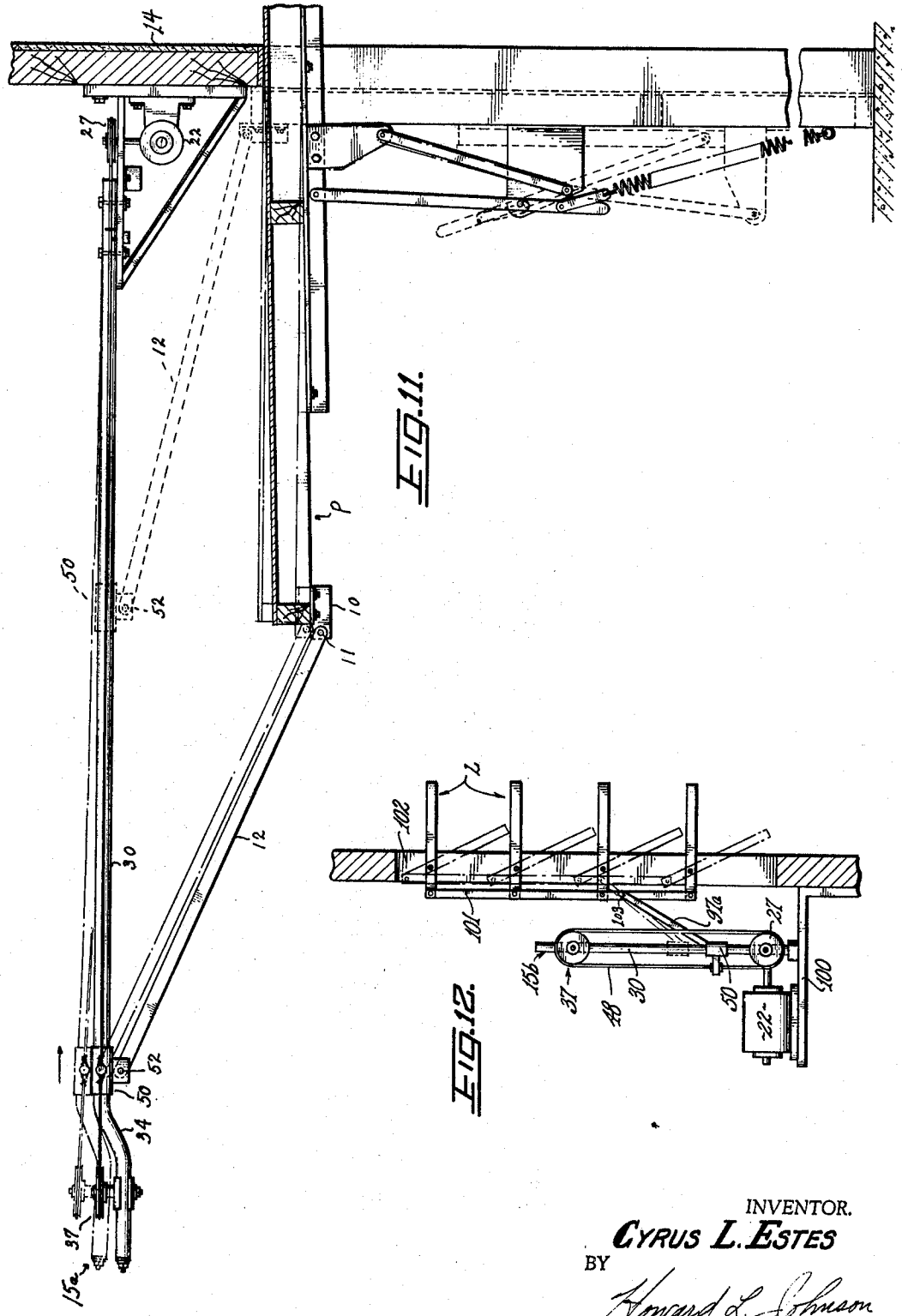


FIG. 11.

FIG. 12.

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United States Patent Office 3,478,469
Patented Nov. 18, 1969

3,478,469

DOOR MOVING MECHANISM

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Filed July 2, 1968, Ser. No. 741,979
Int. Cl. E05d *15/22*
U.S. Cl. 49—199 10 Claims

ABSTRACT OF THE DISCLOSURE

Remote-operable shuttle mechanism can be coupled to movable panel or door to open and close same as by remote control; usable for example with overhead garage-type doors, or paired closures swingable on vertical hinges, or horizontally slidable upright panels, louvers, etc. A generally straight track formed of cylindrical bar or tube stock carries one axially slidable collar for each door, each collar being fixed to a closed-loop cable which cable spacedly lies along opposite sides of the track. The cable is alternately drawn in one direction or the other by a reversible electric gear motor so as to move the collar reciprocably along the track. Each collar is also pivotally connected to a movable panel—by a pull rod for overhead door, in which case the track is located above and horizontally perpendicular to closed position of door when the latter is upstanding; when the track is parallel to the closed position of pair of upright side-hinged swinging doors, each door is lever-attached to a different slide collar on the same track. For sliding doors, collar on parallel, overhead track is attached to top of door which slides or rolls in lower channel. Motor control means are operable at will by each of radio signal, by limit means carried on cable, or manual switch, and include solenoid-operated ratchet-drum relay unit carrying succession of contact lugs which are programmed for continuous sequence of start, stop, reverse, stop, start, stop, etc., of motor.

BACKGROUND OF THE INVENTION

This invention relates to a comparatively simple assembly which, as noted in the foregoing abstract, is readily interchangeable or adaptable to different types of doors which may be already hung, so as in effect to be essentially interchangeable between different types of movable panels which are intended to be opened and shut in different manners. For example, the present remote-operated and motor-driven shuttle assembly can be used to operate an overhead garage door, or a simultaneously-swinging pair of gates, or one or more panels or doors which are rollable or slidable in any plane, etc.

Doors or gates, both indoors and out, have long been motor-operated, including overhead garage doors which are triggered by radio control from the owner's vehicle. However, there have been numerous shortcomings in the various known constructions, including: the high torque motors required to operate swinging gates; screw-and-nut type overhead door channels will bind when subjected to small lateral force; reel-in cables will snag or drag clogging material into their housing; sprocket drives are subject to frequent misalignment, as well as being noisy; a track perpendicularly attached to the door header may let the pull-bar jackknife (and lock) in the open position, but if the track is slanted downward to avoid this, the door may open only incompletely or scrape the top of the automobile. In particular, an operating assembly which could be coupled to an overhead door could not be used or transferred, for example, to a pair of swinging doors, or even (in most cases) to a sliding door. In addition, heavy and complicated units require strong reinforcing and attachment to basic structural elements, particularly when mounted overhead, but they still demand precise or delicate alignment in order to provide semi-continuous operation. Accordingly, it is an object of the present invention to effect these and related problems in a favorable manner, and to provide a highly effective, lightweight, simple and easily installed door-operating shuttle.

BRIEF SUMMARY OF THE INVENTION

The invention provides an electrically-operated shuttle assembly for opening and closing single or double doors (by remote signal, if desired), which assembly consists essentially of (1) an elongated track provided by cylindrical bar or tube stock, one end of which may remain free-hanging or loose in order to obtain advantage of its longitudinal flexibility; (2) a closed-loop cable spaced from and generally parallel to, opposite sides of the track; (3) an axially slidable collar (one for each door) movable along the track and (usually pivotally) secured to a lever arm or draw-bar which is distally connected to a door, the cable being rotatable on the track to the extent of easily accommodating operating strain and flexibility of the track; and (4) an electrical unit consisting of transformer, reversible gear motor and stepping relay, which relay is responsible at will to cable-carried stop means or to distant electrical signals such as tuned RF transmissions, or a manually operated switch (which may be in the same or a distant building). Included are a particularly effective, cooperating pair of flexible contact units, one of which is cable-carried and the other stationary, for transiently closing a circuit when the cable is drawn in one direction past a selected point of the stationary unit, and which does not effect the circuit when the cable is retracted past the same point in the opposite direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a vertical section through a portion of a vertical-tilting lift-type garage door and header, showing in elevation the door-raising shuttle mechanism, the partially open position in phantom.

FIGURE 2 is a vertical sectional view through the left-end portion of FIGURE 1, shown in larger scale.

FIGURE 3 is a bottom plan view of an intermediate length of FIGURE 1, as viewed along the line 3—3.

FIGURE 4 is a top plan view of the assembly of FIGURE 1.

FIGURE 5 is a schematic diagram of the electrical circuit.

FIGURE 6 is a horizontal sectional view taken through the adjacent supporting walls on opposite sides of a pair of horizontally swinging, vertical doors, showing in top plan view, my shuttle assembly connected simultaneously to move the two doors between open position (indicated in phantom) and closed position.

FIGURE 7 is a side elevational view of the assembly of FIGURE 6, with the pair of doors in closed position.

FIGURE 8 is a horizontal sectional view through adjacent walls on each side of a parallel, vertically suspended pair of sliding doors which in operation are moved lengthwise together or apart by the shuttle mechanism which appears in top plan view.

FIGURES 9 and 10 are sectional views through the support shelf of FIGURES 1 and 4, the one view perpendicular to the other, and particularly showing the pair of flexible contact units, one carried by the cable and the other upstanding from the shelf, which form the limit or stop means.

FIGURE 11 is a view similar to FIGURE 1, particularly showing how the free-hanging end of the shuttle mechanism flexes to get the opened door out of a jackknife position in order to close it.

FIGURE 12 shows in vertical section and elevation, an upended shuttle mechanism connected to open and close a series of louvers.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the construction particularly illustrated in FIGURES 1–4 and 11, the vertical door P, by a rearward, perpendicularly projecting bracket plate **10** on its inner face, is pivotally connected at **11** to an elongated pull-rod **12** so as to be shiftable by the present shuttle mechanism between a standing position wherein it thrust-fills a doorway or opening **13** of an upright wall **14**, and an open position wherein it is withdrawn inward and moved tiltingly upward from the doorway **13** to a suspended position beneath and more-or-less parallel to a horizontal ceiling (if present).

The present shuttle assembly is here projected inward, generally horizontally from its fixed attachment to the building wall or header above the doorway **13**. Its inner end **15** is free-hanging so as to be flexible to the extreme position **15***a* (FIG. 11) in the event that the door jackknifes (that is, the lower, forward edge tilts above the rear, inner edge when raised). A shelf **16**, strut **18** and plate **17** form a triangular attachment with the plate **17** juxtaposed and bolted to the inner face of the door header or fixed wall **21** at **19**, **20**. A reversible electric motor **22** is secured to the inner face of the plate **17** by bolts **23**, **24** so as to vertically project a drive shaft **25** extending upward through an opening **26** in the shelf **16** and carries a horizontally disposed drive pulley **27** thereabove.

A tubular member **30** extends from the free end **15** to the support shelf **16**, being bolted onto the top of the latter at **31**, **32**. The tube **30** is angularly stepped or crocked at **34**, and the resulting lower, shorter length **35** is vertically traversed by the shaft **36** of an idler pulley **37**. Within the lower tube length **35**, an eyebolt **38** (FIG. 2) disposes an eyelet end **39** about the shaft, with its outer threaded end **40** received through an apertured closure plate **41** of the tube **30**, and carrying a tightening nut **42**. The pulley shaft **36** descending from above the tube **30** traverses a spacer collar **43**, then a pair of arcuate washers **44**, **45** which conformingly overlie opposite external faces of the tube, the shaft terminally carrying a fastening element or nut **46** on its lower, projecting threaded end **47**. Accordingly, the whole cable loop **48** which is led over the two pulleys **27**, **37** can be drawn drawn taut simply by tightening the nut **42** on the outer end of eyebolt **38** so as to draw the pulley shaft **36** along the parallel aperture slots **54**, **55** of the tube. The idler pulley **37** itself is located on the same level as the longitudinal midplane of the longer and upper tube length or track **29**, so that both stretches of the closed loop or endless cable **48** carried by it will lie along the same midplane and spaced outward approximately equidistant from its respective sides (FIGURE 4).

The upper, longer tube length **29** thus forms a straight track which carries an axially slidable collar or track-follower **50** having a radially directed, downward projecting, paired or split lug **51** which is pivoted on the pull-rod **12** by a pin **52**. The pivot pin **52** is retractable against the force of a compression spring **33** for easy assembly and disassembly. The collar **50** is also formed with a laterally outward-projecting, apertured ear **53** which serves to anchor both ends of the cable **48**. The cable **48** fixedly carries two flexible, trip-disks **49**, **59** (FIGS. 4, 9–10), which upon reciprocable movement of the cable, near each end of travel one or the other of the disks contacts a limit switch **56** or **60**, both of which are on the platform **16**. This momentarily closes an electric circuit through the respective switch. Such limit switches may simply be formed of a pair of upstanding, spring metal fingers **57**, **58** which are fastened to a flexible backing strip **28** of insulating material. The face *a* of each trip disk **49**, **59** which is toward the idler pulley **37** is also formed of insulating material, while the face *b* which bridges the conducting strips **57**, **58** is formed of conducting material such as copper. The cable **48** axially traverses the disks **49**, **59** and they normally project radially or diametrically therefrom; they cannot become laterally disaligned by rotation about the cable. While the resultant circuit closing of each limit switch serves to stop the motor **22**, it will be evident that the motor-drawn cable continues to carry the respective disk past the contact fingers **57**, **58** for some distance before stopping. However, upon reversal of the motor and cable, the reverse face *a* of the disk being drawn over the fingers will not this time close a circuit.

In the construction illustrated in FIGURES 6–7, the straight track **29***a* is located slightly above and generally parallel to the doorway **63** and to the closed position of a pair of vertical doors P1, P2 which are mounted on hinges **61**, **62** so as to swing divergingly and to come together in unison into coplanar position. The track **29***a* is spaced inward from upright wall sections **64**, **65** on either side of the doorway **63** by means of a pair of U-brackets **66**, **67** located adjacent respective ends thereof. A reversible drive motor **68** and its reduction gear case **69** are also fastened to the upright wall **65** by a support bracket **70**, with the drive shaft **71** traversing or journalled in the horizontal track **29***a* to support the drive pulley **72** a small distance above the track. At the other end of the track, the upright shaft **73** of an idler pulley **74** is similarly inserted through the track. Again, as shown in FIG. 2 for the previous form, the cable loop **48***a* is tightened by means of the nut **42**.

A continuous looped cable **48***a* is threaded over the two pulleys **72**, **74**. The track **29***a* carries two slide collars **75**, **77**, each formed with an upward and laterally extending attachment arm **76**, **78** which are oppositely projecting outwardly from the track, and fastened to respective stretches of the cable **48***a* (FIG. 6). Thus, upon the cable being moved in one direction (counterclockwise) the collars **75**, **77** travel apart along the track oppositely; upon the cable being driven in the other direction (clockwise), the collars move toward each other along the track. Each collar has a dependent turret **79**, **80** holding a downwardly projecting pivot shaft **81**, **82** on which one end of a lever arm **83**, **84** is pivoted. The other ends of the respective lever arms are pivotally attached to respective brackets **85**, **86** of the doors P1, P2. Accordingly, the doors are swung open or closed as the motor **68** moves the endless cable loop **48***a* one way or the other.

FIGURE 8 shows still another embodiment of the invention resulting from applying the shuttle assembly to opening and closing vertical doors P3, P4 such as a door which is shifted between open and closed positions along a slide track **88** or on rollers, while remaining parallel to an adjacent, upright wall **90**. Again, a cylindrical rod or tube track **29***b* is located adjacent the top of a doorway **87**, by means of a pair of suspension arms **91**, **92**. A closed-loop cable **48***b* is led around a drive pulley **93** and idler pulley **94**, both of which are supported above the track, and with both cable ends secured to a laterally extending, tensioning ear **95** of a slide collar or track follower **96** which axially embraces the track **29***b*. An oppositely projecting suspension arm **97** is terminally affixed to the inner face of the door P3, P4 so as to support or carry it in its continuing upright position as it is slid out or rolled back and forth along the channel **88** by movement of the slide collars **96** along the overhead track **29***b*.

With reference to FIGURE 5, a low voltage circuit D is formed through a transformer E and ratchet relay F, obtaining its AC line current from leads **98**, **99**. The circuit may be closed by action of either of the trip lugs **49**, **59** in closing switch B; or alternately by a radio-controlled switch A; or by a distant, manually operable switch C (which may be located in a different building or in a different part of the same building). The ratchet re-

lay F comprises a solenoid S which turns a ratchet wheel drum an arcuate integral or "step" each time the circuit D is completed. The drum has a plurality of longitudinal channels adapted to receive selectively-positioned lugs G, H, which upon each rotational step of the drum, trip a particular contact switch of the motor circuit K. Accordingly, the lugs are set to produce an endless succession or sequence (each change or step being effected by transient closing of the circuit D) in the motor circuit K, which results in motor action **22** of forward, stop, reverse, stop, forward, stop, reverse, stop, . . . etc. Such stepping relays using ratchet drum units are commercially available, for example, from Potter and Brumfield, of Franklin, Kentucky. See U.S. Patents 2,872,536, 2,920,151, 2,992,378. The motor **22** (**68**) is of a type which may be reversed by reversing the polarity of the field windings; the polarity of the rotor circuit is not affected.

Thus it will be seen that whenever any one of the switches A, B, C is closed, the solenoid S causes the ratchet drum F to advance to the next position which either closes or brakes the circuit K through the motor **22**; when it closes the circuit it will drive the motor **22** either forward or reverse according to the position of the lugs G, H which are carried on the ratchet drum. In other words, if the motor is running in reverse, the next signal from whatever source will stop it, the next signal will start it forward, the next signal will stop it, the next signal will start it in reverse, the next signal will stop it, etc. The signals from switch B of the self-operating limit switches **56, 60** will only occur while the motor is running; hence their effect will always be to stop it. The signals from A or C can either stop or start the motor, depending on its previous condition.

FIGURE 12 illustrates still another utilization of the shuttle mechanism wherein the track **30** is mounted upstanding from a horizontal base **100**, with its free end **15***b* disposed at the top and its lateral attachment arm **97***a* pivoted at **103** to the upright operating rod **101** of a series of louvers L which are individually end-pivoted within a window opening **102**. Such an installation may be desired, for example, at an attic air inlet for an air conditioning unit (which is wanted closed while a heat-pump is in operation during a cold period), or near the top of an elevator shaft where it is desired to have the louvers open during the day and closed at night, or at other times regulated by the presence of moisture in the air, or dust, or other factors. The combination of small longitudinal flexibility of the track **30**, with the tranverse (rotary) self-adjustability of the slide collar **50** which carries the attachment arm **97***a*, compensates for any minor misalignment or stiffness of movement of the louver rod **101**, and also promotes quick, easy installation of such a shuttle assembly. The cable carried trip lugs **59** can quickly be located for he amount of movement possible for the louvers. It will be apparent also that the motor **22** and drive pulley **27** need not even be on the same floor or level as the louvers as long as the operating rod **101** and slide collar **50** can be coupled together. Thus the operating rod may be several stories high and be connected to a different series of louvers on each floor of the building. In perspective, it will be appreciated also that the reciprocably movable element **101** need not be a door, nor need it necessarily be pivoted to the article or structure which it is carrying back and forth, but may be fixed thereto as in the case of the sliding doors of FIGURE 8. Accordingly the invention is not to be limited to the specific examples which are given herein by way of illustration, but should be construed broadly within the terms of the following claims.

I claim:

1. A mechanism of the character described comprising, in combination:

a longitudinal track of limited longitudinal flexibility projecting from a fixed end to a loose end disposed to accommodate said flexibility;

a reciprocably-movable follower retained on said track or movement therealong, said follower being capable of lateral self-adjustment in movement along the track;

an attachment arm having one end secured to said follower and having its other end secured to a movable element such as a panel, whereby movement of the follower and connected attachment arm is effective to move said element in a predetermined path according to how the element is mounted;

a reversible electric motor;

pulley means including a closed-loop cable located generally parallel to the length of said track and operatively connected to said reversible motor and to said follower for movement of the latter along the track; and

control means for selectively stopping, starting and reversing said motor, including limit means actuated by movement of said closed-loop cable lengthwise along said track for stopping said element adjacent the end of said predetermined path.

2. The mechanism of the preceding claim **1** wherein said track is a substantially straight, cylindrical member, said follower is a collar at least partially rotatable and axially slidable lengthwise along said track, and said pulley means includes a pair of pulley wheels disposed adjacent opposite ends of said track, with said closed-loop cable being led over said pulley wheels and secured to said slidable collar.

3. The mechanism of the preceding claim **1** wherein said track is a substantially straight member of limited longitudinal flexibility, disposed generally horizontally and inward projecting from above the doorway of an overhead door to which said attachment arm is secured, with the inner end of said track being free-hanging.

4. The mechanism of the preceding claim **2** wherein there are two of said collars, each secured to a different point of said closed-loop cable so as to be jointly movable along the track toward and away from each other, and each collar is coupled to an attachment arm which is adapted to be connected to one of a pair of doors, whereby the two doors may both be opened or closed simultaneously by movement of the closed-loop cable in one direction or the other as effected by said reversible motor.

5. The mechanism of the preceding claim **1** which additionally has stop means disposed at alternate positions for contact by said moving cable, which stop means comprise a pair of upstanding resilient, electrically-conducting fingers which are laterally spaced apart by insulating means, and a resilient contact member carried by said cable in position to abut and bendingly pass over said fingers upon movement of the cable in either direction, which member is formed with one contact face of insulating material and an opposite contact face of conducting material, whereby the latter face may complete an electric circuit through said fingers to the reversible motor when moving over them in one direction and not when moving over them in the other direction.

6. The mechanism of the preceding claim **1** wherein said control means includes a stepping relay comprising a solenoid-operated ratchet drum carrying a succession of contact lugs selectively positioned to start, stop and reverse said motor in repetitive sequence in response both to said limit means and to distant activation of said relay.

7. The mechanism of the preceding claim **3** wherein one of said pulley wheels has a shaft transversely intersecting said track and has means for adjustable movement lengthwise to the track whereby the closed-loop cable may be made taut by movement of said shaft.

8. The mechanism of the preceding claim **4** wherein each of said collars are connected to an attachment arm, each of which arms is pivotally secured to one of a pair of vertically hinged, swinging doors which are thus disposed to both open and both close in unison.

9. The mechanism of the preceding claim 4 wherein each of said collars are connected to an attachment arm, each of which arms is secured to one of a pair of vertically slidable doors which are thus disposed to both open and both close in unison.

10. Electrical switch means adapted to be operated by a reciprocably moving cable and comprising a resilient contact disk carried by said moving cable in approximate axial attachment so as normally to project generally diametrically therefrom, one face of the disk being of conducting material and the other face being non-conducting,

and a relatively stationary unit comprising a pair of upstanding resilient fingers of conducting material spaced apart by insulating means and located in position for said contact disk to abut and to bendingly pass over said fingers from either direction upon movement of the cable, whereby the conducting face

of the disk may complete an electric circuit through said fingers when moving over them in one direction and not when moving over them in the other direction.

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J. KARL BELL, Primary Examiner

U.S. Cl. X.R.

49—28, 108; 200—47; 318—266

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,478,469 Dated November 18, 1969

Inventor(s) Cyrus L. Estes

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 2, "or" should read -- for --.

Signed and sealed this 25th day of May 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents