July 7, 1959 K. DAUGIRDAS 2,893,506

DOOR CONTROLLING LINKAGE

Filed March 11, 1958 2 Sheets-Sheet 1

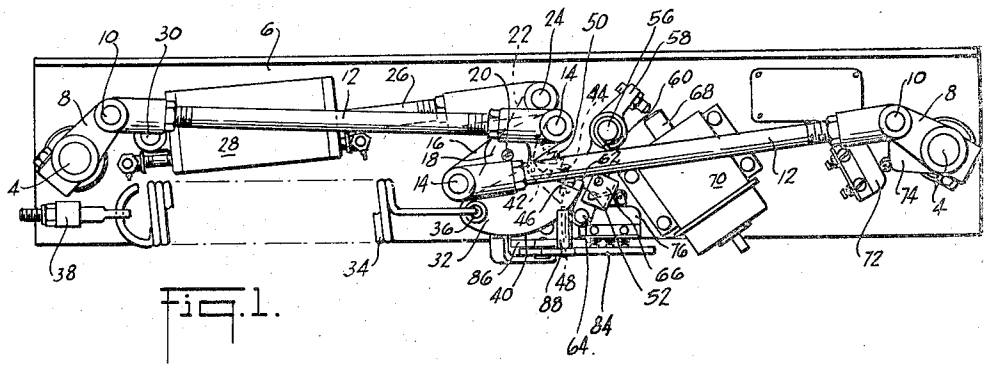

Fig. 1.

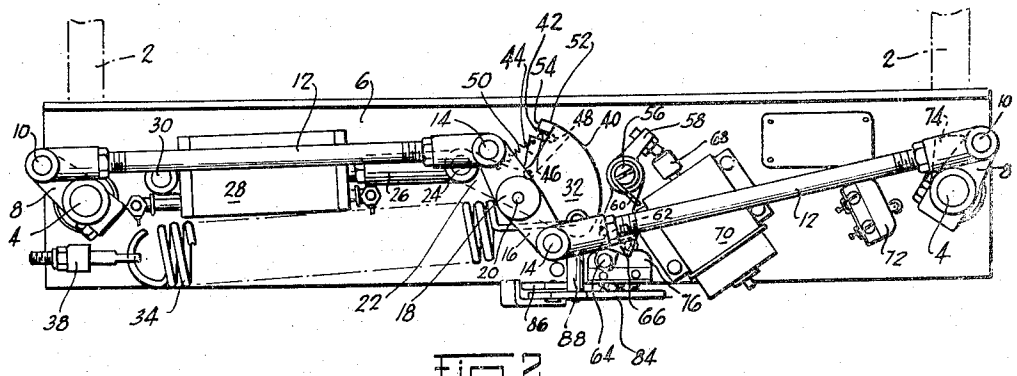

Fig. 2.

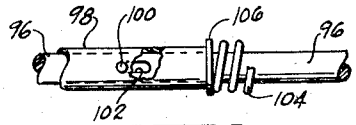

Fig. 7.

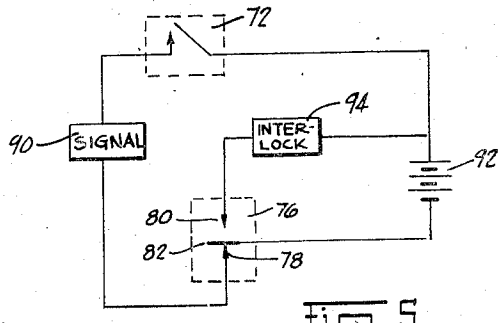

Fig. 5.

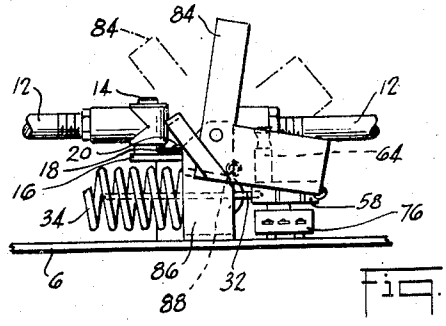

Fig. 4.

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DOOR CONTROLLING LINKAGE

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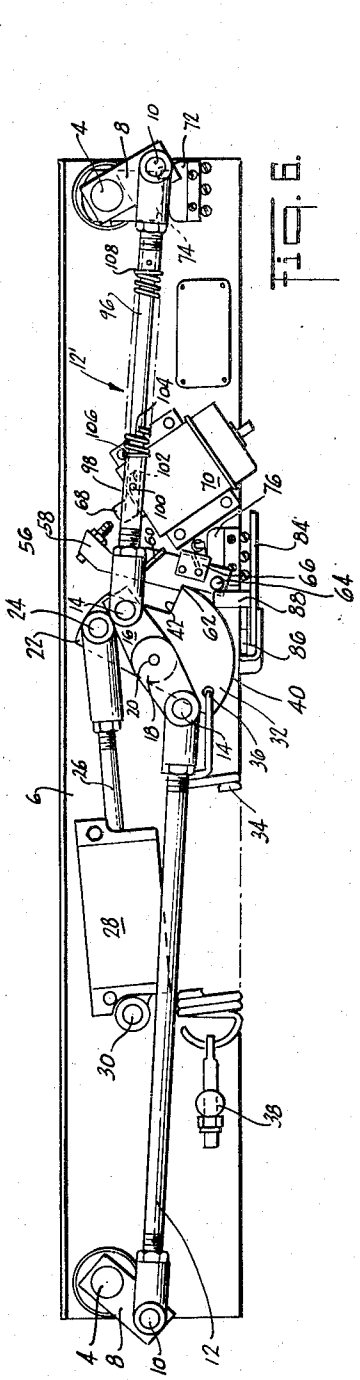

Fig. 6.

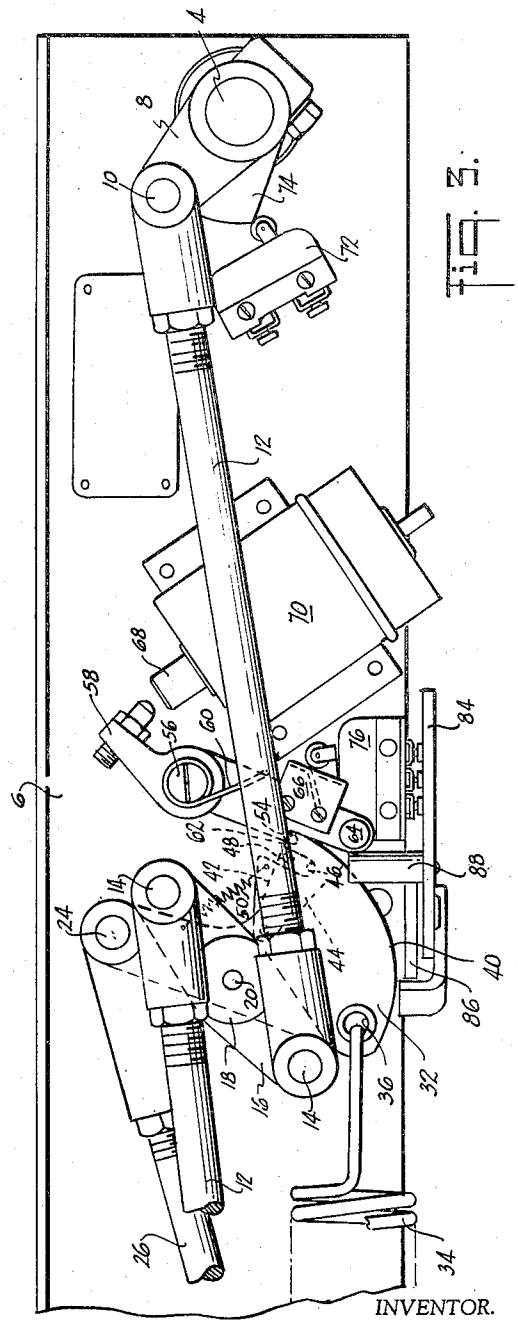

Fig. 7.

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DOOR CONTROLLING LINKAGE

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Application March 11, 1958, Serial No. 720,772

17 Claims. (Cl. 180—82)

The present invention relates to a linkage for use in controlling the movement of doors, and particularly those of a public conveyance such as a bus or a trolley, in which provision is made for latching the doors in closed position but permitting the doors a limited degree of movement while latched, and to alarm and interlock systems operatively associated therewith.

It is essential that the opening and closing of doors in public conveyances be under the control of the operator, and it is highly desirable that means be provided to apprise the operator of the condition of the doors so that he can appropriately control the movement of the vehicle. It is often preferred that a positive interlock, rather than one involving human interposition or action, be provided between the doors and the vehicle driving mechanism so that the vehicle cannot be started until the doors have closed. Various arrangements have been proposed in the past to accomplish these objectives. Nevertheless these safety provisions as thus far provided for in the prior art have not been entirely satisfactory. For example, it is quite possible for the doors to move to their fully closed position and still to grasp individuals who have alighted from the vehicle or who are in too close proximity thereto when the doors close. The outer garments of such individuals can be caught by the doors, these garments being sufficiently thin so that the doors can move to fully closed position, and yet, because of articles in pockets or linings or because of buttons or other fastenings, it is impossible to disengage the garments from the door. There have been a number of accidents of this nature in which the operator of the vehicle has been unaware of the incident and in which people have been dragged along by the vehicle and have sustained injuries thereby.

In accordance with the present invention a linkage is provided which will prevent the occurrence of this type of accident and which will at the same time provide all of the other safety features which are believed necessary or desirable. In particular, although the door is latched in its closed position, it may be moved therefrom for a predetermined limited distance sufficient to permit the disengagement of any objects which the door might have caught but insufficient to give rise to any danger to the occupants of the vehicle. Once the door has moved its aforementioned distance from its closed position, it will be positively prevented from moving any further unless and until the operator should choose to permit the doors to be opened. In addition, movement of the doors for the aforementioned predetermined limited distance while the doors are latched closed will cause the actuation of a signal which will indicate to the operator of the vehicle that something is amiss. Means are provided so that said signal will not be actuated during that period of time between the opening of the doors in accordance with the wishes of the operator and the return of the doors to their fully closed position. An interlock is provided which is effective, when the doors are opened under the control of the operator and until such time as the doors return to their fully closed position, to actuate an interlock—either a different signal or mechanism which directly controls the operation of the conveyance—in order to prevent the conveyance being started until the doors have fully closed.

The present invention is particularly adapted for use in so-called "push doors," that is to say, doors which are opened upon the exertion of manual pressure thereupon by passengers in the conveyance when they wish to alight or enter, and the structure is here specifically disclosed embodied in such a system. However, the invention is also applicable to door control systems in which some form of external power—hydraulic, pneumatic or electric—is utilized to cause the doors to move in one direction or the other.

To accomplish the above objectives a linkage is provided which is connected to the door for movement therewith, that linkage preferably including some means such as a spring for restoring the doors to their closed position and also preferably including means for checking the movement of the doors in at least one direction of movement. The linkage is provided with an element adapted to be engaged by a latch when the doors are in closed position. A lost motion connection is included in the linkage between the door and the latch, that lost motion connection having a limited operative length corresponding to the distance which it is desired that the doors be movable from fully closed position for the safety purposes described above while the latch remains operative. The lost motion connection is biased, as by means of a spring, to its extended position, but may be contracted against the action of the spring to permit the door to move the predetermined limited distance from its fully closed position as aforesaid. Once the latch has been moved to its inoperative position in which it is disengaged from the linkage the door may then be moved to its open position in any appropriate manner.

The linkage and the latch so cooperate that once the latch has been moved to its inoperative position, and the doors have been opened at least part way, the latch will not return to its operative position until the doors have fully closed. The signal to the operator of the vehicle indicating that the doors have been moved from their fully closed position has an actuating system which is sensitive both to the position of the door and to the position of the latch, to the end that whenever the latch is in its inoperative position the signal will not be energized no matter what the position of the door may be, the signal only being energized when the latch is in its operative position and the door has been moved from its fully closed position. Hence the signal will be operative only after the doors have been fully closed and are then slightly opened while remaining latched. The interlock between the door linkage and the operating means for the vehicle is also sensitive to the position of the latch, and it will function to prevent, either positively or by the actuation of an appropriate signal, the starting of the vehicle once the doors have been opened under the control of the operator, until such time as the doors have fully closed.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to the structure and arrangement of a door controlling linkage and signal and interlock systems associated therewith, as defined in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

Fig. 1 is a top plan view of one embodiment of the present invention shown in the position which it assumes

when the latch is operative and the doors are fully closed;

Fig. 2 is a view similar to Fig. 1 but showing the position of the linkage when the latch is inoperative and the doors are fully open;

Fig. 3 is a fragmentary view similar to Fig. 1 but on an enlarged scale, showing the position which the parts assume when the latch is in operative position and the doors have been moved a predetermined distance from their closed position;

Fig. 4 is a fragmentary front elevational view of a portion of the linkage, showing particularly the manual or emergency means provided for unlatching the doors;

Fig. 5 is a schematic circuit diagram of the signal and interlock systems;

Fig. 6 is a view similar to Fig. 1 but showing an alternative embodiment of the present invention; and

Fig. 7 is a fragmentary view on an enlarged scale showing the lost motion connection in the embodiment of Fig. 6.

The invention is here specifically disclosed in connection with a pair of bi-parting doors **2** movable between a closed position in line with and extending toward one another and an open position at right angles thereto. (In the drawings the doors **2** are only fragmentarily disclosed in broken lines in Fig. 2 in their open position.) The doors may be mounted in conventional manner with their upper shafts **4** extending through and appropriately journaled in a supporting plate **6** adapted to be mounted above the doors. Arms **8** are fast on the shafts **4** and are pivotally connected at **10** to elongated links **12** the other ends of which are pivotally connected at **14** to arm **16** fast on sleeve **18** which is rotatable about pin **20** mounted on the base plate **6**. Also fast on the sleeve **18** is an arm **22** which is pivotally connected at **24** to a piston rod **26** which enters checking cylinder **28** which is in turn pivotally mounted at **30** on the base plate **6**. This checking cylinder **28** may, as is conventional, check or limit the speed of movement of the doors from their open to their closed positions. Many types of such checks are available and known. The details of the specific cylinder here disclosed are disclosed and claimed in the copending patent application of Eldred P. Codling entitled "Pneumatic Motion-Checking Device and Door Operating System Including Same," Ser. No. 722,184, filed March 18, 1958 and assigned to the assignee of the present invention.

Also connected to the sleeve **18** for movement therewith is a plate-like element **32** to which one end of a spring **34** is connected at **36**, the other end of the spring being adjustably anchored to the base plate **6** at **38**. The plate **32** is provided with an arcuate peripheral surface **40** which terminates in an inwardly extending surface **42**. Pivotally mounted on the underside of the plate **32** adjacent the surface **42** is a second element part **44** provided with a slot **46** into which pin **48** carried by the plate **32** is received, a spring **50** being active between the part **44** and the arm **22** so as to urge the part **44** to pivot in a counter-clockwise direction until the pin **48** engages the end of the slot **46**. The part **44** is provided with a peripheral surface **52** substantially coincident with the surface **40** of the part **32**, the surface **52** terminating in an inwardly directed surface **54**. When the pin **48** engages the end of the slot **46** the surface **54** extends circumferentially beyond the surface **42** for a predetermined limited distance.

A stud **56** extends up from the base plate **6** adjacent the element **32**, and latch arm **58** is pivotally mounted thereon and biased in a clockwise direction by means of spring **60**. One arm of the latch **58** extends toward the element **40** and carries a shoulder surface **62** adapted to engage either of the surfaces **54** or **42**. This arm of the latch **58** also carries an upstanding pin **64** and a cam **66**. The other end of the latch **58** extends in the opposite direction from the stud **56** to a point opposite the armature **68** of a solenoid **70** mounted on the base plate **6**. The armature **68** is normally withdrawn into the solenoid **70**, a clearance then existing between itself and the latch **58**, but when the solenoid **70** is appropriately actuated the armature **68** will move out therefrom into engagement with the latch **58**, causing it to pivot in a counter-clockwise direction against the action of the spring **60** from its position shown in Fig. 1 to its position shown in Fig. 2. When the latch is in the position of Fig. 1 its surface **62** will engage the element **32** or its associated part **44**, thereby limiting movement of the part **32** in a counterclockwise direction. This is termed the operative position of the latch **58**. When the latch **58** is in its position shown in Fig. 2 its surface **62** is beyond the surfaces **40** and **52**, thus permitting movement of the element **32** in a counter-clockwise direction. This is the inoperative position of the latch **58**. It will therefore be seen that the latch **58** normally tends to assume its operative position under the influence of the spring **60**, and that it is moved to its inoperative position upon the appropriate actuation of the solenoid **70** so as to cause the armature **68** to extend therefrom.

Mounted on the base plate **6** adjacent the arm **8** is a first switch **72**, the arm **8** carrying a cam **74** which engages the switch **72** when the door **2** is in fully closed position and which becomes operatively disengaged from the switch **72** when the door **2** has moved a predetermined position from the closed position toward its open position. Also mounted on the base plate **6** is a second switch **76** which is operatively associated with the cam **66** carried by the latch **58**. When the latch **58** is in its operative position the cam **66** is operatively disengaged from the switch **76**, but when the latch **58** is in its inoperative position the cam **66** operatively engages the switch **76**.

In the form here specifically disclosed, and as may be seen from Fig. 5, the switch **72** is adapted to be closed when the cam **74** is operatively disengaged therefrom and is adapted to be opened when the cam **74** is operatively engaged therewith. The switch **76** has a pair of fixed contacts **78** and **80** and a movable contact **82**, the latter normally (when the cam **66** is not active on the switch **76**) being in engagement with the fixed contact **78** but being movable away from the fixed contact **78** and into engagement with the fixed contact **80** when the cam **66** actuates the switch **76**.

For manual emergency control of the latch, a lever **84** is mounted on arm **86** extending up from the forward edge of the base plate **6**, the lever **84** carrying a pin **38** positioned adjacent and opposite the pin **64** carried by the latch **68**, all as may best be seen in Fig. 4, in which the arm **84** is shown in its normal inoperative position. If the lever **84** is swung in a counter-clockwise direction the pin **88** will engage with the latch carried pin **64** and will thus manually move the latch **58** to its inoperative position against the action of the spring **60**.

As here specifically disclosed a signal **90** of any appropriate type, such as a bell or light, is operatively interposed in an electric circuit including a source **92** of electric power, the switch **72**, and contacts **78** and **82** of the switch **76**. An interlock system **94** is connected in series with the electric source **92** and the fixed contact **80** of the switch **76**. This interlock may be directly and automatically active upon a means for controlling the movement of the vehicle in which the doors are mounted so as, for example, to automatically apply the brake or prevent the depression of the accelerator whenever the interlock system **94** is energized, or it may actuate a separate visual or audible signal to apprise the operator of the situation to which the interlock is sensitive.

The normal position of the doors and the linkage connected thereto is shown in Fig. 1. The spring **34** is contracted and this causes the various parts of the linkage and the doors to assume their illustrated positions. In this position the element part **44** extends out beyond the surface **42** of the element proper **32**, and its surface **54** is engaged by the surface **62** of the latch **58**, which is in

its operative position. The cam 66 is disengaged from the switch 76 and the cam 74 is engaged with the switch 72. The contacts 78 and 82 in the switch 76 will be engaged and the contacts of the switch 72 will be separated. Consequently the circuits through the signal 90 and the interlock 94 are both open, neither the signal 90 nor the interlock 94 will be energized, and the situation will in all respects be normal.

However, if it is desired for any reason to move the doors to a position slightly away from their fully closed position, as when a garment has been caught between them and the doors must yield if the garment is to escape, pressure exerted on the doors 2 to cause them to open will be effective to cause a limited degree of movement of the doors toward their open position, the extent of that movement being determined by the spacing between the latch surface 62 and the surface 42 of the element 32. The element part 44 cannot move in a counterclockwise direction relative to the latch 58 because of the engagement between the surfaces 62 and 54, but the element 32 can move until, as shown in Fig. 3, its surface 42 engages with the latch surface 62, the element part 44 moving relative thereto and extending spring 50. The extent of the movement permitted the doors 2 under these circumstances is such that they will permit the passage therebetween of any reasonable obstruction which might be caught therebetween, but the movement is not so great as to cause any peril to persons remaining inside the conveyance.

When the doors have thus moved this predetermined limited distance, and as may be seen in Fig. 3, the cam 74 will have released the switch 72, and consequently the terminals of that switch will move into engagement with one another. This will close the circuit to the signal 90 (the contacts 78 and 82 of the switch 76 remaining engaged because the latch 58 remains in its operative position), and consequently the operator of the vehicle will be apprised of the fact that there is some unusual condition or occurrence in connection with the doors.

When the doors are to be opened, as when the conveyance reaches an authorized stop, the operator will appropriately actuate the solenoid 70, the latch 58 will be moved into inoperative position, and the doors can then be pushed open. The doors are shown in their open position in Fig. 2. The switch 72 will be closed, because the doors will no longer be in their fully closed position, but movement of the latch 58 to its inoperative position disengages contacts 82 and 78 of switch 76, so that the signal 90 will not be energized. There is no need for any such signal, since the operator of the vehicle is well aware that the doors might be opened. The same movement of the latch 58 to its inoperative position causes engagement between the contacts 80 and 82 of the switch 76, thus closing the circuit though the interlock 94 is energized, thus preventing the vehicle from starting either by means of positive control or by giving some appropriate warning to the operator.

When the operator wishes to start his vehicle he will, of course, want the doors to be closed and latched shut. He will therefore de-energize the solenoid 70, and as a result the spring 60 will urge the latch 58 to pivot in a clockwise direction back to its operative position. However, for so long as the doors are not in their fully closed position the latch 58 will not be permitted to return to its operative position, because the side surface of the latch 58 will engage with the peripheral surface 40 of the element 32 and the peripheral surface 52 of the element 44. Consequently the switch contacts 80 and 82 will remain in engagement and the interlock 94 will remain energized. Once the doors have fully reached their closed position, however, the latch 58 will snap over the surface 54 of the projecting element part 44 and the circuit through the interlock 94 will be broken.

It will be apparent that manual actuation of the lever 84 to move the latch 58 to inoperative position will have precisely the same effect as the remote actuation of the solenoid 70, both insofar as control of door movement is concerned and insofar as energization of the signal 90 and the interlock 94 are concerned.

In the embodiment of Figs. 1–3 it will be seen that the connection between the element 32 and the element part 44 defines a lost motion connection of limited operative length (as determined by the location of the pin 48 and the configuration of the slot 46, which in turn control the degree to which the surface 54 can project beyond the surface 46), and that said lost motion connection is biased to extended position by means of the spring 50.

The embodiment of Fig. 6 is essentially similar to that of Figs. 1–3 except that the lost motion connection is not built into the element 32 but is instead interposed between a door and the element 32. In that embodiment the right hand link 12′ comprises a rod 96 pivotally connected to the arm 8 at 10, that rod being telescopable in sleeve 98 pivotally connected at 14 to the arm 16. The degree of this telescoping movement is controlled and limited by means of a pin 100 fastened to the sleeve 98 and passing through a slot 102 in the rod 96. A spring 104 is compressed between a shoulder 106 on the sleeve 98 and a shoulder 108 connected to the rod 96, thus tending to cause the rod 96 to telescope outwardly with respect to the sleeve 98. It will be apparent, however, that if the door to which the right hand arm 8 is connected should be pushed away from its closed position, it may move for a predetermined distance despite the fact that the element 32 is rigidly held by the latch 58, that movement occurring against the action of the spring 104 and the extent of that movement being determined by the length of the slot 102. There is thus provided a lost motion connection defined by the elements 96, 98, 100, 102, which lost motion connection is of limited operative length, as determined by the length of the slot 102, and which is biased to its extended position by means of the spring 104. Although in Fig. 6 such a lost motion connection is disclosed only in connection with a single door, the left hand door being immovable when the element 32 is engaged by the latch 58, it would, of course, be appropriate, if desired, to provide a similar lost motion connection effective to permit movement of the left hand door.

The linkage and system of the present invention, it will be seen, thus provide for a maximum of safety and security and permit the use and appropriate actuation of signal and interlock systems, all by means of a simple, sturdy, reliable and relatively inexpensive structure.

While but a limited number of embodiments of the present invention have been here disclosed, it will be apparent that many variations may be made, all within the scope of the instant invention as defined in the following claims.

I claim:

1. A door control assembly comprising a door adapted to be moved between first and second positions, a latch movable between operative and inoperative positions, a linkage operatively connected to said door for movement therewith and including an element adjacent said latch and operatively engaged by said latch when the latter is in operative position and when the door is in its first position so as to prevent movement of said element beyond a predetermined position corresponding to a door position intermediate between said first and second positions and only a limited distance from said first position, said latch when in inoperative position operatively disengaging from said element so as to permit said element to move beyond said predetermined position, a lost motion connection in said linkage, and biasing means active on said lost motion connection to urge it to extended position, said lost motion connection being of limited operative length corresponding to the distance between said first position and said intermediate position of said door, whereby said door may be moved for a limited distance

only from its first position to its intermediate position when said latch operatively engages said element, said door being movable to its second position when said latch is operatively disengaged from said element.

2. In the assembly of claim 1, means operatively connected to said linkage for urging said door to closed position.

3. In the assembly of claim 1, means operatively connected to said linkage for urging said door to closed position, and means operatively connected to said linkage for checking the movement of said door in at least one direction.

4. In combination with the assembly of claim 1, signal means, and an actuating system operatively connected to said signal means, operatively connected to said linkage so as to be sensitive to the position of said door, operatively connected to said latch so as to be sensitive to the position thereof, and effective to actuate said signal means when said latch is in its operative position and said door is not in its first position.

5. The combination of claim 4, in which said signal actuating system comprises an electric circuit including first and second switches operatively connected to one another and to said signal means, said linkage comprising a part operatively connected to said first switch so as to actuate said first switch in a signal-giving sense when said dor is not in its first position, said second switch being operatively connected to said latch so as to establish an operative circuit to said signal means only when said latch is in its operative position.

6. In combination with the assembly of claim 4, a conveyance in which said assembly is mounted, said conveyance having a conveyance movement control means, and an interlock operatively connected between said latch and said movement control means effective, which said latch is in its inoperative position, to prevent actuation of said movement control means to cause said conveyance to move, a portion of said linkage operatively engaging said latch when said door is not in its first position and said latch is in inoperative position and retaining said latch in its inoperative position.

7. In combination with the assembly of claim 5, a conveyance in which said assembly is mounted, said conveyance having a conveyance movement control means, and an interlock operatively connected between said latch and said movement control means effective, when said latch is in its inoperative position, to prevent actuation of said movement control means to cause said conveyance to move, a portion of said linkage operatively engaging said latch when said door is not in its first position and said latch is in inoperative position and retaining said latch in its inoperative position, said interlock comprising an electric circuit including a third switch operatively connected to said latch so as to establish a circuit to actuate said interlock when said latch is in its inoperative position.

8. The assembly of claim 1, in which said element comprises two parts, said lost motion connection being interposed between said element parts.

9. The assembly of claim 1, in which said lost motion connection is interposed between said door and said element.

10. A door control assembly comprising a door adapted to be moved between first and second positions, a support, a latch mounted on said support for movement between operative and inoperative position, means operatively connected to said latch for moving it between said positions, a linkage operatively connected to said door for movement therewith and including an element mounted on said support adjacent said latch, said element having a first surface engageable with said latch when the latter is in inoperative position and when the door is not in its first position, whereby said latch is retained in inoperative position until said door has reached its first position, said element having a second surface engageable with said latch when the latter is in its operative position and said door is in its first position, a lost motion connection in said linkage, biasing means active on said lost motion connection to urge it to extend position, said lost motion connection to urge it to extended position, said corresponding to movement of said door from its first position toward its second position to an intermediate position only a limited distance from its first position, whereby said door may be moved from its first position to its intermediate position when said latch operatively engages said element, said door being movable to its second position when said latch is operatively disengaged from said element.

11. A door control assembly comprising a door adapted to be moved between first and second positions, a support, a latch mounted on said support for movement between operative and inoperative position, means operatively connected to said latch for moving it between said positions, a linkage operatively connected to said door for movement therewith and including an element mounted on said support adjacent said latch, said element having a first surface engageable with said latch when the latter is in inoperative position and when the door is not in its first position, whereby said latch is retained in inoperative position until said door has reached its first position, said element having a second surface engageable with said latch when the latter is in its operative position so as to prevent further movement of said element, said element comprising a main part and an extension mounted on said main part with a limited degree of lost motion and biased to extend operatively toward said latch, both of said element parts having individual second surfaces, said second surface on said element extension engaging said latch when said door is in its first position and said second surface on said element main part being spaced a limited distance from said latch when said door is in its first position, whereby said door may be moved for a limited distance only from its first position toward its second position, corresponding to the spacing between said latch and said second surface of said element main part, when said latch operatively engages said element, said door being movable to its second position when said latch is in its inoperative position.

12. A door control assembly comprising a door adapted to be moved between first and second positions, a support, a latch mounted on said support for movement between operative and inoperative position, means operatively connected to said latch for moving it between said positions, a linkage operatively connected to said door for movement therewith and including an element mounted on said support adjacent said latch, said element having a first surface engageable with said latch when the latter is in inoperative position and when the door is not in its first position, whereby said latch is retained in inoperative position until said door has reached its first position, said element having a second surface engageable with said latch when the latter is in its operative position and said door is in its first position, and a lost motion connection in said linkage between said door and said element, biasing means active on said lost motion connection to urge it to extended position, said lost motion connection being of limited operative length, whereby said door may be moved for a limited distance only from its first position toward its second position, corresponding to the operative length of said lost motion connection, when said latch operatively engages said element, said door being movable to its second position when said latch is operatively disengaged from said element.

13. In the assembly of claim 10, first and second switches on said support, a source of electric power, and a signal, all operatively connected, said first switch being operatively connected to said linkage so as to be actuated in a signal giving sense when said door is not in its first position, said second switch being operatively connected

to said latch so as to establish an operative circuit between said first switch and said signal means only when said latch is in its inoperative position.

14. In combination with the assembly of claim 13, a conveyance in which said assembly is mounted, said conveyance having a conveyance movement control means, and an interlock operatively connected between said latch and said movement control means effective, when said latch is in its inoperative position, to prevent actuation of said movement control means to cause said conveyance to move.

15. In combination with the assembly of claim 13, a conveyance in which said assembly is mounted, said conveyance having a conveyance movement control means, and an interlock operatively connected between said latch and said movement control means effective, when said latch is in its inoperative position, to cause said conveyance to move, said interlock comprising an electric circuit including a third switch operatively connected to

said latch so as to establish a circuit to actuate said interlock when said latch is in its inoperative position.

16. In combination with the assembly of claim 10, a conveyance in which said assembly is mounted, said conveyance having a conveyance movement control means, and an interlock operatively connected between said latch and said movement control means and effective, when said latch is in its inoperative position, to prevent actuation of said movement control means to cause said conveyance to move.

17. The combination of claim 16, said interlock comprising an electric circuit including a switch operatively connected to said latch so as to establish a circuit to actuate said interlock when said latch is in inoperative position.

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2,259,579 Newkirk ---------- Oct. 21, 1941

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,893,506 July 7, 1959

Kristupas Daugirdas

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 8, line 4, for "extend" read -- extended --; line 5, for "to urge it to extended position, said" read -- being of limited operative length --.

Signed and sealed this 7th day of June 1960.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents