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Peterson

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[54] **LOCKING DEVICE FOR DOORS**

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[52] **U.S. Cl.** **292/144;** 70/275; 292/177

[51] **Int. Cl.**[2] **E05B 51/02**

[58] **Field of Search** 70/264, 275; 292/144

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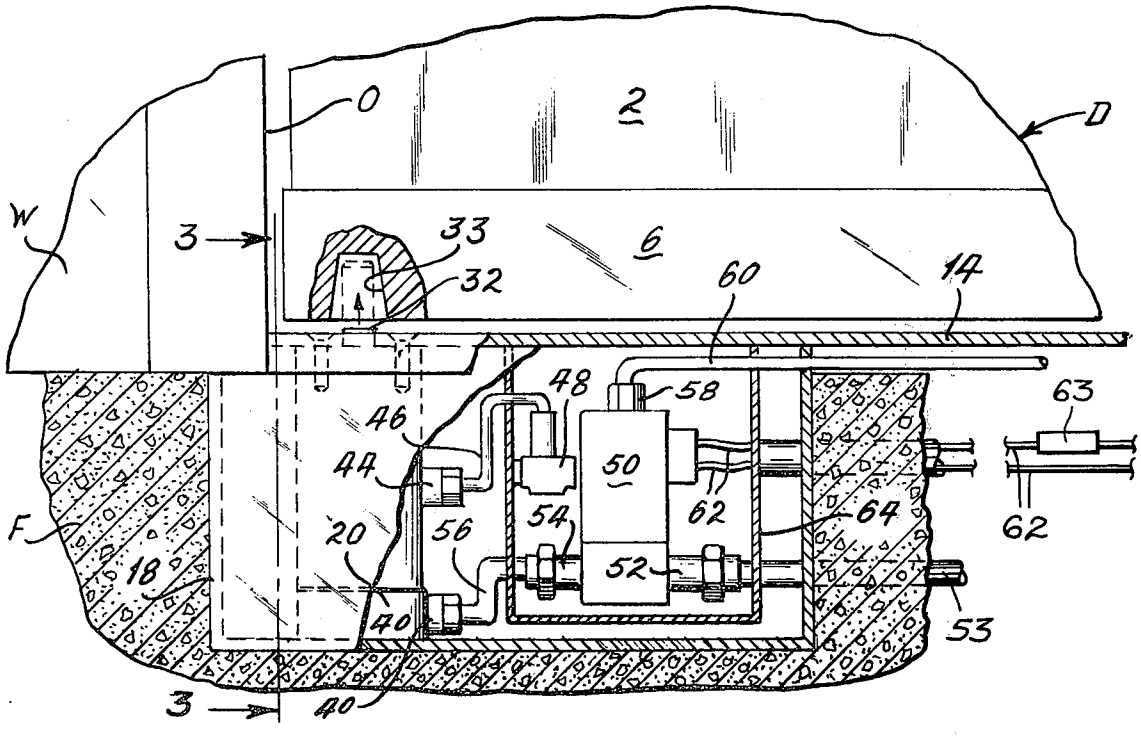
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[57] **ABSTRACT**

A locking device for securing a door includes an air cylinder set into the floor below the door and this cylinder contains a piston which moves a locking element between retracted and extended positions. When in the retracted position, the locking element permits the door to move, but when in the extended position, the locking element projects into the bottom of the door, securing the same. As the piston moves upwardly and approaches its extended position, the piston uncovers a port in the cylinder so that high pressure air acting on the piston is directed to a switch which is connected to a signal at a remote location for indicating that the locking element is extended. The air cylinder is energized through a solenoid valve which is also in the floor and is in series with a door-actuated switch so that the solenoid can only be energized when the door is closed.

7 Claims, 4 Drawing Figures



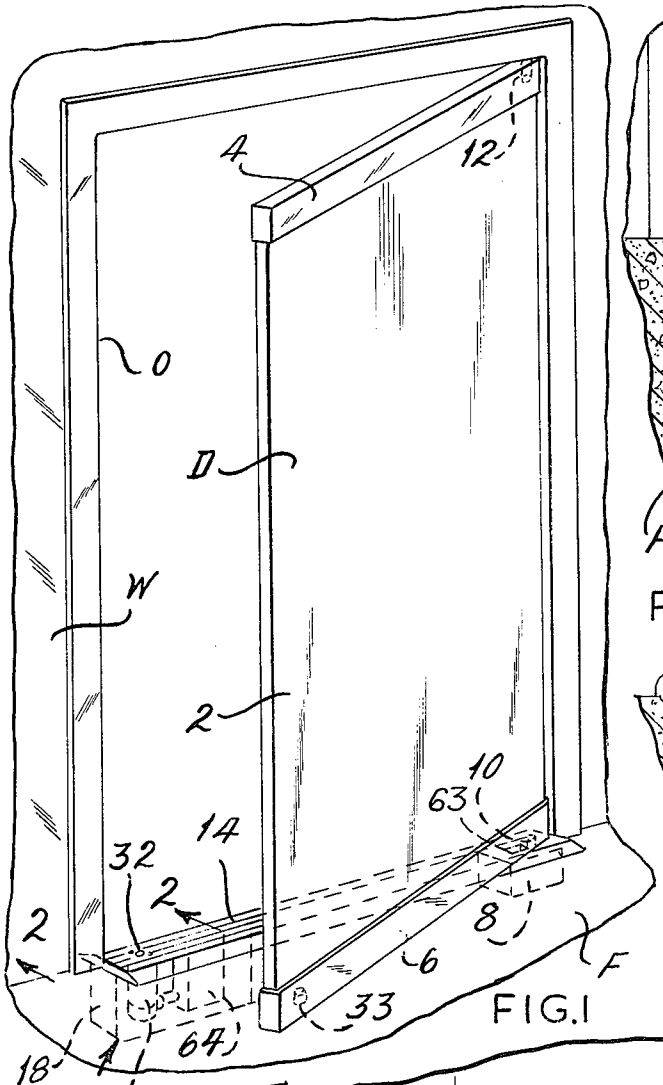


FIG.1

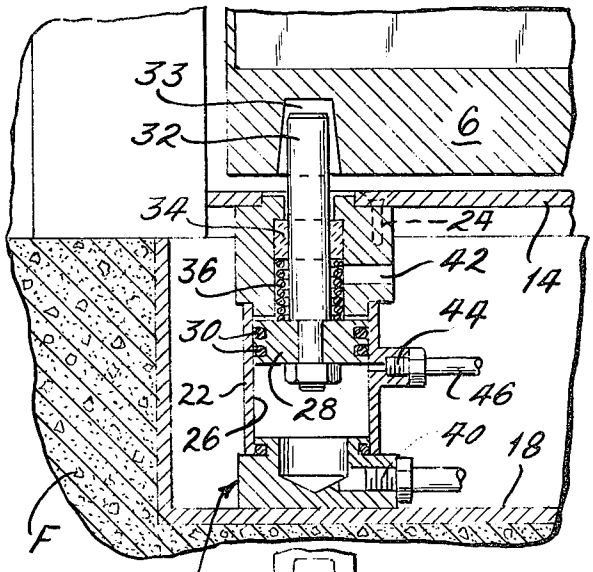


FIG.4

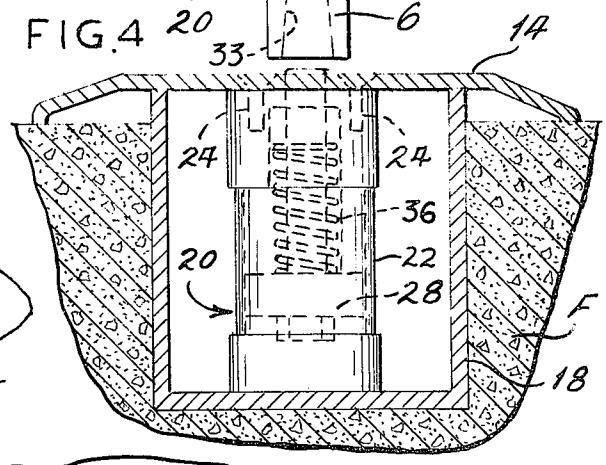


FIG.3

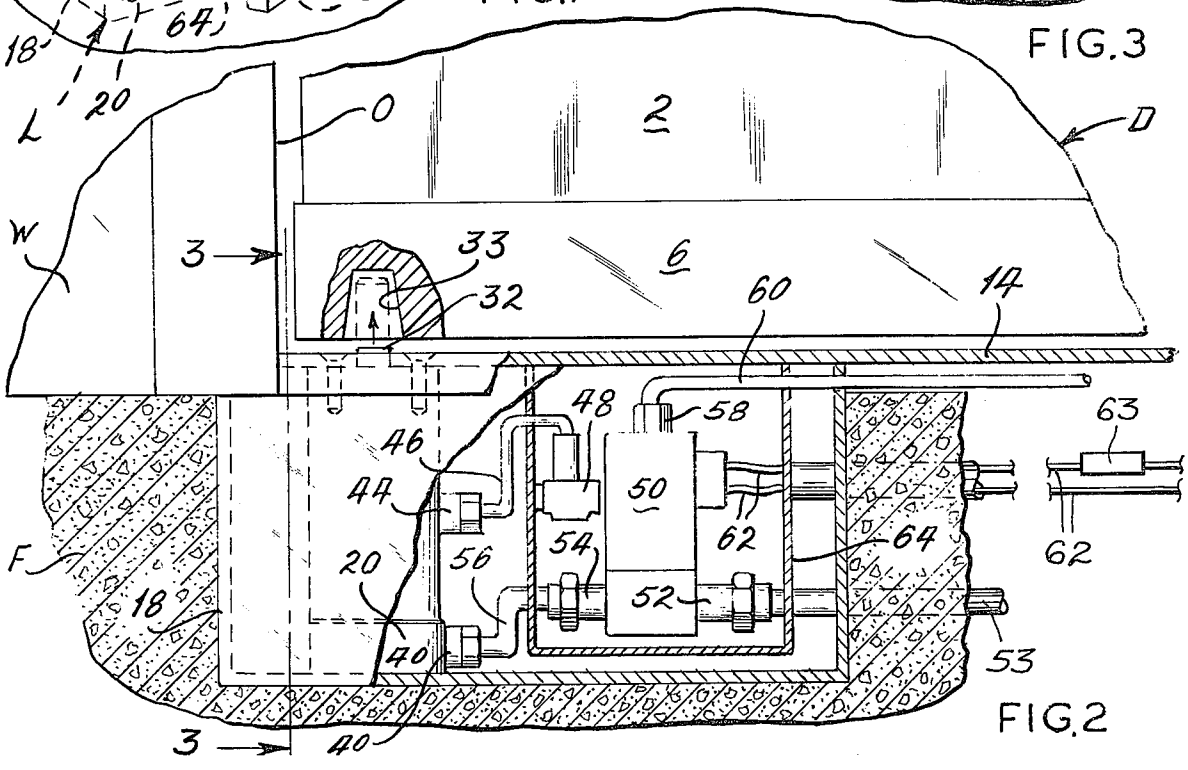


FIG.2

LOCKING DEVICE FOR DOORS

BACKGROUND OF THE INVENTION

This invention relates in general to doors and more particularly to locking devices for doors.

The architectual details of some modern buildings do not lend themselves to conventional locking devices, especially for doors. This is particularly true of doors which are almost entirely glass. In doors of this nature, the glass usually forms a structural portion of the door and has metal rails along its top and bottom for accommodating pivot devices, if the door swings between its open and closed positions, or for following guide rails if the door slides between its open and closed positions. Often the structure above the door is also glass and therefore cannot support a locking device. As a result the locking devices for such doors are often installed in the floors.

Locking devices installed in floors must be quite durable to withstand dirt and impacts. They must also be capable of operating at sub-freezing temperatures and in the presence of ice and snow. Insofar as remotely controlled locking devices are concerned, solenoid actuated locking devices tend to freeze in sub-freezing temperatures and exert extremely low closing forces on the locking element.

SUMMARY OF THE INVENTION

One of the principal objects of the present invention is to provide a locking device for a door which is suitable for installation in the floor. Another object is to provide a locking device which may be used in sub-freezing weather and is not easily jammed with ice or snow. A further object is to provide an air-operated locking device capable of providing a signal when it is locked. An additional object is to provide a locking device of the type stated which is ideally suited for use with doors made almost entirely of glass. These and other objects and advantages will become apparent hereinafter.

The present invention is embodied in a fluid cylinder having an extensible element which moves in response to high pressure fluid directed to the cylinder from a solenoid valve. When the extensible element is extended it will engage and secure a door. The invention also consists in the parts and in the arrangements and combinations of parts hereinafter described and claimed.

DESCRIPTION OF THE DRAWINGS

In the accompanying drawings which form part of the specification and wherein like numerals and letters refer to like parts wherever they occur:

FIG. **1** is a perspective view of a glass door provided with a locking device constructed in accordance with and embodying the present invention;

FIG. **2** is a sectional view taken along lines **2—2** of FIG. **1** with the door in its closed position and the locking device retracted;

FIG. **3** is a sectional view taken along lines **3—3** of FIG. **2**; and

FIG. **4** is a sectional view of the air cylinder for the locking device with the locking rod thereof extended and engaged with the door.

DETAILED DESCRIPTION

Referring now to the drawings, a door D (FIG. **1**) normally occupies a door opening O in a wall W which extends upwardly from a floor F. The door D swings out of the opening O to permit individuals to pass through the opening O. A locking device L installed in the floor F secures the door D in its closed position when the locking device is energized. The floor F may be poured concrete.

The door D includes a relatively thick pane of tempered glass **2** which fills almost the entire door opening O and hence constitutes the major portion of the door D. While the upright side edges of the glass **2** are exposed, the upper and lower edges are encased in top and bottom rails **4** and **6**, respectively, which are made from a suitable metal.

Embedded in the floor F at one lower corner of the door opening O is a closure unit **8** (FIG. **1**) having a pin **10** which projects upwardly into the bottom rail **6** and supports the door D. The upper end of the door D is retained by a top pin **12** which is secured to the wall and projects downwardly therefrom into the top rail **4.** The two pins **10** and **12** are axially aligned, and that axis is the pivot axis for the door D. When the door D is closed, it is disposed over a threshold **14** which is secured firmly to the floor F. The threshold **14** may be an aluminum extrusion.

The locking device L is disposed within a metal housing **18** which is embedded in the poured concrete floor F below that end of the threshold **14** over which the free end of the door D swings. The sidewalls of the housing **18** extend upwardly above the upper surface of the floor, which prevents water from draining into the housing **18.** The top of the housing **20** is completely covered by the threshold **14.**

The locking device L includes an air cylinder **20** (FIG. **4**) having a barrel **22** which is enlarged at its upper end where it is secured to the underside of the threshold **14** by two machine screws **24.** The barrel **22** is provided with a bore **26** having an upright axis, and this bore contains a piston **28** provided with seals **30** which wipe the surface of the bore **26** as the piston **28** moves axially therein. The lower end of the barrel **22** is completely closed, but the upper end is open and is occupied by a piston rod or locking rod **32** which is attained to the piston **28** and extends upwardly therefrom. When the piston **28** is at the lower end of the bore **26,** the rod **32** is retracted and its upper end **32** is generally flush with the upper surface of the threshold **14.** In this regard, the threshold **14** has an aperture for receiving the rod **32.** However, when the piston **28** is at the upper end of the bore **26,** the rod **32** is extended substantially beyond the threshold **14** and indeed far enough to engage the bottom rail **6** of the door D. The bottom rail **6** has a downwardly opening socket **33** which aligns with the locking rod **32** when the door D is closed, and this socket receives the locking rod **32** when the door D is secured by the locking device L. Above the bore **26** the barrel **22** contains a plastic seal or packing **34** and extended between this packing **34** and the piston **28** is a coil compression spring **36** which encircles the rod **32** and urges the piston **28** downwardly.

The barrel **22** (FIG. **4**) at its lower end is provided with a supply port **40** which communicates with the lower end of the bore **26.** The upper end of the barrel **22** has a vent port **42** which likewise communicates

with the upper end of the bore **26** above the piston **28** therein. Between the two ports **40** and **42,** the barrel **22** has still another port, namely a sensing port **44** and this port opens directly out of the side of the bore **26.** When the piston **28** is at the lower end of the bore **26** and the locking rod **32** is fully retracted, the piston **28** is completely below the sensing port **44** so that the sensing port **44** and the vent port **42** are in communication through the bore **26** (FIG. 3). Hence, the sensing port **44** is vented. However, as the piston **28** moves upwardly through the bore **26** it passes across the sensing port **44,** and when it is near its uppermost position it uncovers the sensing port **44** and places that port in communication with supply port **40** (FIG. **4**).

The sensing port **44** is connected by means of a short tubing **46** to a pressure operated microswitch **48** (FIG. **2**) so that when the pressure in the tubing **46** exceeds a prescribed value, the switch **48** will be actuated. The switch **48** is likewise located in the housing **20,** but it is connected to and controls an alarm or signal device located remote from the door D. Thus, when pressurized air enters the supply port **40** and moves the piston **28** past the sensing port **44,** the pressurized air will actuate the switch **48** to signal that the locking rod **32** is fully extended. The air cylinder **20** is controlled by a solenoid valve **50** having an inlet port **52** which is connected to a source of high pressurized air through a high pressure supply line **53.** The valve **50** also has an outlet port **54** which is connected to the supply port **40** of the air cylinder barrel **22** by a short connecting tube **56.** In addition, the valve has an exhaust port **58** which empties into the space beneath the threshold **14** through a short tube **60.** The solenoid valve **50** is operated by electric current supplied through lines **62.** This enables the valve **50** to be controlled from a remote location such as the location of the signal device connected with the pressure operated microswitch **48.**

When the solenoid valve **50** is energized by an electric current, the inlet and outlet ports **52** and **54** are in communication and the exhaust port **58** is closed. However, when the valve **50** is de-energized the passage of high pressure air through the valve **50** is blocked immediately beyond the inlet port. Also, the outlet port **54** and the exhaust port **58** are in communication, thus venting the former.

The solenoid valve **50** is electrically connected with a switch **63** (FIGS. **1** & **2**) located in one of the lines **62** and operated by the door D, with the arrangement being such that valve **50** cannot be opened while the door D is open. The switch **63,** which senses the position of the door D, may be incorporated into the closer unit **8** as disclosed in application Ser. No. 488,656 of Thomas J. Kleumpers entitled DOOR CLOSER WITH SWITCH ACTUATED THEREBY, filed contemporaneously with this application on July 15, 1974. Thus, the locking rod **32** will extend only if the door D is above the threshold **14.**

The switch **48** and the solenoid **50** are contained within a waterproof box **64** located within the housing **18.**

OPERATION

When the building is in use and it is desired to permit individuals to pass through the door opening O, the solenoid valve **50** is isolated from the electrical energy source. As a result, the high pressure of the air within the supply line **53** does not exist much beyond the inlet port **52.** Moreover, the lower end of the bore **26** in the barrel **22** of the air cylinder **20** is vented through the supply port **40** of the barrel **22,** the connecting tube **56,** and the outlet and exhaust ports **54** and **58** of the solenoid valve **50.** Thus, the piston **28** by virtue of the force of gravity and the return force exerted by the spring **36** assumes its lowermost position, and the upper end of the locking rod **32** is generally flush with the threshold **14** and clearly out of the socket **33** on the lower rail **6** (FIGS. **2** and **3**). Hence, the door D is free to swing about the axis of the pins **10** and **12.**

When it is desired to secure the door D in its closed position to prevent passage through the door opening O, the solenoid valve **50** is energized from the remote location. In this regard, it should be noted that because of the door actuated switch, the valve **50** cannot be actuated until the door D is directly over the threshold in its closed position. When the valve **50** is energized, it directs high pressure air from the supply line **53** to the valve outlet port **54** and thence to the supply port **40** of the barrel **22** through the connecting tube **56.** The pressure builds up against the lower face of the piston **28** within the bore **26** and causes the piston **28** to rise against the force of the spring **36.** The piston **28** moves the locking rod **32** upwardly and causes it to project into the socket **33** in the bottom rail **6** of the door D (FIG. **4**), thus, securing the door D. As the piston **18** approaches its uppermost position, it uncovers the sensing port **44** exposing that port to the high pressure air in the bore **26.** This subjects the microswitch **48** to the high pressure air, and as a result the switch **48** activates the signal at the remote location, so as to indicate that the locking rod **32** is extended.

When the solenoid valve **50** is again de-energized, the supply port **40** of the barrel is connected through the valve **50** with the exhaust port **58** of the valve **50,** thus venting the lower end of the bore **26** so that spring **36** forces the locking rod **32** downwardly and out of the socket **33** of the lower rail **6.** This frees the door D so that it can swing open. The reduction in pressure in the bore **26** opens the microswitch **48** so that the signal at the remote location changes to show that the door D is unlocked.

If the building power supply is for some reason cut off, the valve **50** will close and the locking rod **32** will retract, which is all desirable from a safety standpoint. However, this result can be avoided by using a battery back-up system for supplying the electrical energy and a reserve pressure tank for the compressed air.

If the door frame is strong enough the locking device L may be installed in the wall W against the lintel of the opening O, in which case the locking rod **32** would engage the top rail **4** of the door D. Also, where the door D has a side edge made of some material other than glass, the socket **33** can be in that side edge and the locking device can be installed at the door jamb. The locking device L may even be installed in the door D itself, in which case the socket **33** would be in the surrounding structure. When the locking device is installed in the door D, air should be transmitted into the door preferably through a hinge for the door. A hinge suitable for this purpose is disclosed in U.S. Pat. NO. 3,872,541.

This invention is intended to cover all changes and modifications of the example of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. In combination with a movable closure structure such as a door and a surrounding structure containing an opening which is blocked by the closure structure when the closure structure is in its closed position, an improved locking device for securing the closure structure in its closed position, said locking device comprising: a fluid cylinder barrel mounted firmly on one of the structures and having a bore; a piston in the bore of the barrel and movable between the ends thereof; a locking element connected to the piston and projected through one end of the barrel, the locking element being movable with the piston between retracted and extended positions, the locking element when in its retracted position being located beyond the other structure so as not to obstruct movement of the closure structure, the locking element when in its extended position being capable of engaging said other structure to prevent movement of the closure structure away from its closed position; return means for urging the piston to the position in which the locking element is in its retracted position; a fluid line connected to a source of pressurized fluid and to the barrel for admitting the pressurized fluid to the end of the barrel so as to cause a force to be applied to the piston in the direction which moves the locking element to its extended position; an electrically operated valve in the fluid line to isolate the bore of the barrel from the source of pressurized fluid so that the return means will move the locking element to its retracted position; a pressure sensitive electrical switch communicating with the bore of the barrel intermediate the ends of the bore, the location being such that the switch is exposed to and actuated by pressurized fluid in the barrel when the locking element is in its extended position but not when it is in its retracted position, the switch controlling a signal to indicate when the locking element is extended; and electrical switch means responsive to the position of the door and connected with the electrically operated valve to prevent operation of the valve except when the closure structure is in its closed position, whereby when the bore is supplied with pressurized fluid through the electrically operated valve, the locking element will engage said other structure and prevent the closure structure from leaving its closed position.

2. The combination according to claim 1 wherein the pressure sensitive switch communicates with the bore through a port which opens into the bore, and the piston moves past the port as the locking element goes from one of its positions to the other of its positions.

3. The combination according to claim 2 wherein the port for the fluid operated valve is exposed to and the pressure sensitive switch communicates with the bore when the locking element is in both of its positions, and the port is vented through the ore when the locking element is in its retracted position.

4. The combination according to claim 1 wherein the electrically operated valve is a solenoid valve.

5. The combination according to claim 1 wherein the bore of the barrel is vented at the end thereof which is opposite the end at which high pressure fluid is introduced.

6. The combination according to claim 1 wherein the locking device is installed at the bottom of the surrounding structure and the locking element moves upwardly to engage the door.

7. A locking device for securing a door in a closed position within a door opening bordered at its bottom by a floor, said locking device comprising: an air cylinder including a barrel mounted firmly in the floor and having an upright bore therein which is vented at its upper end and a port which opens into the bore intermediate the ends thereof, a piston movable in the bore between a lower position wherein it is below the port and an upper position wherein it is above the port, a spring for urging the piston to its lower position, and a locking rod mounted rigidly on the piston for movement through the upper end of the barrel, the locking rod being retracted below the door so as to not obstruct the door when the piston is in its lower position at the lower end of the bore and being extended to a height sufficient to engage the door and prevent the door from moving when the piston is in its upper position at the upper end of the bore; a solenoid valve connected to a source of high pressure air and to the lower end of the cylinder such that when the valve is closed the bore is vented and when the valve is opened it will direct high pressure air to the lower end of the bore and cause the piston to rise, whereby the locking rod will move upwardly to its extended position; a pressure sensitive electrical switch connected to the port and being actuated by the pressurized air once the piston rises above the port, the switch being connected to a signal which is controlled thereby; and switch means connected with the solenoid valve for sensing the position of the door and for preventing operation of the solenoid valve when the door is in any position other than its closed position, whereby the locking rod when extended will engage the door and prevent it from moving out of its closed position.

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