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[54] **EMERGENCY DOOR OPENING SYSTEM**

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[58] **Field of Search** ..... 49/264, 141, 31, 1, 2, 49/280, 118, 360; 60/52 CD

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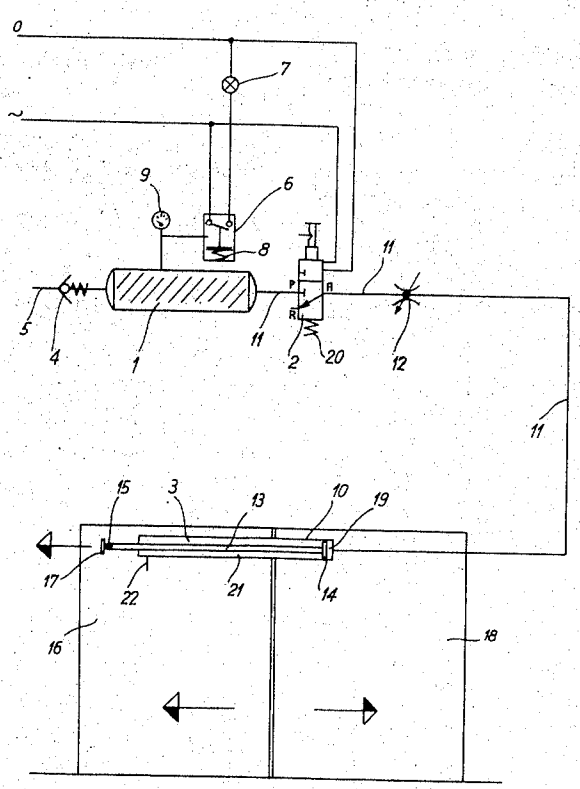
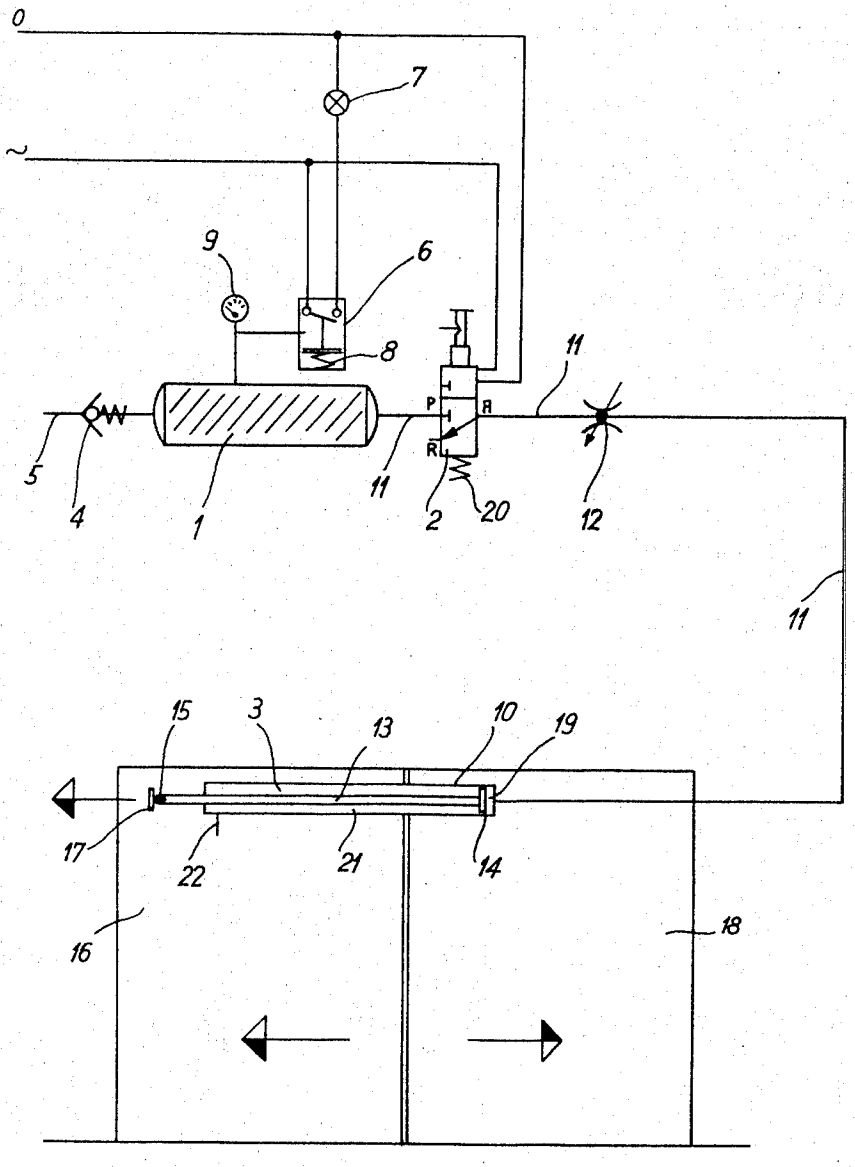
[57] **ABSTRACT**

Emergency door opening system in which pressurized gas is supplied to a pneumatic door opening device through a solenoid control valve automatically opening in the event of power failure. Preferably, the gas flow is restricted downstream of the control valve to open the door at a safe rate.

6 Claims, 1 Drawing Figure

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EMERGENCY DOOR OPENING SYSTEM

The invention relates to an emergency door opening system for an automatically operated door using an electrically operated door opening and closing mechanism.

Doors which are operated automatically by electrically operated mechanisms have the disadvantage that when the power supply is interrupted, the operating mechanisms are rendered inoperative and thus stop in the position occupied at the moment of interruption of power. Thus, if such doors are closed at the moment of power interruption, then they will remain closed during the interruption and as a rule considerable efforts are needed in order to open these closed doors by hand. In some cases, such as a door operated by an electric motor turning a worm drive having a relatively low thread pitch on the worm, an opening of the door by hand is virtually impossible, because worm drives of relatively low pitch can only be operated by rotation of the worm and not by rotation of the worm wheel.

An interruption of the power supply frequently occurs as an incident to an emergency situation, for example, a fire or flood. If under such circumstances the door of a building or a closed space cannot be opened immediately and easily, there is the danger of panic by any people within. Many instances are known of fire catastrophes in which many people experienced panic and lost their lives because the emergency exits could not be opened easily and extreme measures for opening or breaking open emergency exits were precluded because of the panic. Therefore, for automatically operated doors using an electrically driven door opening or closing mechanism, the first minimum requirement is that these doors should be readily openable in the case of interruption of the power supply. This minimum requirement was satisfied in the case of installations using worm gears by selecting worm wheels with relatively high or steep pitched threads or, more often, with multiple worm threads which, in either instance, would not block reverse rotation of the worm wheel, or by providing in the power transmission between the driving motor or the worm drive and the door being moved, a coupling which in the loss of power disengages automatically to permit easy opening of the door.

Subsequent experience proved, however, that these known measures did not alone offer sufficient security against panic. This was especially true in the case of worm gears with a high pitch thread, which necessitated that the driving motor must also be turned backwards via the worm gear during opening of the door so that the opening of the door by hand was nevertheless still guite difficult. The use of couplings was, of course, relatively safe but was fairly expensive, both in the initial cost of the coupling and in operating cost because of the consumption of significant amounts of power in maintaining operative engagement of the coupling. Therefore, safety officals responsible for protecting the public against catastrophe had already contemplated and in some areas already prescribed that the automatically operated doors using electrically driven door opening and closing mechanism must be equipped with means capable on loss of power to open the door automatically.

Various proposals already have been made for emergency door opening systems but all have added considerably to production costs for the complete installation.

Because of this considerable additional expenditure, such emergency door opening installations have been installed only where absolutely required. Absent such stringent governmental regulation, such emergency door opening systems have been omitted even though their advantages in the case of a catstrophe are evident, simply because of the high extra expense.

Therefore, the invention has for its objective an emergency door opening system which can be constructed at sufficiently low cost that it does not add significantly to the production costs for the overall electrically driven door opening and closing installation so that its protection during a catastrophe by far outweighs any minor added cost.

This objective is achieved according to the invention with an emergency door opening system which is characterized by a pneumatic actuating means comprising a pneumatic cylinder and a piston movable therein which, when pressurized, exerts a driving force upon the door in the opening direction, a source of pneumatic pressure, a connecting line between the pressure source and the pneumatic actuating means, and an electrically operable control valve in the connecting line which in the case of power loss pressurizes the connecting line and during normal operation vents the connecting line to the atmosphere.

The advantage of such an emergency door opening system lies in the first place in its extremely small production cost and in the second place in its adaptability for installation in existing electrically operated door installations. The small cost is due mainly to the fact that apart from the control valve, no further control elements are needed.

A particularly advantageous development of the present installation includes, first, an automatically releasable engagement between the pneumatic actuating means and the door associated therewith which allows the door to work independently of the pneumatic actuating means under normal conditions but does permit a power transmission between the pneumatic actuating means and the door only upon pressurization of the former, and, second, throttling means in the connecting line between the pressure source and the pneumatic actuating means. The advantage of this embodiment lies in the fact that the pneumatic actuating means will, under normal operating conditions when electric current is present, remain in its rest position and will not follow the normal movement of the door. Consequently, additional friction caused by needless following of the pneumatic actuating means in ordinary operation will be avoided together with the wear and tear of the pneumatic means caused thereby which permits the use of very simple and inexpensive pneumatic means. At the same time, the throttling means are important to prevent the pneumatic actuating means from being operated too fast. If the door should be partially or wholly open at the moment of the interruption in power, the actuating means must operate without load for a stretch corresponding to the extent the door is open, until it engages the door. If the pneumatic means in this range moved rapidly under no load conditions, it would strike hard against the door connection which could result in damage to the door or to the actuating means.

For the latter preferred embodiment, the pneumatic cylinder preferably has a length approximately corresponding to the distance of travel of the door opening

and is fixedly disposed in a horizontal position, and the piston rod engaged with a stop attached to the door and lying in the path of movement of the rod when the cylinder is pressurized.

The control valve advantageously has three ports: a first port connected to the pressure source, a second port connected with the pneumatic actuating means via a connecting line, and a third port opening to the outside atmosphere, the valve body being developed in such a way that it will establish a connection between the first and second ports in case of loss of power and between the second and third ports under normal conditions. Solenoid valves meeting these requirements are commercially available.

The pressure source desirably takes the form of a tank having a feed line provided with a relief valve for refilling. In addition, a low pressure warning device can advantageously be connected with the pressure tank for the pressure agent for control purposes, which upon loss of pressure in the pressure agent tank responds at the predetermined minimum pressure and operates a signal element, preferably a signal lamp.

In conjunction with the accompanying schematic drawing, one illustrative embodiment of the invention will be explained in detail.

The emergency door opening system consists essentially of a pressure source, such as a tank **1**, for the pressurizing gas, a solenoid valve **2** serving as a control valve and a pneumatic actuating means **3** consisting of a cylinder and a piston movable therein. For the purpose of keeping tank **1** filled, a supply line **5**, equipped with a relief valve **4**, is connected with the pressure tank **1**, together with a pressure responsive switch **6** closing when the atmospheric pressure in the pressure agent tank **1** drops below a minimum predetermined pressure, and switches on the signal lamp **7**. The adjustment of the minimum pressure is accomplished by a corresponding adjustment of the tension of a spring **8** in the pressure switch **6**, by means not shown in the drawing. A manometer **9** is also connected with the same connection of the pressure agent tank **1** as the pressure switch **6**, from which manometer the pressure level in the pressure tank **1** can be observed.

A connecting line **11** extends between the pressure tank **1** and the pneumatic cylinder **10** of the pneumatic actuating means **3**, in which line a solenoid operated control valve **2** and a reduction valve **12** serving as a throttling means are arranged in series. A piston **14** joined to a piston rod **13** is disposed for movement in the cylinder **10**. The driving rod **13** at its free end is equipped with a rubber bumper or cushion **15** which engages while the door is closed against a stop **17** attached to the panel or section **16** of the door. In case of a multiple-section door as shown in the drawing, the two sections **16** and **18** are coupled by means of known linkages not shown in the drawing in such a way that an opening or closing movement of each section is transferred in the opposite direction to the other section. The door, of course, includes the usual electrical operating arrangement, which has not been shown since it is conventional and forms no part of the invention.

The functioning of the emergency door opening system shown in the drawing is as follows: as long as electric current is available, the solenoid valve **2** attached to the electrical leads is in the position shown in the drawing, i.e., the connecting line **11** running to the pneumatic actuating means **3** is vented via the port R of the solenoid valve **2** to the outside atmosphere. Consequently, in this state the interior **19** of the cylinder **10** remains at atmospheric pressure. In this position of valve **2**, the port P to which the pressure tank **1** is connected is closed.

In the case of an interruption in power, solenoid valve **2** is switched over by the reversing spring **20** located in that valve so as to connect port A of the valve with port P and feed pressurized air to line **11** and thence to actuating means **3**. As a result, the piston **14** is shifted toward the left (as seen in the drawing) and this shifting of the piston **14** is transmitted via the rod **13** to the section **16** of the door and also to other sections where present, as already explained. The shifting of piston **14** in cylinder **10** continues until the door section or sections are completely opened. The air located in the cylinder **10** in the empty space **21** behind the piston **14** escapes at the same time via the vent **22** connected with the outside atmosphere.

If the door section should be partially open at the moment of an interruption in power, the reduction valve **12** restricts the gas flow so that piston rod **13** will not be suddenly thrust against stop **17** which, if the door were partially open, would be located some distance from the starting position of rod **13** but instead will be moved slowly toward the stop so that the actual engagement of the rod end against stop **17** can be absorbed without difficulty by the rubber buffer **15**. In this way, a sudden impact against the stop **17** which can lead to damage will be avoided.

Once current is again available, solenoid valve **2** returns to its starting position, connecting line **11** to the outside atmosphere through venting port R. This relieves the pressure on the pneumatic actuating means **3** so that the door section or sections can be easily closed, either by hand or by the usual spring return biasing the door sections to closed position, if present. A sudden reversal of the piston **14** will again be prevented in this case too through the reduction valve **12** functioning as a throttling agent.

After its return, piston **14** remains in rest position so long as there is current, because no fixed connection exists between stop **17** and the free end of rod **13**. As a result, the pneumatic actuating means **3** consisting of cylinder **10** and piston **14** as well as rod **13** is seldom operated and therefore is subject to practically no wear and tear. Therefore, this arrangement can be constructed very simply. The fit between piston **14** and cylinder **10** should not be too tight and the provision of a small clearance between piston **14** and cylinder **10** may even be advisable so that the piston cannot freeze within the cylinder wall as a result of corrosion. Any loss in strength caused by such a clearance is insignificant since the strength of the present invention is relatively unimportant. Moreover, it is recommended for lubrication as well as for anti-corrosion purposes that the cylinder walls be coated with grease. Finally, it will be advantageous to provide a pressure release valve will open only when a certain excess pressure exists in the space **21** of the cylinder **10**. In this way, continuous connection of the space **21** to the outside atmosphere which tends to promote corrosion of the cylinder walls will be avoided.

In the arrangement shown, the cylinder **10** is fixed against movement to permit the rod **13** to exert an opening thrust. Alternatively, under appropriate circumstances, the cylinder could be mounted on an op-

positely moving door section to give a "double action" opening effect. Obviously, the elements of the pneumatic actuating means could be attached to rigid parts of the door section concealed within the door frame for greater safety and more attractive appearance. The stop **17** may, of course, take special forms designed to securely retain the piston rod end in engagement therewith without creating a permanent connection therebetween. Similarly, shorter pneumatic cylinders could be substituted through the use of multiplying linkages or the like.

What is claimed is:

1. Emergency door opening system in combination with an automatically electrically operated door which moves generally within its own plane during opening and closing, comprising pneumatic actuating means for opening said door when pressurized including a pneumatic cylinder, a piston rod movable in said cylinder with its free end engageable with said door, said cylinder being supported against movement with said rod with its axis generally parallel to the plane of the door and being of a length corresponding to the distance of movement of the door, a stop fixed on said door for engagement by the free end of said piston to constitute a one-way connection between said door and piston rod which is disengaged from the door during its normal operation, a pressure tank, a connecting line between said tank and said pneumatic cylinder, an electrically operated control valve in said connecting line, said valve being open in rest position and displaced to closed position when electrically engaged, and means connecting said valve to the electrical power source for said door, whereby upon a power failure, said valve assumes its open rest position, pressurizing said pneumatic cylinder to open the door.

2. The system of claim **1** including a throttling valve in the connecting line downstream of said control valve to control the rate of actuation of the actuating means.

3. The system of claim **1** including means connecting said tank to a pressure line and signal means operable when the tank pressure decreases to a predetermined minimum level.

4. The system of claim **1** wherein said control valve is a solenoid operated valve spring-biased to an open rest position.

5. The system of claim **1** wherein said control valve in its electrically energized position vents the connecting line to the pneumatic actuating means to the atmosphere while closing the line from the pressure source upstream of said valve.

6. The system of claim **1** wherein said door comprises two door panels moving in opposite directions in generally the same plane, and said piston has its free end engageable with one of said panels and said cylinder being attached to the other panel for bodily movement therewith.

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