

BUS DOOR CONTROL SYSTEM

TECHNICAL FIELD

[0001] This invention relates to a door control system for controlling opening and closing of a door.

BACKGROUND

[0002] Buses and coaches typically each have at least a front door and a rear door for passengers to get on and off the bus. Each door is typically operated by a double action pneumatic cylinder comprising a piston that is mechanically connected to the door and that moves between a first position and a second position to accordingly open and close the door. Activation of the pneumatic cylinder is typically controlled by a switch provided at the bus driver's cabin.

[0003] For the safety of passengers in the event that the driver is unable for any reason to open the front or rear doors to allow passengers out of the bus, an emergency door control valve is known to be provided on the exterior of the bus near each of the front and rear doors for a person outside the bus to be able to open the relevant door. The emergency door control valve is manually activated, e.g. by turning a lever or pushing a button, so that system air in the pneumatic cylinder is vented while source air is blocked from being fed to the pneumatic cylinder. This effectively deactivates the pneumatic cylinder so that it exerts no force on the door, thereby allowing the door to be manually opened by applying force on the door panel. A further emergency door control valve may also be provided on the interior of the bus near each of the front and rear doors for passengers in the bus to open the doors. However, use of the emergency door control valve requires sufficient force to be applied to the door panel to open the door against the weight of the door as well as the deactivated pneumatic cylinder.

[0004] As an alternative or in addition to the emergency door control valves, buses may also be provided with one or more emergency hammers for passengers in the bus to break a bus window that is made of glass and leave the bus via the broken window. However, exiting the bus through a broken window carries a risk of

passengers sustaining cuts by glass shards that may remain around the window frame.

[0005] There is therefore a need to improve ease and safety for passengers to be able to exit a bus in the event that the bus driver is unable to open the doors.

SUMMARY

[0006] According to a first aspect, there is provided a door control system for controlling a door of a bus, the door control system comprising: a pneumatic system comprising a directional control valve in pneumatic connection with a double acting pneumatic cylinder and wherein a piston rod of the double acting pneumatic cylinder is mechanically connected to the door and moveable between a first position and a second position to move the door between a closed position and an open position; a first two-way switch in electrical connection with a power supply; a second two-way switch electrically connected to the directional control valve; and an intermediate switch in series connection between the first two-way switch and the second two-way switch, wherein flipping any one of: the first two-way switch, the second two-way switch and the intermediate switch activates the directional control valve to actuate movement of the piston rod from one of: the first position and the second position to another of: the first position and the second position.

[0007] The first two-way switch, the second two-way switch and the intermediate switch together may comprise three switches, wherein one of the three switches is provided at a driver's cabin of the bus, another one of the three switches is provided inside the bus near the door, and a further one of the three switches is provided on the exterior of the bus near the door.

[0008] The further one of the three switches provided on the exterior of the bus near the door may be the intermediate switch.

[0009] According to a second aspect, there is provided a bus comprising a first door control system according to the door control system of the first aspect, wherein the door controlled by the first door control system is a first door of the bus.

[0010] The bus may further comprise a second door control system according to the door control system of the first aspect wherein the door controlled by the second door control system is a second door of the bus.

[0011] The bus may further comprise three emergency exit doors, wherein each emergency exit door is openable by rotating a handle provided on the emergency exit door, wherein a first of the emergency exit doors is provided on a ceiling of the bus at a front half of the bus, a second of the emergency exit doors is provided on the ceiling of the bus at a rear half of the bus, and a third of the emergency exit doors is provided on a side of the bus opposite a side of the bus where the first door of the bus is located.

BRIEF DESCRIPTION OF DRAWINGS

[0012] In order that the invention may be fully understood and readily put into practical effect there shall now be described by way of non-limitative example only exemplary embodiments of the present invention, the description being with reference to the accompanying illustrative drawings, in which:

[Fig. 1] is a schematic illustration of an exemplary embodiment of a bus door control system.

[Fig. 2] is a schematic illustration of four possible configurations of a first two-way switch, a second two-way switch and an intermediate switch of the bus door control system of [Fig. 1] producing a first electrical state.

[Fig. 3] is a schematic illustration of four possible configurations of the first two-way switch, the second two-way switch and the intermediate switch of the bus door control system of [Fig. 1] in producing a second electrical state.

[Fig. 4] is a schematic first perspective illustration of a bus.

[Fig. 5] is a schematic second perspective illustration of the bus of [Fig. 4].

DETAILED DESCRIPTION

[0013] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to.”

[0014] Furthermore, throughout the specification, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0015] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as is commonly understood by a skilled person to which the subject matter herein belongs.

[0016] Exemplary embodiments of a door control system 100 to control opening and closing of a door of a bus will be described below with reference to [Fig. 1] and an exemplary embodiment of a bus 200 will be described with reference to [Fig. 2] and [Fig. 3] wherein the same reference numerals are used to refer to the same or similar parts.

[0017] As shown in [Fig. 1], the door control system 100 comprises a pneumatic system 10. Among other components, the pneumatic system 10 comprises a directional control valve 13 in pneumatic connection with a double acting pneumatic cylinder 14. A piston rod 16 of the pneumatic cylinder 14 is mechanically connected to the door (not shown). The piston rod 16 is moveable between a first position and a second position to correspondingly move the door between a close position and an open position. Actuation of the piston rod 16 between the first position and the second position is according to passage of air from the directional control valve 13 to either a first end or a second end of the pneumatic cylinder 14, wherein the end of the pneumatic cylinder 14 to which air is passed by the directional control valve 13 is electrically determined, as will be described in greater detail below.

[0018] In an exemplary embodiment, the pneumatic system 10 may further comprise a compressed air tank 11 to supply source air to the directional control valve 13 via a bulk liquid separator 12. The pneumatic system 10 may also comprise

a programmable logic controller 15 in connection with the directional control valve 13. In other embodiments, the pneumatic system 10 may comprise similar or other known pneumatic system components that together allow the piston rod of 16 of the pneumatic cylinder 14 to be moved between the first position and the second position when actuated accordingly by the direction control valve 13.

[0019] The door control system 100 further comprises a first two-way switch 21, a second two-way switch 22 and an intermediate switch 23 (i.e., the three switches 21, 22, 23). The intermediate switch 23 is provided in series connection between the first two-way switch 21 and the second two-way switch 22. The first two-way switch 21 is in electrical connection with a power supply 20 while the second two-way switch 22 is electrically connected to the directional control valve 13, such that various configurations of the first two-way switch 21, the second two-way switch 22 and the intermediate switch 23 determine to which end of the pneumatic cylinder 14 air is passed from the directional control valve 13.

[0020] [Fig. 2] shows four possible different configurations of the three switches 21, 22, 23 at which the electrical connection between the power supply 20 and the directional control valve 13 is in a first state. [Fig. 3] shows four possible different configurations of the three switches 21, 22, 23 at which the electrical connection between the power supply 20 and the directional control valve 13 is in a second state that is different from the first state.

[0021] In an exemplary embodiment, [Fig. 2] shows the four configurations of the three switches 21, 22, 23 at which the directional control valve 13 is in the electrical first state and passes air to the first end of the pneumatic cylinder 14 such that the piston rod 16 is at the first position. In other words, when the three switches 21, 22, 23 are in any of these four configurations shown in [Fig. 2], the piston rod 16 is at the first position and holds the door at the closed position.

[0022] In the same exemplary embodiment, [Fig. 3] shows the four configurations of the three switches 21, 22, 23 at which the directional control valve 13 is in the electrical second state and passes air to the second end of the pneumatic cylinder 14 such that the piston rod 16 is at the second position. In other words, when the

three switches 21, 22, 23 are in any of these four configurations shown in [Fig. 3], the piston rod 16 is at the second position and holds the door at the open position.

[0023] Appreciably, it can be seen that when the three switches 21, 22, 23 are in any one of the configurations shown in [Fig. 2], when any one of the three switches 21, 22, 23 (i.e., only the first two-way switch 21 or only the second two-way switch 22 or only the intermediate switch 23) is flipped, this changes the configuration of the three switches 21, 22, 23 to one of the configurations shown in [Fig. 3]. Accordingly, this changes the state of the electrical connection between the power supply 20 and the directional control valve 13 such that the directional control valve 13 changes the end of the pneumatic cylinder 14 to which air is passed, thereby changing the position of the piston rod 16. For example, this may move the piston rod 16 from the first position to the second position.

[0024] Similarly, when the three switches 21, 22, 23 are in any one of the configurations shown in [Fig. 3], when any one of the three switches 21, 22, 23 (i.e., only the first two-way switch 21 or only the second two-way switch 22 or only the intermediate switch 23) is flipped, this changes the configuration of the three switches 21, 22, 23 to one of the configurations shown in [Fig. 2]. Accordingly, this changes the state of the electrical connection between the power supply 20 and the directional control valve 13 such that the directional control valve 13 changes the end of the pneumatic cylinder 14 to which air is passed, thereby changing the position of the piston rod 16. For example, this may move the piston rod 16 from the second position to the first position.

[0025] To illustrate this principle, when the electrical connection is in a first state with the three switches 21, 22, 23 in the configuration shown in [Fig. 2(a)], flipping only the first two-way switch 21 results in the configuration shown in [Fig. 3(e)] and changes the electrical connection to the second state. From the same electrical first state configuration of [Fig. 2(a)], flipping only the intermediate switch 23 results in the configuration shown in [Fig. 3(f)] which also changes the electrical connection to the second state. Again, from the same electrical first state configuration of [Fig. 2(a)], flipping only the second two-way switch 22 results in the configuration shown in [Fig. 3(g)] which also similarly changes the electrical connection to the second state.

[0026] Thus, in the exemplary embodiment where the directional control valve 13 is in the electrical first state and the door is held at the closed position by the piston rod 16 in the first position (i.e., the three switches 21, 22, 23 are in any one of the configurations shown in [Fig. 2]), flipping any one of the three switches 21, 22, 23 activates the directional control valve 13 to actuate movement of the piston rod 16 from the first position to the second position to open the door.

[0027] Depending on the starting configuration of the three switches 21, 22, 23, flipping any one of the three switches 21, 22, 23 will move the piston rod 16 either from the first position to the second position or from the second position to the first position. Essentially, flipping any one of the three switches 21, 22, 23 thus causes a change in the position of the piston rod 16.

[0028] Using the above-described door control system 100, it will be appreciated that when the door is originally closed and the piston rod 16 is in the first position, flipping any one of the three switches 21, 22, 23 will open the door and hold it open because of the change in electrical state experienced by the directional control valve 13 from the first state to the second state that correspondingly moves the piston from the first position to the second position and accordingly moves the door from the closed position to the open position.

[0029] In an exemplary embodiment, one of the three switches 21, 22, 23 is provided at a bus driver's cabin of the bus, another one of the three switches 21, 22, 23 is provided inside the bus near the door, and a further one of the three switches 21, 22, 23 is provided on the exterior of the bus near the door. For example, the further one of the three switches 21, 22, 23 provided on the exterior of the bus near the door may be the intermediate switch 23. In this way, in the event that the bus driver for any reason is unable to open the door, either a passenger in the bus can flip the one of the three switches 21, 22, 23 that is provided in the interior of the bus near the door, or someone outside the bus can flip the one of the three switches 21, 22, 23 that is provided on the exterior of the bus near the door. Flipping any one of the switches 21, 22, 23 will actuate the piston 16 to move the door to the open position and hold it there. In this way, the pneumatic system 10 continues to assist with door

opening and there is no necessity for any passengers or persons outside the bus to apply force on the door panel in order to move the door open.

[0030] The bus door control system 100 described above thus provides a safe and efficient way of opening a door in the event that the bus driver is unable to do so, by making use of the existing pneumatic system 10 that is provided for opening and closing the door to open the door. Unlike prior art systems where force must be applied to the door panel to open the door after system gas of the pneumatic system has been vented by activating an emergency valve provided with the pneumatic system, the present door control system 100 automatically opens the door once any one of the three provided switches 21, 22, 23 is flipped. Furthermore, the door once opened will stay open under the action of the piston rod 16, and will not need to be held manually open as may be the case in prior art systems where the system gas has been vented and the door no longer experiences any pneumatic support.

[0031] The bus door control system 100 also allows the bus driver to open and close the bus door using the bus door control system 100 in the normal course of operation of the bus as one of the three switches 21, 22, 23 can be provided at the driver's cabin. The bus door control system 100 thus provides a common system for opening and closing the bus door during normal use as well as during situations where the bus driver is unable to open or close the door where required.

[0032] A bus 200 provided with the door control system 100 to control opening and closing of the door 210 will thus have enhanced safety compared to existing buses where the door has to be manually opened after venting the system gas, or where passengers have to exit the bus through a broken glass window.

[0033] It will be appreciated that for a bus 200 that has more than one door 210, 220 for letting passengers in and out of the bus 200, as can be seen in [Fig. 4], for example the bus 200 has a first or front door 210 adjacent a front of the bus 200 and a second or rear door 220 adjacent a rear of the bus 200, the bus 200 may comprise two units of the bus door control system 100 such that the first door 210 is controlled by a first bus door control system 100 and the second door 220 is controlled by a second bus door control system 100.

[0034] To further enhance safety of the bus 200, the bus 200 may be provided with three emergency exit doors 231, 232, 233. Each of the three emergency exit doors 231, 232, 233 is openable by rotating a handle (not shown) provided on the emergency exit door. In an exemplary embodiment, a first of the emergency exit doors 231 is provided on a ceiling 240 of the bus 200 at a front half of the bus 200, a second of the emergency exit doors 232 is provided on the ceiling 240 of the bus 200 at a rear half of the bus 200, and a third of the emergency exit doors 233 is provided on a side 290 of the bus 200 opposite a side 280 of the bus 200 where the first door 210 of the bus 200 is located.

[0035] By providing two emergency exit doors 231, 232 on the ceiling 240 of the bus, in the event that the bus 200 falls on its side where the usual door or doors 210, 220 are provided, passengers will still be able to exit the emergency exit doors 231, 232 through the ceiling 240. The third emergency exit door 233 provided on the opposite side 290 of the bus 200 allows passengers to alight in the event that the first and second doors 210, 220 are obstructed even though the bus remains upright and passengers are unable to exit the bus 200 through the first and second doors 210, 220, for example if the bus 200 is stopped with the first and second doors 210, 220 blocked by a wall of a building.

The bus 200 having the door control system 100 for controlling each door (the number of door control systems provided may be according to the number of doors provided in the bus 200) and also having three emergency exit doors 231, 232, 233 on the ceiling 240 as well as on an opposite side 290 of the bus 200 thus allows passengers to readily and safely exit the bus in the event of any situation where the bus driver is unable to open the door(s) to allow passengers out of the bus and/or when the door(s) is obstructed, and also allows the bus driver to control opening and closing of the bus door via the bus door control system 100 during normal operation of the bus.

[0036] While there has been described in the foregoing description exemplary embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations in details of design, construction and/or operation may be made without departing from the present invention. For example,

while it has been described above that when the piston rod is at the first position the door is at the closed position and when the piston rod is at the second position the door is at the open position, it will be understood that in alternative embodiments, when the piston rod is at the first position the door is at the open position and when the piston rod is at the second position the door is at the closed position. Also, while it has been described above that the first door of the bus is the front door and the second door of the bus is the rear door, in alternative embodiments, the first door of the bus may be the rear door and the second door of the bus may be the front door. The bus may also have more than two doors where each of the doors of the bus is controlled by a unit of the bus door control system as described herein.

CLAIMS

[Claim 1] A door control system for controlling a door of a bus, the door control system comprising:

a pneumatic system comprising a directional control valve in pneumatic connection with a double acting pneumatic cylinder and wherein a piston rod of the double acting pneumatic cylinder is mechanically connected to the door and moveable between a first position and a second position to move the door between a closed position and an open position;

a first two-way switch in electrical connection with a power supply;

a second two-way switch electrically connected to the directional control valve; and

an intermediate switch in series connection between the first two-way switch and the second two-way switch,

wherein flipping any one of: the first two-way switch, the second two-way switch and the intermediate switch activates the directional control valve to actuate movement of the piston rod from one of: the first position and the second position to another of: the first position and the second position.

[Claim 2] The door control system of claim 1, wherein the first two-way switch, the second two-way switch and the intermediate switch together comprise three switches, wherein one of the three switches is provided at a driver's cabin of the bus, another one of the three switches is provided inside the bus near the door, and a further one of the three switches is provided on the exterior of the bus near the door.

[Claim 3] The door control system of claim 2, wherein the further one of the three switches provided on the exterior of the bus near the door is the intermediate switch.

[Claim 4] A bus comprising a first door control system according to the door control system of any one of claims 1 to 3, wherein the door controlled by the first door control system is a first door of the bus.

[Claim 5] The bus of claim 4, further comprising a second door control system according to the door control system of any one of claims 1 to 3, wherein the door controlled by the second door control system is a second door of the bus.

[Claim 6] The bus of claim 4 or claim 5, further comprising three emergency exit doors, wherein each emergency exit door is openable by rotating a handle provided on the emergency exit door, wherein a first of the emergency exit doors is provided on a ceiling of the bus at a front half of the bus, a second of the emergency exit doors is provided on the ceiling of the bus at a rear half of the bus, and a third of the emergency exit doors is provided on a side of the bus opposite a side of the bus where the first door of the bus is located.