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(54) Safety arrangement for vehicle doors

(57) A safety arrangement for vehicle doors (2) which are operated by a pressure medium, which arrangement limits the risk of a person's becoming trapped in a bus door with consequent risk of personal injury. The invention brings about a temporary reduction in the air pressure in the door machinery (14). The pressure is reduced during the door closing process and reverts to full pressure when the vehicle exceeds a certain limit speed. This function reduces the risk of injury and makes it easier for someone who becomes trapped, e.g. between door and bodywork while alighting, to free him/herself. It is also possible for another passenger to push the door open and free the trapped person.

The desired function is achieved by leading the pressure medium from the pressure tanks (3) to the door machinery (14) via a pressure limiting value (10) at the time of door opening and by thereafter allowing the air to flow through a different clear passage (11,13), resulting in full pressure, when the doors have closed and the vehicle has reached a certain speed.

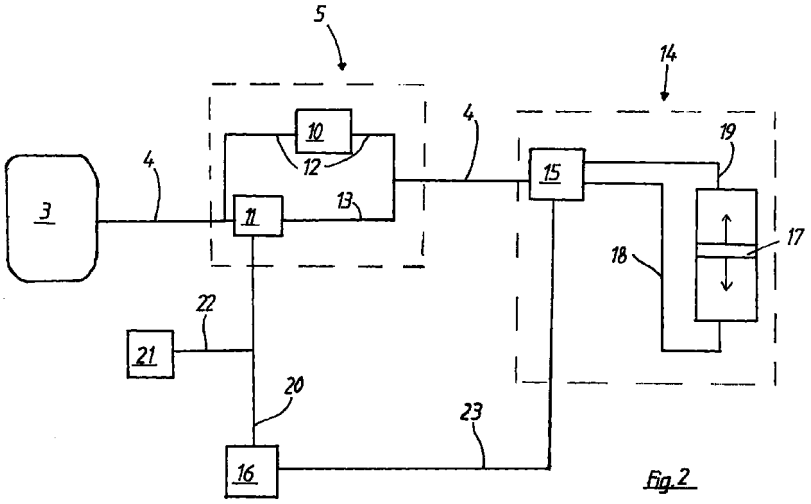


Fig.2

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Description

[0001] The present invention relates to a safety arrangement for vehicle doors according to the preamble to patent claim 1.

State of the art

[0002] Today's buses are often equipped with swing-out double doors operated by compressed air. The compressed air is used for both opening and closing the doors. Door opening may be activated in a number of ways, e.g. by means of controls operated by the driver from the driving position, by passengers pressing buttons at the respective doors, or automatically when, for example, movement is detected in the vicinity of the doors at a time when the vehicle is standing still. When door opening is activated in any of these ways, a signal is imparted to the door machinery, which includes an operating cylinder which is operated by compressed air and which acts upon the doors mechanically so that they open. Closure of the doors is activated by a control operated by the driver whereby the cylinder is activated for closure in a manner corresponding to door opening. The operating cylinder incorporates a piston which is driven in different directions by compressed air for the respective opening and closing operations.

[0003] The air pressure has to be relatively high to keep the doors reliably closed while the vehicle is in motion, so that there is no risk of passengers falling out through being pushed against the doors. The doors are equipped with pressure sensing edges which detect local pressure at the edges of the doors exceeding a certain limit value. If anything is between the doors as they close, the limit value is exceeded and the opening function of the doors is automatically activated. A warning lamp on the instrument panel indicates to the driver when any of the doors are open. This reduces the risk of the driver's setting the bus in motion at a time when anyone or anything has become trapped between the doors while alighting.

[0004] However, problems arise if the sensing edge is out of action. In such circumstances, if a passenger does not succeed in fully alighting before the doors close, resulting for example in his/her foot becoming trapped between door and bodywork, there is no warning to the driver. There is consequent risk of the driver's setting the bus in motion, which means that the passenger who is trapped may be exposed to risk of injury. As the pressure that holds the doors in place is relatively high, it is very difficult for the passenger to free the trapped foot. It is also difficult for other passengers to force the doors open in order to free the person concerned.

Object of the invention

[0005] The object of the invention is to eliminate said disadvantages and provide a new type of safety arrangement for reducing the risk of a passenger becoming trapped between the doors and not being able to free him/herself. This is achieved by an arrangement which exhibits the features indicated in the characterising part of patent claim 1.

[0006] Temporarily reducing the air pressure in the door circuit as the doors close will make it possible for a passenger to be freed if he/she becomes somehow trapped in the doors. The pressure will then be low enough for the doors to give way if such a passenger tries to jerk free whatever has become trapped (foot, handbag etc). Another passenger will also be able to push the door open and free whatever has been trapped between the doors.

[0007] For example, the air pressure will be reduced as the doors open and will revert to full pressure when the doors have closed and the bus exceeds a certain speed, advantageously 5 km/h. This means that anyone who has become trapped will have time to free him/herself before the bus reaches a high speed, thereby preventing risk of a person being dragged along with the bus as it moves off. When the speed exceeds 5 km/h, it is important that the air pressure be high enough to keep the doors securely closed while the vehicle is in motion and that there be no risk of their opening if anything is pressed with great force against them.

List of drawings

[0008]

Fig.1 shows a schematic view of a bus with a safety arrangement according to the invention.

Fig.2 shows a diagram of how the compressed air operates during door opening and closing according to one embodiment of the invention.

Fig.3 shows a pressure limiting arrangement in detail.

Description of an embodiment

[0009] Fig. 1 shows a view of a vehicle, in this case a bus (1). The bus (1) is equipped with a multiplicity of doors (2) operated by a pressure medium. The doors (2) are double and swing out, but single doors are also possible. An undepicted pressure source generates the pressure medium, which is stored in pressure medium reservoirs (3), and supplies the doors with pressure medium. Advantageously the pressure medium is compressed air. In this diagram the compressed air reser-

voirs (3) are fitted in the roof of the rear portion of the bus, but they may also be situated at other locations.

[0010] The air from the compressed air reservoirs (3) is led through a first pressure transmitting connection (4) via a pressure limiting arrangement (5) to door machinery (not depicted) at the respective pair of doors (2). During normal driving, the pressure of the air led to the doors is not limited.

[0011] The pressure limiting arrangement (5) is connected to a door operating device (16) depicted in Fig.2. When this device is activated (manually or automatically), a signal is sent to the pressure limiting arrangement (5), which thereupon reduces the pressure transmitted to the doors. The pressure limiting arrangement (5) is also connected to a detecting device (21), depicted in Fig.2, which detects a certain limit parameter, e.g. a limit speed, and which, when that limit parameter is reached, imparts a signal to the pressure limiting arrangement (5), which thereupon allows the pressure to revert to the original high level.

[0012] Fig.2 depicts schematically how the compressed air operates during the opening and closing of the doors according to one embodiment of the invention. In that embodiment, the pressure limiting arrangement (5) incorporates second and third pressure transmitting connections (12,13). A pressure limiting device (10) is arranged in the second connection (12), and the third connection (13) allows the air to pass through without limiting its pressure. The path which the air follows through the pressure limiting arrangement (5) is controlled by a control device (11). The control device (11) consists of a magnetic valve (11) activated by an electrical signal. The valve (11) functions in such a way that it is open when it is not supplied with electric current, i.e. when it is unenergised, and closed when it is supplied with current.

[0013] During normal driving of the vehicle, the magnetic valve (11) is not supplied with current, which means that the valve is open and the compressed air from the compressed air reservoir (3) passes through the first pressure transmitting connection (4) and the third pressure transmitting connection (13) to the door machinery (14). The door machinery (14) includes a valve (15) which can be set in two alternative positions, viz. a door closing position and a door opening position. The valve (15) is acted upon via an electrical connection (23) by electrical signals from a door operating device (16) which incorporates a button for door opening and a button for door closing. The door machinery (14) further incorporates an operating cylinder (17) which by means of a piston opens and closes the doors. The compressed air pushes the piston in opposite directions for opening and closing respectively. During normal driving, the valve (15) is set in the door closing position whereby the compressed air is directed via a fourth pressure transmitting connection (18) to act upon the operating cylinder (17) for closure. The doors are thus kept closed at a high enough pressure to prevent risk of opening while the vehicle is in motion.

[0014] When door opening is activated by the opening button of the door operating device (16) being pressed, a signal is imparted via an electrical connection (20) to the magnetic valve (11), which is thereupon supplied with current. An electromagnet in the valve (11) is then acted upon and itself acts in a conventional manner upon a valve plug, which is pressed against a seat, thereby preventing the air from passing through the magnetic valve (11). This forces the compressed air from the compressed air reservoir (3) to pass through the second pressure transmitting connection (12), via the pressure limiting device (10), to the door machinery (14). When the door operating device (16) is activated for door opening, a signal is also imparted to the door valve (15), which thereupon switches to the door opening position. The air then passes through a fifth pressure transmitting connection (19) and acts upon the operating cylinder (17) to open the doors.

[0015] For door opening, the magnetic valve (11) is supplied with current after a short timelag, preferably one second. This means that the pressure which acts upon the doors is also reduced after a short timelag so that the doors initially receive the full opening pressure before the pressure is reduced. This means that the opening of the doors is initiated quickly by the high pressure at the beginning of the opening phase, after which opening continues at a controlled rate.

[0016] For door closure, the driver presses the closing button of the door operating device (16) and a signal is imparted via the electrical connection (23) to the door valve (15), which thereupon switches to the closing position whereby the air passes through the fourth pressure transmitting connection (18) and acts upon the operating cylinder (17) for closure. The magnetic valve (11) is not acted upon by the door closing signal, so the air continues to pass through the pressure reducing device (10) during the door closing process, which may take place at a properly controlled rate and in such a way that the force holding the doors together is low as they close. This means that anyone who becomes trapped between the doors as they close can pull them open and thus free him/herself.

[0017] The lower pressure continues even when the doors have closed and the bus moves off. The bus is equipped with a detecting device (21) which detects a parameter which directly or indirectly represents a timelag, in this embodiment a speed of the vehicle. When this parameter reaches a predetermined limit value, a signal (22) is generated and disconnects the power supply to the magnetic valve (11), which thereupon opens. This means that when the doors are closed and the bus moves off and reaches a speed of not more than 10 km/h, advantageously 5 km/h, the air from the compressed air reservoirs (3) passes through the open magnetic valve (11) and hence via the third pressure transmitting connection (13) to the door machinery. The door valve (15) remains in the closing position and

allows the air to pass at higher pressure to the operating cylinder (17), thereby restoring full pressure to keep the doors closed.

[0018] At the time of boarding and alighting and immediately after the bus has moved off, it is therefore possible to force the doors open if someone or something has become trapped in them. When the vehicle speed has thereafter reached the limit value, the doors are kept continuously closed by full air pressure so that there is no risk of their opening while the vehicle is in motion.

[0019] In cases where the vehicle is equipped with so-called trip recorders, the magnetic valve (11) is with advantage connected to the speed signal of the recorder, but other parameters may also be used for activating the magnetic valve, e.g. time or signals from the ABS system. It would also be possible for the pressure increase to be activated manually by the driver by means of a control.

[0020] In this embodiment, the pressure reduction is activated by activation of door opening, since this is advantageous from the signal processing point of view, but other methods and timing may also be appropriate, e.g. the pressure reduction may be activated automatically or manually at a different stage of the door closing process. The principle is that the pressure be low as the closing of the doors approaches completion.

[0021] Fig.3 shows a detailed diagram of a pressure limiting arrangement (5) which forms part of Fig.2 and which is made up of a number of conventional standard components. It incorporates a number of nipples (30-38), the pressure limiting device (10) and the control device (11) in the form of a magnetic valve (11). The magnetic valve (11) is connected via a contact (39) to the detecting device (not depicted in this diagram). The pressure limiting device (10) consists of a pressure limiting valve fitted to a mounting plate (41) by means of fastening devices (40), e.g. threaded connections. The mounting plate (40) makes it possible to fit the arrangement at an appropriate location in the bus. The pressure limiting valve (10) is a standard component incorporating a compression spring which can be set to a desired pressure and which limits the pressure of the air passing through the valve.

[0022] The air passes through the arrangement (5) from left to right as depicted in the diagram. Compressed air from the pressure reservoirs (not depicted) reaches the arrangement via the pressure transmitting connection (4), which preferably consists of a polyamide pipe. In this embodiment the pressure of the incoming air is about 10 bar. This pressure is suitably dimensioned according to the pressure in the vehicle's brake system, in cases where the brake system is of this type. Other incoming pressure values are conceivable, subject to fulfilling the criterion of keeping the doors securely closed while the vehicle is in motion.

[0023] The air supplied to the door machinery during the door closing process is directed, as previously described, via the pressure limiting valve so that the doors are acted upon at a lower pressure. This lower pressure is preferably about 5 bar. The criterion for the lower pressure is that it has to be high enough for the door machinery to be able to close the doors, while at the same time being low enough to allow a person to push the doors open in the event of an imminent accident in connection with door closure.

[0024] In another embodiment, the pressure limiting arrangement may consist of a device switchable between first and second positions whereby the first position supplies the door machinery with air at full pressure and the second position with air at limited pressure. This device may be activated in the same manner as the pressure limiting arrangement described above.

[0025] Nor is it excluded that the door machinery might operate with preloaded door actuating devices so that a reduced door closing force can be achieved at higher air pressure instead of lower air pressure as exemplified above.

Claims

1. Safety arrangement for vehicle doors (2) equipped with door machinery (14) operated by a pressure medium for opening and closing of said doors (2), whereby a pressure generating arrangement generates a pressure medium which is led to the door machinery (14), **characterised** in that a first pressure transmitting connection (4) is arranged between the pressure generating arrangement (3) and the door machinery (14), along which connection a pressure limiting arrangement (5) is arranged.

2. Arrangement according to patent claim 1, **characterised** in that the pressure limiting arrangement (5) incorporates at least not only a second pressure transmitting connection (12), in which second connection a pressure limiting device (10) is arranged, which means that a first pressure is transmitted to the door machinery (14), but also a third pressure transmitting connection (13), via which second connection a second pressure is transmitted to the door machinery (14).

3. Arrangement according to patent claim 2, **characterised** in that the pressure limiting arrangement (5) incorporates a control device (11) which at least during the door closing process directs the pressure medium in the form of compressed air from the pressure generating arrangement (3) through the second connection (12) whereby the pressure limiting device (10) limits the pressure of the air transmitted to the door machinery (14), and which, a certain time after closure, directs the air from the pressure generating arrangement (3) through the

second connection (13) instead, resulting in the door machinery (14) being acted upon by the second pressure, which pressure is different from, and preferably higher than, the limited pressure, so that while the vehicle is in motion the doors are kept closed with sufficient force not to be pushed open by the force of a person leaning against them.

4. Arrangement according to patent claim 3, **characterised** in that at the time of door opening the control device (11) directs the air through the first connection (12) so that the pressure is limited.

5. Arrangement according to either of patent claims 3 or 4, **characterised** in that the control device (11) is connected to a detecting device (21) which detects a certain parameter and which, when that parameter reaches a predetermined limit value, causes the control device (11) to direct the air through the second connection (13).

6. Arrangement according to patent claim 1, **characterised** in that the pressure limiting arrangement (5) incorporates a pressure limiting device (5) which is switchable between at least first and second positions, whereby in the first position a first pressure is supplied to the door machinery (14) and in the second position a second pressure is supplied to the door machinery (14).

7. Arrangement according to patent claim 6, **characterised** in that the pressure limiting device (5) is connected to a detecting device (21) which detects a certain parameter and which, when that parameter reaches a predetermined limit value, causes the pressure limiting device (5) to switch from the first position, in which the pressure supplied to the door machinery (14) is limited, to the second position, which allows full pressure to be supplied to the door machinery (14).

8. Arrangement according to either of patents claims 5 or 7, **characterised** in that the detecting device (21) is designed to detect a limit speed.

9. Arrangement according to patent claim 8, **characterised** in that the limit speed is less than 10 km/h, preferably about 5 km/h.

10. Arrangement according to either of patent claims 2 or 6, **characterised** in that the pressure limiting device (10) consists of a valve which reduces the air pressure when the air passes through it.

11. Arrangement according to patent claim 4, **characterised** in that the control device (11) consists of a magnetic valve (11) which is open when it is not energised, in which open position the air is directed through the third connection (13), and which closes when the detecting device (21) detects the limit parameter, whereupon the valve (11) is energised, in which closed position the air is then directed through the second connection (12) and is forced to pass through the pressure limiting device (10), thereby reducing the air pressure.

12. Arrangement according to patent claim 13, **characterised** in that at the time of door opening the magnetic valve (11) is energised after a short timelag, preferably about 1 second.

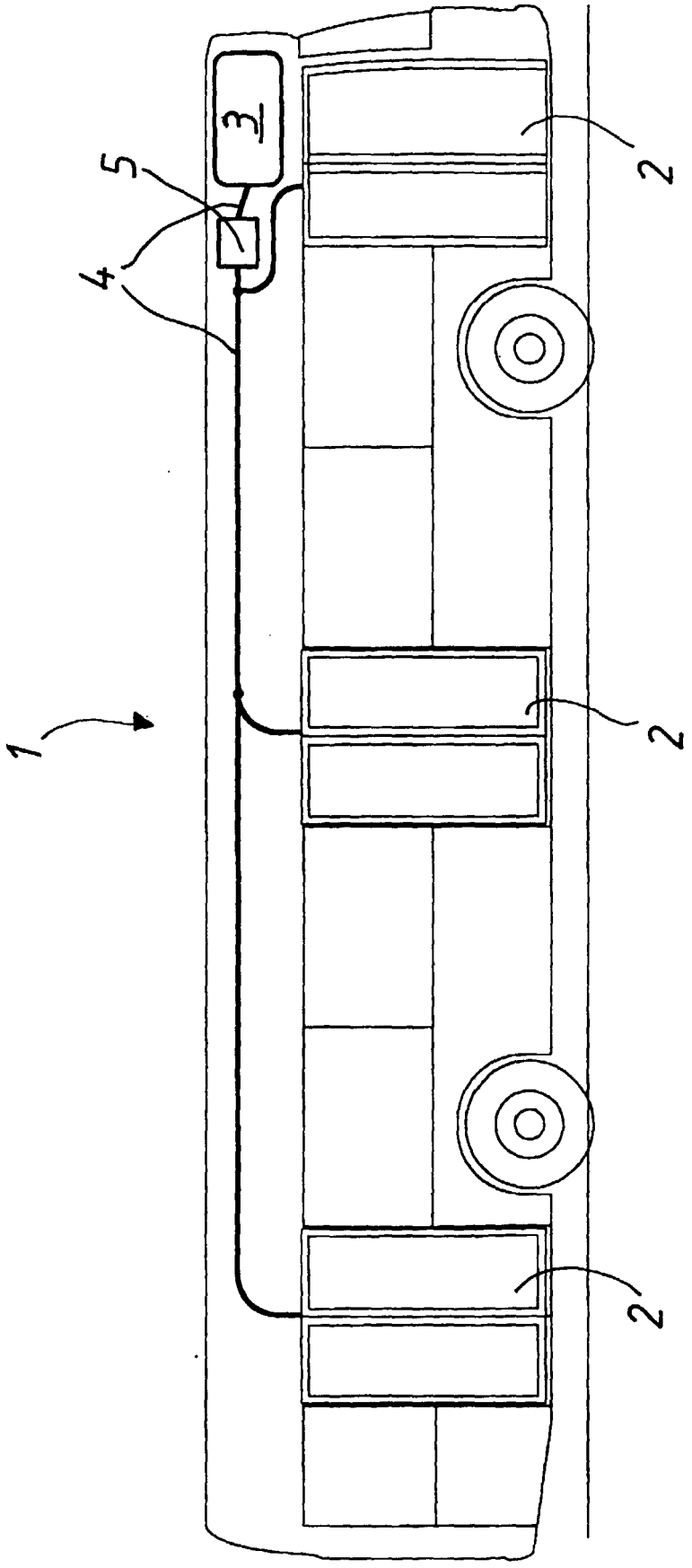


Fig 1

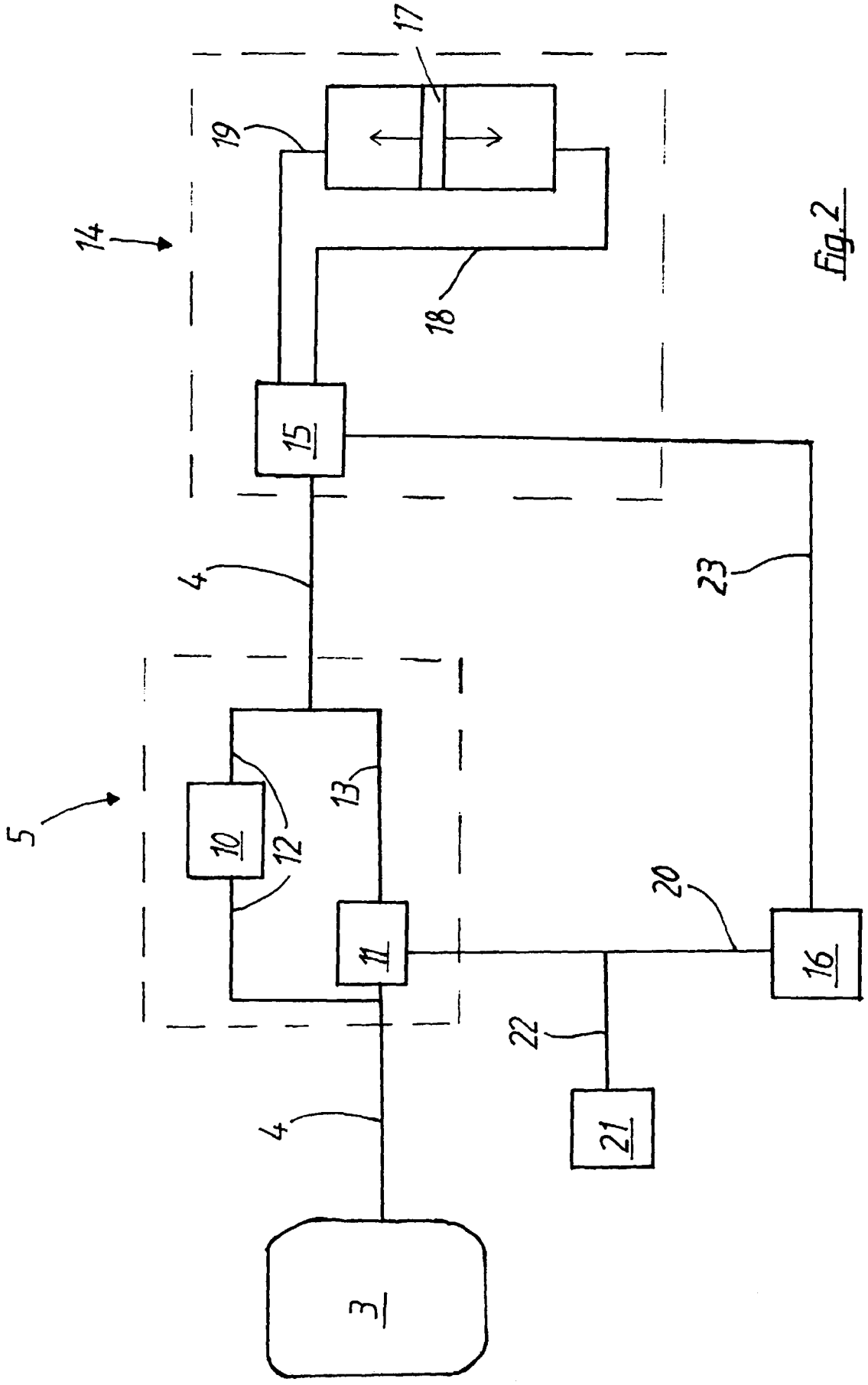


Fig.2

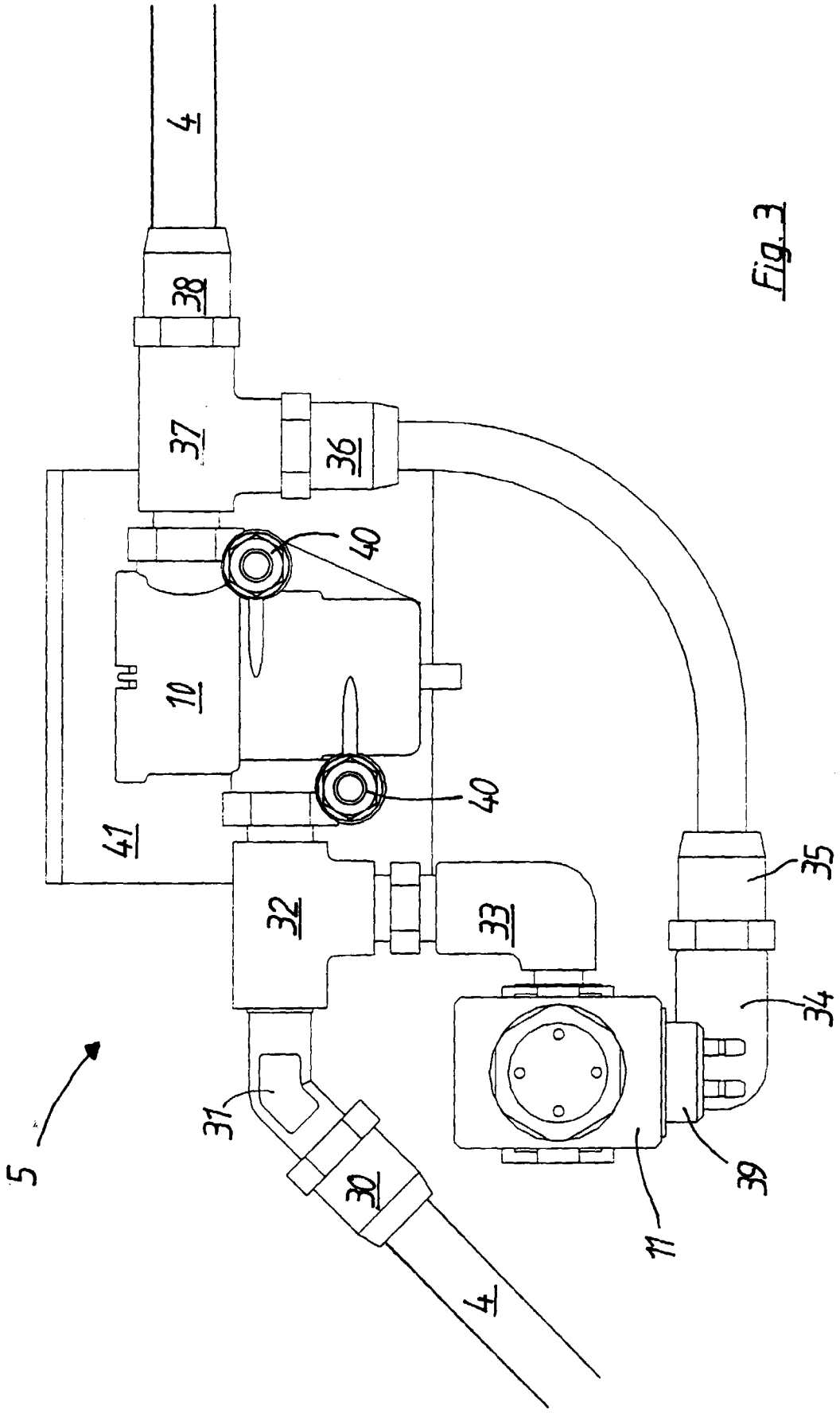


Fig. 3