PATENT SPECIFICATION (11) 1 560 385

1 560 385

(21) Application No. 44877/76 (22) Filed 28 Oct. 1976 (19)
(31) Convention Application No. 2 548 351
(32) Filed 29 Oct. 1975 in
(33) Fed. Rep. of Germany (DE)
(44) Complete Specification published 6 Feb. 1980
(51) INT. CL.³ G05D 16/04
(52) Index at acceptance
F2V L2D L3D LZ1
(72) Inventors KARL-HEINZ DEIKE
and HEINZ-WERNER KÖNIG

(54) IMPROVEMENTS IN OR RELATING TO FLUID-PRESSURE CONTROL VALVES

(71) We, WABCO FAHRZEUGBREMSEN G.m.bH., formerly known as WABCO WESTINGHOUSE G.m.b.H., a Company organised according to the laws of the Federal Republic of Germany, of 3000 Hannover 91, Postfach 91 12 80, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The invention relates to a fluid pressure regulating valve suitable for providing, from a varying inlet pressure, an outlet pressure which does not vary in the same way as the inlet pressure.

Fluid-pressure regulating valves are used in commercial vehicles which are designed for transporting very high pay loads. These commercial vehicles are generally equipped with three axles, and depending on the expected operating conditions, either the front axle is designed in the form of two steering axles or the rear axle is designed in the form of a driving axle and a dead axle. In the case of cross-country vehicles, there may be two driving axles.

Since, when using these vehicles the double axle is not always subjected to the highest loads, for example, when a vehicle travels empty or is only carrying a load which it would be possible for one axle to bear, it is desirable to relieve, in one case, the second steering axle or, in the other case, the dead axle, or weight in order to keep it serviceable for as long as possible.

One way of doing this is to lift the dead axle of a double rear axle, and devices are known which lift the axle mechanically, hydraulically or pneumatically, so that the wheels of the dead axle of a double rear axle can no longer touch the road.

When an axle-lifting device is fitted to a vehicle, the lifting may need to be done as a special operation, but it can be made automatic by the use of a switching arrangement which must sense the load on the axle and operate at some selected load level. In addition, the extra cost to a vehicle, of providing a lifting axle is relatively high, and it is also very difficult and extremely expensive to fit such an axle to a vehicle later on.

In the development of heavy duty vehicles, the use of air cushioning is becoming prevalent, and in heavy duty vehicles with air suspension the air cushion bellows pressure on additional axles is controlled by means of a regulating valve which senses the load state of the vehicle as the air cushion bellows pressure on the main axles of the vehicle. In air-suspension vehicles it is still desirable to avoid using the additional axles when the load at any time can be safely taken by the main axles.

There are known, for example from Auselegeschrift 1,655,774, regulating valves which at smaller control pressures supply a weak pressure and of which the supplied pressure increases considerably at high control pressures, i.e. they transmit their supplied pressure on a characteristic corresponding to the controlled pressure and in accordance with the particular surface ratios of the valve piston, which runs in a continuously ascending curve.

It is an object of the present invention to provide a fluid-pressure regulating valve which controls the flow of fluid in a novel way. The fluid-pressure regulating valve is intended for use in a multi-axle vehicle in which the loading of an auxiliary axle is controlled according to the load on a main axle.

According to the invention a fluid-pressure regulating valves comprises a first pressure-actuated mechanism and a second pressure-actuated mechanism which between them enclose a chamber having an inlet port and an outlet port, a flow valve arranged to be operated by means of the second mechanism to control communica-

tion between the ports, the first and second mechanisms being coupled and so arranged that the valve is open when the pressure level in the inlet port is low, the valve shuts when a first pressure level in the chamber is exceeded, and the valve reopens at a second higher pressure lever in the inlet port.

The second pressure-actuated may be arranged to move in response to variations of the pressure level in the chamber at the said low pressures, and having moved, as the pressure increases, to the position where the flow valve is shut, to remain at the said position while the first mechanism moves in response to variations of the pressure level in the inlet port at higher pressures, until the second pressure level is reached.

In an embodiment of the invention, the first pressure-actuated mechanism is a first piston slidably mounted in a first bore and the second pressure-actuated mechanism is a second piston slidably mounted in a second bore, the chamber being formed between the working faces of the pistons, the pistons being urged towards each other by respective springs, the flow valve being arranged so as to close when the second piston moves away from the first piston, and the pistons being so coupled that the second piston is moved by the first piston when the first piston moves at pressures above the second pressure level.

The initial lengths of the springs may be adjustable by screws, to set the first and second pressure levels.

The flow valve may have a seat provided by a valve seat support which extends across the chamber, a guide member which is attached to the first piston and extends through the valve seat support, and a valve member which is arranged to be moved along the guide by the second piston, the valve member forming a flow discharge valve with the second piston.

The regulating valve according to the invention is designed so that in use, it applies a fixed pressure to the air cushion bellows of an auxiliary axle of a multi-axle vehicle so long as the vehicle is loaded and the load does not exceed the capacity of the main axles. The fixed applied pressure is chosen to hold the auxiliary axle on the road and to resist bouncing of the wheels, without the auxiliary axle being loaded enough to cause wear. The fixed pressure is derived from the pressure of the main axle air cushion bellows. When the vehicle is unloaded, the main axle air bellows pressure may be below this fixed pressure, in which case the regulating valve applies to the auxiliary axle air cushion bellows the same pressure as exists in the main axle air cushion bellows. When the load weight exceeds the load capacity of the main axles the pressure regulating valve applies a pressure corresponding to the amount by which the load exceeds the load capacity of the main axles to the air cushion bellows of the auxiliary axle.

A fluid-pressure regulating valve in accordance with the invention will now be described by way of example only and with reference to the accompanying drawings, in which: —

Figure 1 is a sectional elevation representation of the valve when it is providing a fixed pressure to the auxiliary axle air cushion bellows; and

Figure 2 is the characteristic curve of the valve, showing the fixed-pressure region as P1–P2.

The valve possesses a compressed air inlet port 1 for connection to the air cushion bellows of a main axle which may be a steering axle or a rear driving axle, and for a compressed air outlet port 2 for connection to the air cushion bellows of an auxiliary axle which may be a steering axle or a dead axle.

Arranged in the upper part of the housing is a first piston 3 which is acted on by a main spring 4, the tension of which is adjustable by means of a screw 5. In operative connection with the first piston 3, by way of a stop 9, is a second piston 6 arranged in the lower part of the housing and acted on by an auxiliary spring 7, the tension of which is adjustable by means of a screw 8. A chamber formed by the piston face 10 of the first piston 3 and the face 11 of the second piston 6 is divided into a main part 15 and an auxiliary part 16 by a housing cross-piece 12, which is simultaneously designed as a valve seat 14*a* and forms a valve unit with a valve body 14 which is under the action of a valve spring 13. The main part 15 of the chamber is connected to the inlet port 1, and the auxiliary part 16 of the chamber to the output port 2. An air vent 17 is provided in the valve housing. This air vent 17 permits the escape of air trapped behind the pistons 3 and 6 as they move, air from behind the first piston 3 escaping into the second piston 6 via the central passage in the first piston 6.

The operation of the pressure-regulating valve is as follows:

Compressed air flows, by way of the inlet port 1, from the air cushion bellows of a first steering axle or a rear driving axle, into the chamber 15 and by way of the valve 14*a*, opened by the second piston 6 which is held in the upper end position by means of the auxiliary spring 7, into the chamber 16, and further, by way of the outlet port 2, into the air cushion bellows, not shown, of a second steering axle or a dead axle. The auxiliary spring 7, adjusted to a value corresponding to a particular vehicle total weight by means of the screw 8, holds the

piston 6 in the upper end position, that is to say the valve 14*a* remains open, until the set value—indicated in the graph, Figure 2, by P_1—is exceeded and the piston 6 is then moved downwards against the force of the auxiliary spring 7, the valve body 14, which is under the force of the spring 13, following this movement and thereby closing the valve 14*a*. The closure of the valve 14*a* has the effect that in a particular weight range of the vehicle there is no further increase of pressure by way of the connection 2 into the air cushion bellows of the second steering axle or the dead axle until the load range that is limited by the adjustment of the main spring 4 by means of the screw 5, indicated by P_2 in the graph, Figure 2, is reached. On reaching the level of pressure in the air cushion bellows of the first steering axle or in the driving axle that corresponds to this load range, the first piston 3 is moved upwards against the force of the main spring 4 and, by means of the stop 9, takes along with it the second piston 6, whereby the valve 14*a* opens and allows the passage of fluid between the inlet port 1 and the outlet port 2 according to the ratio of the working areas of the surfaces 10 and 11.

On removing the air, that is to say on unloading the load weight, the equilibrium of the pistons 3 and 6 is destroyed, both pistons run downwards and the valve 14*b* opens in stages and air discharges through the vent 17 into the atmosphere, until the equilibrium corresponding to the predetermined surface ratios is reproduced.

WHAT WE CLAIM IS:—

1. A fluid-pressure regulating valve comprising a first pressure-actuated mechanism and a second pressure-actuated mechanism which between them enclose a chamber having an inlet port and an outlet port, a flow valve arranged to be operated by means of the second mechanism to control communication between the ports, the first and second mechanisms being coupled and so arranged that the valve is open when the pressure level in the inlet port is low, the valve shuts when a first pressure level in the chamber is exceeded, and the valve reopens at a second higher pressure level in the inlet port.

2. A fluid-pressure regulating valve as claimed in Claim 1, wherein the second pressure-actuated mechanism moves in response to variations of the pressure level in the chamber when the pressure in the chamber is low.

3. A fluid-pressure regulating valve as claimed in Claim 1 or 2, wherein the first pressure-actuated mechanism moves in response to variations of the pressure level in the inlet port when the flow valve is shut.

4. A fluid-pressure regulating valve as claimed in any one of Claims 1 to 3, wherein the first and second pressure-actuated mechanisms both move at pressures above the second pressure level and remain in a fixed relationships relative to each other.

5. A fluid-pressure regulating valve as claimed in any one of Claims 1 to 4, wherein the pressure-actuated mechanisms are first and second pistons slidably mounted in respective bores with working faces in opposition so as to form the chamber, multiple spring means urge the pistons together and urge a flow valve member into contact with the second piston, and a seat for the flow valve member is provided in the chamber.

6. A fluid-pressure regulating valve as claimed in Claim 5, wherein the pistons are coaxial, and a guide member for the flow valve member is attached to the first piston.

7. A fluid-pressure regulating valve as claimed in Claim 5 or 6, wherein the initial lengths of the spring means urging the pistons together are adjustable by means of respective screws.

8. A fluid-pressure regulating valve as claimed in Claim 6 or Claim 7, wherein the flow valve member is urged away the first piston by means of a spring.

9. A fluid-pressure regulating valve as claimed in any one of the preceding claims, wherein the flow valve member is arranged with the second pressure-actuated mechanism to form a discharge valve from the outlet port to the inlet port.

10. A fluid-pressure regulating valve as claimed in any one of Claims 5 to 9, wherein means are provided for venting fluid from the rear of the pistons.

13. A fluid-pressure regulating valve substantially as herein described with reference to and as illustrated by Figure 1 of the accompanying drawings.

ABEL & IMRAY,
Chartered Patent Agents,
Northumberland House,
303–306 High Holborn,
London WC1V 7LH.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained

1560385 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

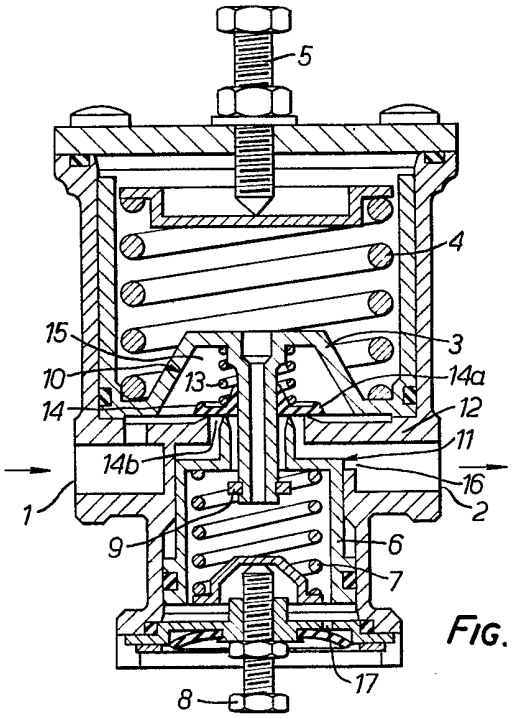

FIG. 1.

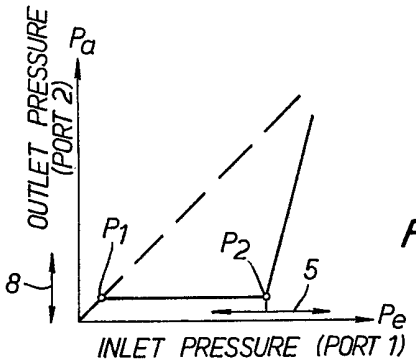

FIG. 2.