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(54) Deceleration sensing valve for vehicle brake proportioning valves

(57) A deceleration sensing valve for association with a vehicle brake proportioning valve includes a valve body (21), Fig. 1, which tends to move to open under its own inertia as the deceleration of a road vehicle exceeds a given value, and a valve seat (24) for the valve body. The opening movement of the valve body results in restriction of the braking pressure to the rear wheel(s) of the vehicle by allowing input pressure, supplied to a chamber 26 *via* passages 17, 23 and the decelleration sensing valve, to bias a proportioning piston 6. When the vehicle is lightly loaded, braking results in sufficient decelleration to unseat the valve body 21 before brake pressure rises sufficiently to break through a valve 22. When the vehicle is heavily loaded, the decelleration is insufficient to move the valve body 21 before brake pressure in valve chamber 20 acts on the body 21 and maintains the valve body seated on seat 24. In a further embodiment, Fig. 5, a rod 42 of a spring-biassed pressure-responsive piston 41 is substituted for valve 22.

FIG.1

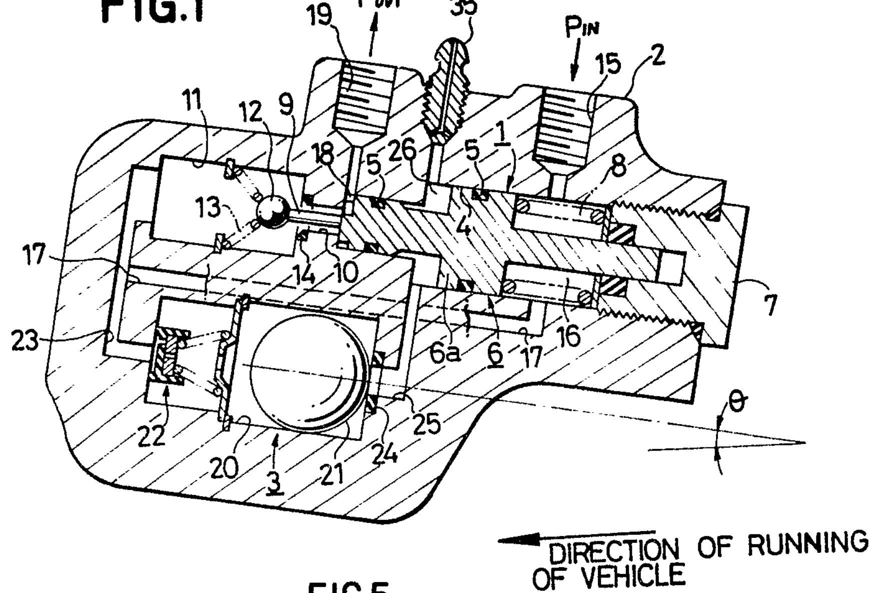

FIG.5

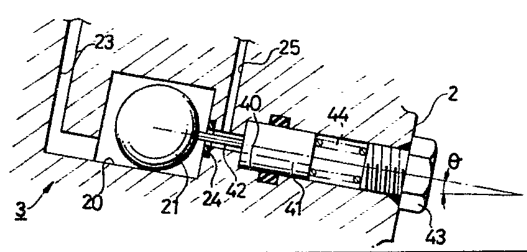

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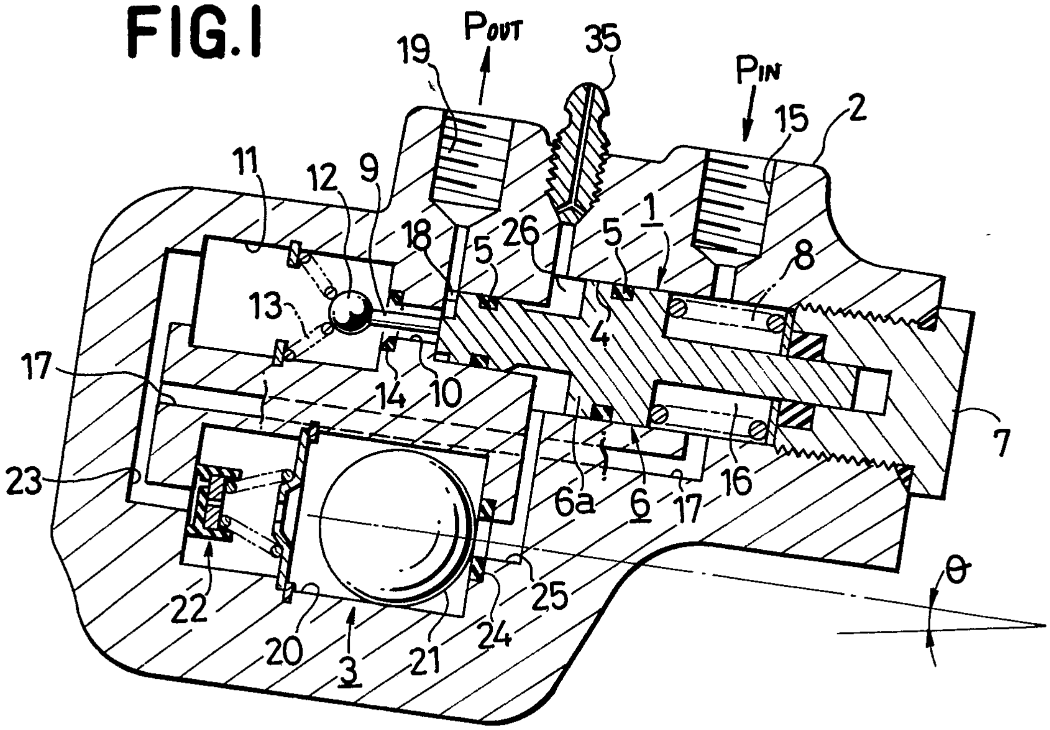
FIG.1



DIRECTION OF RUNNING OF VEHICLE

FIG.2

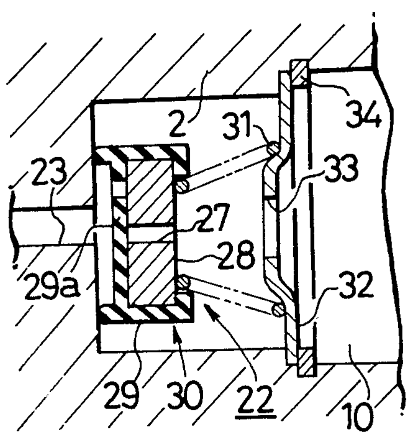


FIG.3

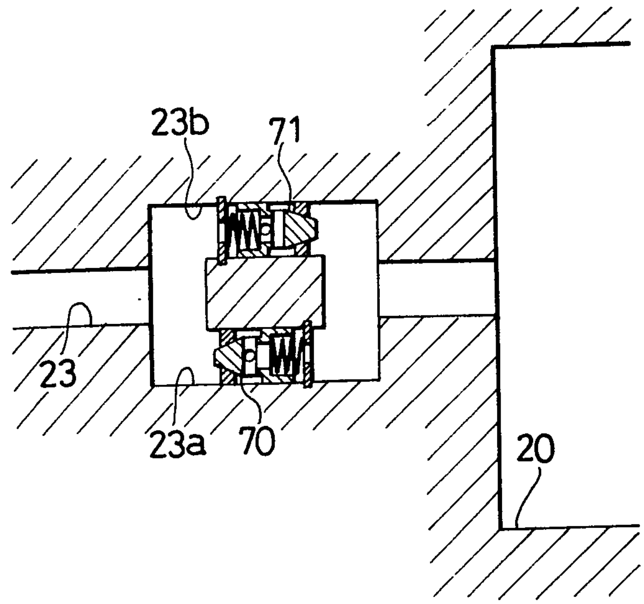


FIG.4

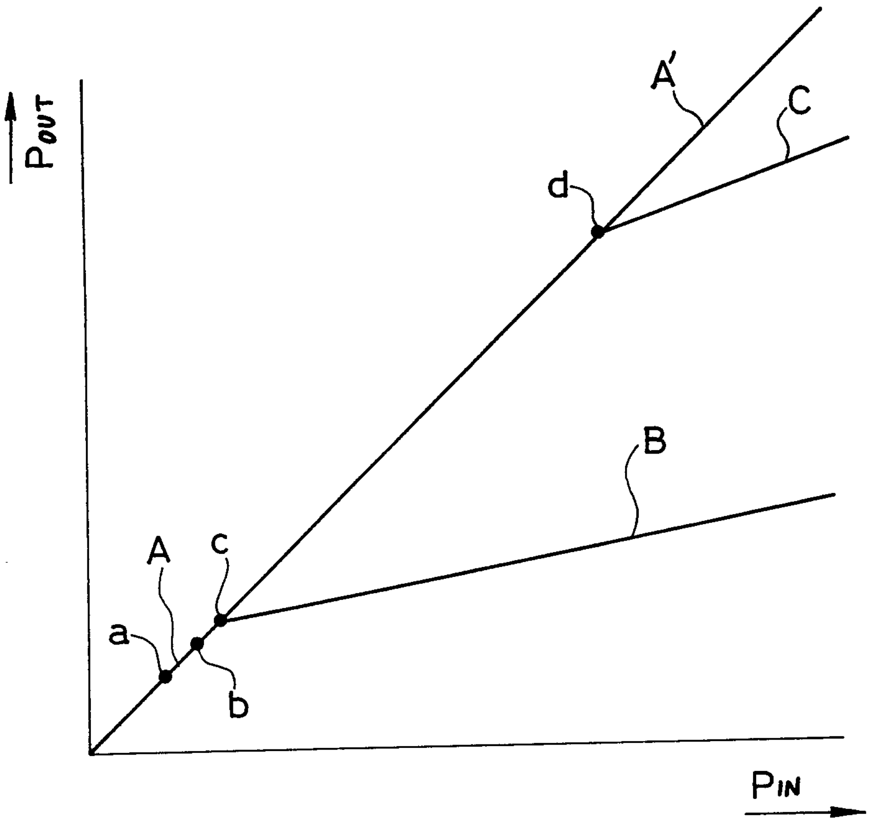


FIG.5

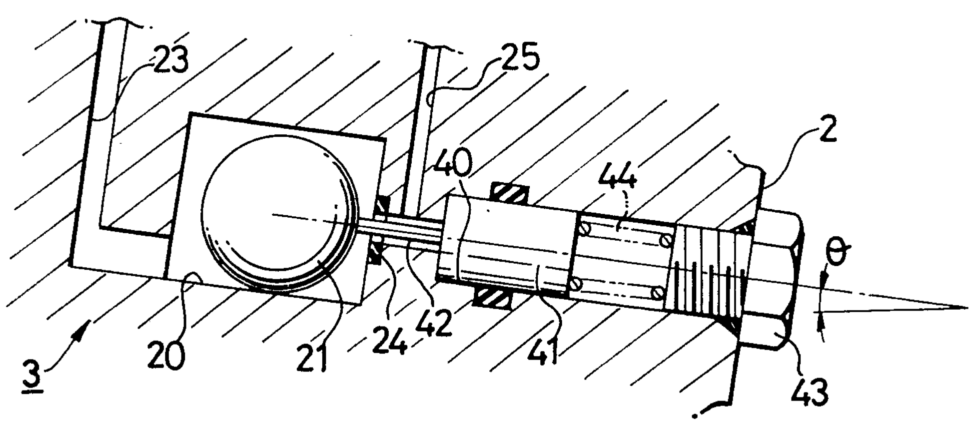


FIG.6

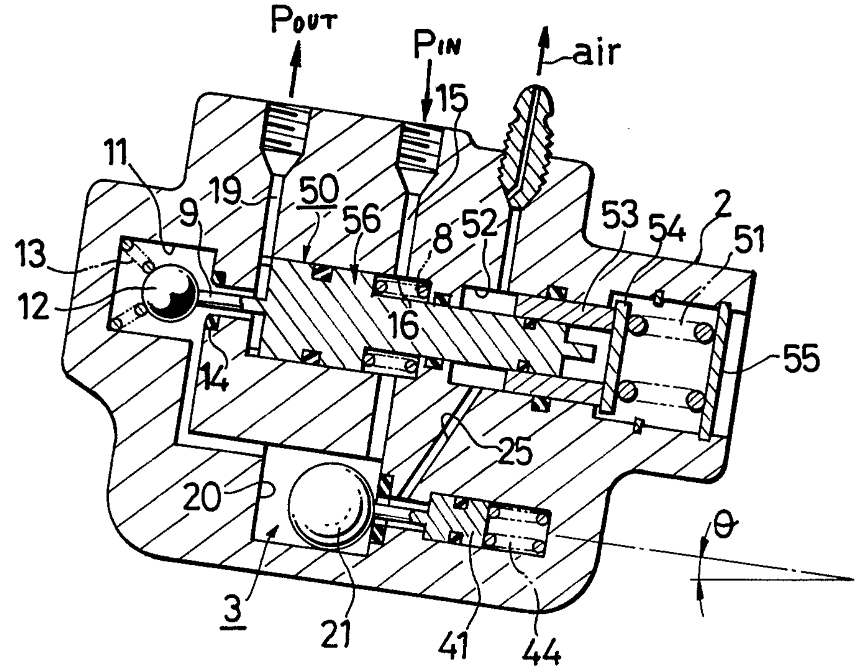

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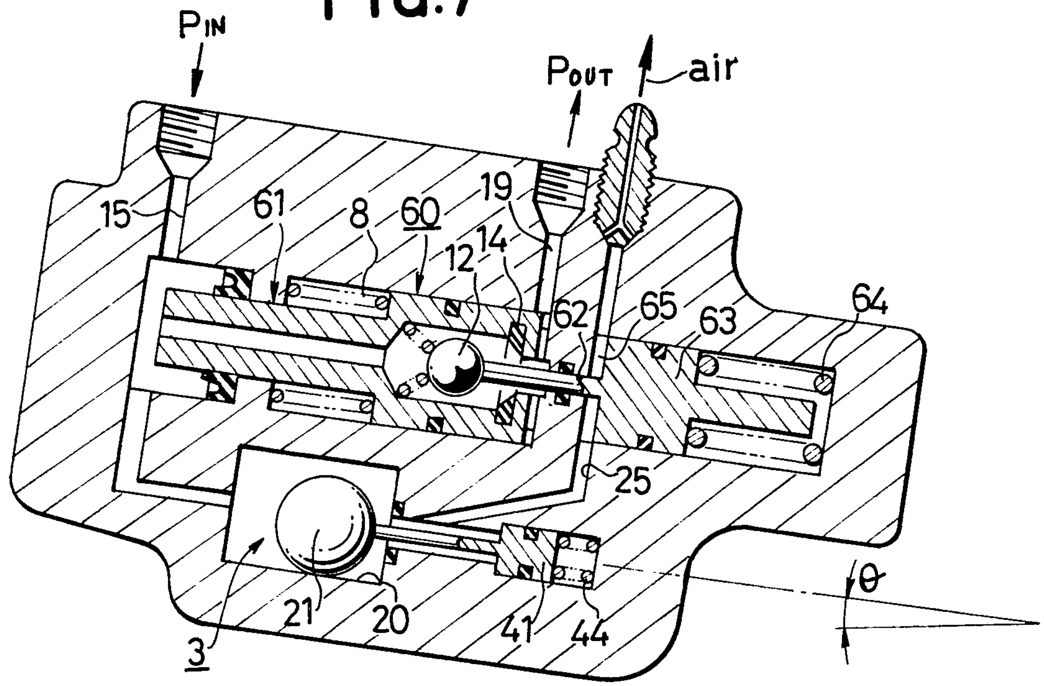
FIG.7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SPECIFICATION

Deceleration sensing valve

The invention relates to a deceleration sensing valve which operates by sensing the deceleration of a vehicle, and more particularly, to a deceleration sensing valve including a valve body which is adapted to move under its own inertia whenever the deceleration of the vehicle exceeds a given value and a valve seat on which the valve body seats.

In conventional deceleration sensing valves, a valve seat is located forwardly of a valve body, as viewed in the direction of movement of the valve body under its inertia. When a given deceleration is obtained by a low brake liquid pressure as when the vehicle is empty, the valve body is caused to move into seating on the valve seat its inertia, thereby interrupting a flow path to maintain the brake liquid pressure which is introduced to a point downstream of the deceleration sensing valve at a low value. On the other hand, when a given deceleration is not obtained if brake liquid pressure increases to a high value as when the vehicle is occupied, the valve body is located remote from the valve seat under gravity, permitting the high liquid pressure to be introduced into the flow path downstream of the deceleration sensing valve. A deceleration sensing valve of the kind described is used in combination with a proportion valve which increases the brake liquid pressure introduced into a rear wheel cylinder at a low increase rate relative to the brake liquid pressure introduced into a front wheel cylinder, and normally controls the magnitude of a bias applied to the proportion valve in accordance with the magnitude of the brake liquid pressure introduced into the flow path downstream of the deceleration sensing valve, in a manner such that the bias is maintained low to enable the proportion valve to be responsive to a low brake liquid pressure when the vehicle is empty while the bias is increased to enable the proportion valve operable only after a high brake liquid pressure is obtained when the vehicle is occupied, thus assuring braking characteristics which are suitable when the vehicle is empty and occupied, respectively.

However, because of the location of the valve seat forwardly of the valve body as viewed in the direction of movement thereof under inertia and the arrangement that the valve body moves under inertia until it seats the valve seat, conventional deceleration sensing valves suffer from a disadvantage that in particular when the vehicle is empty, extraneous factors such as oscillations of the vehicle may cause a shift in the timing when the valve body becomes seated. This in turn causes a variation in the brake liquid pressure which is confined in the flow path downstream of the deceleration sensing valve, thus making the empty vehicles characteristic unstable.

It is an object of the invention to provide a deceleration sensing valve which can help to produce a stable braking characteristic, in particular when the vehicle is travelling empty. This is achieved, according to the invention, by locating a valve seat on which a valve body seats as it moves under its own inertia whenever the deceleration of a vehicle exceeds a given value, rearwardly of the valve body, as viewed in the direction of movement thereof under its inertia.

The invention will be described in more detail by way of example with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal section of a deceleration sensing valve according to one embodiment of the invention which is combined with a proportion valve;

Figure 2 is a fragmentary enlarged view of a part of Fig. 1;

Figure 3 is a longitudinal section of a valve mechanism according to another embodiment;

Figure 4 is a graph illustrating the braking characteristic;

Figure 5 is a longitudinal section of a deceleration sensing valve according to a further embodiment of the invention; and

Figures 6 and 7 are longitudinal sections of the deceleration sensing valve shown in Fig. 5 combined with proportion valves of different forms.

Referring to Fig. 1, there is shown a proportion valve 1 which is formed in a casing 2, in which a deceleration sensing valve 3 according to the invention is also disposed. The casing 2 is formed with a bore 4 in which a plunger 6 of the proportion valve 1 is slidably fitted in liquid tight manner by means of a seal member 5. The plunger 6 is urged to the left by a spring 8 which is interposed between the right-hand end face of a portion 6a of the plunger having an increased diameter which is formed intermediate its end and the left-hand end face of a plug 7 which blocks the right-hand opening of the bore 4. The left-hand end of the plunger 6 is provided with a rod 9, which loosely extends through an opening 10 into a chamber 11 whenever the plunger 6 is urged to the left by the spring 8 to assume its non-operative position shown in Fig. 1, the opening 10 communicating with the bore 4. Received with the chamber 11 is a valve body 12 which is adapted to be subject to a thrust from the rod 9 and which is urged by a spring 13 in a direction to seat 13 in a direction to seat on a valve seat 14 which is formed around the opening 10. However, it is to be noted that the force of the spring 8 is greater than that of the spring 13, so that the plunger 6 is normally maintained in its non-operative position shown, with the valve body 12 being held apart from the valve seat 14 by means of the rod 9.

The casing 2 is formed with an input port 15 which is connected to a master cylinder, not shown, and which also communicates with a chamber 16 in which the spring 8 is received. The chamber 16 communicates with the chamber 11 which contains the valve body 12 through a passage 17 which is formed to extend through the casing 2. The casing is also formed with an output port 19 which is connected to a rear wheel cylinder, not shown. The chamber 16 also communicates with the putput port 19 through the opening 10 and through a chamber 18 which is defined around the step between the plunger 6 and the rod 9.

The deceleration sensing valve 3 includes a chamber 20 and a ball-shaped valve body 21 which is received therein in a freely rollable manner. It is to be noted that by mounting the casing 2 on the chassis, not shown, with an angle of inclination, θ, the valve body 21 normally assumes its lowermost position within the chamber 20. The uppermost portion of the chamber 20 which contains the valve body 21 communicates with the chamber 11 containing the valve body 12 of the proportion valve 1 through a valve mechanism 22 and passages 23, 17. On the other hand, the lowermost portion of the chamber 20 communicates with a chamber 26 which is formed in the left end portion of the plunger portion 6a having an increased diameter, through a valve seat 24 on which the valve body 21 seats by gravity and through another passage 25.

As shown in exaggerated form in Fig. 2, the valve mechanism 22 includes a disc-shaped member 28 which is centrally formed with a through-opening 27 in substantial alignment with the axis thereof, and an elastic member 29 formed of a material such as rubber and which is disposed to surround the periphery of the member 28 and having an apertured flexible portion 29a located adjacent to the passage 23 and adapted to block the through-opening 27 under its own resilience. The combination of the disc-shaped member 28 and the elastic member 29 constitutes together a valve body 30. The valve body 30 is biased in one direction by a spring 31 so as to close normally the passage 23. Accordingly, the valve mechanism 22 becomes open whenever a brake liquid pressure prevailing within the chamber 11 exceeds a given value to allow the brake pressure to be introduced into the chamber 20. Subsequently, when the brake pressure within the chamber 11 decreases, the hydraulic fluid introduced into the chamber 20 is displaced toward the chamber 11 through the opening 27 and a clearance formed between the disc-shaped member 28 and the flexible portion 29a which is then flexed under the pressure thereof.

As illustrated in Fig. 3, a valve mechanism having the same function can be formed by providing a pair of parallel branch paths 23a, 23b in the passage 23, with a check valve 70 or 71 disposed in each branch path to permit a flow in the opposite direction from the other. It will be understood that the check valve 71 corresponds to the flexible portion 29a mentioned above.

A reference numeral 32 shown in a Fig. 2 represents a retainer functioning as an abutment for the spring 31, numeral 33 an opening formed in a shank portion of the retainer, a numeral 34 a stop ring which supports the retainer. In Fig. 1, a reference numeral 35 represents an air vent valve.

In operation, when a brake pedal, not shown, is depressed to produce a brake liquid pressure within the master cylinder, the brake pressure is transmitted through the input port 15 to the ouput port 19 through a path including the chamber 16, passage 17, chamber 11, opening 10 and chamber 18, allowing the pressure to be introduced into the rear wheel cylinder. During an initial phase of a braking operation when the brake liquid pressure is low, the plunger 6 of the proportion valve 1 is not operated, so that a liquid pressure which is substantially equal to the liquid pressure introduced into the front wheel cylinder which is connected to the master cylinder, or an input brake liquid pressure P_{IN}, is introduced into the rear wheel cylinder, as indicated by a rectilinear characteristic A in Fig.4.

When the vehicle is empty, a brake liquid pressure of a relatively low magnitude is sufficient to cause the deceleration of the vehicle to exceed the given value, as indicated at point *a* in Fig. 4, whereby the ball-shaped valve body 21 rolls to the left, as viewed in Fig. 1, under its own inertia to move away from the valve seat 24. When the brake liquid pressure increases under such condition to a value indicated by point *b* in Fig. 4, the hydraulic fluid forces the valve body 30 of the valve mechanism 22 open to permit a fluid flow into the chamber 20 through the passages 17, 23 and thence into the chamber 26 through the clearance formed between the valve body 21 and the valve seat 24 and through the passage 25. As mentioned previously, since part of the chamber 26 is formed in the left-hand end of the plunger portion 6a having an increased diameter, the brake pressure introduced into this chamber urges the plunger to the right against the resilience of the spring 8.

As the brake liquid pressure further increases to a value indicated by a point *c* in Fig. 4, the bias applied to the plunger to urge it to the right, or the bias applied by the brake liquid pressure introduced into the chamber 26, combined with the bias applied by the brake liquid pressure which acts upon the left-hand end face of the plunger 6 exceeds the sum of the force of the spring 8 and the bias applied to the plunger 6 to urge it to the left by the brake liquid pressure introduced into the chamber 16, whereby the plunger 6 moves to the right, allowing the valve body 12 to seat on the valve seat 14. Thereupon, a further increase in the brake liquid pressure which is introduced into the rear wheel cylinder through the opening 10 is prevented.

Subsequently, as the liquid brake pressure further increases, the bias applied to the left-hand end face of the plunger 6 does not increase since the valve body 12 seats on the valve seat 14 while the biases applied by the brake liquid pressure introduced into the chambers 16, 26 continue to increase. Since the surface area of the plunger 6 which is subject to the hydraulic pressure prevailing in the chamber 16 is chosen to be greater than the surface area of the plunger which is subject to the hydraulic pressure prevailing in the chamber 26, the plunger 6 then moves to the left, thus moving the valve body 12 away from the valve seat 14. As a result, the brake liquid pressure acting on the left-hand end face of the plunger 6 and hence supplied to the rear wheel cylinder increases to cause a movement of the plunger 6 to the right, thus causing the valve body 12 to be seated on the valve seat 14 again. In this manner, the plunger 6 reciprocates to the left and right as the brake liquid pressure continues to increase, causing the brake liquid pressure P_{OUT} supplied to the rear wheel cylinder to be increased with respect to the input brake pressure P_{IN} at a low increase rate which depends on the difference of the surface areas subject to the respective hydraulic fluids (see rectilinear portion B shown in Fig. 4).

In contrast to the braking characteristic of the vehicle when it is empty, when the vehicle is occupied, the deceleration of the vehicle remains to be a small value if the brake liquid pressure increases to a value which is sufficient to force the valve body 30 of the mechanism 22 open (see point b in Fig. 4). Hence the valve body 21 is maintained in engagement with the valve seat 24 by gravity. When the valve body 30 is forced open under this condition to permit a flow of the brake pressure liquid into the chamber 20, the hydraulic fluid maintains the valve body 21 held against the valve seat 24 as a result of a pressure differential between the pressure prevailing in the chamber 20 and the pressure prevailing in the passage 25 and the chamber 26. Consequently, the valve body 21 cannot be moved away from the valve seat 24 of the brake liquid pressure further increases to cause the deceleration of the vehicle to exceed the given value. Since no brake liquid pressure is introduced into the chamber 26 on the left-hand side of the plunger portion 6a under this condition, the only bias applied to the plunger 6 to cause it to move to the right is obtained by brake liquid pressure applied to the left-hand end face of the plunger 5. Consequently, the plunger 6 cannot move to the right if the brake liquid pressure increases to point *c*, in contradiction to the operation when the vehicle is empty. In this instance, an operation of the plunger 6 is avoided if the surface area on the right-hand end of the plunger portion 6a which communicates with the chamber 16 is designed to be greater than that on the left-hand end of the plunger 6. Hence, a brake liquid pressure which is substantially equal to that produced within the master cylinder can be introduced into the rear wheel cylinder (see rectilinear portion A' shown in Fig. 4). On the other hand, if the relationship of the surface areas mentioned above is designed to be opposite from that mentioned above, the operation of the proportion valve 1 can be initiated at a brake liquid pressure (see point *d* shown in Fig. 4) which is greater than the corresponding value effective when the vehicle is empty, by an amount which depends on the magnitude of the difference in the surface areas (see rectilinear portion C shown in Fig. 4). In either instance, a braking characteristic can be obtained which is appropriate when the vehicle is occupied.

Fig. 5 shows a liquid pressure sensing valve according to another embodiment of the invention. In this embodiment, the valve mechanism 22 mentioned above is omitted, and instead a piston 41 is slidably fitted in a bore 40 which communicates with the passage 25, with a rod 42 mounted on the piston 41 to thrust the valve body 21 mentioned above. In addition, a spring 44 is interposed between the piston 41 and a plug 43 which blocks the bore so that the valve body 21 is normally prevented from seating on the valve seat 24 by the presence of the rod 42. In other respects, the arrangement is similar to that shown in Fig. 1.

In this embodiment, the brake liquid pressure is immediately introduced into the chamber 20, passage 25 and the chamber 26 through the passage 23 as soon as it is produced, and the pressure acts on the left-hand end face of the piston 41, tending to move it to the right. Consequently, by arranging such that a deceleration of a given value is obtained before the piston 41 moves to the right to thereby allow the valve body 21 to seat on the valve seat 24 when the vehicle is empty, the valve body 21 rolls to the left under its inertia before it seats on the valve seat 24, so that a subsequent movement of the piston 41 to the right cannot allow the valve body 21 to seat on the valve seat 24, thus allowing a similar braking characteristic to be obtained as mentioned in connection with the previous embodiment when the vehicle is empty.

By contrast, when the vehicle is occupied, the brake liquid pressure causes the piston 41 to move to the right to allow the valve body 21 to be seated on the valve seat 24 before the valve body 21 rolls to the left under its inertia, and the subsequent increase in the brake liquid pressure maintains the valve body 21 seated on the valve seat 24, thus allowing the desired braking characteristic to be obtained as in the previous embodiment when the vehicle is occupied.

It will be seen from the above description of the two embodiments that the controlled pressure which is produced in the passage 25 downstream of the deceleration sensing valve 3 of the invention is high and low when the vehicle is empty and occupied, respectively, in a manner opposite to that of the conventional deceleration sensing valve intitially mentioned. Thus, the manner of utilizing the controlled pressure is opposite from that of the prior art, but a variety of proportion valves which are suitable for use with the invention can be easily constructed.

Fig. 6 shows proportion valve 50 in accordance with an additional embodiment which is provided with a second spring 51 so that the resilience of the second spring does not act on the proportion valve when the vehicle is empty, but acts when the vehicle is occupied, thus allowing different braking characteristics to be obtained when the vehicle is empty and occupied. Specifically, the proportion valve 50 is constructed essentially in the same manner as the conventional proportion valve so that it becomes operative whenever the brake liquid pressure exceeds a given value to reduce the rate of increase of the brake liquid pressure to a given value. In Fig. 6, the proportion valve 50 includes a chamber 52 in which a controlled brake liquid pressure from the deceleration sensing valve 3 is introduced. One end of a piston 53 is disposed in the chamber 52, and the second spring 51 is interposed between a plate 54 fixedly mounted on the other end of the piston 53 and a retainer 55 which is disposed in the casing 2. The plate 54 is located opposite to one end of a plunger 56 which is slidably fitted into a bore formed in the piston 53 to constitute the proportion valve 50. In other respects, the arrangement is similar to that shown in Fig. 1 except that a deceleration sensing valve shown in Fig. 5 is used and that a communication is maintained between the chambers 16, 11 through the chamber 20 of the deceleration sensing valve, and accordingly corresponding parts are designated by like reference numerals.

In operation, when the vehicle is empty, as a brake liquid pressure of a high magnitude is introduced into the chamber 52, both the piston 53 and the plate 54 move to the right, with the plate 54 located out of interference with the plunger 56. As a consequence, only the force of the spring 8 acts on the plunger 56, allowing the proportion valve 50 to initiate its operation at a low brake pressure. On the other hand, when the vehicle is occupied, a brake liquid pressure of a high magnitude is not introduced into the chamber 52, so that both the piston 53 and the plate 54 remain in their non-operative positions shown. The proportion vave 50 tends to initiate its operation at a low brake pressure in a similar manner as when the vehicle is empty, but the right-hand end of the plunger 56 moves into abutment against the plate 54 before the plunger 56 can move enough to the right to permit the valve body 12 to be seated on the valve seat 14, with the force of the second spring 51 acting on the plunger 56. Consequently, the proportion valve 50 cannot operate at the described low brake pressure, but initiates its operation only when a higher liquid pressure is obtained. Alternatively, the operation of the proportion valve 50 can be entirely prevented by using a stronger spring for the second spring 51. Accordingly, it will be apparent that the braking characteristic as illustrated in Fig. 4 can be achieved with this form of proportion valve.

Fig. 7 shows another embodiment of proportion valve 60 in which the lift of the valve body 12 can be adjusted to attain the different braking characteristics when the vehicle is empty and occupied. Specifically, the proportion valve 60 shown houses the valve body 12 within the valve body 12 a plunger 61 as a deviation from that mentioned previously. However, a proportion valve of such construction is also known in the art. In the conventional proportion valve, a rod 62 which is used to thrust the valve body 12 is fixedly mounted on the casing 2, but in the present case the rod 62 is connected to a piston 63 for movement therewith. The piston 63 is urged by a spring 64 in one direction so that the degree of extension of the rod 62 or the lift of the valve body 12 from the valve seat 14 is normally at its maximum. The passage 25 downstream of the deceleration sensing valve 3 is connected in communication with a chamber 65 formed in the left-hand end face of the piston 63. In other respects, the arrangement is similar to that shown in Fig. 6, and corresponding parts are designated by like reference numerals.

With this form of proportion valve, as a liquid pressure of an increased magnitude is introduced into the chamber 65 when the vehicle is empty, the piston 63 and the rod 62 move to the right to decrease the lift of the valve body 12 while when the vehicle is occupied, the lift of the valve body 12 is maintained at its initial value since the rod 62 does not move to the right. Accordingly, the magnitude of the liquid pressure which is required to move the plunger 61 against the resilience of the spring 68 until the valve body 12 becomes seated on the valve seat 14 is greater when the vehicle is occupied, resulting in the braking characteristics as indicated by rectilinear characteristics B and C in Fig. 4 to be obtained.

While the invention has been shown and described herein with reference to specific embodiments thereof, it should be understood that the invention is not limited thereto, but many modifications, changes and variations can be made within the scope of the invention.

CLAIMS

1 A deceleration sensing valve including a valve body which is adapted to move under its own inertia whenever the deceleration of a vehicle exceeds a given value and a valve seat on which the valve body seats; characterized in that the valve seat is disposed rearwardly of the valve body as viewed in the direction of movement thereof under its inertia, whereby the valve body is moved away from the valve seat if the deceleration of the vehicle exceeds a given value before a brake liquid pressure reaches a given value while if the deceleration of the vehicle does not reach the given value if the brake pressure reaches the given value so that the valve body then fails to move under its inertia, the valve body remains seated on the valve seat by gravity and is maintained seated on the valve seat under the brake liquid pressure.

2. A deceleration sensing valve for a hydraulic braking system comprising a valve body which is disposed in a chamber in a movable manner and adapted to move under its own inertia whenever the deceleration of a vehicle exceeds a given value, an inlet passage opening into the chamber, a valve mechanism which opens when the liquid pressure in the inlet passage exceeds a given value to introduce the liquid pressure into the chamber, an outlet passage which opens into a rear portion of the chamber as viewed in the direction of movement of the valve body under its inertia, and a valve seat located around the opening of the outlet passage and adapted to have the valve body seated thereon, the valve seat cooperating with the valve body to block the outlet passage.

3. A deceleration sensing valve according to claim 2 in which the valve body is in the form of a ball.

4. A deceleration sensing valve according to claim 2 or 3 in which the valve mechanism is disposed within the chamber.

5. A deceleration sensing valve according to claim 2 or 3 in which the valve mechanism is disposed within the inlet passage.

6. A deceleration sensing valve according to claim 4 in which the valve mechanism includes a disc-shaped member having a through-opening formed in alignment with its central axis, and an elastic member disposed in surrounding relationship with the disc-shaped member and having a flexible portion which is adapted to block the through-opening by its own resilience in the region of the inlet passage.

7. A deceleration sensing valve according to claim 5 in which the valve mechanism comprises a pair of check valves disposed each in one of a pair of parallel branch paths formed in the passage which is opened or closed by the valve mechanism, the respective check valves permitting a flow in opposite direction from each other.

8. A deceleration sensing valve according to any one of claims 2 to 7, further including a proportion valve normally urged in one direction to be maintained in its non-operative position and adapted to be operated whenever the liquid pressure exceeds a given value to cause an increase in the output liquid pressure at a low rate of increase with respect to an increasing input liquid pressure, the proportion valve including a plunger which is formed with a surface to which the liquid pressure is applied to urge it to move in a direction opposite to that in which it is normally urged, the liquid pressure from the outlet passage being applied to the surface.

9. A deceleration sensing valve according to any one of claims 2 to 7, further including a proportion valve which is normally urged in one direction by a first spring to be maintained in its non-operative position and adapted to be operated whenever the liquid pressure exceeds a given value to increase the output liquid pressure at a low rate of increase with respect to the input liquid pressure, and a bias transmitting member which is subject to the force of a second spring, the liquid pressure from the outlet passage being applied to the bias transmitting member, thus controlling it between a first and a second position in which it interferes and does not interfere with the proportion valve.

10. A deceleration sensing valve according to any one of claims 2 to 7, further including a proportion valve internally housing a valve which opens or closes a flow path between an input and an output port, the proportion valve including a rod which thrusts the valve body to move it away from its associated valve seat when it is maintained in its non-operative position, the proportion valve becoming operative whenever the liquid pressure exceeds the given value to increase the output liquid pressure at a low rate of increase with respect to the increasing input liquid pressure by controlling a movement of the valve body, the rod being reciprocable, and a liquid pressure from the outlet passage being applied to the rod to control its reciprocating movement.

11. A deceleration sensing valve comprising a valve body disposed in a chamber in a movable manner and adapted to move under its own inertia whenever the deceleration of a vehicle exceeds a given value, an inlet pas-

sage which opens into the chamber, an outlet passage which opens into a rear portion of the chamber as viewed in the direction of movement of the valve body under its inertia, a valve seat formed around the opening of the outlet passage and on which the valve body is adapted to seat, the valve seat cooperating with the valve body to block the outlet passage, and a piston disposed to extend through the valve seat for movement into and out of the chamber, the piston extending into the chamber when it is non-operative and is adapted to move out of the chamber whenever the liquid pressure introduced into the chamber through the inlet passage exceeds a given value.

12. A deceleration sensing valve according to claim 11 in which the valve body is in the form of a ball.

13. A deceleration sensing valve according to claim 11 or 12, further including a proportion valve normally urged in one direction to be maintained in its non-operative position and adapted to operate whenever the liquid pressure exceeds the given value to increase the output liquid pressure at a low rate of increase with respect to the increasing input liquid pressure, the proportion valve including a plunger which is formed with a surface to which a liquid pressure is applied to urge the plunger in a direction opposite to that in which it is normally urged, the liquid pressure from the outlet passage being applied to the surface.

14. A deceleration sensing valve according to claim 11 or 12, further including a proportion valve normally urged in one direction by a first spring to be maintained in its non-operative position and adapted to operate whenever the liquid pressure exceeds a given value to increase the output liquid pressure at a low rate of increase with respect to the input liquid pressure, and a bias transmitting member which is subject to the force of a second spring, the liquid pressure from the outlet passage being applied to the bias transmitting member to control it between a first and a second position in which it interferes with and does not interfere with the proportion valve.

15. A deceleration sensing valve according to claim 11 or 12, further including a proportion valve which houses a valve body for opening or closing a flow path which provides a communication between an input and an output port, the proportion valve including a rod which thrusts the valve body to move away from its associated valve seat whenever the valve is maintained in its non-operative position, the proportion valve becoming operative whenever the liquid pressure exceeds the given value to increase the output liquid pressure at a low rate of increase with respect to the increasing input liquid pressure by controlling a movement of the valve body, the rod being disposed in a reciprocable manner, and the liquid pressure from the outlet passage being applied to the rod to control its reciprocating movement.

16. A deceletation sensing valve constructed and arranged for use and operation substantially as described herein with reference to any of the examples in the accompanying drawings.

17. A hydraulic braking system for a motor vehicle comprising a deceleration sensing valve according to any one of the preceding claims.

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