(12) UK Patent Application (19) GB (11) 2 063 404 A

(21) Application No **8035833**
(22) Date of filing **7 Nov 1980**
(30) Priority data
(31) **54/145896**
(32) **9 Nov 1979**
(33) **Japan (JP)**
(43) Application published **3 Jun 1981**
(51) INT CL[3] **B60T 13/56**
(52) Domestic classification F2F 825 FB
(56) Documents cited **GB 2046382A** **GB 2032549A**
(58) Field of search **F2F**
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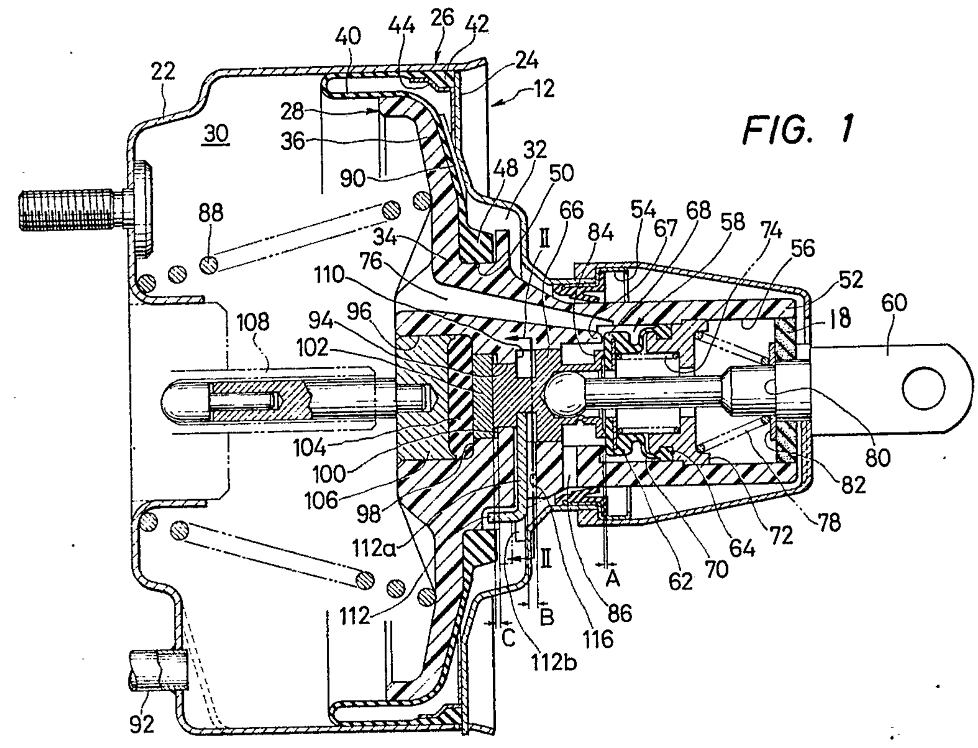
(54) **Brake Booster Assemblies**

(57) In a brake booster a resilient buffer 104 is located between a power piston 28 and an output member 106. An outer peripheral portion 98 of the buffer is acted upon directly by the power piston and is compressed on initial brake application. The remainder of the buffer is acted upon by the power piston through a plate member 102 only after initial movement of the power piston and therefore only after initial compression of the outer peripheral portion of the buffer. Axial movement of the plate member 102 relative to the power piston is limited by a shoulder 100 of the power piston, so that the extent of the differential compression of the buffer is limited to an acceptable minimum.



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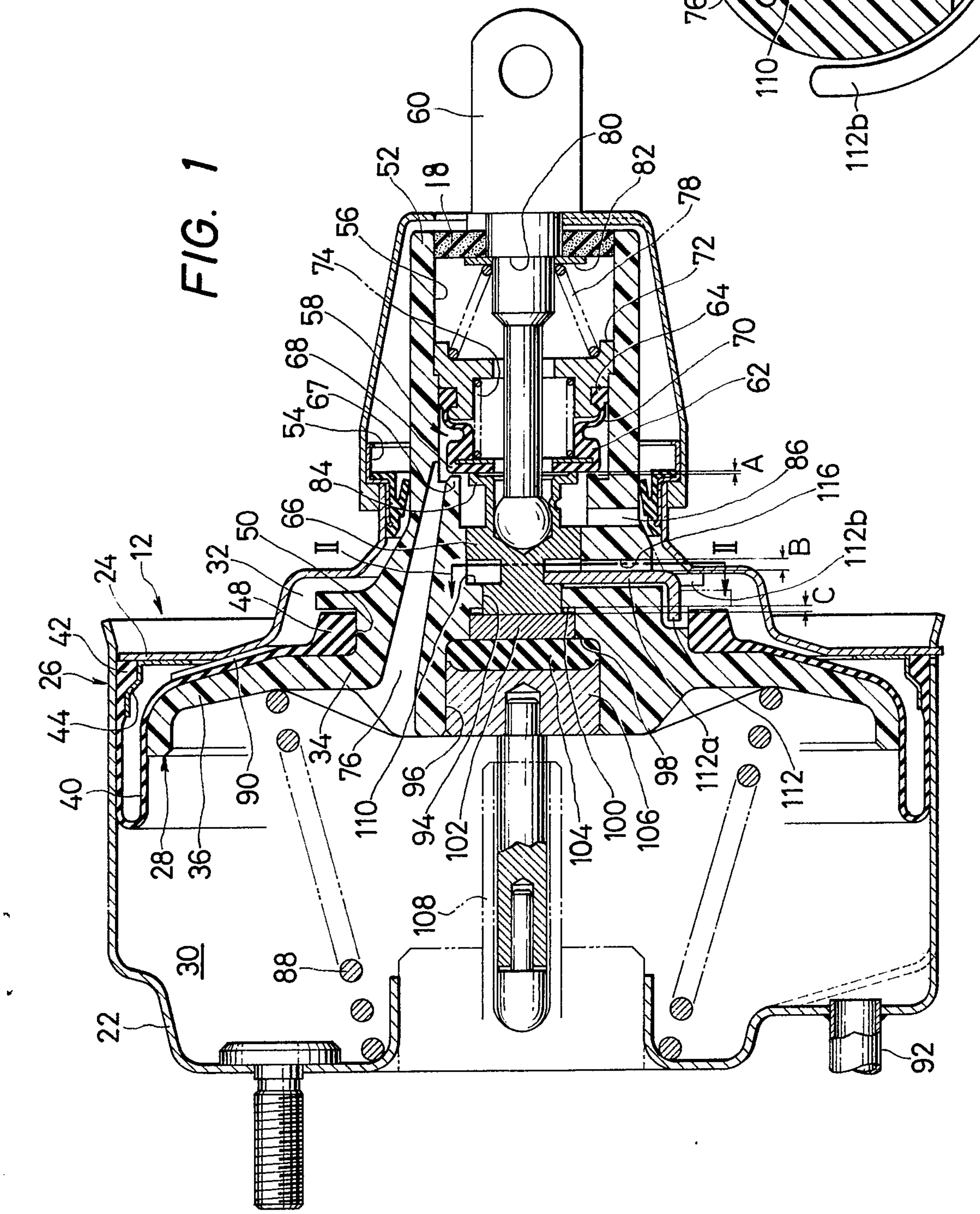
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II
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B
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C
12
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36
90
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110
96
94
102
104
100
106
98
112a
112
108
88
30
22
92

FIG. 1

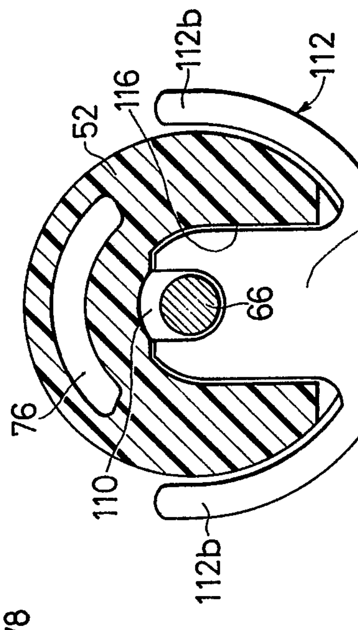
112b
112
116
52
112a
66
76
110
112b

FIG. 2

SPECIFICATION
Brake Booster Assemblies

This invention relates to brake booster assemblies or servo motors of the type used to operate power-assisted brakes.

Known brake booster assemblies usually consist of a housing having a power piston and diaphragm forming a movable wall for reciprocable movement in the housing or container, the movable wall dividing the housing into two compartments. A pressure differential across the movable wall causes movement of the wall. A control valve operated by the operator of the vehicle regulates the degree of vacuum or subatmospheric pressure established at one side of the movable wall. The movable wall is connected with the master cylinder of the hydraulic brake system of the motor vehicle so that when a pressure differential is effective on the movable wall and hence a power movement of the wall is produced, hydraulic fluid is displaced from the master cylinder into the hydraulic brake system to apply the brakes of the vehicle.

It is desirable for a resilient member such as a rubber buffer to be provided between the power piston and an output member leading to the brake master cylinder. Generally such a buffer has been designed to transmit a proportion of the reaction force to a control member for the control valve, and the remainder of the reaction force directly to the power piston. This gives the operator a "feel" of the brake effort provided by the brake booster, but imparts substantial stresses on the buffer itself.

The invention provides a brake booster assembly having a resilient member between a power operable member and and an output member, and a plate member of smaller cross-sectional area than the resilient member between the resilient member and a shoulder of the power operable member, wherein limited axial relative movement is permitted between the plate member and the power operable member so that initial movement of the power operable member in a brake engaging direction transmits an actuating force to the output member through an outer peripheral portion only of the resilient member until compression of the resilient member brings the plate member into operative engagement with the shoulder, and thereafter continued movement of the power operable member in brake engaging direction transmits the actuating force to the output member through the whole of the resilient member.

The shoulder of the power operable member which limits the axial movement of the plate member relative to the power operable member defines the limit of differential deformation of the resilient member or buffer, and suitable choice of location of this shoulder enables buffer life to be considerably extended. Advantageously the axial movement permitted between the plate member and the power operable member is chosen to be the minimum which provides an acceptable reaction feedback to the brake pedal, and therefore an acceptable "feel" of the brake effort provided by the brake booster.

Drawings

Figure 1 is an axial section through a brake booster assembly according to the invention; and

Figure 2 is a cross section taken along the line II—II in Figure 1.

The brake booster of Figure 1 has a fluid pressure servomotor 12 connected to a master cylinder (not shown) for applying the front wheel brakes and rear wheel brakes (not shown) with an operational hydraulic force in response to an input force applied to a pedal (not shown) by an operator.

The fluid pressure servo motor 12 has a first housing shell 22 fast to a second housing shell 24 by a twist lock arrangement 26. A power piston 28 is located within the first shell 22 and the second shell 24 to form a first variable volume chamber 30 and a second variable volume chamber 32. The power piston 28 comprises a central hub 34 with a diaphragm backing plate 36 extending therefrom. A diaphragm 40 has a first bead 42 on its periphery which is held between flange 44 on the second shell 24 and the first shell 22, and a second head 48 which is snapped into groove 50 adjacent the backing plate 36.

The hub 34 has a rearwardly extending projection 52 which extends through opening 54 in the second shell 24. The projection 52 has an axial bore 56 into which a control valve mechanism 58 is located for supplying an operational input from a pedal (not shown) through push rod 60.

The control valve mechanism 58 has a valve assembly 62 which is sequentially operated upon movement of a plunger 66 by the push rod 60 to interrupt vacuum and allow air to develop a pressure differential across the power piston 28.

The valve assembly 62 has a face 68 separated from a fixed bead 64 by a flexible section 70. The bead 64 is retained within the bore 56 by a retainer 72. A first spring 74 connected to the retainer 72 urges the face 68 toward a first valve seat 67 adjacent a vacuum passage 76. The first valve seat will be referred to herein as the vacuum seat 67. The vacuum passage 76 connects the first chamber 30 with the interior of the bore 56 of the hub 34. A second spring 78, located between the retainer 72 and a ring 82 abutting a shoulder 80 of the push rod 60, urges a second valve seat 84 on the plunger 66 into contact with face 68. The second valve seat will be referred to herein as the air seat 84.

A return spring 88 located between the shell 22 and the hub 34 urges a buffer 90 on the diaphragm 40 towards the shell 24. In this position, a vacuum communicated from the intake manifold through a conduit 92 past a check seat (not shown) into the front chamber 30 will evacuate air from the second variable volume chamber 32 by way of a radial passage 86, the bore 56 and the vacuum passage 76 to effect movement of the power piston 28.

The left forward end of the plunger 66 extends into an opening 94 which communicates with a reaction chamber 96. The reaction chamber 96 is of a stepped bore type to form two annular shoulders 98 and 100. Within the stepped reaction chamber 96 are captive a plate 102, a rubber-like material 104 and a head 106 of a driven member 108. The driven member 108 connects with a master piston (not shown) of the brake master cylinder. The plate 102 is free to slide in the reaction chamber 96 and forms a clearance marked C with respect to the shoulder 100 as will be later described in greater detail. The clearance C and shoulder 100 provide a main characteristic of the invention, as will be explained below.

The plunger 66 is formed with a reduced diameter portion 110 which is straddled by a bifurcated stem portion 112*a* of a key 112. The key 112 has a pair of fingers 112*b* for abutting engagement with the shell 24. The bifurcated portion 112*a* is an axially loose fit in a radial recess 116 in the power piston 28 to form a clearance B between the bifurcated portion 112*a* and the rear face of the radial recess 116 in the rest position of the booster as shown in Figure 1 and described later in greater detail.

The assembly operates as follows. In the position shown, every part of the braking servomotor 12 occupies its rest position. It should be noted that in this position there is a small clearance A between the vacuum seat 67 and the valve face 68, while the air seat 84 engages the face 68 of the valve assembly 62 so that the chamber 32 is in communication with the other chamber 30 and both are at subatmospheric pressure. Air at atmospheric pressure present in the bore 56 through a filter 18, is isolated from both chambers.

When an operator applies an input force to a brake pedal (not shown), the push rod 60 will move to allow spring 74 to move the face 68 of the valve assembly 62 against the vacuum seat 67 to interrupt communication between the first chamber 30 and the bore 56 through the passage 76. The clearance A is calculated to the minimum which is sufficient to maintain communication between the first chamber 30 and the bore 56 in the rest position. Further movement of the push rod 60 will move the atmospheric seat 84 away from the face 68 to allow air at atmospheric pressure, present in the bore 56, to enter the rear chamber 32 through the passage 86. With air in the rear chamber 32 and vacuum in the front chamber 30, a pressure differential exists across the power piston 28. This pressure differential will create an operational force which will be transmitted through the hub means 34 to move the head 106 of the driven member 108 through plate 102 and rubber material 104, so that braking fluid pressure is developed in the brake master cylinder (not shown) in the ordinary manner.

It will be understood from the foregoing that the necessary minimum calculation of the clearance A is effective to provide a prompt interruption of communication between the first chamber 30 and bore 56 during the initial portion of the brake applying stroke and hence a prompt development of braking effort or better responsive character of the braking system.

In this operation, a major part of the reactional force developed in the reaction rubber material 104 is received by the shoulder 98 of the power piston 28 while the remainder is received by the plate 102 and in turn by the plunger 66 to be sensed by the operator through the push rod 60 and the brake pedal (not shown).

The clearance B exists when the fingers 112*b* of the key 112 abut the internal face of the shell 24 and the annular shoulder at the left hand end of the reduced diameter portion 110 of the plunger 66 is urged by the spring 74 into abutment with the key. This is the rest position as shown. The clearance B is so dimensioned that the plunger 66 may move forwardly over the clearance A and in addition the atmospheric seat 84 may move away from the face 68 through a distance large enough to allow air at atmospheric pressure present in bore 56 promptly to enter the rear chamber 32. This results in a prompt development of the pressure differential across the piston 28 and hence a good response of the valve assembly 62 and hence the servomotor 12. Upon termination of the input force, the return spring 88 will urge the air seat 84 against the face 68 and the face 68 away from the vacuum seat 67 to allow the vacuum present in chamber 30 to evacuate the rear chamber 32.

During brake release, the key 112 is, on the initial portion of the pedal stroke, spring urged by the spring 88 and plunger 66 to the right until the forked portion 112*a* abuts the rearward face of the radial recess 116 so that the clearance B is dissipated, with the result that the face 68 moves away from the vacuum seat 67 to a maximum distance to provide the largest possible section passage therethrough for promptly evacuating air in the rear chamber 32. Prompt restoration of the servomotor is thus achieved. This largest possible section passage is maintained until the fingers 112*b* of the key 112 abut the internal face of the rear shell 24. Shortly thereafter buffer portions 90 of the diaphragm 40 abut the shell 24. The clearance B then restores its original size between the bifurcated stem portion 112*a* and the rightward face of the radial recess 116 as shown.

The clearance C is calculated so as to provide stopper means for the plate 102 when the plunger 66 moves to the right relative to the hub 34 in the restoring operation so that overdeformation of the rubber material 104 is prevented.

In the case of either brake application or brake release, there is relative movement between the plunger 66 and the hub 34. Because the plunger 66 is acted upon only by pedal pressure whereas the hub 34 is subjected to the pressure differential force from the power piston 28, this relative movement could cause serious strain on the neighbouring two portions of the reaction member 104 abutting the shoulder 98 and the plate 102, respectively. Moreover this strain would be repeated in every actuation of the servomotor, and could lead to ruin of the reaction member 104. The strain is however minimized by the shoulder 100 and the clearance C.

The shoulder 100 serves as a stop means for suppressing to a minimum the relative movement between the plate 102 and the power piston. The greatest differential deformation allowed is defined by the distance C which should therefore be chosen as small as possible commensurate with providing adequate feedback or "feel" to the brake pedal.

In the event that vacuum is not available and the operator is required to make a "no power" brake application, the head 106 is moved relative to the hub 34 until the shoulder at the right hand end of the reduced diameter portion 110 of the plunger 66 abuts the bifurcated portion 112*a* of the key 112, and then the plunger 66 urges the hub 34 and hence the power piston 28 against the bias of the spring 88, pushing the driven member 108 to the left.

Claims

1. A brake booster assembly having a resilient member between a power operable member and an output member, and a plate member of smaller cross-sectional area than the resilient member between the resilient member and a shoulder of the power operable member, wherein limited axial relative movement is permitted between the plate member and the power operable member so that initial movement of the power operabe member in a brake engaging direction transmits an actuating force to the output member through an outer peripheral portion only of the resilient member until compression of the resilient member brings the plate member into operative engagement with the shoulder, and thereafter continued movement of the power operable member in the brake engaging direction transmits the actuating force to the output member through the whole of the resilient member.

2. A brake booster according to claim 1, wherein the plate member is located in a stepped bore in the power operable member, and the resilient member is located in a larger diameter portion of the stepped bore.

3. A brake booster according to claim 2, wherein a control member for actuating a control valve mechanism for the power operable member extends through the power operable member into abutment with the plate member, the shoulder of the power operable member being an internal shoulder formed between the portion of the stepped bore receiving the plate member and a smaller diameter bore in the power piston receiving the control member.

4. A brake booster according to claim 2 or claim 3, wherein the output member has a head portion which is operatively received as a sliding fit in the larger diameter portion of the stepped bore.

5. A brake booster according to claim 1, substantially as described herein with reference to the drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.