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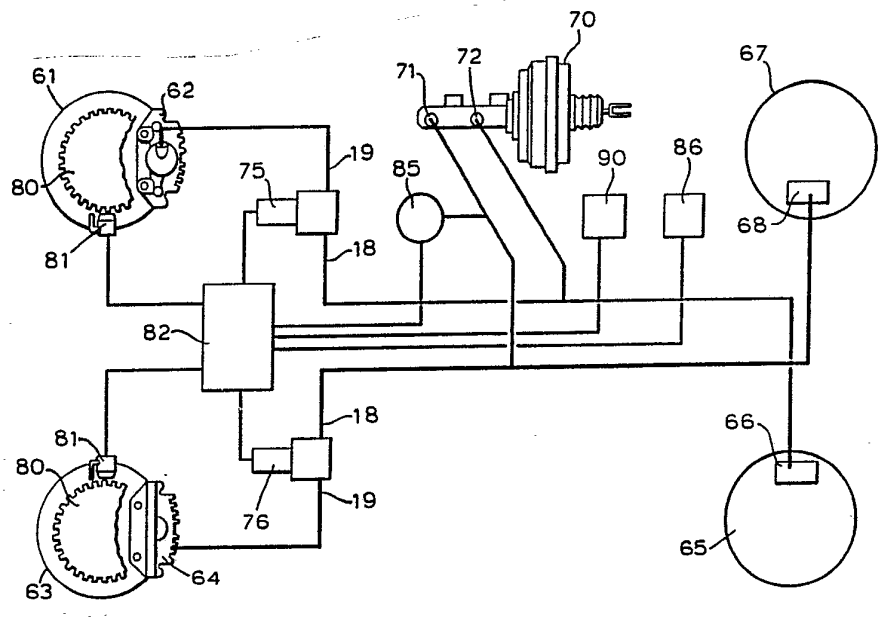

(57) Abstract

A vehicle braking system has a master cylinder (70) which will produce a source of high pressure fluid upon brake actuation, said master cylinder (70) is connected by a brake line to a brake actuator (62; 64) which upon actuation of the master cylinder (70) will be pressurised to apply a brake (61, 63) associated with one of the wheels of the vehicle, a servo mechanism (75, 76) is provided in the line between the master cylinder (70) and brake actuator (62, 64) and sensors (80, 81) are provided for sensing the motion of the vehicle and when the vehicle is stationary applying a signal to a control unit (82) which will cause the servo mechanism (75, 76) to isolate the brake actuator (62; 64) from the master cylinder (70) and apply pressure to the brake actuator (62; 64) to apply the brake (61, 63).

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VEHICLE BRAKE SYSTEMS

The present invention relates to vehicle brake systems and in particular to means for holding and releasing the brakes of a vehicle while it is stationary.

Hitherto it has been proposed to provide solenoid shut-off valves in the brake lines of a vehicle braking system, so that the valves may be shut while the brakes are applied, in order to maintain the brakes in the applied condition. Such systems are controlled by wheel speed sensors which will provide a signal to indicate when the vehicle is stationary, after which the valves may be shut to hold the brakes. One problem with such systems is that the locking of the wheels during a braking operation could produce a false indication that the vehicle is stationary. It is inappropriate that the brakes should be held on under such circumstances.

According to one aspect of the present invention a vehicle braking system comprises; a master cylinder which will produce a source of high pressure fluid upon brake actuation, said master cylinder being connected by a brake line to a brake actuator which upon actuation of the master cylinder will be pressurised to apply a brake associated with one of the wheels of the vehicle, characterised in

that a servo mechanism is provided in the line between the master cylinder and a brake actuator, means is provided for sensing motion of the vehicle and means is provided for controlling the servo mechanism so that when the vehicle is stationary the servo mechanism will isolate the brake actuator from the master cylinder and apply pressure to the brake actuator to apply tbe brake.

The present invention is particularly advantageous for controlling the vehicle on an incline, for example when performing a hill start, the control system may consequently include an inclinometer, so that it is only effective when the vehicle is on an incline. Alternatively, the system may be under manual control.

Release of the brakes is preferably automatically controlled so that it will occur, as drive is applied to the vehicle. This may be achieved by sensing the clutch and/or throttle mechanisms, so that the valve means is controlled to release the brake when, for example, the clutch begins to bite; or means may be provided in the transmission system for sensing the application of a torque thereto by the engine of the vehicle. Alternatively release of the brake may be under manual control.

It is not desirable to maintain pressure on the brake

actuator over excessive periods, for example when the vehicle is parked. The control system may consequently act to release the brake, when the parking brake of the vehicle is applied or when the ignition is switched off while the parking brake is applied.

The present invention is applicable to multi-brake braking systems, where one or more of the brakes may be controlled in the manner described above, by one or more valve means, each valve means controlling one or more of the brakes.

Various embodiments of the invention are now described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a diagrammatic illustration of a vehicle braking system in accordance with the present invention; and

Figure 2 is a diagrammatic sectional elevation of a brake servo mechanism which may be used in the system illustrated in Figure 1.

Figure 1 illustrates a dual braking system for a front wheel drive vehicle, in which the front wheels are provided with disc brakes 61 and 63 controlled by actuating calipers

62 and 64 respectively and the rear wheels are provided with drum brakes 65 and 67 controlled by hydraulic cylinders 66 and 68 respectively.

The dual system is controlled by a servo-assisted dual master cylinder 70 of conventional design. The master cylinder 70 has two outlets 71 and 72 which provide a source of hydraulic fluid for the two legs of the dual system, one serving the caliper 62 of the offside front wheel and the cylinder 66 of the nearside rear wheel and the other serving the caliper 64 of the nearside front wheel and the cylinder 68 of the offside rear wheel.

Brake control servos 75 and 76 are provided in each of the branches of the legs serving calipers 62 and 64 respectively. These brake control servos 75 and 76 are of identical construction and only one is described below.

The brake control servo 75 has a cylinder 15 with stepped bore 16. The larger diameter portion 17 of the bore 16 is closed and has an inlet 18 and an outlet 19.

A piston 20 is slidingly sealed in a small diameter portion 21 of bore 16. A valve member 22 is slidingly located within the larger diameter portion 17 of the bore 16, a stem 23 of the valve member 22 being slidingly located in

an axial bore 24 in piston 20, so that the piston 20 is movable axially relative to the valve member 22. A cylindrical skirt formation 25 extends from the outer periphery of valve member 22, coaxial with stem 23 and an inwardly directed flange 26 on the end of skirt formation 25 remote from the valve member 22 engages over an enlarged diameter head portion 27 on the piston 20, so that the valve member 22 is captive on the piston 20. A compression spring 30 acts between the head portion 27 of piston 20 and valve member 22 to urge the valve member 22 away from the piston 20, the expansion of the spring 30 being limited by engagement of the flange 26 with head portion 27. An elastomeric seat formation 31 is provided on the valve member 22 coaxial with and opposed to the inlet 18 and spring means 32 acts between the closed end of cylinder 15 and the valve member 22 to urge the seat formation 31 away from the inlet 18, so that when the piston 20 is fully retracted and the flange 26 on skirt 25 engages the shoulder between portions 17 and 21 of bore 16, the seat formation 31 will be clear of inlet 18.

A casing 40 is mounted coaxially of the cylinder 15 adjacent to the open end of the small diameter portion 21 of bore 16 thereof. The casing 40 is formed from two pressings 41 and 42 which are joined together at their outer peripheries, the outer periphery 43 of a diaphragm 44

being trapped therebetween to locate the diaphragm 44 and to seal the joint between the pressings 41 and 42. A piston 45 is located within the casing 40, the inner periphery 46 of the diaphragm 44 being secured to the piston 45 to divide the casing 40 into two chambers 47 and 48. The piston 45 has a stem 49 which is coaxial with cylinder 15 and extends into engagement with the piston 20, a diaphragm 50 providing a seal between the stem 49 and the casing 40. A compression spring 51 acts between the end of casing 40 adjacent cylinder 15 and the piston 45 to urge the piston 45 away from the cylinder 15. Inlet/outlet ports 52 and 53 are provided to the chambers 47 and 48 respectively.

The brake control servos 75 and 76 are mounted with inlet 18 connected to the master cylinder 70 and outlet 19 connected to the brake calipers 62 and 64 respectively. Chamber 48 of the brake control servo 14 is connected via port 53 to vacuum and chamber 47 is connected via port 52 and a solenoid control valve selectively to vacuum or to atmosphere. The solenoid control valves are connected to a control unit 82.

When de-energised, chamber 47 will be connected to vacuum so that there will be no pressure differential across the diaphragm 44 and spring 51 will force the piston 45 to the

right as illustrated in Figure 2. In this condition, the inlet 18 is connected to the outlet 19 so that calipers 62 and 64 may be pressurised to apply brakes 61 and 63 when the service brake is applied by actuation of the master cylinder 70.

When the solenoid valve is energised by a control signal from control unit 82, chamber 47 is connected to atmosphere and the pressure differential across diaphragm 44 causes piston 45 to move to the left as illustrated in Figure 2. This movement of piston 45 in turn moves piston 20. Upon initial movement of piston 20, the valve member 22 will move with the piston 20, spring 32 which is of lower spring rate than the spring 30 being compressed until a seat 31 engages the end wall and closes inlet 18. Continued movement of the piston 45 will then cause piston 20 to compress spring 30, so that it moves relative to the valve member 22. This movement of the piston 20 displaces fluid in the larger diameter portion 17 of bore 16 to pressurise brake calipers 62 and 64 respectively and apply the brakes 61 and 63.

Wheel speed sensors are associated with both front wheels, these sensors comprising a toothed disc 80 which is mounted for rotation with the brake disc and an inductive pickup 81 which is positioned adjacent the teeth of the disc 80. The

inductive pickups 81 produce a signal which alternates at a frequency proportional to the rotational speed of the wheel with which it is associated. The signals from the pickups 81 are fed to a control unit 82 where they are processed to provide a signal when the vehicle is stationary.

A pressure switch 85 is provided in the leg of the braking system connected to outlet 71 of master cylinder 70. This pressure switch 85 produces a signal when the master cylinder 70 has been released and pressure in the system is zero, this signal being fed to the control unit 82. Optionally, the vehicle may also be provided with an inclinometer 86 which will detect whether the vehicle is on a fore and aft slope, and when it is will produce a signal which is again fed to control unit 82.

A sensor 90 is provided on the vehicle clutch control mechanism, the sensor 90 producing a signal when the clutch starts to engage. The signal from sensor 90 is again fed to the control unit 82 and upon receipt of the signal from the sensor 90, if the brakes 61 and 63 are held on by brake control servos 75 and 76, the control unit 82 will act to de-energise the solenoid valves 75 and 76 and release the brakes 61 and 63.

Further inputs to the control unit 82 are provided by a

sensor (not shown) associated with the vehicle parking brake and also optionally the ignition system, so that the brake control servos 75 and 76 will be de-energised and the brakes 61 and 63 released when the parking brake is applied or the ignition is switched off while the parking brake is applied. Manual control means may also be provided to hold or release the brakes 61 and 63 or to override automatic control of the system described above.

In a modification of the system described above, brake control servos may also be provided in the branches of the legs serving the hydraulic cylinders 66 and 68 so that brakes 65 and 67 may be held or released in similar manner to brakes 61 and 63. Alternatively, the brake control servos 75 and 76 may be provided in the legs before they branch to the respective front and rear brakes, so that one brake control servo in each leg will control all of the brake actuators in that leg. Wheel speed sensors may also be provided on the rear wheels of the vehicle.

As the brake control servos 75 and 76 themselves apply pressure to the calipers 62 and 64, there is no need for the brake system to be pressurised when the valve is closed to isolate the calipers 62 and 64 from the master cylinder 70. Consequently as the brake control servos 75 and 76 are only energised when a vehicle stationary signal is produced

and the master cylinder 70 has been released, as indicated by the absence of a signal from pressure switch 85, the possibility of holding the brakes in the on position when the wheels have locked during a braking operation, is avoided.

The brake control servos 75 and 76 as described above, may also be used in a vehicle wheel spin control system, as covered in our co-pending PCT Application claiming priority from UK Patent Application No. 8728890 dated 10th December 1987 (Agents' reference P462 A2251). A wheel spin control system as covered by that application may consequently be used in conjunction with the system of the present application, the brake control servos 75 and 76 and wheel speed sensors 80, 81 being common to the two systems. In such cases, proportional pressure solenoid valves may be used to control the brake control servos 75 and 76 so that for wheel spin control the amount of brake effort may be controlled as desired. In such circumstances, the proportional pressure solenoid valves will be controlled by control unit 82 to provide maximum pressure differential across the diaphragm 44 when the vehicle comes to a halt.

The brake system according to the present invention may also include an antilock braking system, in which case the wheel speed sensors 80, 81 of the present invention may be

shared with the antilock braking system.

While in the above embodiment vacuum operated brake control servos are used, fluid pressure brake control servos of the type disclosed in co-pending PCT Application claiming priority from UK Patent Application No. 8728890 in which fluid pressure is applied to the end of piston 20 remote from inlet 18, may alternatively be used.

CLAIMS

1. A vehicle braking system comprising a master cylinder (70) which will produce a source of high pressure fluid upon brake actuation, said master cylinder (70) being connected by a brake line to a brake actuator (62; 64) which upon actuation of the master cylinder (70) will be pressurised to apply a brake (61, 63) associated with one of the wheels of the vehicle, characterised in that a servo mechanism (75, 76) is provided in the line between the master cylinder (70) and a brake actuator (62; 64), means (80, 81) is provided for sensing motion of the vehicle and means (82) is provided for controlling the servo mechanism (75, 76) so that when the vehicle is stationary the servo mechanism (75, 76) will isolate the brake actuator (62; 64) from the master cylinder (70) and apply pressure to the brake actuator (62; 64) to apply tbe brake (61, 63).

2. A vehicle braking system according to Claim 1 characterised in that the servo mechanism (75, 76) is actuated when the vehicle is stationary and the service brake of the vehicle is released.

3. A vehicle braking system according to Claim 1 or 2 characterised in that the servo mechanism (75, 76) comprises a piston (20) and cylinder (15) assembly, the

cylinder (15) being connected to the master cylinder (70) and to the brake actuator (62; 64), a shut-off valve (22) being provided to close connection with the master cylinder (70) and means (40) being provided to selectively control the shut-off valve (22) and movement of the piston (20), so that fluid may be displaced from the cylinder (15) into the brake actuator (62; 64) thereby applying the brake (61, 63).

4. A vehicle braking system according to Claim 3 characterised in that the shut-off valve comprises a valve member (22) which is mounted in the cylinder (15) for axial movement thereof, said valve member (22) being arranged initially to move with the piston (20) to close the connection to the master cylinder (70), relative movement between the piston (20) and valve member (22) then being permitted so that fluid may be displaced from the cylinder (15) to the brake actuator (62; 64).

5. A vehicle braking system according to Claim 4 characterised in that the valve member (22) is movable axially of the cylinder (15) between a closed position in which it closes connection with the master cylinder (70) and an open position in which connection to the master cylinder (70) is open, a first spring means (30) being provided to bias the valve member (22) away from the piston

(20) and towards its closed position and a second spring means (32) being provided to bias the valve member (22) towards its open position, expansion of the first spring means (30) being restricted so that when the piston (20) is fully retracted, the second spring means (32) will bias the valve member (22) to its open position, the spring rate of the first spring means (30) being greater than that of the second spring means (32) so that upon movement of the piston (20), the second spring means (32) is first compressed until the valve member (22) is in its closed position and upon continued movement of the piston (20) the first spring means (30) will then be compressed to permit movement of the piston (20) relative to the valve member (22).

6. A vehicle braking system according to Claim 5 characterised in that a flanged cylindrical portion (25) of the valve member (22) engages over an enlarged head portion (26) of the piston (20) to limit relative axial movement therebetween, the first spring means (30) acting against opposed faces of the piston (20) and the valve member (22).

7. A vehicle braking system according to any one of Claims 3 to 6 characterised in that movement of the piston (20) is controlled by a vacuum actuator (40) in which movement is in response to pressure differential across a

control piston (45).

8. A vehicle braking system according to any one of Claims 3 to 6 characterised in that movement of piston (20) is controlled by direct application of hydraulic fluid under pressure to the end of the piston (20) remote from the cylinder (15).

9. A vehicle braking system according to Claim 7 or 8 characterised in that a solenoid valve controls the pressure differential across the control piston (45) or pressure of hydraulic fluid delivered directly to the end of the piston (20) remote from the cylinder (15).

10. A vehicle braking system according to any one of Claims 1 to 9 characterised in that the servo mechanism (75, 76) is controlled to release the brake actuator (62; 64), when drive is applied to the wheels of the vehicle.

11. A vehicle braking system according to Claim 10 characterised in that sensing means (90) is provided in the clutch and/or throttle mechanisms or in the transmission system for sensing an application of torque thereto by the engine of the vehicle, said sensing means (90) providing a signal to release the servo mechanism (75, 76) when drive is applied to the wheels of the vehicle.

12. A vehicle braking system according to any one of the preceding claims characterised in that means (85) is provided for sensing the pressure in the service brake system of the vehicle and for providing a signal indicative that the service brake is not applied.

13. A vehicle braking system according to any one of the preceding claims characterised in that an inclinometer (86) provides a signal indicative of whether the vehicle is on a fore and aft incline or not.

14. A vehicle braking system according to any one of the preceding claims characterised in that manual means is provided for controlling the servo mechanism (75, 76) and/or overriding automatic control of the servo mechanism (75, 76).

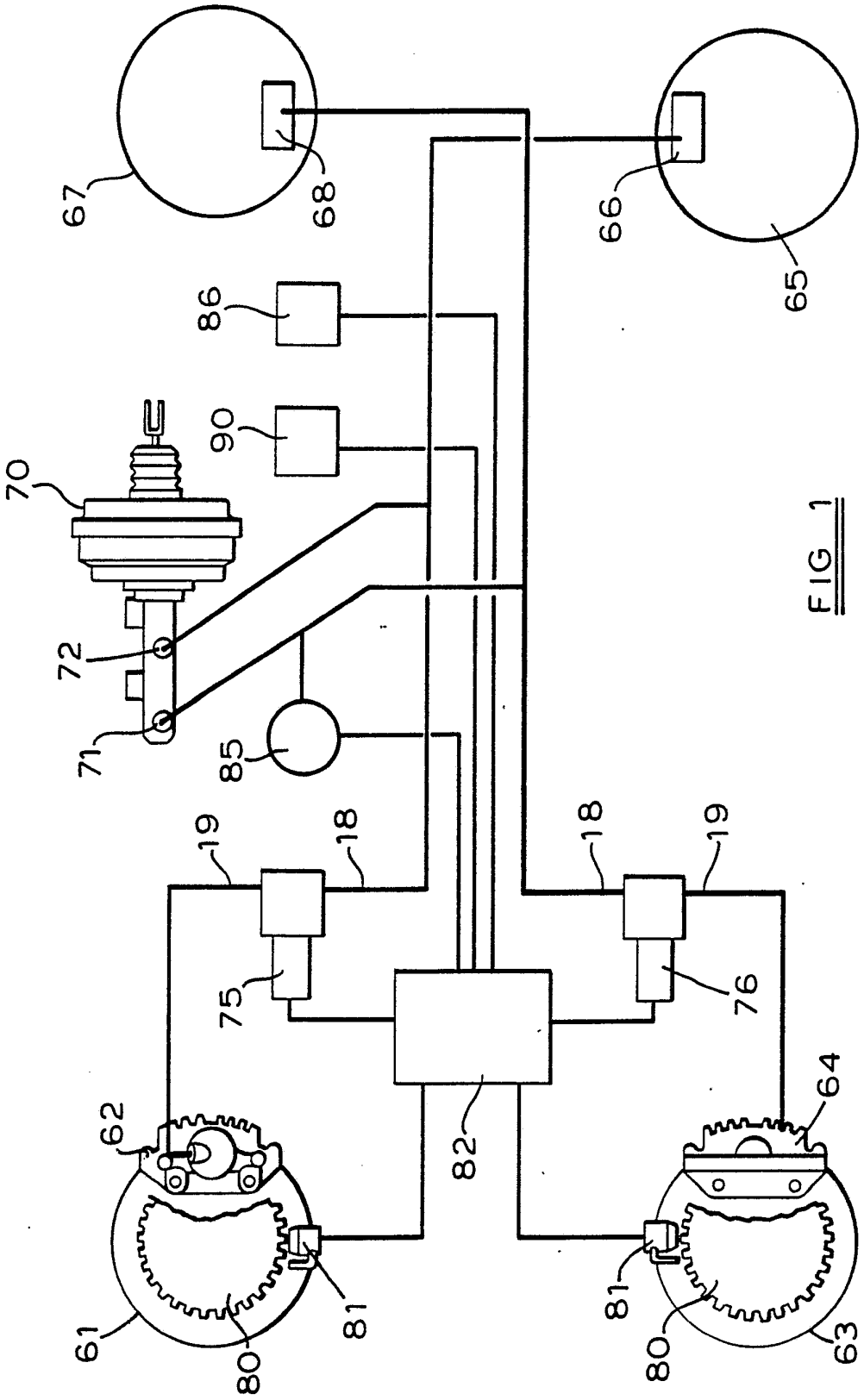
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FIG 1

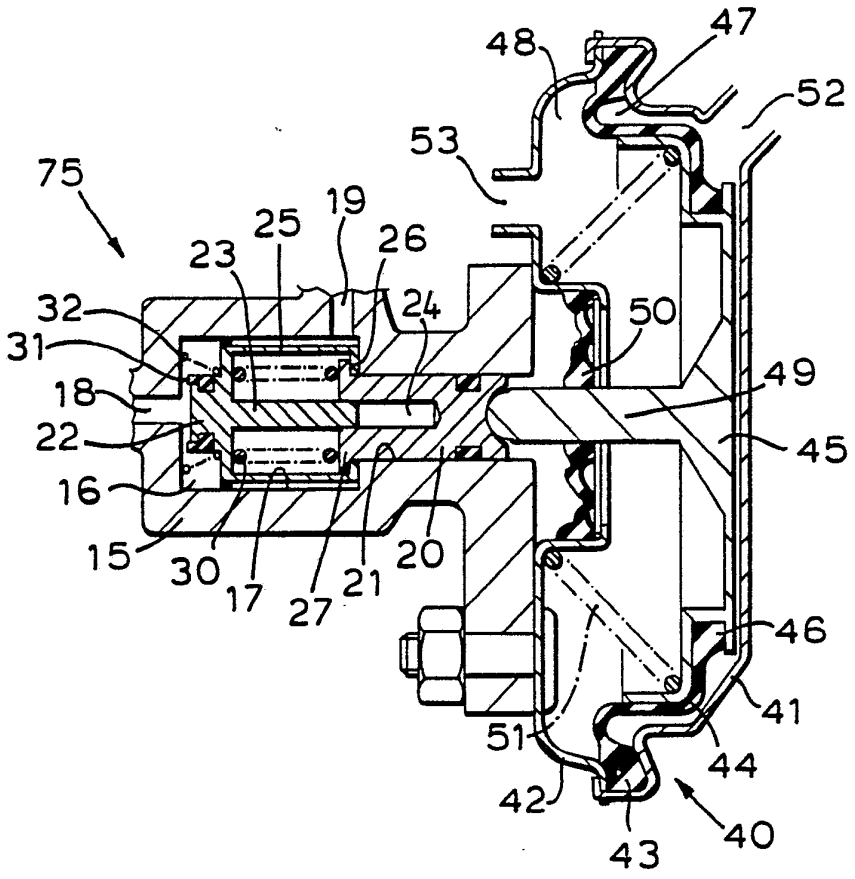
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FIG 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/01032

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 60 T 7/12; B 60 T 11/18; B 60 T 11/10

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 60 T 11/00; B 60 T 7/00

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	FR, A, 1115982 (BENDIX AVIATION) 2 May 1956, see page 4, right-hand column, line 21 - page 5, left-hand column, line 16; figure 1 --	1
A	GB, A, 2167507 (AB VOLVO) 29 May 1986, see abstract; figure --	1
A	DE, A, 3618532 (NISSAN) 4 December 1986	
P,A	EP, A, 0251156 (ADAM OPEL) 7 January 1988	

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* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22nd February 1989	- 1. 03. 89
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	B.C.G. VAN DER PUTTEN

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 8801032

SA 25453

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 24/02/89
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A- 1115982		US-A- 2997850	
		DE-B- 1104363	
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