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(54) Parking brake system for vehicles

(57) A parking brake system for rail wagons includes an actuator, eg. a lock actuator (27), having "apply brake" and "release brake" connections (28 and 29). A control device in the form of a double-acting master cylinder (25) supplies hydraulic pressure to the connections (28) and (29) to apply the release brake blocks (22) on a rail wheel (23) according to the direction of operation of the master cylinder piston (26) from a "dead band" range of movement near the centre of its stroke. An indicator (33) detects pressure at the connections (28) and (29) to indicate when the brake is released or applied.

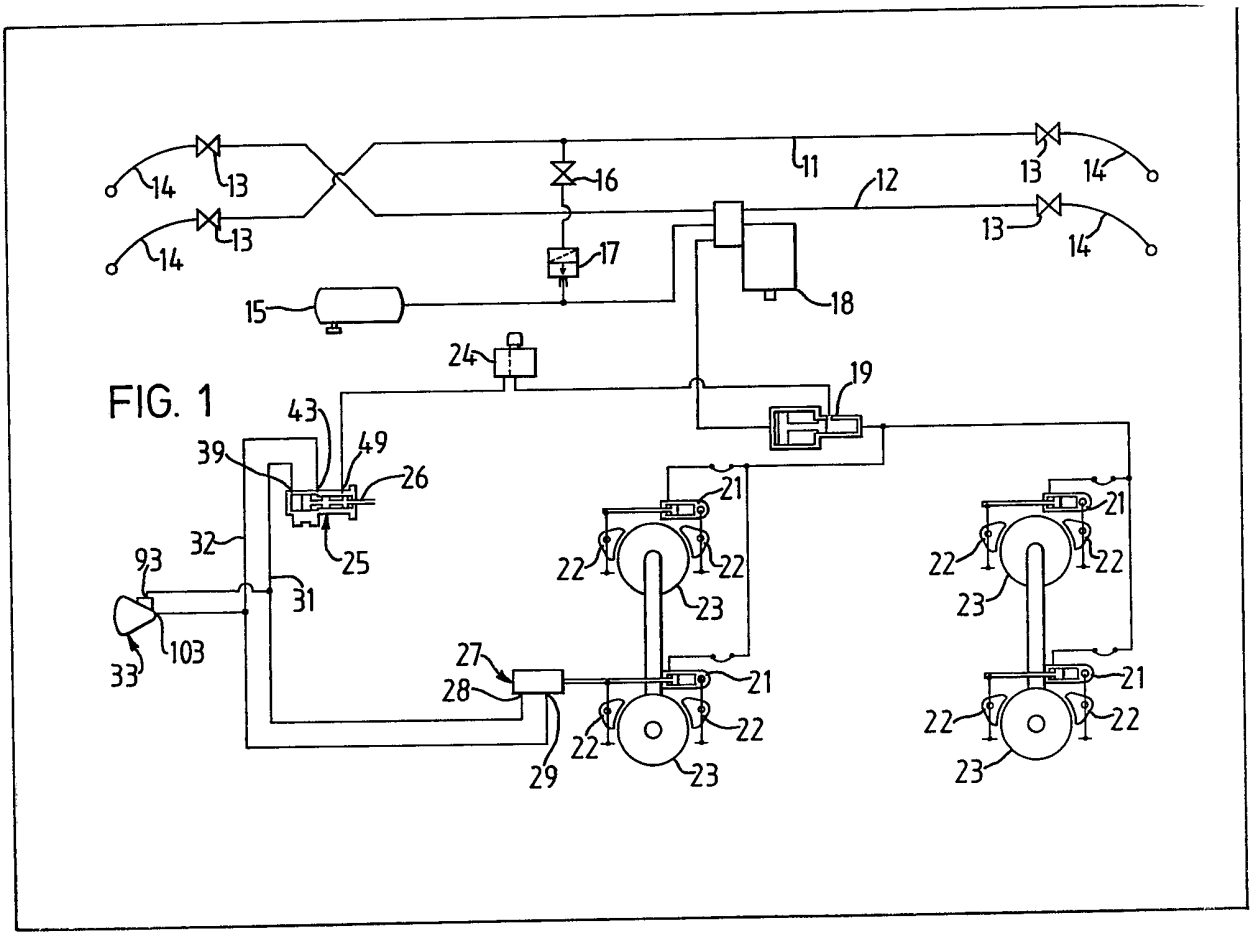

FIG. 1

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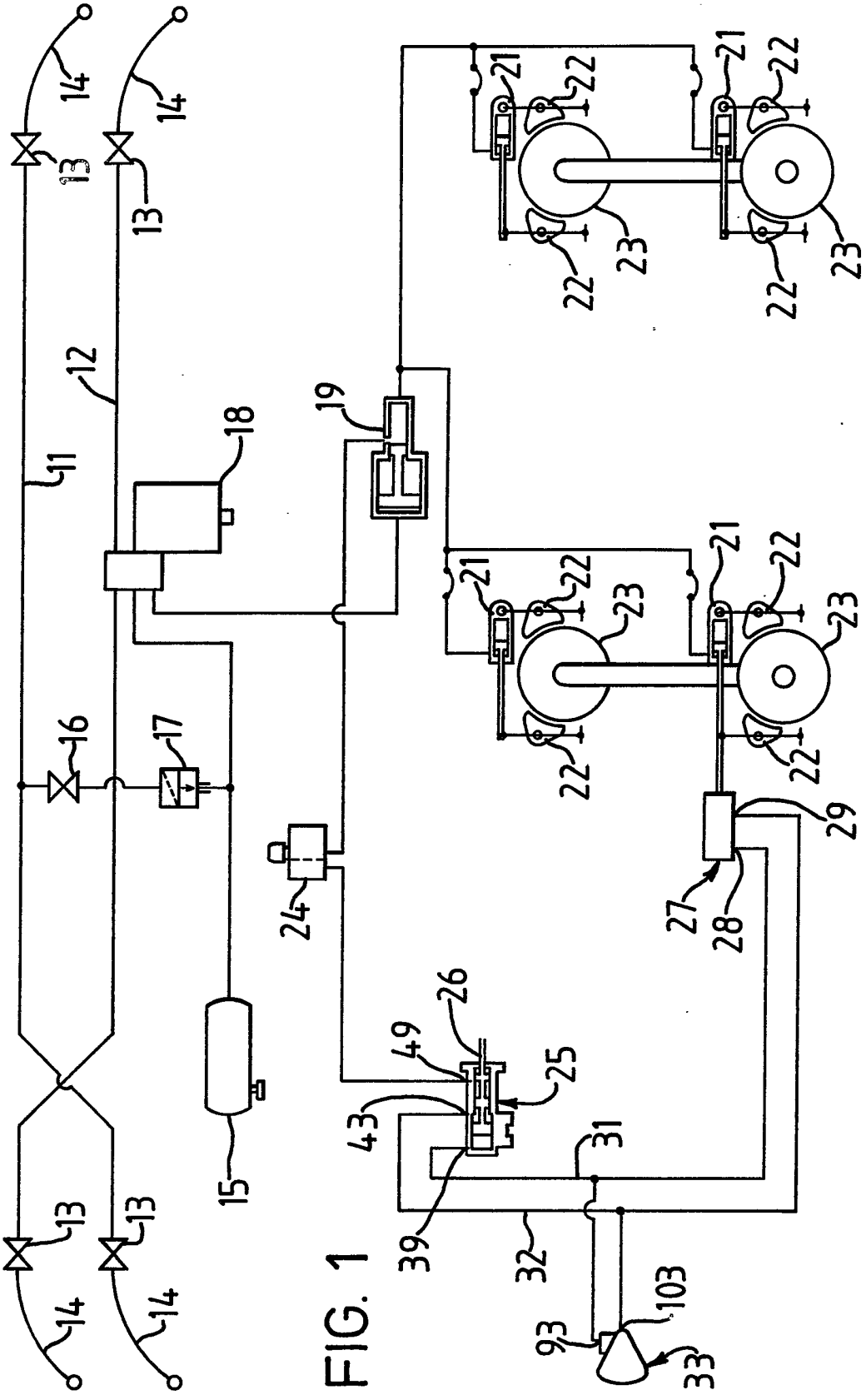
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FIG. 1

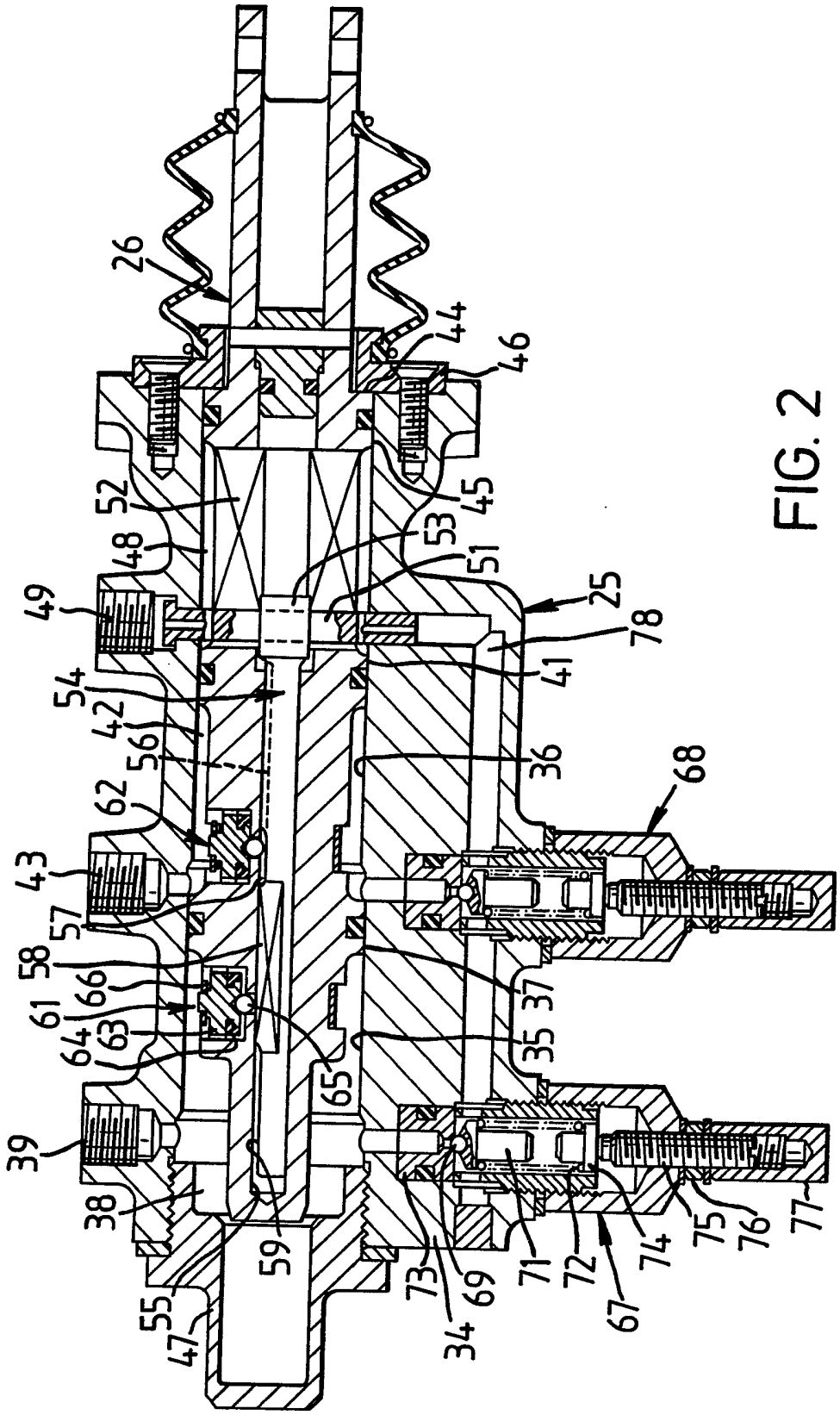
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FIG. 2

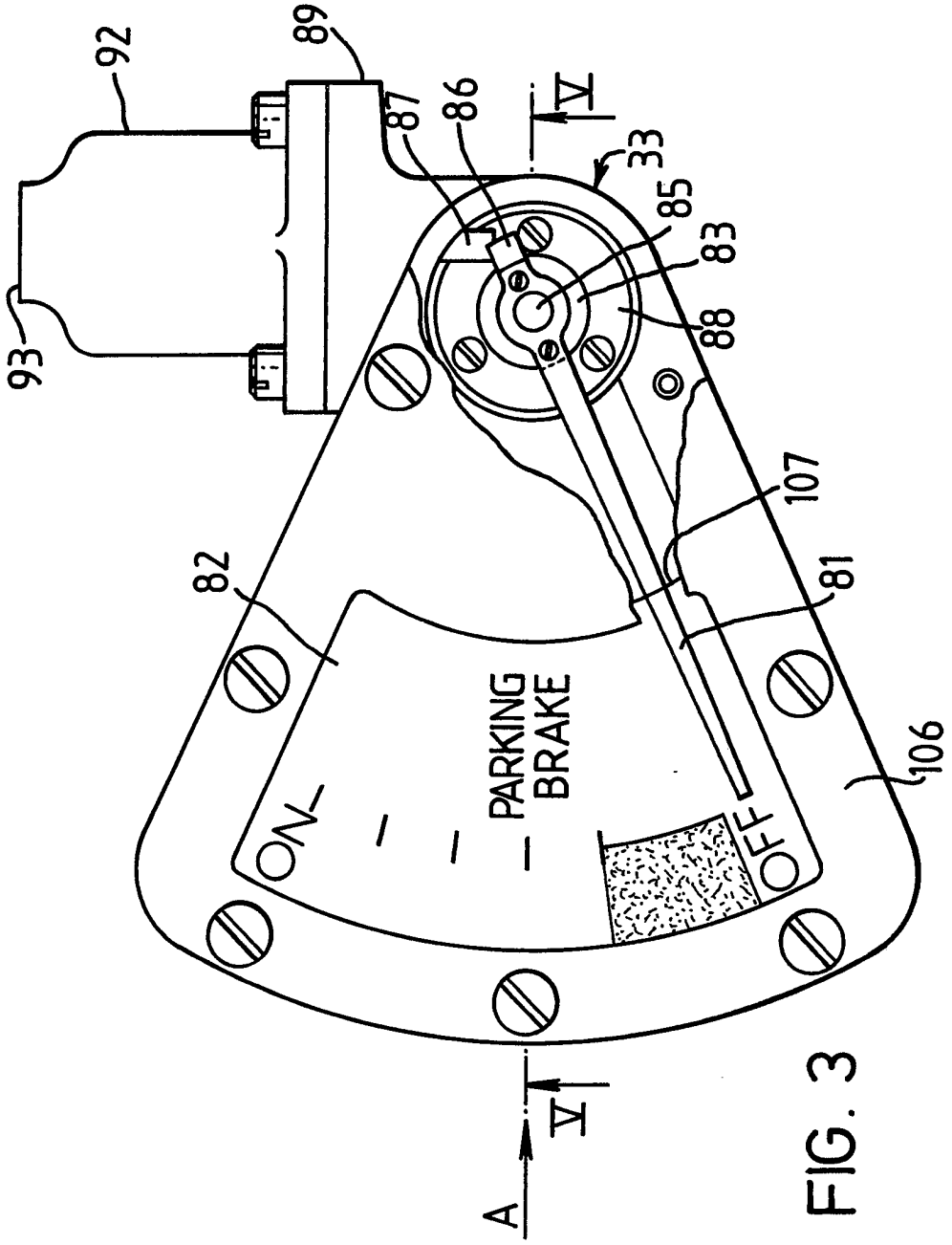

FIG. 3

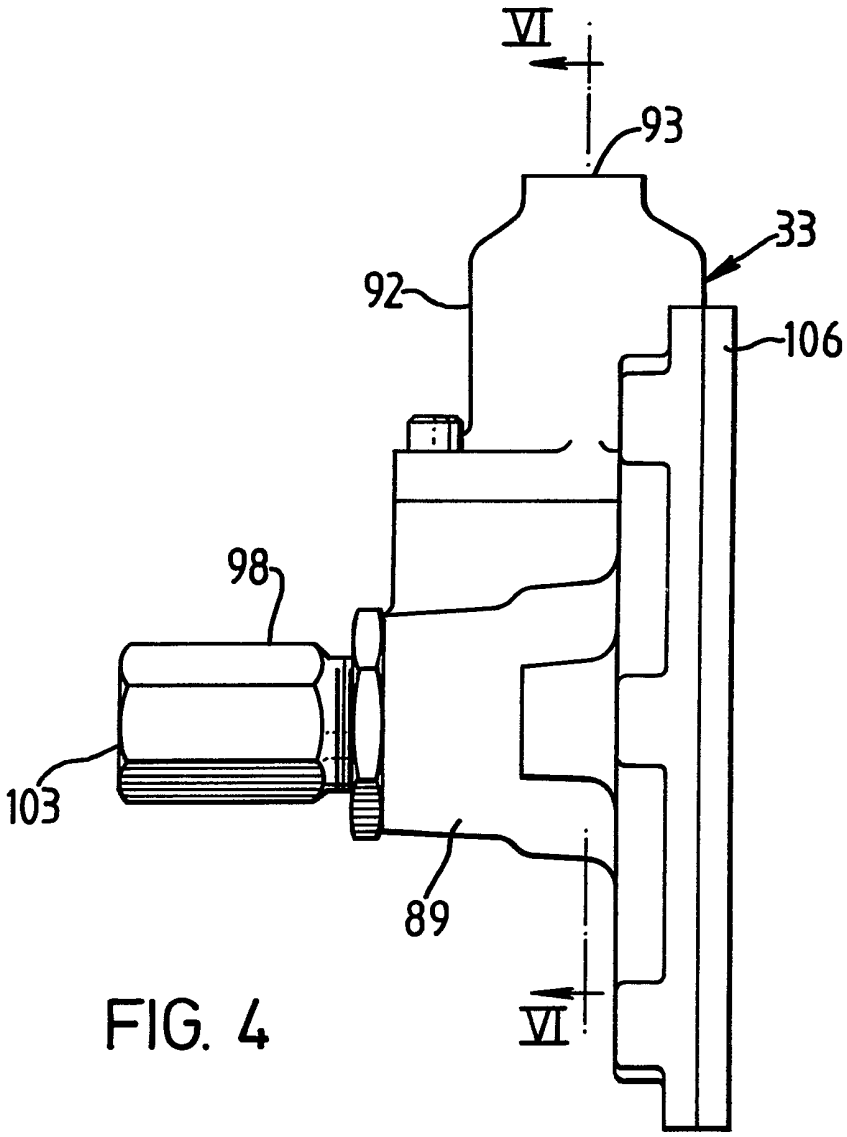

FIG. 4

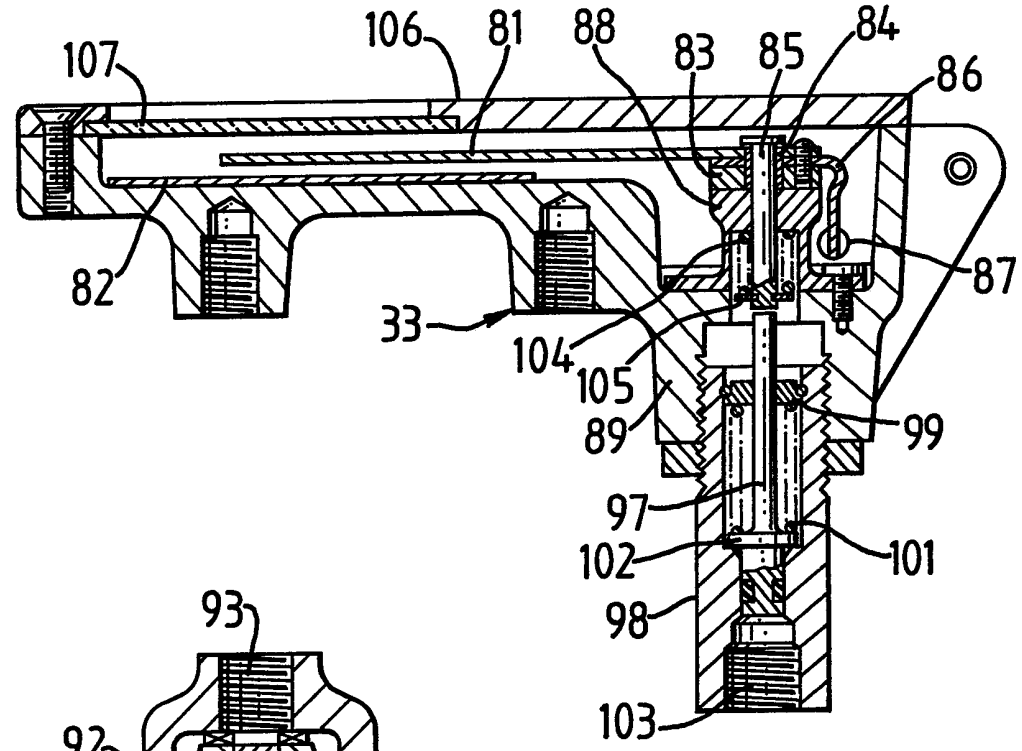
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FIG. 5

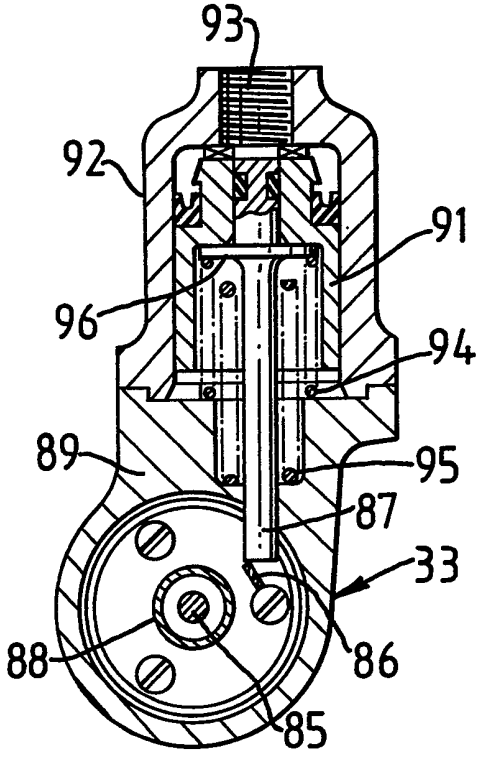
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FIG. 6

SPECIFICATION

Parking brake system for vehicles

The invention relates to parking brake systems for vehicles, particularly but not exclusively rail wagons.

Parking brake systems for rail vehicles are usually totally mechanical, with the operator input from a handwheel and leadscrew mechanism or from a long lever which can be pinned down into the on position. Whilst such systems are robust and reliable, the mechanical linkages are difficult to design without occupying valuable cargo space.

The present invention provides a parking brake system for vehicles comprising a fluid operated parking brake actuator having an "apply brake" connection through which fluid pressure can be admitted to operate the actuator in the direction to apply the brakes and a "release brake" connection through which fluid pressure can be admitted to operate the actuator in the direction to release the brakes, a fluid pressure control device having a control member movable in one direction to cause fluid pressure to be transmitted to the actuator "apply brake" connection and movable in the other direction to cause fluid pressure to be transmitted to the actuator "release brake" connection, and an indicator sensitive to fluid pressure at the actuator "apply brake" connection so as to indicate that the brake is applied when the pressure at said connection reaches one pre-determined magnitude and to fluid pressure at the actuator "release brake" connection so as to indicate that the brake is released when the pressure at said connection reaches another pre-determined magnitude.

The invention and further aspects thereof will now be described by way of example and with reference to the accompanying drawings, of which:–

Fig. 1 is a diagram of a complete rail wagon brake system incorporating a parking brake system according to the invention;

Fig. 2 is a cross-section of a hydraulic master cylinder shown in Fig. 1;

Fig. 3 is a front elevation of an indicator shown in Fig. 1;

Fig. 4 is a view on arrow A in Fig. 3;

Fig. 5 is a cross-section on the line V-V in Fig. 3; and

Fig. 6 is a cross-section on the line VI-VI in Fig. 4.

Referring to the drawings, a rail wagon braking system includes an air reservoir feed pipe 11 and a brake pipe 12, both extending the length of the wagon and having the usual coupling cocks 13 and coupling hoses 14 at each end. An auxiliary air reservoir 15 is connected to the reservoir feed pipe 11 through an isolating cock 16 and a strainer, check valve and choke assembly 17 and this supplies a distributor 18.

The braking system as described so far is conventional and uses known components. However, the distributor 18 does not supply the usual type of air actuator, but supplies an air-operated hydraulic master cylinder 19 which generates hydraulic pressure to operate pull-type hydraulic actuators 21 which apply brake blocks 22 to the wagon wheels 23 for service braking.

The air-operated master cylinder 19 is connected to a hydraulic supply tank 24 which is also connected to a fluid pressure control device in the form of a parking brake hydraulic master cylinder 25. This includes a stepped piston 26 which is connected to a leadscrew mechanism of conventional type for operation by a handwheel (not shown).

One of the wheels 23 has its brake blocks connected to a fluid operated parking brake actuator 27. This is a hydraulic unit of the type known as a lock-actuator. By supplying pressure through an "apply brake" connection 28 the parking brake actuator 27 is extended to apply the brake blocks 22. The actuator remains locked in a "brake on" state when pressure is removed from connection 28 but is released when subsequently pressure is supplied to a "release brake" connection 29.

The parking brake master cylinder 25 will be described in more detail with particular reference to Fig. 2, but from Fig. 1 it can be seen that the stepped piston 26 has a major diameter which is movable in a major diameter bore portion and a minor diameter movable in a minor diameter bore portion. By moving the stepped piston 26 to the left of Fig. 1 a pressure is generated by a piston area defined by the major diameter and is transmitted to the actuator "apply brake" connection 28 by means of line 31. By moving the stepped piston 26 to the right of Fig. 1 a pressure is generated by an annular piston area defined by the major and minor diameters and is transmitted to the actuator "release brake" connection by means of line 32.

An indicator 33 is connnected into lines 31 and 32 and thus to the actuator "apply brake" and "release brake" connections 28 and 29. This will be described in more detail below with particular reference to Figs. 3-6 after the more detailed description of master cylinder 25.

Referring to Fig. 2, the parking brake master cylinder includes a body 34 having a stepped bore with a major diameter portion 35 and a minor diameter portion 36. One piston land 37 is slidable in the major diameter portion 35 to define a piston area by which pressurised oil in a chamber 38 may be transmitted from an "apply brake" port 39 connected to line 32 and the actuator "apply brake" connection 28 when the piston 26 is moved to the left of Fig. 2. Another piston land 41 is slidable in the minor diameter bore portion 36 to define an annular piston area between the major and minor diameters. When the piston 26 is moved to the right of Fig. 2 oil is pressurised in an annular chamber 42 between piston lands 37 and 41 and may be transmitted through a "release brake" port 43 connected to line 33 and the actuator "release brake" connection 29.

Piston 26 is shown in Fig. 2 in the full "release brake" position wherein a shoulder 44 adjacent another piston land 45 abuts a stop ring 46 screwed

to one end of the body 34. A stop to limit piston travel in the "apply brake" direction is provided by a screwed-in end plug 47.

Between piston lands 41 and 45 another annular chamer 48 is connected to a reservoir port 49 by passages in a transverse pin 51. Slots 52 in the piston allow sliding movement of the piston and provide rotational location. The pin 51 extends through an eye end 53 in an axial pin 54 which is slidable in an axial bore 55 in the piston 26. A longitudinal groove 56 in the axial pin 54 provides fluid communication from the reservoir port 49 to the end of axial bore 55, past flats 57, 58 and 59 which are machined or otherwise formed on pin 54.

The axial pin 54 acts as a cam for operating two poppet type cut-off and recuperation valves 61 and 62 controlling flow between the reservoir port 49 and chambers 38 and 42 respectively. Each of the valves 61 and 62 comprises a valve member 63 slidable in a respective counter-bore in the piston and having a rubber seal ring 64 for sealing against the base of the counterbore. Each valve member 63 is lifted by a respective ball 65 which is biassed against the axial pin 54 by a respective C-shaped spring 66 manufactured from rectangular strip.

Flow from chambers 38 and 42 to the reservoir port 49 is also controlled by pressure relief valves 67 and 68 respectively. These are of conventional construction and each comprises a respective ball 69 captive in a recess in a plunger 71 loaded by a coil spring 72 against a valve seat 73. The spring load is adjustable by moving another plunger 74 by means of screw 75 which is locked and sealed by nuts 76 and 77. When pressure in chamber 38 reaches a pre-determined magnitude set by relief valve 67, oil flows back to the supply tank 24 through a passage 78 in the body 34 and passages in the transverse pin 51. Similarly, when pressure in annular chamber 42 reaches another pre-determined magnitude set by relief valve 68 oil flows back to the supply tank 24 by the same route.

The full operation of the parking brake master cylinder can be seen by considering movement of the piston 26 towards the left of Fig. 2 from the position shown and the return movement. As shown cut-off valve 61 is unseated and cut-off valve 62 is seated. The cut-off valves remain in this state as the piston 26 advances to the left so that no pressure is being generated in chamber 38. The volume of annular chamber 42 increases, any excess depression being compensated by flow past cut-off valve 62 which can act as a non-return valve. This state continues until the ball of valve 62 rises onto the axial land alongside flat 58, which will occur whilst the ball of valve 61 is still on this same land. Both valves 61 and 62 thus remain unseated for a further small movement of the piston 26 which may be called the "dead band" of piston travel.

With a further movement of piston 26 to the left of Fig. 2, the ball of valve 61 drops onto flat 59 to allow the valve to seat so that pressure builds up in chamber 38 and the brake is applied. Pressure is limited by pressure relief valve 67 so that the handwheel may fully wound to its limit of movement. Valve 62 remains unseated so that the actuation "release brake" connection 28 remains open to the supply tank 24.

Reversing the handwheel to release the brake causes the piston 26 to move to the right of Fig. 2, allowing pressure in chamber 38 to decay until valve 61 is lifted. The piston 26 continues through the "dead band" until the ball of valve 62 drops onto flat 57 and pressure is generated in annular chamber 42 and transmitted to the actuator "release brake" connection 29 to unlock the parking brake actuator 27 and release the brake. Relief valve 68 is set at a pressure above the known release pressure of actuator 27 and allows the handwheel to be fully wound back.

The indicator 33, which will now be described in more detail with particular reference to Figs. 3 to 6, comprises indicator means in the form of an indicator member of pointer 81 which moves to a position as shown on a dial 82 to provide a "brake on" signal when pressure at the actuator "apply brake" connection reaches one pre-determined magnitude which substantially coincides with the setting of relief valve 67. The "brakes on" signal ceases by the pointer 81, returning to the "off" position indicated on dial 82 when pressure at the actuator "release brake" connection reaches another pre-determined magnitude which is below the setting of relief valve 68.

The pointer 81 is secured to a disc 83 of friction material being located by a low-friction bush 84 and pivotable on a pin 85. Also secured to the friction disc 83 is a cranked arm 86 which as shown in the drawings is contacted by and end face of a plunger 87.

Pin 85 is slidable in a pedestal block 88 secured to a housing body 89 to which dial 82 is secured. Plunger 87 is slidable in the body 89 and also in an annular piston 91 which is itself slidable in a cylinder 92 secured to the body 89 and having a port 93 connected to line 31 and thus the actuator "apply brake" connection 28. Annular piston 91 is biassed away from the body 89 by a light helical spring 94. This is concentric with a heavy helical spring 95 (i.e. higher spring rate) which as shown in Fig. 6 is fitted leaving a large clearance between the spring end and a flange 96 on plunger 87.

Pin 85 is aligned with another plunger 97 slidable in a plunger housing 98 which is screwed into the body 89 and in a bearing block 99 which is retained by a round wire circlip. Plunger 97 is biassed by a spring 101 which bears against a flange 102 and which in turn abuts a step in the bore of the plunger housing 98. As shown in Fig. 5 this leaves a clearance between the adjacent ends of pin 85 and plunger 97 which can be adjusted by screwing the plunger housing 98 in or out.

A port 103 is provided in the plunger housing 98 for connection to line 32 and thus to the actuator "release brake" connection 29.

The friction block 83 is resiliently biassed against the pedestal block 88 by another spring 104 which abuts a snap ring 105 engaged in a groove in the pin 85 and the end face of a counterbore in the pedestal block. The pointer 81 is protected from dirt, water etc. by a cover plate 105 provided with a transparent window 107. Note that in the cross-section of Fig. 5

the pointer 81 is rotated from the position shown in Fig. 3 so as to be included in the section.

As shown in the drawings, the indicator is in the normal "brake off" state with no pressure at either port 93 or 103. When pressure is generated in line 32 and transmitted to port 93, the effect of a small pressure rise is that the annular piston 91 moves against the light spring 94 to abut the main body 89. This also moves plunger 87 by the same amount, so that the cranked arm 86 is rotated and the pointer 81 moved to approximately the mid position of its range of movement. The pressure required for this will be low, eg. little more than will be sufficient to return piston 91 against its own weight, the static head of oil and seal friction when the parking brake master cylinder piston is moved back to the "dead band" range.

The distance moved by piston 91 is sufficient for flange 96 to abut the end of spring 95, so that a further rise in pressure at port 93 causes plunger 87 to move against the higher spring rate of spring 95. The pointer 81 continues to move progressively with increasing pressure until the "on" position on dial 82 is reached at substantially the same pressure as that set by relief valve 67.

If the pressure at port 93 now decays, either because the handwheel is wound back or slight seepage or temperature changes, the pointer 81 remains in the "on" position by virtue of the friction disc 83 which thus acts as restraining means. Plunger 97 acts as release means to release the pointer 81 when subsequently the parking brake handwheel is wound fully back to generate pressure in line 32 and port 103 sufficient to move the plunger 97 against spring 101 into contact with the pin 85 and to relieve the load of spring 104. The pointer then falls by gravity to the "off" position, since the pressure at port 93 will have decayed at this stage and plunger 87 will have retracted to the position shown in the drawings. If necessary the pointer 81 may be suitably weighted or a torsion return spring added.

Plunger 87 may be replaced by a Bourdon tube mechanism for rotation of the indicator pointer and other forms of indicator may be used. For example, pressure switches and electrical memory devices may be used to generate a liquid crystal or similar display. Since a rail wagon may stand for some time without use the problem of electrical supply could be overcome by the use of solar cells.

CLAIMS

1. A parking brake system for vehicles comprising a fluid operated parking brake actuator having an "apply brake" connection through which fluid pressure can be admitted to operate the actuator in the direction to apply the brakes and a "release brake" connection through which fluid pressure can be admitted to operate the actuator in the direction to release the brakes, a fluid pressure control device having a control member movable in one direction to cause fluid pressure to be transmitted to the actuator "apply brake" connection and movable in the other direction to cause fluid pressure to be transmitted to the actuator "release brake" connection, and an indicator sensitive to fluid pressure at the actuator "apply brake" connection so as to indicate that the brake is applied when the pressure at said connection reaches one pre-determined magnitude and to fluid pressure at the actuator "release brake" connection so as to indicate that the brake is released when the pressure at said connection reaches another pre-determined magnitude.

2. A parking brake system according to Claim 1, wherein the fluid pressure control device comprises a hydraulic master cylinder having a piston which constitutes said control member.

3. A parking brake system according to Claim 2, wherein the piston is stepped, having a major diameter movable in a major diameter bore portion of the master cylinder and a minor diameter movable in a minor diameter bore portion, pressure at the "apply brake" connection being generated by a piston area defined by the major diameter and pressure at the "release brake" connection being generated by an annular piston area defined by the major and minor diameters.

4. A parking brake system according to any preceding Claim, wherein the indicator comprises an indicator means which provides a "brake on" signal when pressure at the actuator "apply brake" connection reaches said one pre-determined magnitude, said "brake on" signal remaining when pressure at the actuator "apply brake" connection is released and ceasing when pressure at the actuator "release brake" connection subsequently reaches said other pre-determined magnitude.

5. A parking brake system according to Claim 4, wherein said indicator means comprises an indicator member which is movable by fluid pressure at the actuator "apply brake" connection into a "brake on" position and so provides the "brake on" signal, restraining means which holds the indicator member in the "brake on" position and release means operable by fluid pressure at the actuator "release brake" connection to release the indicator member so that the "brake on" signal ceases.

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