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Papiau

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[54] **FLUID PRESSURE UNBALANCE INDICATOR WITH PLURAL PISTONS**

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[52] **U.S. Cl.** ..... **200/82 D,** 200/83 D, 200/153 LA

[51] **Int. Cl.** **H01h 35/38**

[58] **Field of Search** 200/82 D, 82 R, 83 D, 153 LA

[56] **References Cited**

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[57] **ABSTRACT**

A fluid pressure unbalance indicator comprising two separate pistons respectively subjected to forces created by the pressure prevailing in two independent fluid circuits, the pistons acting in opposition to one another and being mounted in a housing so as to move in conjunction with one another and to operate electrical contact members under the influence of a pressure difference which denotes failure of one of the fluid circuits and which produces a force capable of overcoming the force of a resilient system associated with the pistons. In the invention, the resilient system is situated in a region of the housing accessible to both pistons, and each end of the resilient system bears on a fixed portion of the housing and is engageable by the piston subjected to the higher of the fluid pressure forces.

2 Claims, 4 Drawing Figures

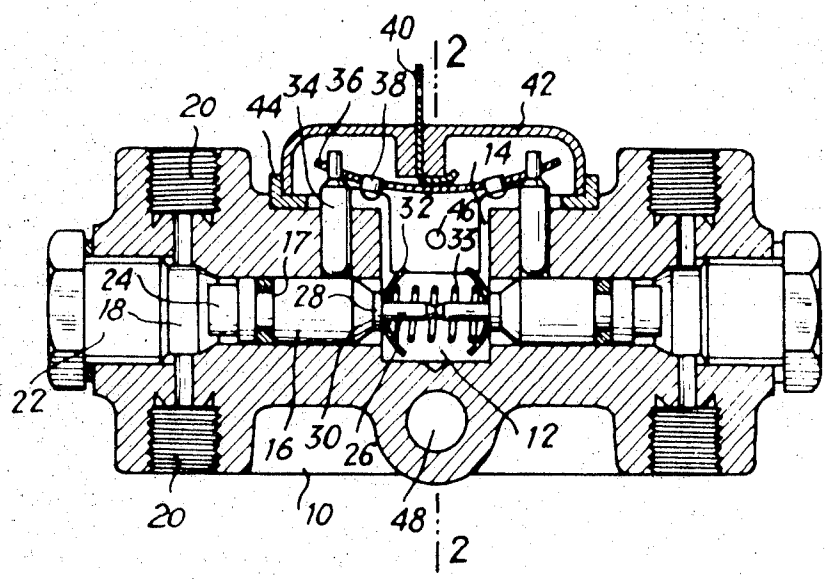


FIG. 1

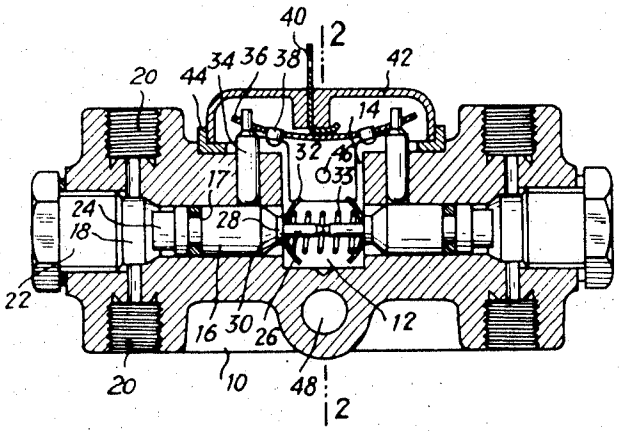


FIG. 2

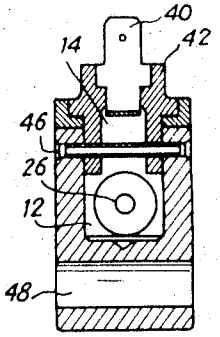


FIG. 3

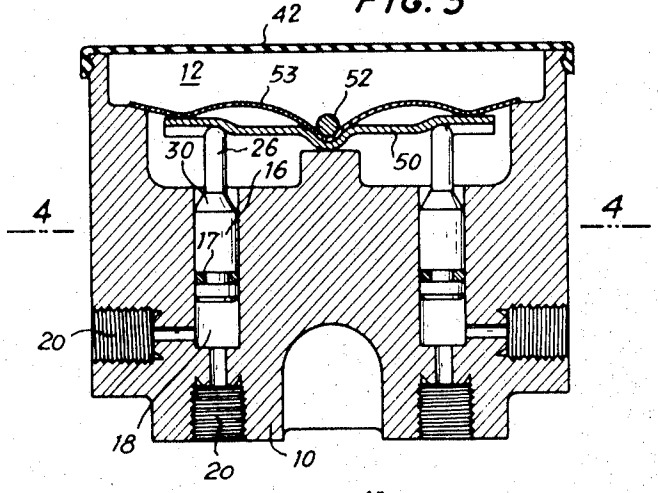
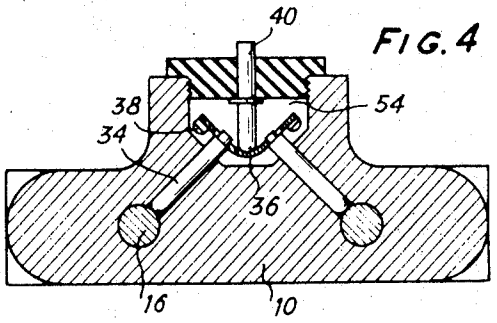


FIG. 4



FLUID PRESSURE UNBALANCE INDICATOR WITH PLURAL PISTONS

This invention relates to a fluid-pressure unbalance indicator particularly for use in a dual circuit hydraulic braking system for an automobile, in order to operate a warning means in the occurence of a failure in one of the braking circuits.

Conventionally, fluid-pressure unbalance indicators include two pistons, each exposed to the pressure in one of the braking circuit, and interconnected so as to act in opposition, that is, so that respectively opposed thrusts will be exerted by each piston on the other piston. When the brakes are applied, the pistons will remain substantially stationary if the pressure forces in both braking circuits are equal but, if the pressure forces are different, the combined movement of the pistons is utilized for closing an electrical switch.

It is known to provide these indicators with resilient means urging the set of pistons toward a balanced position, and also resisting movement of the set of pistons when the pressure difference is too small to denote failure of a braking circuit. Unfortunately, these resilient means systematically return the pistons into the balanced position when the brakes are not applied, so that, if one of the braking circuits fails, the warning means will display a signal only when a brake application is being performed. To overcome this disadvantage, it has been proposed that locking means should hold the pistons in the off-center position which they occupy when they receive pressures of different level. However, the known embodiments require a partial disassembly of the indicator or special pressurizing of the braking circuits for resetting the set of pistons into the balanced position when the defective circuit has been repaired.

An object of the present invention is to provide a fluid-pressure unbalance indicator which comprises no locking means for maintaining the set of pistons in the position denoting a pressure unbalance, and which is capable of automatically resuming its balanced position when the pressures are equal again.

In the indicator according to the invention, a resilient system is located in a region of the housing accessible to both pistons, each end of the resilient system bearing on a fixed part relative to the housing and being engageable by the piston subjected to the higher of the fluid-pressure forces.

It will be appreciated that a resilient system of this kind acts only on the piston associated with the fluid circuit which is not faulty. The other piston therefore remains in the fault indicating position until the repair of the faulty circuit enables the fluid pressures to be made equal again.

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

FIG. 1 is an elevational view in cross-section of an indicator according to a preferred embodiment of the invention.

FIG. 2 is a cross-sectional view along the line 2—2 in FIG. 1.

FIG. 3 is an elevational view in cross-section of another embodiment of the invention.

FIG. 4 is a cross-sectional view along the line 4—4 in FIG. 3.

Referring to FIGS. 1 and 2, the fluid-pressure unbalance indicator comprises a housing 10 having a longitudinal bore. In the middle of this bore, a cavity 12 is formed by the continuation of a rectangular opening 14 in the wall of the housing 10. On either side of the cavity 12, a piston 16 carrying an annular seal 17 is slidably mounted in the bore. The outer end of each piston 16 defines, in the bore, a pressure chamber 18 having orifices 20 adapted for connection to a hydraulic braking circuit. A threaded plug 22 sealingly closes each end of the bore.

Due to the symmetry of the device, only those reference numerals which relate to one side of the device are indicated in FIG. 1.

The outer end of each piston 16 carries a stop member 24 to limit the travel of the pistons towards the plugs 22. The opposite end of the piston is extended axially by a finger 26 of relatively small diameter, which is integral with the piston and is joined to the piston by a shoulder forming portion 28 of slightly larger diameter and by a conical portion 30. The two fingers are designed to take up a position end to end. Two washers 32, each slidably receiving one finger 26, are held apart by a spring 33. The washers 32 normally bear on opposite walls of the cavity 12, and they can also be engaged by the shoulders 28.

FIG. 1 illustrates the position taken up by the pistons 16 when the brake fluid entering the chambers 18 exerts substantially equal pressure forces. In this position, termed and the balanced position, the fingers 26 meet substantially at the centre of the cavity 12. A device for detecting the positions of the pistons 16 comprises two followers 34 of insulated material, slidably received in the wall of the housing 10 and having rounded ends which bear on the pistons. Outside the housing 10 the followers 34 are interconnected by a resilient strip 36 bearing two electric contact studs 38. An electrical terminal 40 passes through a boss on the underside of a cover 42 of insulating material and makes electrical contact with the centre of the strip 36, pushing the latter so that it bends resiliently. A gasket 44 is inserted between the housing 10 and the cover 42, and two lugs on the cover fit into the housing opening 14 and are traversed by a fixing pin 46 (FIG. 2). The housing also contains a fixing hole 48.

During operation, a warning circuit (not shown) is connected between the terminal 40 and the housing 10, and the chambers 18 are connected to the fluid circuits of a braking system having two independent circuits. If both circuits are operating satisfactorily, application of the brakes moves the pistons 16 into, or confirms them in, the balanced position shown in FIG. 1 and described above. In this position the contact studs 38 are off the housing, and the warning circuit does not give any signal. If one fluid circuit is faulty, the piston 16 receives the normal braking pressure pushes the other piston by way of the fingers 26, until the stop member 24 on this other piston engages the threaded plug 22. This movement of the pistons has two separate effects. Firstly, the spring 33 is compressed between the two washers 32, one of which is pushed by the driving piston whereas the other bears on the wall of the cavity 12. When the brakes have been released, therefore, the spring expands and returns the driving piston into its initial position, whereas the driven piston continues to bear on the threaded plug. Secondly, the follower 34 associated with the driven piston engages the conical portion 30

of its piston and, under the bias of the resilient strip **36,** slides down the slope of the conical portion until the contact stud **38** on the strip **36** engages the housing **10,** so making contact and operating the warning circuit. Contact continues to be made as long as there is a fault in the fluid circuit since, as we have just seen, releasing the brake does not modify the position of the driven piston. Once the faulty fluid circuit has been repaired, however, the two pistons can be restored to their equilibrium position merely by feeding both circuits with braking pressure. The inclined surface of the conical portion **30** forms a cam surface on which the follower **34** ascends, pushing the strip **36** until the contact stud **38** is off the housing **10** again, in which position the warning circuit ceases to operate.

Thus, the resilient system comprising the spring **33** efficiently produces a resisting force which opposes movement of the pistons and prevents the pistons from being shifted due to a pressure difference too slight to denote failure of a fluid circuit. If, however, the pistons have moved, the piston belonging to the faulty circuit remains stationary after the brakes have been released and stays in the position which operates the warning circuit.

FIGS. **3** and **4** illustrate a very similar embodiment, and elements fulfilling the same function are designated by the same reference numerals. In this embodiment, the pistons **16** are mutually parallel and interact by way of a lever **50** pivoted centrally on a pin **52.** A spring **53,** which fulfils the same function as the spring **33** in the first embodiment, has two arms situated on opposite sides of the pin **52,** each of which bears on the housing **10** and can be engaged by the end of the lever **50** under the influence of one piston **16.** The means for making electrical contact are housed in a hollow boss **54** projecting from one side of the housing **10.**

I claim:

1. A fluid pressure unbalance indicator comprising:

a housing;

a pair of pistons in said housing;

a pair of bores formed in said housing, one piston being slidably and sealingly mounted in a respective bore, one end of each piston defining a pressure chamber at one end of each of said bores, the other end of each piston being adjacent to a cavity in said housing intermediate said bores;

means for transmitting the movement of one piston to the other piston, said movement resulting from a difference between the forces applied on said pistons by the fluid pressures in said pressure chambers;

first means located in said cavity, the corresponding end of said first means being engageable by the piston exposed to the higher of the fluid pressure forces generated in said pressure chambers, the opposite end of said first means engaging a fixed portion of said housing, said first means including resilient means generating a restoring force on said last-mentioned piston yieldably urging the latter to its rest position; and

electrical switch means operable in response to the movement of said pistons, said electrical switch means including contact means, second resilient means urging said contact means closed, and plunger means interconnecting said second resilient means and said pistons to permit the second resilient means to close said contact means when the piston exposed to the higher fluid pressure moves away from its rest position;

each of said pistons having a cam surface formed thereon, said plunger means including two plungers, each plunger cooperating with a respective cam surface;

each of said cam surfaces being a conical surface connecting the corresponding piston surface to an axially-extending, smaller diameter extension of said corresponding piston.

2. The indicator of claim **1,** wherein said pistons are coaxial with their extensions facing one another, said first means comprising a pair of washers slidable on said extensions respectively, said resilient means including a spring yieldably urging said washers apart.

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