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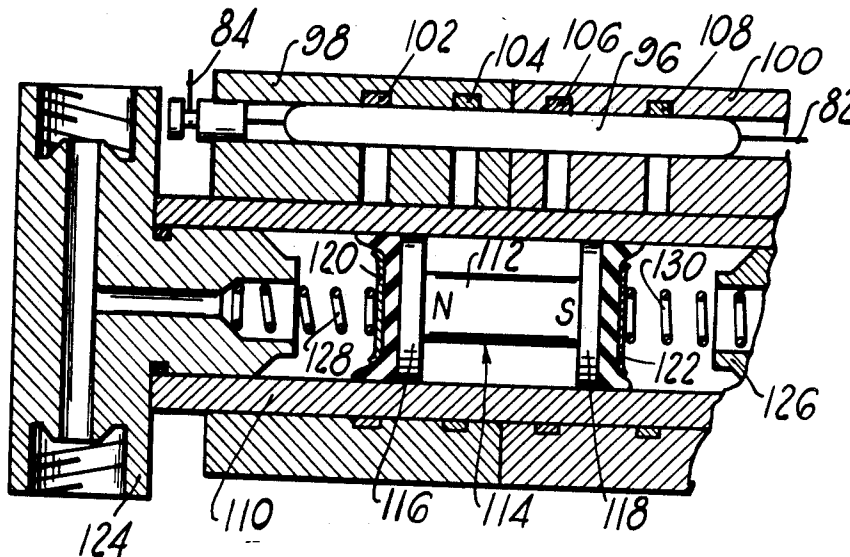
[56] **References Cited**
UNITED STATES PATENTS
 2,791,657 5/1957 Bloxsom et al. 200/81.9(M)
 3,057,977 10/1962 Caswell 200/81.9(M)
 3,199,093 8/1965 Cheney 335/205X
 3,227,837 1/1966 Weinstein..... 200/81.9(M)
 3,325,756 6/1967 Maxwell 335/205
 3,363,073 1/1968 Bouguet 200/81.9(M)

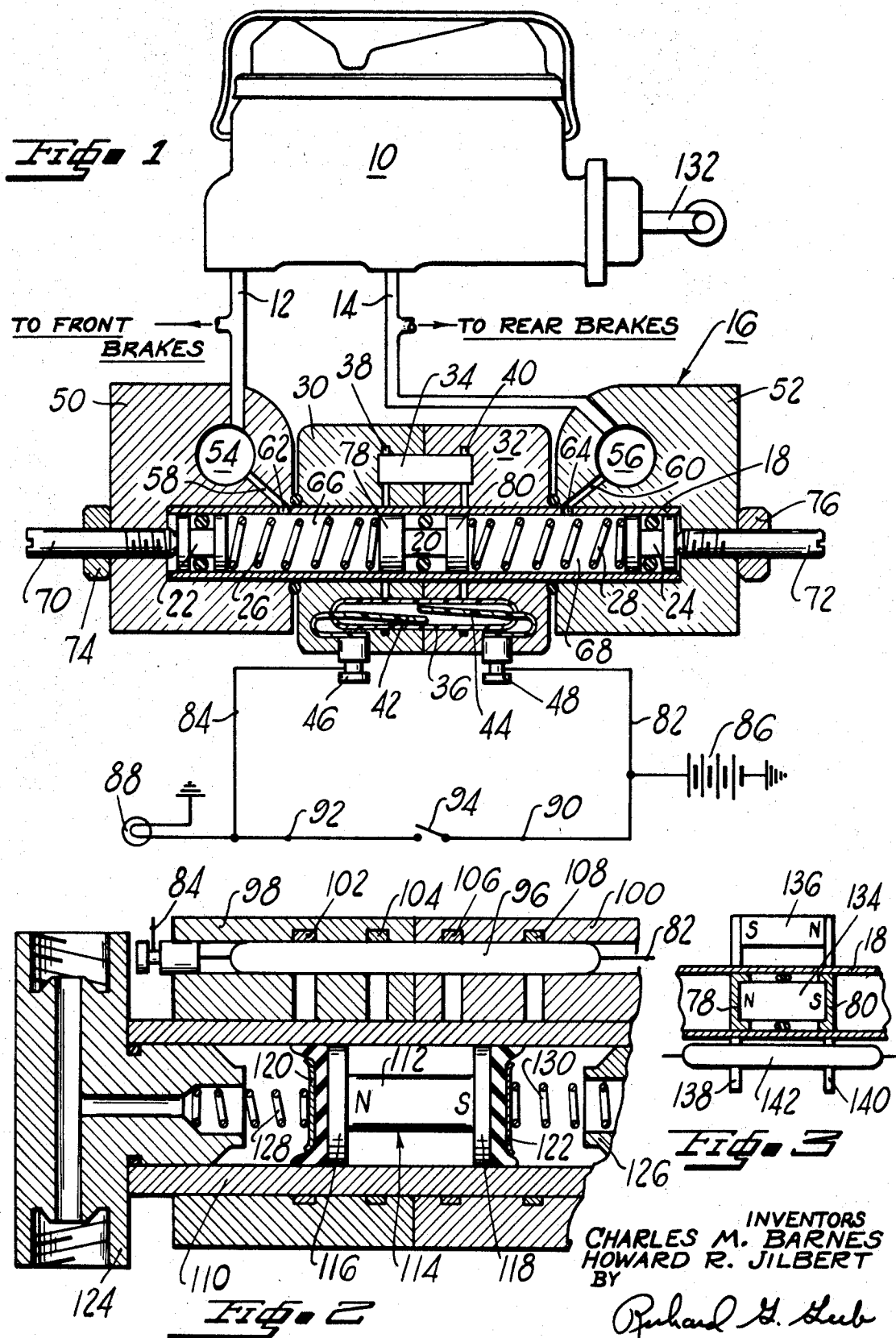
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[54] **DIFFERENTIAL PRESSURE SWITCH WITH
 IMPROVED MAGNETIC PISTON ACTUATOR
 MEANS**
5 Claims, 3 Drawing Figs.

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200/81.9
 [51] Int. Cl. **H01h 35/38**
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61.45M, 67F, 81.9(M), 83.6, 84.3;
335/205

ABSTRACT: A device for use in a hydraulic circuit or between two separate hydraulic circuits which can detect a pressure differential between two portions of the circuit or between the two separate circuits and can actuate a signalling device which will indicate that a pressure differential exists or has existed.





DIFFERENTIAL PRESSURE SWITCH WITH IMPROVED MAGNETIC PISTON ACTUATOR MEANS

SUMMARY

Prior art devices similar to this invention are best illustrated in U.S. Pat. No. 3,342,959 and as has been stated in the summary of the prior art by this patent: "There are many forms of pressure switch designs and operations which have utilized electrical switching which embodies the use of magnetically operated "reed" switches or switch capsules having at least one spring supported contact that can be moved responsive to a magnetic field of appropriate strength." However, and as is the specific case in this prior art U.S. Pat. No. 3,342,959, there is not heretofore ever been observed the utilization of such a "reed" switch for a system where not only must it operate in an off-on manner, but must maintain the energization of an electrical circuitry after it has once been actuated. It is a principle object of this invention to disclose to the prior art a manner of utilization of a reed switch with structure that will not only provide the energization of an electrical circuitry but will maintain the same once the "reed" switch has been closed.

It is a more particular object of this invention to adapt a reed switch and its actuating magnet within the device having a pressure responsive element normally shunting a significant portion of the magnetic flux from the reed switch, which will prevent its contacts from closing, but which upon sensing a predetermined pressure differential will cause the actuation of the reed switch.

A further object is to use a pressure responsive means as a shunting device which after having been moved to permit actuation of the switch does not, upon return, have sufficient shunting of the magnetic flux to reopen the switch.

DRAWING DESCRIPTION

Other objects and advantages of this invention will appear from the following description of the drawings in which:

FIG. 1 is a cross-sectional illustration of a switch in accordance with the principles of this invention schematically connected within a hydraulic braking circuit between the master cylinder and the wheel brake means;

FIG. 2 is a cutaway cross-sectional view of a modification of a switch structure in accordance with the principles of this invention; and

FIG. 3 is a cutaway cross-sectional view of yet another modification.

DETAILED DESCRIPTION

With reference now to FIG. 1 there is shown a master cylinder 10, such as is familiar with the automotive vehicles of today, that is adapted to develop separate pressures for conduits 12 and 14 communicated to discharge ports of the master cylinder 10. A pressure switch 16 is shown interposed in the conduits 12 and 14 between the master cylinder 10 and the front and rear brakes of the vehicle (not shown). While this connection is shown schematically to be a solid line, it should be understood by those skilled in the art that the appropriate conduits, fittings, etc. will be utilized for this purpose. The pressure switch 16 is constructed by utilizing a cylinder or tube 18 within which a floating piston 20 and two adjusting pistons 22 and 24 at each end of the cylinder 18 are located by means of springs 26 and 28, so that the floating piston 20 is centered within the cylinder 18. To the center of the cylinder intermediate housing structures 30 and 32 are abuttingly joined about a magnet 34 and a "reed" switch capsule 36. Flux carriers formed of magnetically conductive materials such as iron 38 and 40 extend around the cylinder 18 and the magnet 34 and the "reed" switch 36. Spring contacts 42 and 44 of "reed" switch 36 are connected to terminals 46 and 48 respectively.

The construction of the switch 16 is then completed by joining the end housings 50 and 52 to the cylinder 18 with O-ring seals interposed between end housings 50 and 52 and the in-

termediate sections 30 and 32. These end housings 50 and 52 have fluid inlet chambers 54 and 56 connected by passages 58 and 60 to radial passages 62 and 64 in the cylinders 18. Thus, the fluid from the conduits 12 and 14 is communicated to the internal bore of the cylinder 18 to chambers 66 and 68 on opposite side of the floating piston 20. End housings 50 and 52 are provided with bolts 70 and 72 having lock nuts 74 and 76 threadably related thereto for adjusting the position of pistons 22 and 24 regulating the force of springs 26 and 28 in the cylinder 18. It should be noted that the pistons 20, 22 and 24 are each provided with O-ring seals in the reduced areas between the lands forming the faces of the respective pistons in order to maintain the integrity of chambers 66 and 68. The springs 26 and 28 are compressed by the adjusting bolts 70 and 72 via pistons 22 and 24 in order to position the floating piston 20 so that its lands 78 and 80 are positioned to immediately underlie the flux carriers 38 and 40 respectively; whereby the floating piston 20 may serve as a shunt for the magnetic flux of magnet 34 and thereby prevent the full effect of the magnetic flux via flux carriers 38 and 40 from normally closing contacts 42 and 44.

It should be noted that structure 30 and 32 are to be constructed from nonmagnetic materials and so also must tube 18.

Appropriate leads 82 and 84 connect the terminals 48 and 46 to an electrical source such as a vehicle battery 86 and an indicator such as a lightbulb 88. Additional electrical leads 90 and 92 are provided between the battery 86 and the bulb 88 with a portion 94 of the vehicle's ignition switch interposed in order to test the lightbulb 88 whenever the vehicle's engine is started. In other words, whenever the ignition switch is turned to the start position, or whenever a start button is operated within the vehicle, the bulb 88 will be illuminated in view of the completion of the electrical circuit from the battery 86 thereto via switch 94.

With regard now to FIG. 2 there is shown a modified form of the invention having a reed switch 96 within intermediate nonmagnetic housing portions 98 and 100 with four flux carriers 102, 104, 106 and 108 about the reed switch 96, and cylinder 110. In this embodiment the reduced portion 112 of piston 114 is constructed from a permanent magnet and the lands 116 and 118 against which face seals 120 and 122 are positioned are made of magnetically conductive material. The cylinder 110 of nonmagnetic material is closed by the end fittings 124 and 126 which also forms the means for compression of springs 128 and 130 centering piston 114 within cylinder 110. These end fittings 124, 126 are mated to cylinder 110 by appropriate means, and intermediate housing portions 98 and 100 are bonded to the cylinder 110 by any suitable resin.

OPERATION

With respect to the operation of FIG. 1, a vehicle operator will depress a brake pedal (not shown) to move the master cylinder push rod 132 inwardly to pressurize separate chambers within the master cylinder 10 and thereby provide separate fluid pressures to conduits 12 and 14. Assuming a normal operation these separate pressures will be respectively communicated to the front brakes and the rear brakes as well as chambers 54 and 56 of the switch 16; and as the pressures will be equal, the piston 20 will not be moved from its position shown in FIG. 1.

However, if there should be a leak in one or the other of the brake systems, the piston 20 will move to the left or to the right, as the case may be to remove the shunting of the magnetic flux from the magnet 34 and permit the magnetic flux to close contacts 42 and 44 of "reed" switch 36 whereby the electrical circuit between the battery 86 and the bulb 88 is closed and the bulb is illuminated.

Upon release of the brakes by the operator, the fluid pressure will be returned to the master cylinder and the springs 26 and 28 will again recentre the floating piston 20 in the bore.

However, as there is still a portion of the magnetic flux from magnet 34 passing via carriers 38 and 40 around the reed switch, it will be sufficient to maintain the closure of the contacts 42 and 44; i.e., shunt 20 is properly proportioned to allow for the decreased reluctance of the magnetic circuit through the closed switch whereby the flux density required to hold the switch closed is not as great as the flux density required to close it in that the airgap at the contacts 42 and 44 has been reduced to zero. It should be appreciated that in order to open the reed switch 36, it must be subjected to a magnetic field of sufficient strength and polarity opposite that utilized to close it. Therefore, the bulb 88 will remain illuminated so long as the brake system for the vehicle which has malfunctioned to cause its illumination has not been repaired and the reed switch 36 reopened by a mechanic.

With respect to the structure of FIG. 2, the magnet 112 is normally positioned via the springs 128 and 130 to have its magnetic conductive lands 116 and 118 intermediate flux carriers 102, 104 and 106, 108. Thus, if the piston 114 is caused to move by a pressure differential between the chambers on its opposite faces, as with regard to piston 20 of FIG. 1, the flux density at the reed switch 96 is increased and is sufficient upon the underlying of the lands 116 and 118 with carriers 102 and 106 or 104 and 108 to activate the switch. In this situation the location of the carriers 102, 104, 106 and 108 is such that in the normal released attitude of piston 114 the magnet 112 will provide a flux density that is reduced by the air gap between the lands 116 and 118 and the flux carriers sufficient to maintain the contacts of the reed switch 96 closed after they have been pulled together by magnetic forces.

It should be appreciated by those skilled in the art that if desired, the shunt of the magnetic flux to vary the flux density through the reed switch may be such as to allow the reed switch contacts 42 and 44, as in the case of either FIGS. 1 or 2 to open by their own spring force.

With respect to FIG. 3 there is shown the use of reverse magnets 134 and 136 in cooperation with flux carriers 138 and 140 and a reed switch 142 in a housing assembly, such as shown in FIG. 1. In the released attitude the reverse polarity for magnets 134 and 136, as respects each other, will not permit the carriers 138 and 140 to transmit sufficient flux density for operation of the switch 142. In the event the piston carrying magnet 134 is moved by a pressure differential thereacross, the carriers 138 and 140 will transmit sufficient flux density for the operation of switch 142.

We claim:

1. In a switch responsive to a pressure differential between first and second hydraulic systems:

a housing defining bore therewithin;

a piston shiftable in said bore defining first and second chambers between opposite ends of the piston and corresponding ends of the bore;

said first and second chambers being in fluid communication with said first and second hydraulic systems respectively;

a magnet mounted in said piston;

magnetically operated switch means mounted in said housing;

said piston carrying said magnet from a first position wherein a substantial portion of the flux lines are bypassed around said switch means when the hydraulic pressures in said first and second chambers are equal, to a second position communicating a substantial proportion of the flux lines of the magnet to the switch means upon shifting of the piston due to a pressure differential between said first and second chambers; and

said switch means having a pair of overlapping, normally spaced contacts presenting an airgap therebetween, the magnetic force required to close said switch being proportional to the airgap, whereby a larger magnetic force is

required to initially close said switch means than that required to maintain said contacts together, thereby permitting return of the piston to the first position after movement of the latter to the second position without opening said contacts.

2. The invention of claim 1; and flux carrying means mounted in said housing for carrying magnetic flux from the magnets to said switch.

3. In a switch responsive to a pressure differential between first and second hydraulic systems:

a housing defining a bore therewithin;

a piston shiftable in said bore, defining first and second chambers between opposite ends of the piston and corresponding ends of the bore;

said first and second chambers being in fluid communication with said first and second hydraulic systems respectively;

a magnet mounted in said housing;

magnetically operated switch means mounted in said housing;

said piston being disposed in a first position between said magnet and said switch means when the hydraulic pressures in said first and second chambers are equal whereby a portion of the flux lines from said magnet are shunted through the piston thereby preventing operation of the switch means;

said magnet operating said switch means as a result of increased flux therethrough upon shifting of the piston from between said magnet and said switch means due to a pressure differential between said first and second chambers; and

said switch means having a pair of overlapping, normally spaced contacts presenting an airgap therebetween, the magnetic force required to close said switch being proportional to the airgap, whereby a larger magnetic force is required to initially close said switch means than that required to maintain said contacts together, thereby permitting return of the piston to the first position after movement of the latter to the second position without opening said contacts.

4. The invention of claim 3; and

flux carrying means mounted in said housing for carrying magnetic flux from the magnets to said switch.

5. In a switch responsive to a pressure differential between first and second hydraulic systems:

a housing;

magnetically operated switch means mounted in said housing;

a magnet mounted in said housing for operating said switch means;

means shiftable in said housing from one position established by equal pressures in said first and second systems to another position established by a pressure differential between said first and second hydraulic systems;

said shiftable means in said one position being adapted to shunt a portion of the flux lines from said magnet around the switch means to prevent actuation of the latter when the shiftable means is in said one position;

said magnet closing said switch means upon shifting of the shiftable means to said another position; and

said switch means having a pair of overlapping, normally spaced contacts presenting an airgap therebetween, the magnetic force required to close said switch means being proportional to the airgap, whereby a larger magnetic force is required to initially close said switch means than that required to maintain said contacts together, to permit return of the shiftable means to said one position after initial movement of the latter to the other position without opening said contacts.