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54 **Apparatus for minimising the amount of fluid leaked from a component in a hydraulic system when the component has failed.**

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Description

This invention relates to an apparatus for minimising the amount of fluid leaked from a component in a hydraulic power system when the component has failed e.g. a hose has burst.

Hand-held hydraulic tools such as roadbreakers and rock drills are supplied with the hydraulic operating fluid by way of hoses which are connected via a power source prime mover such as a diesel or petrol engine to a tank serving as a reservoir for the fluid. Such hoses are subject to severe wear and tear during use and as a result frequently split or crack. Since the hydraulic fluid continuously circulates through these hoses at pressures of at least 140614 Kg/m² (200 psi) even when the tools are not being operated i.e. during standby or rest periods, fluid leaks at high velocity through such fissures in the hose wall. This may lead to a quite substantial loss of the expensive operating fluid and will create an unacceptable hazard to the site operatives and the environment.

In some cases the leakage can be kept to tolerably acceptable levels should an operative notice the leak quickly enough and deactivate the prime mover. However, in most cases, and particularly where the hoses are long, the operative may not notice the leak until significant fluid loss has occurred.

DE—A—2715569 (Volkswagenwerk) discloses a device for switching off a hydraulic system or parts thereof before excessive quantities of hydraulic fluid flow out from the system as a result of some failure.

The device comprises a reservoir for the fluid and a smaller volume chamber contained within the reservoir and connected to the reservoir by a throttle opening. The reservoir and the chamber are each provided with a float for monitoring the level of the fluid. The reservoir float follows rapid changes in the fluid level immediately and the chamber float follows with a delay. The relative movement between the two floats, resulting from a rapid change in the fluid level, is utilised to control a switch to which the floats are connected and which switch deactivates the system power source upon such a rapid change in the fluid level.

The disadvantage of this device is that since actuation of the switch is controlled by fluctuations in the fluid level in the reservoir as well as by fluctuations in the fluid level in the chamber, a significant quantity of fluid will tend to be lost anyway before the system power source is deactivated since the reservoir contains far more fluid than the chamber.

It is therefore an object of this invention to overcome this disadvantage.

According therefore to the present invention we provide apparatus for minimising the amount of fluid leaked from a component in a hydraulic power system when the component has failed, the apparatus comprising a tank for use as a reservoir for the hydraulic fluid, the tank having a first chamber for storing a main volume of the

fluid, a second chamber communicating with the first chamber for storing a reference volume of the fluid, the second chamber having a cross-sectional area which is smaller than that of the first chamber and means for deactivating the system power source when the quantity of fluid in the second chamber has, as a result of its leakage from the system, fallen to or below a preset level, wherein the second chamber is located above the first chamber which is, in use, completely filled with the hydraulic fluid so that in normal operation the fluid level of the tank is within the second chamber and the means for deactivating the system power source is responsive solely to the fluctuation of the level of the fluid in the second chamber.

Since in our apparatus the means for deactivating the system power source responds solely to the fluctuation of the level of the fluid in the second chamber, which contains less fluid than the first chamber, losses of fluid following a component failure in an hydraulic system incorporating our apparatus will tend to be less than that in the prior art device described above.

An embodiment of the invention will now be described with reference to the accompanying drawings in which:—

Figure 1 is a perspective schematic view of the apparatus partially cut away at the front to reveal an internal portion thereof,

Figure 2 is a front view of the apparatus showing the fluid level during normal operation, and

Figure 3 is a view similar to that shown in Figure 2 showing the fluid level after shut-down of the system.

The apparatus comprises a tank 1 providing a reservoir for a hydraulic fluid which is to serve as the working fluid in a conventional hydraulic power system incorporating hoses and other like components and a power source such as a diesel or petrol engine.

The tank 1 comprises a lowermost chamber 2 for storing a main or major volume of the fluid, an upper chamber 3 for storing a reference minor volume of the fluid and an upper chamber 4 communicating with the chamber 3 serving as an expansion chamber. The upper chambers 3 and 4 are housed in an extension 5 to the lowermost chamber 2.

The top wall 6 of the lowermost chamber 2 is provided with an inlet 7 for fluid returning from the system after use while the lower wall 8 of the chamber 2 is provided with an outlet 9 to supply fluid to the system for use.

The upper chamber 3 is formed between the front wall 10 of the tank 1 and an open-ended vertical channel component 11 which is welded to the wall 10. The expansion chamber 4 is formed within the extension 5 by means of a flange 12 extending from the base of the channel component 11 and welded to the adjacent walls 10, 13, 14 and 15 of the tank 1.

The channel component 11 terminates short of the top wall 16 of the extension 5 and a series of drain holes 17 is provided in each of the walls 18,

19 and 20 of the component 11 close to the base thereof. The holes 17 provide access for fluid to enter the expansion chamber 4 from the chamber 3 or leave the expansion chamber 4 to enter the chamber 3. Depending from the top wall 16 of the extension 5 is a conventional oil filter element 21 for an oil filter or breather, the element 21 extending into the chamber 3 formed by the channel component 11. Mounted on the wall 15 of the tank 1 is a conventional fluid level gauge 22 to provide a visual indication of the fluid level in the expansion chamber 4. Located at a position just above the drain holes 17 is a conventional fluid level limit switch 23 (shown in schematic form). This switch 23 is electrically connected by means (not shown) to the power source for example, a petrol or diesel engine, so that when the fluid in the chamber 3 falls to the level of the switch 23, the switch 23 switches off the power source to cause circulation of the fluid within the system to cease.

Referring to Figure 2, during normal operation of the system, the fluid 24 fills the lowermost chamber 2 and forms a column 25 in the chamber 3, above the level of the switch 23. The level 26 of fluid in the chamber 3 remains substantially constant if operation is normal but in any case the fluid column 25 forms a fluid reference volume and because of the relative dimensions of the chambers 2 and 3, fluid level fluctuations in the reference chamber 3 are much greater than those in the lower chamber 2 if the same volume of fluid were entering or leaving only the lower chamber. Hence a small quantity of fluid lost from the main chamber 2 will result in a rapid and considerable change in fluid level in the reference volume.

Referring to Figure 3, if a leakage occurs in the system as a result of a hose split or the like, fluid 24 will leave the tank 1 and the level 26 of fluid in the reference chamber 3 will fall until it reaches the limit switch as shown in Figure 3. At this stage, the switch 23 will cut off the power source to prevent further leakage of fluid from the system. The drain holes 17 are dimensioned so as to prevent replenishing of the reference volume from the expansion chamber 3 by ensuring the flow rate through these holes is much less than the loss rate from the reference volume once a serious leak develops in the system.

By suitable selection of the dimensions of the reference chamber 3, the volume of the fluid leaked from the tank 1 during failure of a component can be limited to an extremely low level.

A manual override should be fitted to the fluid level switch to prevent the power source being cut out while topping up the fluid reservoir after maintenance or repairs.

The apparatus substantially eliminates the problem of fluid expansion through the temperature range associated with outdoor work.

Claims

1. Apparatus for minimising the amount of fluid leaked from a component in a hydraulic power system when the component has failed, the

apparatus comprising a tank (1) for use as a reservoir for the hydraulic fluid, the tank (1) having a first chamber (2) for storing a main volume of the fluid, a second chamber (3) communicating with the first chamber (2) for storing a reference volume of the fluid, the second chamber (3) having a cross-sectional area which is smaller than that of the first chamber (2) and means (23) for deactivating the system power source when the quantity of fluid in the second chamber (3) has, as a result of its leakage from the system, fallen to or below a preset level, characterised in that the second chamber (3) is located above the first chamber (2) which is, in use, completely filled with hydraulic fluid so that in normal operation the fluid level of the tank (1) is within the second chamber (3) and the means (23) for deactivating the system power source is responsive solely to the fluctuation of the level of the fluid in the second chamber (3).

2. Apparatus as claimed in claim 1, characterised in that the means for deactivating the power source comprises a fluid level switch (23) located in the second chamber (3).

3. Apparatus as claimed in claim 1 or claim 2, characterised in that the tank (1) includes an expansion chamber (4) communicating with the second chamber (3) but isolated from the first chamber (2).

4. A hydraulic power system, characterised in that the system includes the apparatus claimed in any of claims 1 to 3.

Patentansprüche

1. Vorrichtung zur Verminderung der Menge der aus einem Bauelement in einer Hydraulikanlage bei Störung austretenden Leckflüssigkeit, bestehend aus einem Tank (1) als Vorratsbehälter für die Hydraulikflüssigkeit, wobei der Tank (1) eine erste Kammer (2) zum Speichern eines Hauptvolumens der Flüssigkeit, eine mit der ersten Kammer (2) in Verbindung stehende zweite Kammer (3) zum Speichern eines Bezugsvolumens der Flüssigkeit, wobei die zweite Kammer (3) einen Querschnitt hat, der kleiner ist als derjenige der ersten Kammer, sowie eine Einrichtung (23) zum Außerbetriebsetzen der Kraftquelle der Anlage aufweist, wenn die Flüssigkeitsmenge in der zweiten Kammer (3) als Folge des Ausleckens aus der Anlage auf oder unter ein vorgegebenes Niveau abgefallen ist, dadurch gekennzeichnet, daß die zweite Kammer (3) oberhalb der ersten Kammer (2) angeordnet ist, die im Betrieb völlig mit Hydraulikflüssigkeit gefüllt ist, so daß bei Normalbetrieb der Flüssigkeitspegel der Tanks (1) innerhalb der zweiten Kammer (3) liegt, und daß die Einrichtung (23) zum Außerbetriebsetzen der Kraftquelle der Anlage allein auf die Schwankungen des Flüssigkeitspegels in der zweiten Kammer (3) anspricht.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Einrichtung zum Außerbetriebsetzen der Kraftquelle ein Flüssigkeitspegelschalter (23) ist, der in der zweiten Kammer (3) angeordnet ist.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Tank (1) eine Ausdehnungskammer (4) enthält, die mit der zweiten Kammer (3) in Verbindung steht, jedoch von der ersten Kammer (2) getrennt ist.

4. Hydraulikanlage, gekennzeichnet durch eine Vorrichtung nach einem der Ansprüche 1 bis 3.

Revendications

1. Appareil pour minimiser la quantité de fluide fuyant d'un organe d'un système à commande hydraulique en cas de défaillance de cet organe, l'appareil comprenant une cuve (1) à utiliser comme réservoir pour le fluide hydraulique, la cuve (1) comprenant une première chambre (2) destinée à emmagasiner un volume principal du fluide, une seconde chambre (3) communiquant avec la première chambre (2) pour emmagasiner un volume de référence du fluide, la seconde chambre (3) ayant une aire en section transversale qui est inférieure à celle de la première chambre (2) et des moyens (23) destinés à mettre hors d'action la source d'énergie du système lorsque la quantité de fluide dans la seconde

chambre (3) est, par suite de sa fuite du système, tombée à, ou au-dessous de, un niveau préétabli, caractérisé en ce que la seconde chambre (3) est placée au-dessus de la première chambre (2) qui, lors de l'utilisation, est complètement remplie de fluide hydraulique afin que, en fonctionnement normal, le niveau du fluide de la cuve (1) soit à l'intérieur de la seconde chambre (3), et les moyens (23), destinés à mettre hors d'action la source d'énergie du système, ne réagissent qu'à la variation du niveau du fluide dans la seconde chambre (3).

2. Appareil selon la revendication 1, caractérisé en ce que les moyens destinés à mettre hors d'action la source d'énergie comprennent un commutateur (23) à niveau de fluide placé dans la seconde chambre (3).

3. Appareil selon la revendication 1 ou la revendication 2, caractérisé en ce que la cuve (1) comprend une chambre (4) d'expansion communiquant avec la seconde chambre (3), mais isolée de la première chambre (2).

4. Système à énergie hydraulique, caractérisé en ce que le système comprend l'appareil selon l'une quelconque des revendications 1 à 3.

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