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K. R. HERMAN

2,283,439

ACCUMULATOR DIAPHRAGM

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FIG. 1

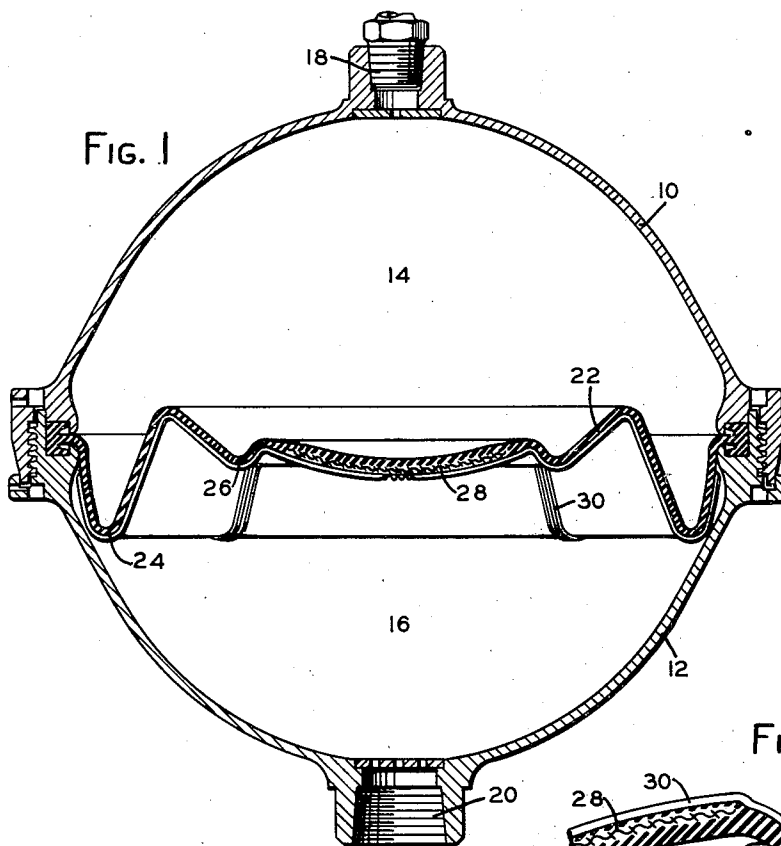


FIG. 2

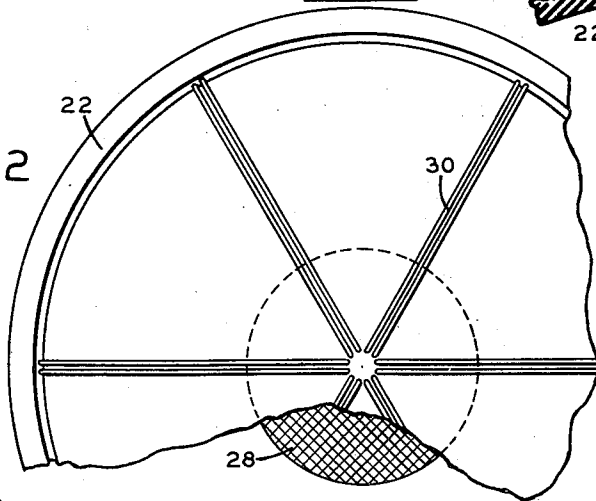


FIG. 3

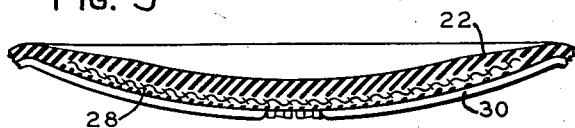
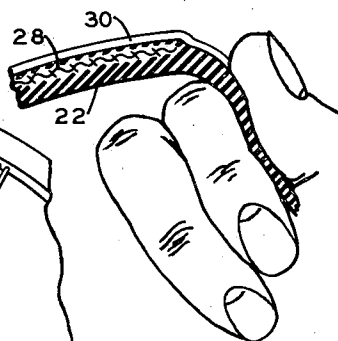


FIG. 4



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ACCUMULATOR DIAPHRAGM

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4 Claims. (Cl. 138—30)

This invention relates to power transmissions, particularly to those of the type comprising two or more fluid pressure energy translating devices, one of which may function as a pump and another as a fluid motor.

The invention is more particularly concerned with a flexible diaphragm used as a separator in an air-loaded accumulator of the spherical type for use in power transmission systems of this character. In the copending application Serial No. 309,735, filed December 18, 1939, there is disclosed an accumulator having a flexible diaphragm formed of oil-proof synthetic rubber and arranged to be clamped between two hemispherical halves of the accumulator proper. The diaphragm there disclosed has been found in practice to operate satisfactorily under normal conditions. Difficulties have, however, been occasionally experienced, and it is an object of the present invention to provide an improved diaphragm eliminating these difficulties. One such difficulty encountered is that occasionally the accumulator will not release its full oil capacity into the working circuit. This has been found to be due to trapping of oil within the folds of the accumulator when the same is nearly empty, and if the center portion of the diaphragm contacts the oil outlet and is forced against the same with sufficient pressure, oil will be trapped within the annular corrugations which are still unflattened against the hemispherical sides of the accumulator.

It is an object of the present invention to provide a diaphragm which will prevent any trapping of oil so that the oil chamber may be completely emptied under both conditions of high or low pressure in the air chamber.

It has also been found difficult to manufacture perfect diaphragms of the previous type and furthermore to detect certain imperfections therein except as is manifested by ultimate failure in operation. This difficulty centers around the necessity for centrally locating a fabric reinforcement within the diaphragm itself which reinforcement is provided for preventing the diaphragm from being forced through the screen over the oil outlet. Accordingly, it is another object of the invention to provide an improved diaphragm wherein the location of the fabric reinforcement may be readily determined in a simple manner and to thus detect imperfect diaphragms before placing them in service.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accom-

panying drawing wherein a preferred form of the present invention is clearly shown.

In the drawing:

Figure 1 is a cross section of an accumulator incorporating a preferred form of the present invention.

Figure 2 is a bottom view of the accumulator diaphragm shown in Figure 1.

Figure 3 is a cross section through the central portion of the diaphragm on a larger scale.

Figure 4 is a view corresponding to Figure 3 showing a method of testing the location of the reinforcement.

The accumulator may be formed as in the aforesaid copending application by two generally hemispherical cups 10 and 12 which are screw threaded together at their open ends to provide an air chamber 14 and an oil chamber 16. The former is provided with a charging connection 18 while the latter has a screened oil connection 20.

A diaphragm 22 is clamped between the two halves and serves to separate the air from the oil regardless of the relative volumes of fluid within the accumulator. For this purpose the diaphragm is provided with annular corrugations 24 and 26 of varying depth. The central portion of the diaphragm is made significantly thicker than the remainder thereof and is provided with a fabric reinforcing disk 23.

The lower face of the diaphragm is provided with a plurality of pairs of radial ribs 30 which are located closely adjacent to one another to provide a U-shaped groove between the ribs. These ribs preferably extend as close as possible to the center of the diaphragm. When the diaphragm is pressed into engagement with the lower half 12, the ribs prevent the flat face of the diaphragm from contacting the walls of the oil chamber over those portions immediately adjacent to the ribs. The groove between the ribs also forms a channel through which oil which might be trapped in the corrugations may be drained through the connection 20.

The reinforcement 23 is positioned beneath the upper surface of the diaphragm but closely adjacent thereto. In the process of manufacturing the diaphragm, a mold cavity conforming to the shape of the finished diaphragm is charged with disks of raw synthetic rubber of smaller diameter than the finished diaphragm but of greater thickness. This has been found necessary in order to cause the raw material to flow radially outward to fill the mold cavity and to push any air within the cavity ahead of it. The reinforcement is laid on top of the main body of raw

material and a thin disk of raw material placed on top of the reinforcement. If the various disks of raw material are not carefully centered in the mold cavity, it is found that, due to the flow of material radially outward, the reinforcement is sometimes carried some distance off from its desired central position.

The positioning of the reinforcement near to but just beneath the upper surface of the diaphragm enables the location of the reinforcement to be checked after the diaphragm has been finished. This may be tested, as illustrated in Figure 4, by bending a portion of the diaphragm adjacent to the edge of the reinforcement in such a way as to place the upper surface in tension. When this occurs, the edge of the reinforcement appears to protrude from the upper surface. In fact, it is possible to see the fabric pattern through the thin film of artificial rubber when it is thus placed in tension. In this way the location of the reinforcement may be readily checked although such reinforcement is not the least bit visible when the diaphragm is unstressed. This latter fact is due to the smooth surface of the upper half of the mold cavity which, regardless of the final position of the reinforcement, always produces a smooth surface on the top face of the diaphragm.

It will thus be seen that the present invention provides an improved diaphragm which will prevent the trapping of oil as the accumulator becomes nearly emptied of oil and also provides a ready means whereby the accuracy of location of the central reinforcing patch may be readily checked.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A flexible diaphragm for separating gas and liquid in a fluid pressure accumulator comprising a sheet of flexible, impervious, rubber-like material annularly corrugated so as to flex, without substantial stretching, into either half of substantially a sphere in which the diaphragm is diametrically positioned, said diaphragm having a plurality of small raised ribs on its liquid contacting surface, said ribs, when the diaphragm is in contact with the walls of the liquid chamber of the accumulator, providing drainage paths

extending to the liquid outlet whereby trapped liquid pockets may be fully drained when emptying the accumulator of liquid.

2. A flexible diaphragm for separating gas and liquid in a fluid pressure accumulator comprising a sheet of flexible, impervious, rubber-like material annularly corrugated so as to flex, without substantial stretching, into either half of substantially a sphere in which the diaphragm is diametrically positioned, said diaphragm having a plurality of small raised ribs on its liquid contacting surface and arranged in parallel sets providing channels therebetween, said ribs, when the diaphragm is in contact with the walls of the liquid chamber of the accumulator, providing drainage paths extending to the liquid outlet whereby trapped liquid pockets may be fully drained when emptying the accumulator of liquid.

3. A flexible diaphragm for separating gas and liquid in a fluid pressure accumulator comprising a sheet of flexible, impervious, rubber-like material annularly corrugated so as to flex, without substantial stretching, into either half of substantially a sphere in which the diaphragm is diametrically positioned, said diaphragm having a plurality of small raised ribs on its liquid contacting surface and arranged radially from the center of the diaphragm, said ribs, when the diaphragm is in contact with the walls of the liquid chamber of the accumulator, providing drainage paths extending to the liquid outlet whereby trapped liquid pockets may be fully drained when emptying the accumulator of liquid.

4. A flexible diaphragm for separating gas and liquid in a fluid pressure accumulator comprising a sheet of flexible, impervious, rubber-like material having a portion overlying the liquid inlet when the accumulator is emptied of liquid, and means for preventing rupture of the diaphragm by gas pressure when overlying said inlet, said means comprising a fabric reinforcement subject to lateral displacement within the diaphragm during the manufacture thereof, said reinforcement being positioned beneath but closely adjacent one surface of the sheet whereby the location of the reinforcement may be visually evidenced by locally flexing the diaphragm adjacent the edge of the reinforcement.

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