March 7, 1944. A. L. PARKER 2,343,320

ACCUMULATOR

Filed March 18, 1940

FIG. 1.

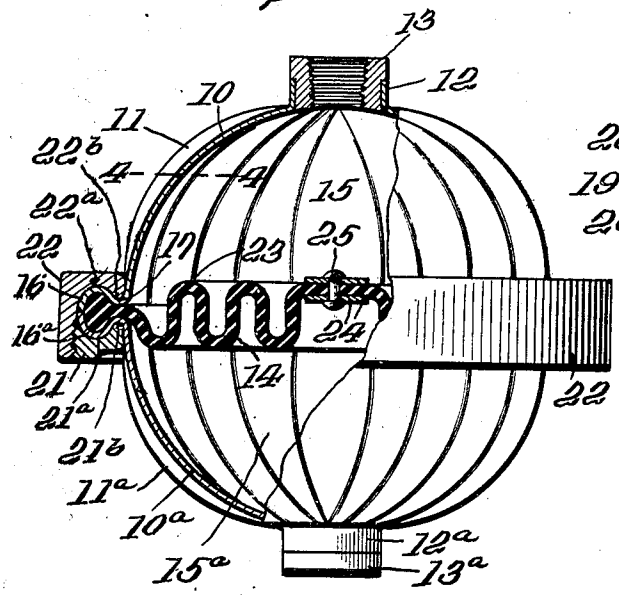


FIG. 3.

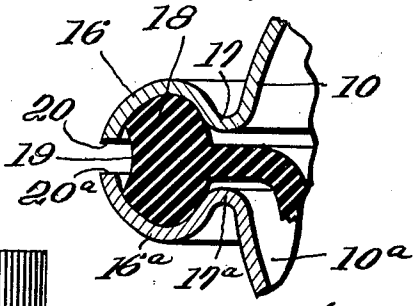


FIG. 4.

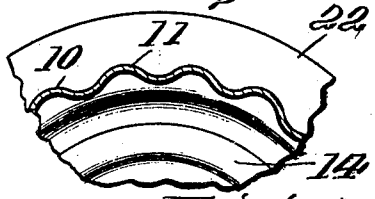


FIG. 5.

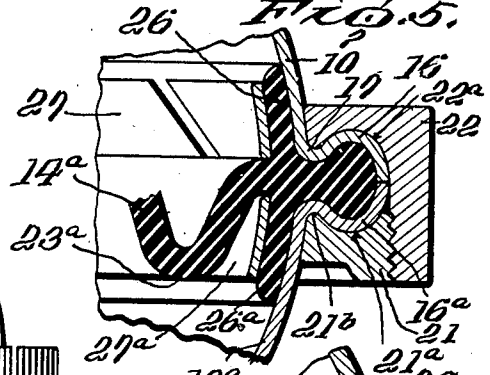


FIG. 2.

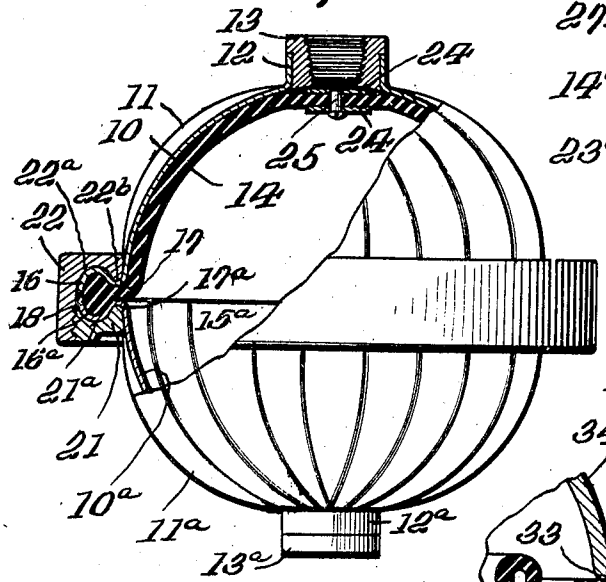


FIG. 6.

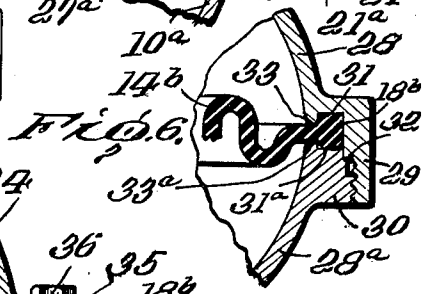
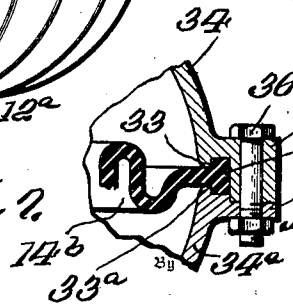


FIG. 7.



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UNITED STATES PATENT OFFICE

2,343,320

ACCUMULATOR

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4 Claims. (Cl. 138—30)

The present invention relates to new and useful improvements in pressure accumulators or condensers, and more particularly to improvements in an accumulator which is adapted to be employed in fluid pressure systems.

In various types of fluid pressure systems, it is desirable to employ an accumulator. In general, such an accumulator consists of a casing within which is secured a flexible diaphragm member. This diaphragm divides the casing into two chambers or compartments, each of which communicates with a separate fluid pressure line. One of the compartments is in communication with the main fluid or hydraulic pressure line, and the other compartment is in communication with another pressure line, preferably a compressed air line. The purpose of the accumulator is to store up a reserve supply of fluid under pressure which is adapted to gain access to the main pressure delivery line when needed.

An accumulator of this type may be employed for augmenting the work of a pump in a fluid pressure system under certain conditions. Thus, where there are two or more hydraulic units to be operated by a single pump, fluid is pumped from a reservoir and delivered to the main delivery line which supplies the fluid to each hydraulic unit. This main delivery line is also connected to one of the compartments of the accumulator, and the other compartment of the accumulator may be connected to a compressed air line. Where several hydraulic units are to be operated at the same time, the pump may not be able to deliver sufficient fluid under pressure to all of the units, and in this case, the accumulator serves to force additional fluid under pressure back into the main delivery line as soon as the pressure in the main line drops a predetermined amount. Similarly, where a fluid pressure system is subjected to pulsating pressure surges, the accumulator serves to check the drop in pressure and to maintain the pressure more constant. Then again, the accumulator may be employed to directly operate a hydraulic unit, in which case the pump may be connected so that it will build up pressure in one compartment of the accumulator to a certain point and then be cut out until the pressure in this compartment of the accumulator has dropped a predetermined amount. There are various types of installations in which accumulators may be employed, but such accumulators are particularly adapted for use with the fluid pressure systems of aircraft or the like.

An object of the present invention is to provide an improved and efficient sealed connection between the casing and the diaphragm which divides the casing into separate compartments or chambers.

A further object of the invention is to provide a connection between the casing and the diaphragm wherein the fluid under pressure within the casing tends to more tightly seal the connection between the diaphragm and the casing so as to prevent leakage.

A further object of the invention is to provide an accumulator of the above type, wherein the diaphragm has an enlarged annular beaded edge which is adapted to be tightly clamped between similarly shaped parts of the casing, and wherein means are provided for limiting the clamping movement between the parts.

A still further object of the invention is to provide an accumulator wherein the casing is formed of separate sections suitably shaped to receive the enlarged or beaded edge of the diaphragm, and wherein means are provided for limiting the clamping movement of the parts of the casing so as to prevent undue compression of the edge of the diaphragm.

A still further object of the invention is to provide a novel form of diaphragm for the accumulator, wherein the diaphragm normally assumes a pleated or corrugated intermediate position so that movement thereof one way or the other under the influence of fluid under pressure will not stretch the diaphragm, nor will it tend to pull the diaphragm from its connection with the casing.

The above and other objects of the invention will in part be obvious and will be hereinafter more fully pointed out.

In the accompanying drawing,

Figure 1 is a side view, partly in section, showing the assembled accumulator with the diaphragm in an intermediate position.

Figure 2 is a similar side view, partly in section, showing the assembled accumulator with the diaphragm extended into contact with one inner face of the casing.

Figure 3 is an enlarged fragmentary side view, in section, showing the formation of the edge of the diaphragm and the cooperating parts of the casing before the parts are clamped tightly together.

Figure 4 is a sectional view, taken along the line 4—4 of Figure 1, showing the ribbed or corrugated construction of the casing.

Figure 5 is a fragmentary side view, in section, showing a modified form of diaphragm with addi-

tional means for maintaining a fluid tight joint.

Figure 6 is a fragmentary side view, in section, showing a modified form of diaphragm employed with a modified construction of casing.

Figure 7 is a fragmentary side view, in section, showing a further modified form of casing.

One form of the invention is shown in Figures 1 through 4 of the accompanying drawing. The accumulator casing is illustrated as being spherical, but it is to be clearly understood that the shape of the casing may be altered, if required. The casing is illustrated as including a pair of semi-spherical members 10, 10a which are substantially identical. These casing members 10, 10a may be formed from stamped sheet metal, and are provided with ribs 11, 11a for strengthening and reinforcing purposes. The casing member 10 is provided with an outwardly extending annular skirt portion 12 which defines an opening therein, and the casing member 10a is provided with a similar skirt portion 12. Adapters 13, 13a are suitably secured to the portions 12, 12a, respectively, as by welding or the like. These adapters are illustrated as being internally threaded for receiving suitable conduits. The accumulator casing is divided by a diaphragm 14 into separate compartments or chambers 15, 15a so that the adapter 13 is in communication with the chamber 15, and the adapter 13a is in communication with the chamber 15a.

The annular edge portions of the casing members 10, 10a are similarly shaped, as particularly shown in Figure 3. The edge portion 16 of the casing member 10 extends outwardly therefrom and is shaped to provide an inner concave surface and an outer convex surface. The edge portion 16 merges into the casing member 10 in such a manner as to provide a depending lip 17. The edge portion 16a of the casing member 10a is similarly and oppositely shaped to provide an inner concave surface and an outer convex surface and an upstanding lip 17a which is opposed to the lip 17 on the casing member 10. The edge portions 16, 16a are also opposed to one another and form therebetween a recess within which the enlarged beaded edge 18 of the diaphragm 14 is disposed. This beaded edge 18 of the diaphragm is provided with a recessed portion 19 at the outer edge thereof between the opposed ends 20, 20a of the edge portions 16, 16a, respectively. The parts are shown separated in Figure 3, that is, before the casing members are clamped together.

In order to clamp the casing members 10, 10a together and to effect a tight seal between the diaphragm and the casing members, male and female clamping members 21, 22, respectively, are employed. These clamping members have threaded engagement with one another. The inner surface 21a of the male clamping member 21 is shaped to provide a concave surface into which the outer convex surface of the edge portion 16a is adapted to fit. The male clamping member is also provided with a shoulder portion 21b which fits snugly within the recess provided by the lip 17a. The inner surface 22a of the female clamping member 22 is also shaped to provide a concave surface into which the outer convex surface of the edge portion 16 is adapted to snugly fit. The female clamping member 22 is also provided with a shoulder portion 22b which snugly fits within the recess provided by the lip 17.

When the clamping members are placed in engagement with the edge portions 16, 16a of the casing members 10, 10a, and threaded into one another, the casing members will be drawn together from the separated position of Figure 3 to the clamped position of Figures 1 and 2. During this clamping movement the bead 18 of the diaphragm 14 is deformed so as to entirely fill the recess provided between the edge portions 16, 16a. The diaphragm is preferably made from some form of material which is deformable but substantially noncompressible so that the recess 19 in the bead is filled by movement of the bead during the clamping action. This recess in the bead serves to prevent the material thereof from being forced outwardly between the edges 20, 20a of the edge portion 16, 16a, respectively. The edges 20, 20a abut against one another when the parts are tightly clamped and thus serve as a limiting means for preventing undue compression of the diaphragm. However, the clamping of the bead 18 on the diaphragm serves to completely seal the joint between the casing members 10, 10a, and the lips 17, 17a also become slightly imbedded in the narrow portion of the diaphragm within the bead 18. The abutting edges 20, 20a also serve to prevent the lips 17, 17a from compressing the diaphragm too tightly. There is thus provided an efficient fluid seal, and any fluid under pressure which tends to leak between the diaphragm and the lips 17 or 17a will simply tend to force the bead 18a outwardly into tighter sealing contact with the edge portions 16, 16a so that the fluid under pressure in the chambers 15 or 15a will serve to more tightly seal the connection between the diaphragm and the casing. The large bead 18 on the diaphragm 14 not only serves as a fluid sealing means, but also as an anchoring means cooperating with the edge portions of the casing members to firmly secure the diaphragm to the casing members.

The diaphragm 14, as indicated above, is preferably formed of a material which is flexible and deformable, but substantially noncompressible. Preferably, the diaphragm is moulded in its original form to normally assume the position shown in Figure 1 wherein there are a plurality of annular pleats or corrugations 23. Thus, when the diaphragm is extended one way or the other within the accumulator casing, the pleats 23 are unfolded to permit the diaphragm to assume the position shown in Figure 2 wherein it is substantially in contact with one of the casing members. The pleated form of the diaphragm permits this movement without any stretching of the diaphragm so that no pulling force will be exerted on the connection between the diaphragm and the casing. The central portion of the diaphragm may be provided with some form of reinforcing means to prevent the diaphragm from being forced through one of the openings in the adapters 13, 13a. As illustrated, washers 24 are secured on opposite sides of the diaphragm by a pin or rivet 25. One of the washers will thus engage the inner edge of one of the adapters to prevent the diaphragm from being blown through the opening. The diaphragm may be originally formed with a single washer moulded within the body thereof in this central region, or the adapters may be formed with a plurality of small openings so that the diaphragm will not be forced therethrough.

In using the accumulator, the chamber 15a may be connected through the adapter 13a to the working fluid line which may be a hydraulic pres-

sure line. The chamber 15 may be connected through the adapter 13 with a compressed air line. When the pressure of the hydraulic or working fluid is built up, the diaphragm 14 will tend to assume the position shown in Figure 2, thus enlarging the chamber 15a and reducing the size of the air chamber 15. Thus, when the pressure of the working fluid drops, the air pressure operating in the chamber 15 will tend to force the diaphragm 14 downwardly so as to force the working fluid in the chamber 15a into the hydraulic pressure line. Thus, the pressure of the fluid in the hydraulic line can be maintained substantially constant for various purposes which have been previously mentioned above.

In Figure 5, there is shown a modified form of diaphragm and sealing means. In this form of the invention, the diaphragm 14a is provided with pleats 23a and with an enlarged bead 18a which is clamped between the edge portions 16, 16a of the casing members 10, 10a, respectively by means of the clamping members 21, 22 in the same manner as pointed out above. The diaphragm 14a is provided with oppositely extending flange portions 26, 26a which contact with the adjacent inner surface of the casing members 10, 10a, respectively. These flange portions 26, 26a serve as an additional sealing means for preventing leakage of the fluid, and split resilient rings 27, 27a are employed for maintaining the flange portions 26, 26a in tight contact with the inner surface of the sealing members. Thus, the fluid under pressure in both compartments of the casing and also the resilient rings serve to maintain the flange portions of the diaphragm in tight sealing contact with the sealing members.

In Figure 6, there is shown a modified form of the accumulator casing. In this form of the invention, the casing members 28, 28a are formed of machined parts and not from stamped sheet metal, as illustrated in connection with Figures 1 through 5. The casing member 28 is shaped to provided a depending internally threaded skirt portion 29 which threadedly engages a male portion 30 on the casing member 28a. Thus, the casing members may be turned relative to one another to effect the clamping of the diaphragm. The casing member 28 is provided with a recessed portion 31, and the casing member 28a is provided with a recessed portion 32, these recessed portions opposing one another and serving to house the enlarged beaded edge 18b on the diaphragm 14b. The portions 29, 30 on the casing members are shaped to provide abutting shoulders 32 which serve to limit movement of the casing members toward one another. The casing members are also provided with opposed annular lips or shoulder portions 33, 33a which serve to clamp the diaphragm. In Figure 7, there is shown a further modification of the form of the invention shown in Figure 6. In this form of the invention, the casing members 34, 34a are provided with outwardly extending shoulder portions 35, 35a abut against one another and serve to to receive locking bolts 36. The shoulder portions 35, 25a abut against one another and serve to limit movement of the casing members toward one another.

From the foregoing description, it will be seen that the present invention provides a highly efficient form of accumulator wherein an enlarged beaded portion on the diaphragm is securely anchored between suitably shaped parts of the casing members. The anchoring bead on the diaphragm also serves as a fluid seal when compressed by movement of the casing members toward one another. This clamping movement of the casing members is limited by shoulder means so that the diaphragm will not be unduly compressed and damaged.

It is to be clearly understood that various changes in details of construction and arrangement of parts may be made without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. An accumulator comprising a pair of members defining a casing and having edge portions shaped to provide opposed recesses, a diaphragm extending across the casing and having around the edge thereof an enlarged annular bead disposed between the edge portions of said members, clamping means for effecting movement of said members toward one another whereby to clamp the said bead, and means providing annular flange portions on the diaphragm and disposed within the casing and abutting against the inner surfaces of the said members whereby to provide an additional fluid seal.

2. An accumulator comprising a pair of members defining a casing and having edge portions shaped to provide opposed recesses, a diaphragm extending across the casing and having around the edge thereof an enlarged annular bead disposed between the edge portions of said member, clamping means for effecting movement of said members toward one another whereby to clamp the said bead, means providing annular flange portions on said diaphragm disposed within the casing and abutting against the inner surfaces of said members whereby to provide an additional fluid seal, and resilient split rings contacting with the inner surfaces of said flange portions and serving to force the said flange portions outwardly into tight contact with the said members.

3. An accumulator comprising a pair of sheet metal semi-spherical casing members having the edge portions thereof turned outwardly and shaped to provide opposed recesses and position the edges so that they are adapted to be placed in abutted relation, said outwardly turned portions where they join the casing members being spaced from each other when said edges are abutted to provide an entrance to the opposed recesses of less width than the maximum distance between said opposed outwardly turned portions, a diaphragm extending across the casing and having around the edge thereof an enlarged annular bead disposed within the opposed recesses in the outwardly turned portions and dimensioned so as to be compressed by said portions when the edges are in abutted contact, and clamping rings recessed to receive said outwardly turned edge portions of the casing and adapted to secure the casing members together with the edges in abutted contact.

4. An accumulator comprising a pair of sheet metal semi-spherical casing members having the edge portions thereof turned outwardly and shaped to provide opposed recesses and position the edges so that they are adapted to be placed in abutted relation, said outwardly turned portions where they join the casing members being spaced from each other when said edges are abutted to provide an entrance to the opposed recesses of less width than the maximum distance between said opposed outwardly turned portions, a diaphragm extending across the cas-

ing and having around the edge thereof an enlarged annular bead disposed within the opposed recesses in the outwardly turned portions and dimensioned so as to be compressed by said portions when the edges are in abutted contact, the portion of the bead adjacent the meeting abutted edges of the casing being cut away so as to avoid projecting said bead between the edges when compressed by the projecting members, and clamping rings recessed to receive said outwardly turned edge portions of the casing and adapted to secure the casing members together with the edges in abutted contact.

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