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[54] **FLOATING FLUID BARRIER**
3 Claims, 3 Drawing Figs.

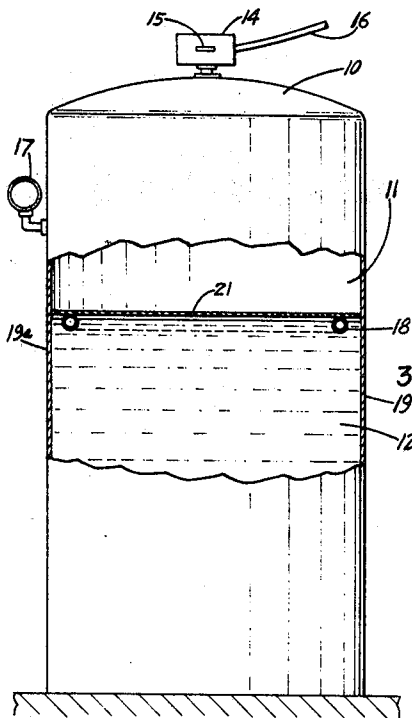
[52] U.S. Cl. **220/26**
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 [50] Field of Search 220/26,
 26S, 26SI, 26D, 93

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ABSTRACT: This invention is a floating fluid barrier with a resilient frame which will float in one of the fluids and sink in the other to support a flexible membrane secured directly to the frame, which is of sufficient stiffness to be self-supporting for a distance of up to one-half inch, the frame must resist being crushed under pressure differentials of whatever nature are employed in the tank with which it is used and desirably, of course, provides a margin of safety above nominal functioning pressure differentials.



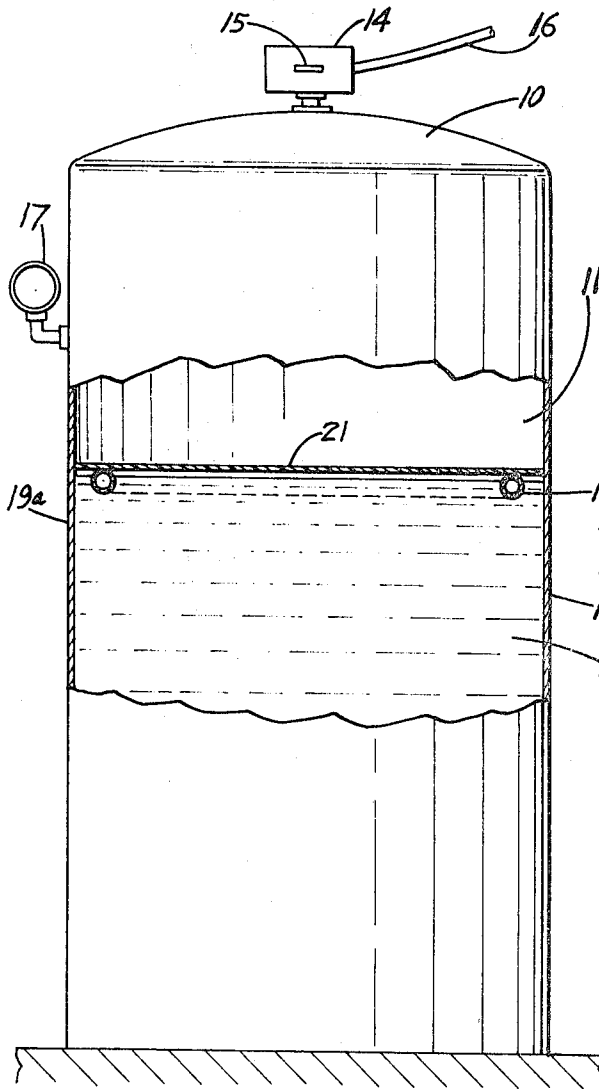


FIG. 1

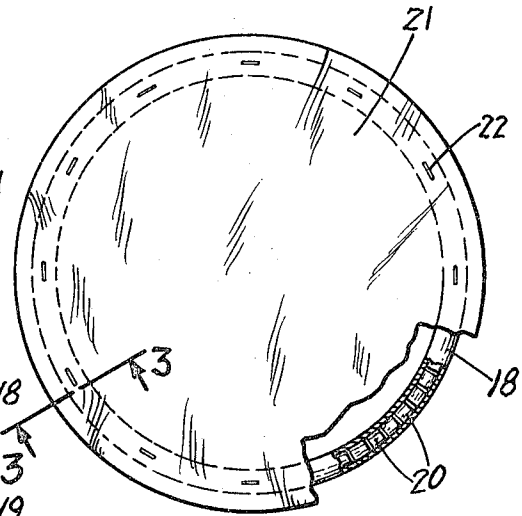


FIG. 2

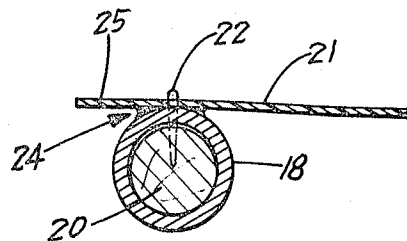


FIG. 3

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FLOATING FLUID BARRIER

BACKGROUND OF THE INVENTION

This invention is a floating barrier between two fluids which is desired to prevent any absorption of the lighter in the heavier exemplary of which is the water system which uses air pressure to provide a relatively steady flow of water such as are commonly used on farms and other locations where city water is not available.

There are two common major techniques for accomplishing this one of which requires periodically adding air above the water which is gradually absorbed into the water or leaks from the tank and is replaced by the air source. This system requires considerable in the way of controls, valves and the like which are subject to failure. The second major technique is to isolate the air from the water originally by means of enclosing the air source in air tight sack and less expensively and more recently by providing a floating diaphragm of some sort which would serve as a separation between the air and the water.

SUMMARY OF THE INVENTION

The present invention is an improvement on a previously known floating diaphragm type separators. While this invention was conceived and reduced to practice as a water diaphragm system, it is obvious that it might be applied to any system where a liquid and a gas or any two fluids having different specific gravities might need to be separated one from the other to prevent absorption of one by the other while retaining them in the same container as the necessary part of the functioning system. The invention will be described and disclosed as used in a water system as being exemplary of this type of a system where two fluids are to be separated one from the other as much as possible while yet retaining them within the same container to permit interaction.

IN THE DRAWINGS

The invention is disclosed in the attached sheet of drawings which are briefly described as follows:

FIG. 1 is a side elevation of a water tank with a portion of the side broken away to show the diaphragm in use;

FIG. 2 is a plan view of the diaphragm with a portion of both the diaphragm membrane and the frame broken away to illustrate internal construction while broken lines illustrate the hidden parts; and

FIG. 3 is an enlarged fragmentary sectional view of the structure shown in FIG. 2 and taken along the line 3-3. A detailed description of the invention follows:

Referring first to FIG. 1, there is shown the representation of an ordinary water tank 10 of the type used on water systems remote from city pressure wherein the upper portion of the tank 11 is filled with air, while the lower portion of the tank 12 receives the water. 14 represents the usual pressure switch with a manual turnoff control 15. When the water pump builds pressure to a predetermined value, the pressure switch automatically interrupts the circuit in the line represented by the fragment 16 and stops the electrically controlled water pump. Air under pressure in tank portion 11 will continue to force water out of tank portion 12 and into the system on demand until the pressure falls below a predetermined value, at which point the pressure switch 14 again activates the pump to reestablish maximum pressure. The number 17 identifies a pressure gauge which indicates whether the system is operating within its normal limits or not. Not shown is a conventional means for separately introducing air into the portion 11 of the tank and an air release valve which permits excess air to escape when too much air has been placed in the tank.

In the usual system of this type the air and the water are exposed to each other in the normal course of events, the pressures within the system ranging from roughly 20 to 40 p.s.i. above atmospheric, although in presently isolated cases which are becoming more common the range is higher even up to from 50 to 70 p.s.i., a certain amount of the air is absorbed by water. In some systems there is incorporated into the pump

which pumps water also an air pump. When the quantity of air in the tank is low as indicated by the rapid turning off and on of the pressure switch when water is drawn, the air pump may be turned on so that the volume of air is reestablished. When this amount becomes excessive, the air relief valve permits the excess to escape. With emersion pumps, however, there is no longer an air pump associated with the water pump. Consequently, the manner of reestablishing air volume in the tank is to add air to portion 11 via the ordinary air valves such as are used in tires or the like. While this system requiring the addition of air is not entirely unsatisfactory, it often does result in getting sufficient air into the system so that a combination of air and water is expelled from the taps that are opened which is rather unpleasant.

A different approach to the solution of maintaining proper air volume in the tank is to introduce an air impervious bag or sack into the top of the tank which was filled with air and separate the air from the water. The structure was reasonably satisfactory as far as operation is concerned, but it had the drawback of being rather expensive. The next step was to make what had become known as floating diaphragms, of which this invention is an advanced form, but the early units were thought to need two diaphragm membranes or sheets extending across the frame for any one of a number of reasons among others, it being thought that the space between the two membranes and the frame needed to be filled with air in order to float the diaphragm structure successively.

After it was established that this was not necessary, the two membrane structures continued to be as a means of assuring the retention of the frame within the membranes. As there is little or no pressure on the membrane itself, however, I finally reasoned that it was not necessary to have two layers of membrane for the diaphragm and in fact, that a single membrane might even be superior. I have discovered that if the frame member itself is of sufficient lightness in overall construction both in the use of materials and in the manner in which the materials are put together so that it will float on the water, a single membrane held in an approximately tank-fitting position be being secured directly to the frame will very suitably separate the air from the water and minimize the absorption of the former by the latter. Systems which used to require the addition of air volume every few months often go for a period exceeding a year without requiring additional air with the use of this diaphragm.

Another requirement of a successful diaphragm that is going to be of widespread use is one which may be inserted through tank drainage or inspection holes or other tank openings provided in existing systems. Consequently, the diaphragm structure must be one that can be somehow reduced to a size that will pass through say a 1 1/4 inch in diameter opening and yet extend itself to substantially fill the cross-sectional area of the tank once inside. Accordingly, the supporting frame must be something that can yield and yet recover its shape once inside the tank. For this purpose I have used a resilient material formed into an endless tube or hollow toroid such as that shown at 18 in FIGS. 1 and 2 which is noticeably smaller than the diameter of the tank as at both of the cut ends in the cross-sectional representation of the diaphragm are seen to stand away from the tank sides 19 and 19a.

Since the frame member 18 is in the form of a hollow tube it displaces substantially more than its own weight in water and therefore floats. By the same token, however, as simply an air cell, it would either have to retain sufficient pressure to resist crushing under normal operating pressure to it requires support to keep this from happening. If the material of the frame to member 18 is not of a lower specific gravity than water, it would not continue to float when crushed. For this reason the inside of the tube is supported to resist compressive forces by elements having a lower specific gravity than water but also having sufficient strength to resist at least normal working pressures of the tank. In fact it is desirable to have them resist pressures substantially in excess of normal working pressures

as a safety factor. some plausible materials for this are cork, wood, or as I prefer, an expanded foam plastic which is very light and yet strong enough to resist pressure differentials in excess of eight atmospheres. While the most common operating pressure for these tank systems does not exceed say 40 p.s.i. at maximum, nevertheless they are sometimes run in a higher bracket, sometimes as high as 50 to 70 p.s.i. and as a safety factor I prefer the 120 p.s.i. maximum resistance. These elements may be seen in the tube at 20 and they are of such construction as to be individually waterproof in the event that the frame member 18 develops a leak. The units are separated from each other as can be observed in FIG. 2, the purpose for which is to allow frame member 18 to be distorted when inserting the entire structure through a small-sized aperture in the tank.

Membrane 21 may be of any suitable material that will be substantially impervious to air so as to separate the air and the water effectively. I have used rubber for this purpose and find it very satisfactory. In addition there are polyvinyl chloride materials which are acceptable as far as health standards go, and which may be even more acceptable in that, carefully made, they do not have an undesirable taste effect on the water. The membrane 21 may be secured to the frame member 18 in one of a number of ways and I have illustrated several here but heat sealing is presently believed to be the most satisfactory. In FIG. 3 which is an enlarged sectional view of a fragment of the frame tube member 18 with one of the compressive strength reinforcing members 20 and the sheet of membrane 21 is seen secured alternatively both by a staple 22 and a suitable adhesive 24. Although not easily illustrated, a heat seal between the membrane member 21 and tube member 18 seems to be the best way of securing the membrane to the frame.

The subject of securing the membrane 21 to tube member 18 points up another desirable function of the compressive resistant structural members 20. It is because of the compression members 20 that the staple 22 has something really secure to engage and anchor in. Furthermore, the water resistant nature of the elements 20 also makes feasible the use of something like staples 22 which if they were stainless steel would not rust and yet their penetration of the frame tube 18 would not result in function destroying leakage since the members 20 are independently water resistant.

The principle reason for the member 18 being formed into a shape that is similar to but smaller than the inside diameter of the tank 10 is because the water tanks while in a generally cylindrical shape and therefore having approximately circular cross section are not so precisely built as to form an exact circle, hence there is some need for adjustment of the diaphragm structure to the inside of the tank. In addition the tanks often are seam riveted and the rivets provide obstructions with respect to which the membrane member must yield in order to move up and down the tank as is necessary for successful operation.

The membrane itself can be quite thin since only that por-

tion designated at 25 extends beyond the frame member 18 and it therefore need only be self-supporting for a distance of say one-half of an inch or the like. The elongated frame member 18 is itself from 1 to 1/2 inch smaller in diameter than the inside of the tank so that the membrane must be supported for a distance ranging from one-eighth inch to one-half inch or more by its own strength beyond the frame. Membrane 21 is also similar in shape to the cross sectional shape of the tank but is substantially the same size as or even slightly larger than the tank in order to force it into contact with the tank walls. The contact between the membrane and tank wall is ideal but is not always achievable if the tank varies substantially from round.

Because the frame is resilient and the sheet 21 is flexible, it is possible to crush the diaphragm after the manner of a crushable hat or the like and thereby insert it through a relatively small opening in an existing tank after which it will expand to a shape that will roughly conform to the tank. While it has been illustrated in FIG. 1 as floating on the water with the frame member 18 underneath the diaphragm, the structure works equally well in a reverse position so that it is not material whether the unit ends up one side or the other on top in the tank.

Although I have disclosed and described my invention in terms of water tanks and used this particular application as exemplary of the broad idea, it is obvious that any two fluids one of which has greater density than the other may be separated in this manner if desirable to prevent one from being absorbed by the other.

I claim:

1. A floating fluid barrier of the type used to separate two fluids of different densities in vertically extending cylindrical tanks that are operated at pressures equaling several atmospheres, said floating barrier comprising:

- a. a flexible and resilient tubular frame having a toroidal shape with its planar dimensions slightly smaller than the horizontal dimensions of the tank in which it is to be used, said frame having a density that enables it to float on the denser of the fluids to be separated by the barrier;
- b. short, distinct substantially cylindrical highly noncompressible elements inside said tubular frame to prevent collapse of the tube when subjected to pressures in excess of several atmospheres and whereby said elements do not interfere with the flexibility of the frame;
- c. a single flexible sheet of material impervious to the fluids to be separated secured directly to the said frame in tangential relation to the cross section of the tube and extending slightly beyond said frame in all directions in the plane of the sheet.

2. The floating fluid barrier of claim 1 in which said elements are expanded or foam plastic that will float in one of the fluids to be separated.

3. The floating fluid barrier of claim 1 in which said sheet is not more than an inch larger in diameter than the frame.