

July 23, 1957

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SEPARATOR FOR LIQUIDS

2,800,232

Filed Dec. 9, 1953

2 Sheets-Sheet 1

Fig. 2

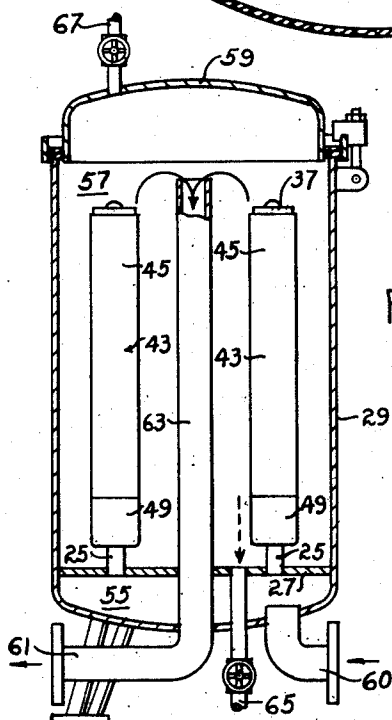
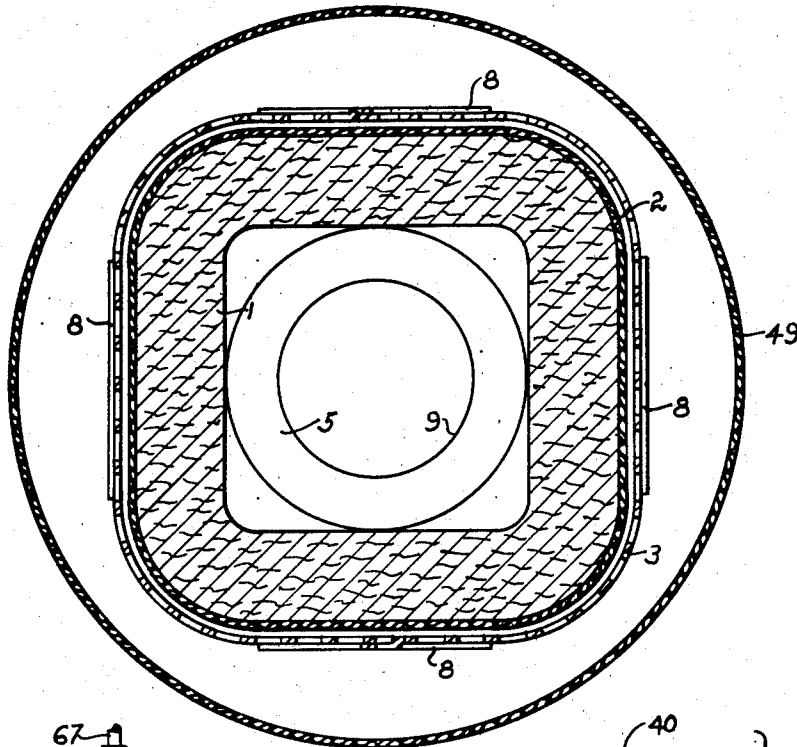
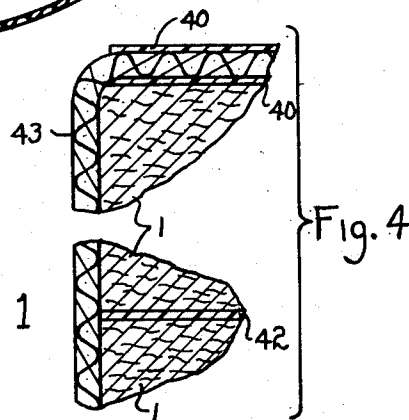


Fig. 1



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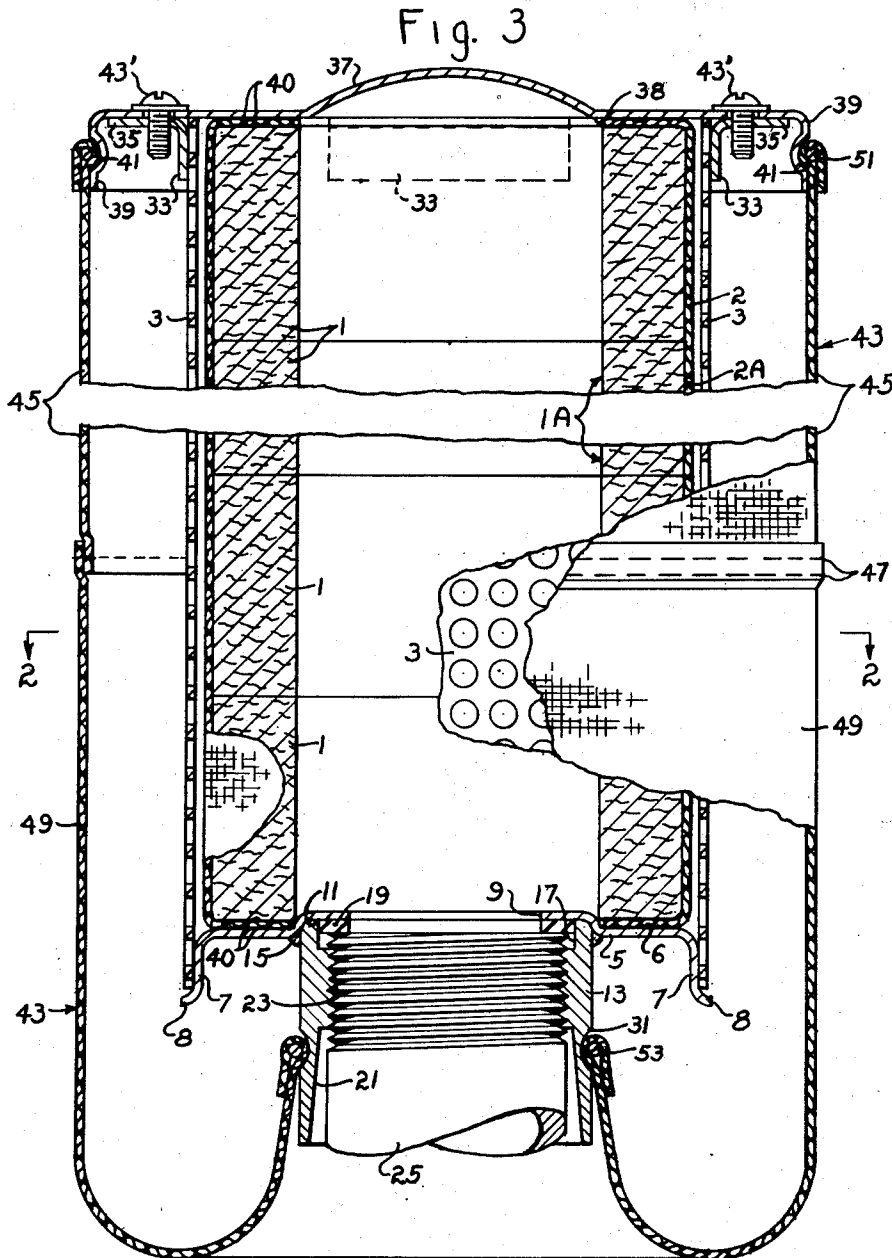
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SEPARATOR FOR LIQUIDS

Harvey E. Marvel, Fort Wayne, Ind., assignor to Bowser, Inc., Fort Wayne, Ind., a corporation of Indiana

Application December 9, 1953, Serial No. 397,195

13 Claims. (Cl. 210—497)

This invention relates to a separator for liquids, especially emulsified liquids, and is particularly adapted for removing water from a water in oil emulsion such as water and gasoline, diesel oil, fuel oil, jet fuel, kerosene and other similar products. The full range of possible applications for this invention has not been explored so that it may be found suitable for separating other mixtures and emulsions and other types of emulsions than those mentioned.

It is an object of the invention to provide a separator which is in cartridge form and which can be readily replaced by a new cartridge when the original cartridge becomes fouled or otherwise rendered inoperative.

Another object of the invention is to provide a cartridge structure which is inexpensive so that it can be discarded when necessary.

A further object of the invention is to provide a structure which can be manufactured without defects which would reduce the effectiveness of separation.

Yet another object of the invention is to provide a structure in which the separating medium is of substantially uniform density throughout.

Another object of the invention is to provide a separating medium which is made of glass fiber layers which are compressed to a predetermined density and bonded together to maintain said density.

It is another object of the invention to produce a cartridge by cementing together a plurality of hollow blocks of predensified fiber glass.

A further object of the invention is to provide a cartridge which has a substantially square cross-section (taken normal to the axis of the cartridge) so that a greater lateral area is available than in the case of a circular cylinder of comparable diameter and so that a practical maximum efficiency in the use of material which is manufactured in square blocks may be attained.

It is yet another object of the invention to provide a cartridge as described above which is encased in a bag or stocking and which is further axially compressed between heads and within a cage.

Still another object of the invention is to provide an additional medium which is attached to the cage so as to surround it on the liquid discharge side in order to prevent the entrainment of one separated liquid in the other.

A further object of the invention is to provide the additional medium with a section which is pervious to only one of the separated liquids and with another section which is pervious to both separated liquids.

Still another object of the invention is to dispose the portion of the additional medium which is pervious to both liquids in a position to which one of said liquids will collect due to the differences in specific gravity of the liquids.

These and other objects will become apparent from

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a study of this specification and the drawings which are attached hereto are made a part thereof and in which:

Figure 1 is a vertical sectional view of a separator tank showing the cartridges mounted therein and the preferred disposition of the fluid connections.

Figure 2 is a horizontal sectional view of the separator cartridge taken substantially on line 2—2 of Figure 3.

Figure 3 is an elevation view with parts in section showing the separator unit.

Figure 4 is an enlarged view of the cartridge with parts in section showing the blocks cemented together and the resilient cement seal.

This invention constitutes an improvement in the cartridge disclosed in my prior application Serial No. 181,391 filed August 25, 1950, now Patent No. 2,725,986, dated December 6, 1945, for Water Fuel Separator in which is disclosed the use of rings of fiber glass which are resin impregnated but which are not precompressed or predensified and consequently must be compressed as they are made into a cartridge and must be mechanically retained in the compressed state.

It is a laborious and expensive procedure to manufacture such a cartridge by compacting successive stacks of fiber glass of a thickness at from 8 to 16 inches to a thickness of one inch and repeating this operation 30 or more times to form a single element. Further, in this process, the rings often become crumpled, bend over, folded and otherwise deformed or torn so that the cartridge may have channels through which the liquid mixture is bypassed. The degree of compression may also vary along the length of the cartridge.

In addition to the cost of the cartridge packed in accordance with the prior disclosure, there was a considerable loss because of defective cartridges.

In order to overcome these defects, I have developed a cartridge which is made up of fiber glass layers, bonded with a resin such as a phenol formaldehyde, thermosetting resin similar to that previously used except that the fiber glass mat is constricted or compressed during curing of the resin so that the fiber glass is held in the compressed or predensified state by the polymerized resin. The word predensified as set forth in this application is defined as a compact state wherein a predetermined quantity of fiber glass per unit of volume has been bonded, compressed and cured to a specified thickness.

While the material can be made in a variety of densities, I prefer to utilize an eight pound density. That is, the weight of material which has been compressed to a cubic foot volume is eight pounds.

This material is prepared in square slabs or blocks which are approximately two inches thick in the predensified but not mechanically restrained condition. From the block is cut a plurality of tubular elements or sections 1 which are preferably square with the internal and external corners rounded.

Bearing in mind that the sections are approximately two inches thick, a sufficient number of them are stacked freely on a mandrel to a length of some 34 or 35 inches to form a single element 1A. The sections may be cemented 42 (Figure 4) together if desired but are preferably free.

A sleeve or stocking 2 of cotton, knit tubing which is of ribbed construction so that it will yield radially, is pulled over the assembled sections and the ends of the sleeve are bent over the end surfaces of the end sections and are cemented thereto with a suitable resilient synthetic rubber cement. The sleeve is pervious to both water and oil.

After the cement has set the completed cartridge 2A is withdrawn from the mandrel and is ready for use.

Since the cartridge is not structurally able to withstand the required differential of pressures usually encountered in the separating process, it is housed in a cage 3 which has a cross-sectional form similar to that of the cartridge and is of perforated metal or similar material. The dimensions of the cartridge and cage are such that the cartridge, including the stocking slide easily into the cage but, of course, the cage and cartridge should fit reasonably close, so that the cartridge will not be excessively strained when differential pressure is applied from an inside out direction.

The cage 3 is provided with a bottom head 5 which is provided with four down-turned ears 7 which are bent outwardly at their free ends 8. The head enters the cage to the point that the ends 8 contact the cage and is fixed thereto as by welding. The head is provided with a central opening 9 and is formed or dished to provide a central recess 11 which serves to center a coupling or conduit 13 which is then brazed to the head at 15.

The coupling is provided with a recess 17 adjacent the end which is fixed to the head and a gasket 19 is deposited therein. The other end of the coupling is provided with a tapered recess 21 which converges inwardly toward a threaded section 23 and serves to guide the coupling into place on a nipple 25 which projects upwardly from the deck plate 27 of the tank 29. The coupling is also externally grooved at 31 for a purpose to be described.

A top ring 35 is provided at its inner side with down-turned ears 33 which are welded or otherwise fixed to the walls of the cage near the upper end thereof so that the surface of the ring is flush with the end of the cage. The ring is entirely outside of the cage so that it does not impede the insertion or withdrawal of a cartridge.

A circular cap 37 is provided with a peripheral, axially downwardly extending rim flange 39 which encompasses the ring 35. The flange is grooved at 41 for a purpose to be described.

The ring is provided with suitable tapped holes and the cap with openings for the reception of screws 43 which hold the cap in place on the ring.

The cap 37 is provided with a flat seat 38 and the head 5 is provided with a flat seat 6, which are disposed in a position to contact the ends of a cartridge which is positioned in the cage.

As stated above the cartridge in the free state, as manufactured, has a length of between 34 and 35 inches whereas the distance between the flat surface 6 on the head and the flat surface 38 on the cap is approximately 31.5 inches when the cap is in place. Thus the cartridge is compressed a substantial amount during the installation of the cap. The end surfaces of the cartridge are therefore in pressure contact with the surfaces 6 and 38 throughout the entire periphery of the cartridge so that the passage of liquid between the cartridge and the head and cap is precluded. This compression also insures that each ring of fiber glass is in sealing relation with the adjacent rings when these rings are not cemented together.

Further, to insure a seal, between the end of the cartridge and the surfaces 6 and 38, resilient synthetic rubber cement 40 may be applied to the stocking, which is folded over the end of the fiber glass element, in sufficient quantity to fill the grooves of the stocking. Thus the cement will be in continuous contact with the surfaces and the cartridge and a seal is insured.

An outer collector sleeve 43 is constructed of a cylindrical tube 45 of "nylon" cloth or paige cloth, made of 25% wool and 75% cotton, at the upper end which is sewn at 47 to a cylindrical tube 49 of linen toweling which extends downwardly. A cord 51 such as a mercerized cotton shoe string is used to tie the upper edge of the collector sleeve in the groove 91.

For certain types of liquid mixtures and emulsions

the use of 90 mesh stainless steel screen has proven satisfactory for the upper section of the collector sleeve.

A similar cord or string 53 is used to hold the lower end of the toweling 49 to the coupling where the groove 31 serves to hold the cord and cloth in place. The toweling cylinder is preferably looped upwardly to the coupling as shown in Figure 3 so that a pocket is formed to receive the heavier of the separated constituents.

The upper section of the collector sleeve extends to within a few inches of the bottom of the cage 3 so that the separated heavier constituent which is restrained by the upper section will be forced to travel downwardly until it reaches the lower section which will permit the heavier constituent to pass through. Thus the undesired or heavier constituent is collected in the pocket of the collector sleeve and flows to the lower part of chamber 57. The other lighter constituent flows through the upper section of the sleeve and collects in the upper part of chamber 57 until the level of the outlet tube 63 has been reached.

Referring to Figure 1, it will be seen that the tank 29 is provided with deckplate 27 extending across its lower end to form an inlet chamber 55 and an effluent chamber 57. The tank has a cover 59 which can be opened to permit access to the compartment 57.

A drain tube 65 is fixed in the deckplate and compartment 55 and an outlet connection 61 comprises a tube 63 which extends through the deckplate and terminates adjacent the upper end of the chamber 57.

A drain tube 65 is fixed in the deckplate and communicates with the lower part of the chamber 57. A vent 67 is provided in the cover.

It will also be seen that the nipples 25 are set in the deck plate and communicate with the inlet chamber 55 at one end and with the separator cartridge at the other.

Thus the liquid mixture or emulsion flows through inlet 60, into chamber 55, through nipples 25 couplings 13, radially outwardly through the cartridge 1, stocking 2 and cage 3 into the space between the cage and the interior of the sleeve 43, which, as is shown in Figure 3, is held spaced from the cage by the cover 37 which projects beyond the cage.

As the liquid emerges from the cartridge it is separated into its constituent liquids. In the case of water and oil emulsions, or other mixtures, the water tends to settle to the bottom and the oil tends to carry the water with it. The function of the sleeve is to prevent the continued entrainment of the water in the oil. The water globules are trapped by collector sleeve cylinder 45 and flows downwardly, there along while the oil passes through it very readily. The water is thus given time to settle toward the bottom of the unit where it collects in the pocket formed in the lower cylinder. The lower portion, being made of linen toweling, does not prevent the passage of the water. The globules merge into a body and the water pours in streams through the toweling and collects adjacent the deck plate in chamber 57. It may be drawn off when required through drain 65.

The other liquid is drawn off from adjacent the top of the chamber 57 in order to minimize the chance of carrying entrained water over into the discharge pipe. The vent is opened when the tank is drained or filled.

It is obvious that various changes may be made in the form, structure and arrangement of parts without departing from the spirit of the invention. Accordingly, applicant does not desire to be limited to the specific embodiment disclosed herein primarily for purposes of illustration; but instead, he desires protection falling fairly within the scope of the appended claims.

What I claim to be new and desire to protect by Letters Patent of the United States is:

1. A water separator cartridge comprising a porous stack of elements, said elements comprising a number of layers of bonded fiber glass material, said layers com-

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pressed to a predetermined thickness whereby a uniform density of substantially eight pounds per cubic foot is provided throughout the length of the cartridge.

2. A water separator cartridge comprising a plurality of superimposed layers of fiber glass material, the fibers in each layer being compressed and bonded to the same uniform porous density of substantially eight pounds per cubic foot, and means for holding the layers assembled.

3. A water separator cartridge comprising a porous mass of fiber glass material, said material being forcibly compressed to a predetermined density, and a binder for said material for maintaining said predetermined density.

4. A water separator cartridge comprising a plurality of superimposed porous elements of fiber glass, the fibers of each element being forcibly compressed to a predetermined density, a binder for maintaining the predetermined density of each element, and means for holding the elements assembled so that the density of the cartridge is uniform through substantially its entire length.

5. A water separator cartridge comprising a number of superimposed porous elements of fiber glass, the fibers of each element being forcibly compressed to a predetermined density, a binder for maintaining the predetermined density of each element so that the density of the cartridge is uniform through substantially its entire length, and liquid pervious means for holding the elements assembled.

6. An expendable water separator cartridge comprising a porous structure of predensified glass fiber elements for water-oil emulsion breaking, a sleeve of liquid pervious material enclosing said elements, said sleeve having ends folded over the ends of said cartridge, and resilient cement disposed adjacent the ends of the sleeve for securing the ends of the sleeve to the ends of the cartridge and forming continuous sealing rings.

7. In combination, a pair of spaced members, a separator cartridge for water-oil emulsion breaking interposed between said members and comprising a porous structure of superimposed predensified glass fiber elements, a sleeve of liquid pervious material enclosing said structure, said sleeve having ends folded over and secured to the ends of said cartridge, and resilient cement interposed between the ends of the sleeve and said members forming continuous sealing rings therebetween.

8. A liquid separating unit comprising a pair of spaced members, one of said members having an opening therein, a perforated cage disposed between said spaced members, a porous cartridge of coalescing material disposed within the cage for water-oil emulsion breaking, a liquid pervious sleeve enclosing said cartridge, said sleeve having ends folded over the ends of said cartridge, resilient cement interposed between the folded ends of the sleeve and said members forming continuous sealing rings therebetween, an outer sleeve secured in sealing relation about the cage, said outer sleeve comprising an upper part of water droplet repellent material and a lower part of water penetrable material.

9. A liquid separating unit comprising, in combination, a pair of spaced members, one of said members having an opening therein, a perforated cage disposed between said spaced members, a porous cartridge of predensified coalescing material disposed within the cage for water-oil emulsion breaking, and an outer sleeve including an upper part of water droplet repellent material secured about the cage.

10. A water and fuel separating unit comprising, in

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combination, a pair of spaced members, one of said members having an opening therein, a perforated cage disposed between said spaced members, a porous cartridge of predensified fiber glass material disposed within the cage for water-oil emulsion breaking, and an outer sleeve including an upper part of water nonpervious material and a lower part of water pervious material surrounding the cage in a sealing relationship.

11. A water and fuel separating unit comprising, in combination, an inlet conduit, a head member having a central opening communicating with the inlet conduit, said head member provided with an offset seat, a cage member disposed on said seat, closure means mounted on the other end of the cage and exteriorly thereof, a porous cartridge of predensified bonded glass fiber material compressed between said head member and said closure means, an outer collector sleeve means including an upper section of water nonpervious material and a lower section of water pervious material, said lower section adapted to collect and pass the water, and means for securing said outer sleeve about the cage.

12. A water and fuel separating unit comprising inlet means, a base member having an offset seat mounted on said inlet means, a cage disposed on said seat, closure means mounted on the other end of said cage, a porous cartridge of precompressed fiber glass material disposed between the base member and closure means for water-oil emulsion breaking, sleeve means including an upper part of water nonpervious material and a lower part of water pervious material, said upper part being pervious to oil and means for securing said sleeve in sealing relationship about the cage.

13. A water and fuel separating unit comprising, in combination, a pair of spaced members, one of said members provided with inlet means, a cage disposed between said members, a cartridge of precompressed fiber glass disposed within the cage for water-oil emulsion breaking, an outer sleeve means including an upper section of water nonpervious material and a lower section of water pervious material, said upper section being substantially 75 percent cotton and 25 percent wool, and means for securing said sleeve in a sealing relationship about the cage.

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