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ASSEMBLY FOR SEPARATING IMMISCIBLE FLUIDS

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2 Sheets-Sheet 1

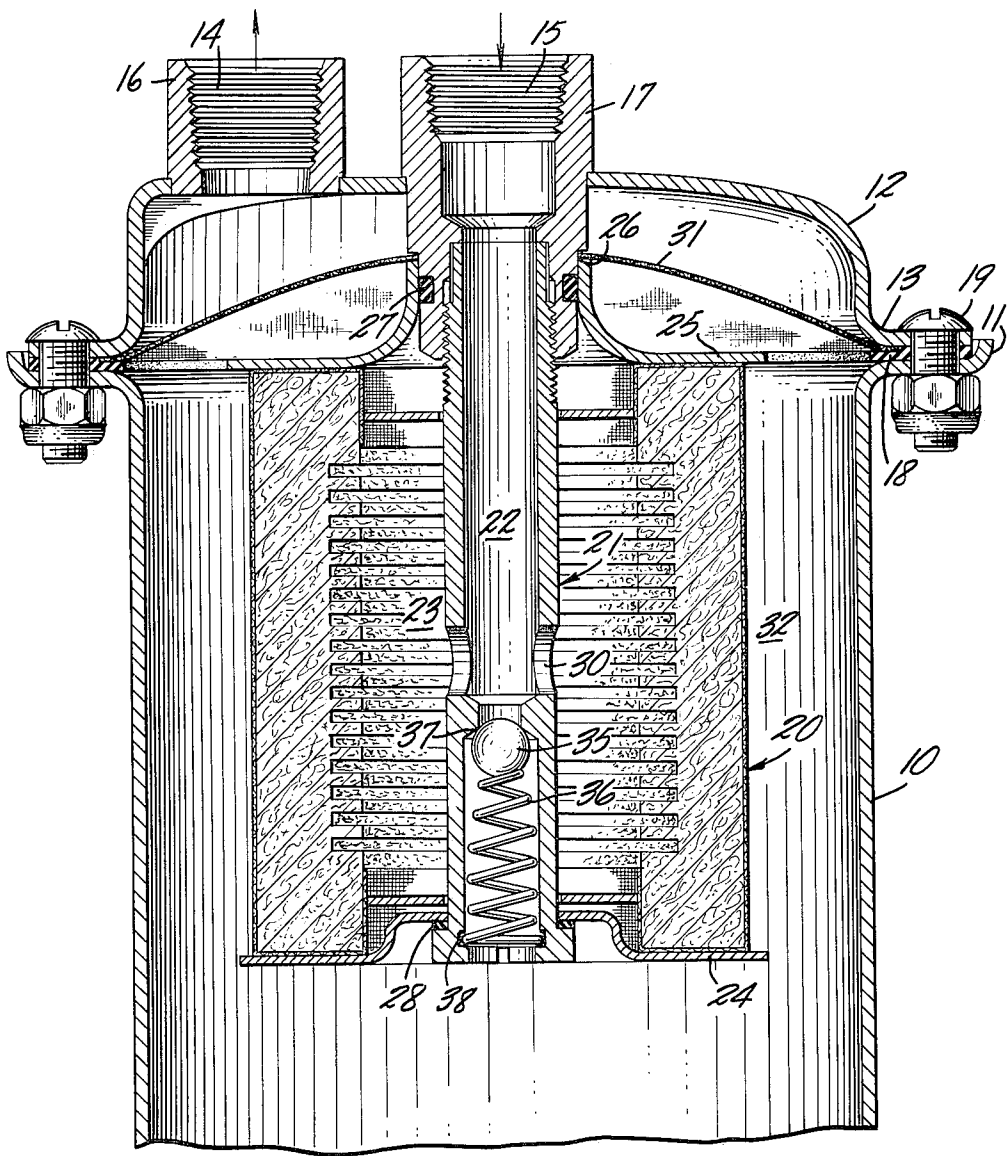


FIG. 1.

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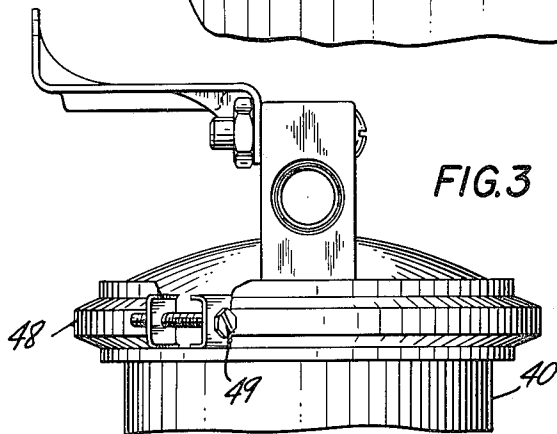
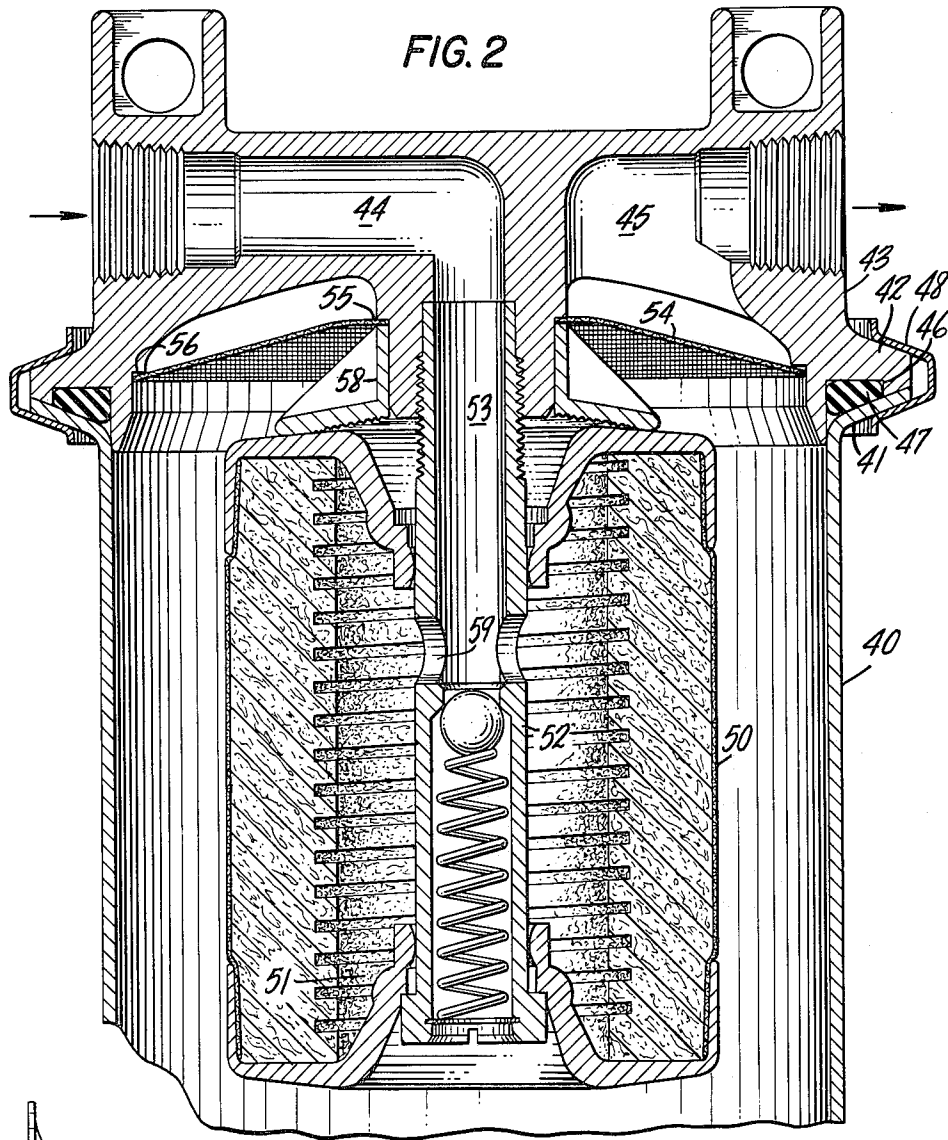
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2 Sheets-Sheet 2



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ASSEMBLY FOR SEPARATING IMMISCIBLE
FLUIDS

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This application is a continuation-in-part of applications Serial Number 111,850 filed May 22, 1961 and Serial Number 82,442 filed on January 13, 1961, both now abandoned.

The present invention relates to an improvement in an assembly for separating immiscible fluids, and more particularly to an assembly wherein the coalescer element and separator element are so fitted in the housing as to be readily and easily removed and reassembled in servicing.

Coalescer and separator elements and the enclosures in which they are placed require periodic cleaning or replacement, and it is important that access to these be relatively simple. In most assemblies, the mode of attachment of the coalescer element and separator element in the enclosure makes their removal an awkward task. Such assemblies comprise a head and a bowl attached thereto in which these elements are disposed. The coalescer and separator elements normally are placed loosely in or attached to the bowl in a manner such that when the bowl is removed from the head the coalescer and separator elements remain within the bowl. Consequently, repair, replacement or cleaning of the coalescer and separator elements and the bowl entails an additional operation, and practically requires servicing both, when servicing only one would suffice. This type of construction also means that the coalescer and separator elements must be carefully placed in or attached to the bowl so as to ensure alignment with the inlet and outlet connections of the head, and careful reassembly of the bowl to the head is required. The disassembly operation may also involve the disconnecting of the unit from the inlet and outlet connections which will be accompanied by draining or spilling resulting in loss of fluid over the surrounding area.

Moreover, in fuel water separators, an automatic drain valve may also be fitted within the bowl. Consequently, attachment of the coalescer and separator to the bowl as well, means that both must be removed to gain access to the drain valve. This additional operation unnecessarily complicates assembly and disassembly and is, of course, undesirable.

The complexity of the construction greatly increases when, as is frequently the case, a series of two or more coalescer and separator element stages as well as drain valves and the like are to be included in the same housing. These should be accessible individually, if the structure is not to be completely disassembled each time one part requires attention. If one operation makes each part individually accessible without disturbing the other parts, servicing is greatly facilitated.

It is easy in these structures to achieve a design that requires a three-handed operator to cope with assembly and disassembly. Since, in view of the confined space available for such assemblies, usually only one operator can work on the assembly at a time, it is desirable that two hands be sufficient for each operation that must be performed during servicing.

The assembly of the invention comprises a head provided with passages for inlet and outlet of fluid, a coalescer element and a separator element removably secured to the head by means of a centrally disposed core or pin,

and a bowl removably attached to the head. In this way, the bowl can be removed without disturbing the coalescer and separator elements and connections thereto, and access to other parts attached to the bowl, such as a drain valve, is facilitated. The coalescer element is preferably of the generally cylindrical central passage type, and may be held upon a core between two plates or washers generally disc-like in configuration. The head washer, in addition to acting as a brace for the head end of the coalescer element, also acts as a supporting clamp for the separator element. The separator element, also generally disc-like in shape, requires no support at its outer periphery, but may rest against the head, being held in place by a snap or press fit in an indentation or niche therein. Support may, however, be provided for the separator by lengthening it to extend into the joint between the head and the bowl. In this embodiment, preferably the periphery of the separator element is held within the joint, so as to secure it in position. The inner end of the separator element is apertured so as to accommodate the portion of the head which connects to the core, and preferably is secured at its inner periphery at the junction between the head and the head washer in a niche, depression or indentation in the head. The separator element and head washer can be suitably curved to facilitate this. Thus, the separator element is held securely at least at the inner periphery, and optionally at both peripheries. Where an open-ended coalescer element is employed, the head washer is arranged in a manner to prevent bypass of fluid past the coalescer element. Suitably, the head and bowl may be flanged at their point of joining to facilitate accommodation of the separator element and a gasket within the joint over a sufficient length to hold them securely and prevent leakage.

The shank of the core is hollow, and connects, at the head end, with one of the passages in the head. The core for attaching the coalescer and separator preferably comprises a single bolt having a hollow shank. Openings in the shank communicate with the central passage of the coalescer element. The other passage in the head communicates through the separator element with the space between the coalescer element and the bowl.

Provision is made in the attachment of the coalescer and separator elements to the head and in the construction of the elements to ensure that all or part of the fluid entering the assembly through the inlet head passage must pass through the coalescer and separator elements before emerging from the assembly. This can be done in several ways. Each end of the central passage of the coalescer element can be closed off, and the core passed therethrough in a manner to prevent leakage. A coalescer element having a passage open at one or both ends can be used, the open ends of the passage being closed off by plates or washers of suitable configuration, held in place by the core against the coalescer element and against the head in a manner to prevent leakage.

The assembly suitably may be adapted to provide a pressure relief mechanism by including within the core a relief valve, such as a spring-loaded ball valve, which will open on the build-up of excessive pressures, thereby discharging the fluid into the bowl bypassing the coalescer element. In this manner, continued flow of fluid through the system, blocked, for example, by a clogging of the coalescer element, may be provided.

The assembly of the invention is useful for any type of fluid separation, such as filtration of solid particles suspended in fluid, and removal of droplets of one or more suspended immiscible fluids from a suspending fluid, upon selection of the appropriate type of coalescer and separator elements. To separate solid suspended matter, a filter-type coalescer element is employed.

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The assembly is particularly adapted to receive as the coalescer element one or a plurality of depth-type coalescer elements in the central position supported by the core, and for combination therewith as the separator element, a surface-type filter element mounted in the position supported by the head washer. A combination of depth- and surface-type elements also can be used as the coalescer element.

Depth-type elements, as is well known, are usually composed of one or more layers of nonwoven bats of fibrous material such as glass fibers, ceramic fibers, asbestos fibers, polyethylene fibers, polypropylene fibers, polyvinyl chloride fibers, nylon fibers, polyacrylonitrile fibers, and cellulose acetate fibers, such as are described in applications Serial Nos. 29,745, filed May 17, 1960, and 74,130, filed December 6, 1960. Molded or bonded fibrous layers, prepared by bonding together layers of fibers in any configuration by a synthetic resin or cellulose derivative present as a bonding agent or in shredded or fibrous form, also can be employed as coalescers.

Surface-type filter elements used as the separator element are also well known, and can be made of metals and alloys, such as stainless steel, Monel, Nichrome, copper, brass, and iron, including magnetic alloys, synthetic plastic, such as polystyrene, polytetrafluoroethylene, polyethylene, and polypropylene, cellulose, or cellulose derivatives, such as ethyl cellulose and cellulose acetate, in the form of, for example, paper, microporous synthetic resin or cellulose derivative membranes, wire mesh, sintered metal or synthetic resin particle layers such as those described in United States Patent No. 2,554,343, textile fabrics, sintered wire mesh, and perforated plates. The sintered meshes described in United States Patent No. 2,925,650 can also be used as the separator element.

The depth- and surface-type elements can have any desired configuration. Pleated, folded, grooved, and convoluted elements present a larger surface area, and are preferred for use as the coalescer element.

Flow of fluid through the assembly under normal conditions preferably is as follows. Fluid enters through the central passage of the head opening into the core, passes through the core, out the openings therein, and thence through the coalescer element, into the bowl, and through the separator element, to the peripheral passage of the head, whence it leaves the assembly.

FIG. 1 is a side elevational view, with parts broken away and in section, of an assembly embodying the invention, wherein the separator element is secured at both inner and outer peripheries.

FIG. 2 is a side elevational view, with parts broken away and in section, of another assembly embodying the invention, in which the separator element is secured at the inner periphery, and supported at the outer periphery by a press fit in a niche in the head.

FIG. 3 is a side elevational view of the assembly illustrated in FIG. 2, showing the clamping means.

The assembly illustrated in FIG. 1 comprises a cup-shaped filter bowl 10 having a lateral annular flange 11, removably attached to a head 12 provided with a co-operating annular flange 13, and outer and inner passages 14 and 15 in fittings 16 and 17, respectively, attached to the head, for example, by welding. Both fittings 16 and 17 in the head are designed for connection to the fluid system. The annular flanges 11 and 13 are abutted with an annular gasket ring 18 interposed, and suitable means, such as a plurality of bolts 19, clamp these elements together in a fluid-tight manner to provide a casing for the unit. The cylindrical coalescer element 20 is of the depth-type, made of fibrous glass having interior grooves to increase surface area and therefore extend its life, bonded together by synthetic resin and enclosed by a facing of textile fabric. The element is attached to the head upon the core 21, which is in the form of a bolt threaded into the fitting 17. The bolt shank has a passage 22 connected to the inner passage 15 of the head 12, in this case in a

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fitting 17. The open ends of the central passage 23 of the coalescer element 20 are closed off by the bottom plate or washer 24 and top plate 25, serving as the head washer and fitting into an indentation 26 in the side of the fitting 17 in the head. Both plates or washers are held in place by the core 21 with the O-ring 27 and gasket 28 therebetween preventing leakage from the passage, past the coalescer element 20.

Flow communication between the passage 23 of the coalescer element 20 and the passage 22 of the core 21 is provided by a plurality of drain holes 30, formed through the side wall of the core.

The separator element 31 is provided in the form of an apertured disc, the inner periphery of which is fitted in the indentation 26 and held in place therein by the washer 25, and the outer periphery of which is supported between the gasket 18 and the flange 13. The separator element 31 is of the surface-type, and in this case is a disc of Monel wire mesh. The separator element 31 as shown is in the form of a dished washer, which can be fabricated in a simple stroke of a punch press.

It should be noted that this assembly may also be used to advantage even when a coalescer element is not necessary. Under this condition, separator element 31 serves as the sole means for separating the immiscible fluids. Separator element 31 may be retained in position at its outer periphery between the flanges 11 and 13 of the bowl and head and supported at its inner periphery by being snapped in place in indentation 26. If desired, any suitable clamping means may be employed to support the inner periphery of separator element 31 in indentation 26 against the head. In its retained position, it is seen that the separator element intercepts fluid flow between the inner fluid passage 15 and the outer fluid passage 14. Accordingly, all flow from chamber 32 must pass through the separator element 31 to the outer fluid passage 14.

Coalescer element 20 inherently acts as a particle filter in addition to acting as a coalescer for separating immiscible fluids. Depending upon the quantity and size of particular matter in the fluid and the surface area and nature of the coalescer element employed, in time the coalescer will begin to clog under normal operating conditions. If the unit is not serviced regularly, the pressure drop across the coalescer may increase to undesirable levels. Thus, where it is necessary or desirable to maintain constant flow, a relief valve may be easily incorporated into the assembly without limiting the accessibility of the individual components or complicating the assembly.

Passage 22 extends through the entire length of the core 21, thereby permitting communication between the inlet passage 15 and the chamber 32 of the bowl 10. A relief valve in the form of a ball or poppet valve 35 is spring-loaded to a closed position by spring 36 against a valve seat 37 provided within the passage 22, closing off its lower end, so that under normal conditions, fluid entering passage 22 discharges through openings 30 into the central passage 23 of the coalescer element 20. Spring 36 is seated in a retaining niche or indentation 38 in core 21, and is sufficiently compressed to exert a force on poppet 35 capable of retaining it in its seated or closed position against the valve seat 37. When the pressure drop across the coalescer element 20 exceeds a predetermined minimum, because of clogging of the element or any other cause, the downward pressure on poppet 35 exceeds the spring compression force and poppet 35 unseats. Fluid is then discharged through the lower portion of passage 22 into the inner chamber of the bowl thus bypassing the coalescer element. Consequently, the desired flow conditions may be maintained at all times.

It will be seen that the bowl 10 can be removed without disturbing the coalescer and separator elements 20 and 31, which remain attached to the head, and that the

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coalescer and separator elements can be removed for servicing separately, without disturbing the inlet and outlet connections. At the time the coalescer element 20 is removed, the separator 31 also is removed.

In operation of the assembly as a fuel-water separator, 5 water-containing fuel is supplied through the passage 15 of fitting 17, and thence flows via passage 22 of the core 21 and openings 30 to the passage 23. The fuel then passes through the coalescer to the chamber 32 of the bowl 10, through the separator element 31 and thence 10 emerges from the assembly via passage 14 of fitting 16. Any dirt particles in the fuel will be deposited on the inner surface of the coalescer 20, and entrained droplets of water contaminating the fuel will be coalesced therein to form larger drops, emerging on the other or outer 15 side of the coalescer. The heavier water drops will then fall down into the bottom of chamber 32 of the bowl 10, where the water collects and may be removed, if desired, by valve means. Any drops entrained in the fuel flow which are too large to pass through the separator 31 are filtered out here, and eventually fall down, in turn, to the bottom of the bowl 10.

Whenever the pressure drop across the coalescer element exceeds a predetermined minimum value, poppet 35 opens and allows the fluid, or part of it, to bypass the coalescer element into chamber 32. The fluid flows through the separator element 31 and thence emerges from the assembly via passage 14 of fitting 16. Upon 20 correction of the excessive pressure condition, the valve closes, restoring normal flow.

Another embodiment of the invention is illustrated in FIGURES 2 and 3. There, the filter bowl 40 is provided with a lateral annular flange 41 adapted to match the cooperating annular flange 42 in the head 43. As in the structure previously described, the head 43 is provided with inlet passage 44 and outlet passage 45. Co- 25 operating flange 42 contains an annular groove 46 in its matching surface, in which there is disposed an O-ring gasket 47 to ensure a fluid tight seal between the head 43 and the bowl 40. Clamp 48 may be employed to lock the head 43 to the bowl 40 by suitable tightening means, such as a threaded screw 49. Thus, the head and bowl in clamped position form an enclosure for the filter elements.

The cylindrical coalescer element 50, shown in FIG. 2, has a central passage 51 and is of the type having both ends closed. The core 52 is a bolt having a hollow shank containing a passage 53. The shank end of the core 52 is threaded, thereby permitting it to engage the head 43 in a manner such that passage 44 in the head 43 com- 30 municates with passage 53 in the shank of bolt 52.

The separator element 54 is in the form of a centrally apertured disc, the inner periphery of which fits into the indentation or annular niche 55 in the head, and the outer periphery of which snaps against the annular niche 56 in the head. A washer or collar 58, of metallic or molded plastic material or the like, secures the separator element 54 in place by clamping the inner periphery of the separator element against the niche 55 of the head 43. When the bolt 52 is threaded into the head 43, it re- 35 tains in place the coalescer element 50, the collar 58 and the separator element 54.

Flow communication between the passage 53 of the core 52 and the coalescer element 50 is provided by a plurality of drain holes 59, formed through the side wall of the core.

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The assembly is of simple construction, and provides ready accessibility to all parts of the structure without enlargement or reconstruction of the main assembly structure. Servicing of the assembly is quite simple. Removal of the bolts 19 or clamp 48 enables the operator to re- 40 move the bowl 10, 40, giving access to the inside of the head and both coalescer and separator elements at the same time, and making it possible for the operator to clean the bowl and service any parts therein such as a valve without disturbing the coalescer and separator elements. Both coalescer and separator elements can be serviced or replaced by removal of a single bolt, the core 21, 52.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An assembly for separating immiscible fluids comprising, in combination, a head, a bowl removably secured to the head, first and second fluid passages in the head opening into the bowl, a tubular wall portion of the head enclosing the first passage and extending to- 45 wards the bowl, a core removably secured to the tubular wall portion of the head and being adapted to support a coalescer element thereon, the core comprising a hollow shank opening into the first passage in the head, a coalescer element having a central passage inserted over and removably secured to the core, pressure relief means in the core, the core shank having holes therein opening into the central passage of the coalescer element in a manner such that all fluid passing through the first pas- 50 sage must also pass through the coalescer element, and a separator element removably secured to the tubular wall portion and extending across the top of the bowl and the second passage of the head, supported at the external periphery between the bowl and the head, in a manner such that all fluid passing through the second passage must also pass through the separator element, the coalescer and separator element being secured to the head separately from the bowl, and remaining attached thereto when the bowl is removed.

2. An assembly in accordance with claim 1 in which the core is a bolt threaded into a portion of the head.

3. An assembly in accordance with claim 1 wherein the separator element comprises a wire mesh.

4. An assembly in accordance with claim 1 in which the pressure relief means comprises a passage communicating between the hollow shank and the bowl, a compressible spring, a ball, and a seat for the ball in the passage, said spring being adapted to maintain the ball closed, against said seat under normal operating condi- 55 tions, and being adapted to open when the pressure drop across the coalescer element exceeds a predetermined minimum.

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65 REUBEN FRIEDMAN, *Primary Examiner*.

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