AIR SEPARATOR FOR LIQUIDS

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This invention relates to improvements in air
separators, such, for example, as are suitable for
use in gasoline measuring and dispensing pumps
for removing air from the pumped gasoline be-
fore it enters the meter.

The invention has for its object the provision
of an air separator of improved construction
which enables efficient separation of air at a
rapid rate with a substantially less volumetric
capacity than has heretofore been necessary in
separators for the purpose described.

The invention also has for an object the pro-
vision in an air separator of improved construc-
tional features which enable substantial econom-
ies in manufacture to be effected without im-
pairing the efficiency of separation of air from
liquid.

These and other objects of the invention will
more particularly appear from the following de-
scription of one illustrative example of the in-
vention in the accompanying drawings, in which:

Fig. 1 is a top plan view of an air separator
embodying the invention;

Fig. 2 is a sectional elevational view taken
on the line 2—2 of Fig. 1;

Fig. 3 is an end view of the separator;

Figs. 4 and 5 are cross sectional views taken
on the lines 4—4 and 5—5, respectively of Fig. 2;

Fig. 6 is a fragmentary bottom plan view of
the separator; and

Fig. 7 is a fragmentary sectional view taken
on the line 7—7 of Fig. 2.

Referring to these drawings: the separator in-
cludes a three part casing (Fig. 2) consisting of
a hollow cylindrical body 1, having flanges
2 and 3 one at each end thereof, and heads 4
and 5 having flanges 6 and 7 which match the
flanges 2 and 3 and are respectively secured
thereof, with gaskets 9 interposed between, as
by a plurality of cap screws 8 (Fig. 3). This
casing is intended to be supported with the axis
of the cylindrical body horizontal or substan-
tially so.

The pipe connections for the separator are all
made with the body portion 1, so that the heads
may be removed if and when required without
doing any more than removing the cap screws
8. Formed on the lower portion of the body
1 is a portion 10 which is outwardly offset from
the outer periphery of the body and which ex-
tends from flange 2 longitudinally of the body
to a point about midway between the two flanges
2 and 3, where it terminates with a pad 11, hav-
ing a plurality of tapped holes 12 therein for
attaching the flanged outlet of a pump or the
delivery pipe of a pump, as the case may be.

This offset portion 10 has cored therein a lon-
gitudinal passage 13, having a vertical entrance
14 in pad 11 and a horizontal exit 15 in flange
2. A similar offset portion 16 is formed in the
upper part of body 1 and has a pad 17 with
tapped holes 18 therein to enable attachment
thereof of the flanged inlet end of a meter or a
delivery pipe, as the case may be. This offset
portion 16 has a cored passage 19 therein with a
horizontal entrance 20 in flange 3 and a vertical
exit 21 in pad 17.

Referring next to Fig. 4, the endless flange
6 of head 4 is annular, except for a single U-
shaped offset portion 22 surrounding a rece-
23, which leads outwardly from a larger and
dish-shaped recess 24 in head 4, such recess be-
ing embossed by the annular portion of flange
6. This recess 24 is converted into a chamber
by means of a segmented circular plate 25 of
thin sheet metal. The head 4 has a shallow
annular groove 26 therein, which is embossed
by the annular portion of flange 6 and which
receives the thin plate 25. The depth of groove
26 equals the thickness of plate 25 so that the
outer face of the plate lies in the same plane as
that face of flange 6, which is clamped against
gasket 9 and to flange 2. The head 4 has two
cylindrical posts 27 projecting from its inner
face and extending to the inner face of plate
25, which is fixed to these posts by screws 28.

The curved margin of plate 25 is pressed against
the adjacent end of the cylindrical body 1 to
close the right hand end of the opening therein,
except for a segment-shaped opening 29 above
the horizontal and weir-like edge 29' of the
plate. This is the opening provided by the seg-
mentation of the plate. This plate covers only
a small portion of recess 23, which registers with
the described exit 16 of passage 13. Thus, liquid
containing air enters the separator at 14 and
passes through passage 13, exit 15, recess 23,
chamber 24, over weir 29' and through open-
ing 29 into the right hand portion of the cylin-
drical opening in body 1, hereinafter called the
inlet chamber 30.

Intermediate the ends of the body 1 and with-
in its hollow interior, is an internal annular
flange 32, against which abuts a roll 33 of
50 wrinkled wire-mesh fabric. This roll 33 parti-
tions the hollow interior body 1 into two cylin-
drical chambers, one, the described inlet cham-
ber 30 and the other, a chamber 34, located on
the outlet side. The flange 32 may have upper
and lower diametrically-opposite recesses 35.
therein to receive, one in each, the ends of a thin bar 36, which extends diametrically across the chamber 34 and serves to prevent axial deflections of the central portion of roll 33 under the pressure of liquid and in the direction of liquid flow.

The head 5 is an exact duplicate of head 4. This will be clear from Figs. 2 and 3. It has a similar thin segmental-circular plate 37, similarly mounted in a groove in 38 in the heads held in place by screws 39 threaded into posts 40. However, the head 5 is turned 180° from head 4 so that the segment-shaped opening 41 has below the horizontal edge 42 of the plate and communicates with the bottom of chamber 34. The chamber 43 in head 5 has its exit at its upper end in a recess 44, which is surrounded by an inverted U-shaped offset 45 in the flange 7 of head 5 and which registers with the entrance 26 of passage 19. Thus, air-free liquid taken from the bottom of outlet chamber 38 passes out through opening 41, chamber 43, recess 44, entrance 26, passage 19 through exit 21 to any desired point of delivery.

Extending obliquely through the pad 17 is a passage 46 leading into the uppermost part of chamber 34 and intersecting the latter with an equal axis opening 47 along the major axis of which are twice the length of the minor axis and twice the diameter of passage 46. The inlet opening 47 has its major axis disposed longitudinally of the cylindrical chamber 34 at the exact top thereof in order to facilitate the entrance of air bubbles, which rise to the top of the chamber. The outer end of passage 46 receives the pipe-threaded end of a compression coupling 48. The inner end of this coupling is closed except for a single very small opening 49 therethrough, having a diameter of for example 1/2 inch. The coupling 48 is adapted to connect with copper tubing 50, which leads to a suitable liquid recovery chamber, such for example as that shown in Fig. 3 of De Lancey Patent No. 2,124,666, granted November 1, 1938.

The body at its lowest portion has a drain opening 51 normally closed by a pipe plug 52.

The body 1 and the heads 4 and 5 are designed so that they may be made by die casting. No machining operations are required except the tapping of such of the die-cast holes as require it. The plates 27 and 37 are stamped from sheet metal with the necessary holes therein. These plates are duplicates as are the heads 4 and 5. Thus, there are only three kinds of principal parts needed to make up the separator casting and these may be constructed in quantities at low unit cost.

The roll 33 is a crinkled, wire-mesh coalescing pack. It is made up of a suitable length of a fabric constructed of fine wire, preferably of non-corrosive metal, such as Monel metal. This metal is woven into a tubular fabric, which is flattened down, forming a two-ply strip, which is then crimped and finally wound into roll form. This roll is a standard article available in the market and can be procured in any diameters and widths desired. The roll presents a compact mass of interfitting and intertangled wires and provides a very great number of very small interstices. The passages through the mass are exceedingly fine and necessarily tortuous.

The coalescing roll 33 frictionally engages the peripheral wall of chamber 30 and is held in axial position against flange 32 by pressure of the liquid. The roll 33 may readily be removed from chamber 30, after head 4 has been removed, unwound, cleaned, rolled up again and replaced in the chamber. The removal of heads 4 and 5 is readily effected and all the pipe connections are with the body casting 1.

The use of this roll 33 is what enables the volumetric capacity of the separator to be substantially reduced. The roll has the property of coalescing the air bubbles contained in the liquid. Very small bubbles are made into big ones. The small bubbles are slow to rise in the liquid and, since separation is by gravity, a larger volume of the separating chamber would be necessary to get out all the air at the same rate of liquid flow through the separator. However, if the small bubbles in the liquid in the right hand or inlet chamber 30 of the separator are made to combine with others during their passage through the roll 33 so that large bubbles emerge with the liquid into the left hand or outlet chamber 34, these large bubbles will rise rapidly through the liquid and enable the same degree of effectiveness of air separation to be effected at the same rate of flow with a much smaller volumetric capacity of the separator. In the present example, the separator has a volume of 191 cubic inches and liquid leaves its outlet at the rate of 15 gallons a minute. The described volume is a reduction of approximately two-thirds in the volumetric capacity which could be necessary in a separator not having a coalescing pack, such as herein described.

The air bubbles, rising in chamber 34, collect in the uppermost portion thereof and pass out through passage 46 and finally through the very small exit opening 49 to a suitable liquid recovery chamber. By elongating the inlet 47 of passage 46, the entrance of air bubbles into the passage is facilitated. The small exit opening 49 presents little resistance to the passage of air but much more resistance to liquid. In normal operation, after the separator chamber is once filled with liquid, some liquid will escape with the air through the exit 49 and be separated therefrom in the liquid recovery chamber in the well known manner.

The invention thus provides an air separator of improved construction and small volume, which separator is designed for rapid and efficient separation of air from liquid and for manufacture in quantities at very low unit cost.

What is claimed is:

1. In an air separator, a body having a cylindrical opening therethrough and adapted to be supported with the axis of such opening disposed substantially horizontally, heads one for closing each of the two opposite ends of the opening in said body, a coalescing pack in roll form located inside said body intermediate the endheads and dividing the interior of the body into two cylindrical chambers, each head having an endless flange of annular form except for a single U-shaped outward offset therein and having a recess embossed by said flange, a thin segmental-circular plate fixed to each head and forming therebetween a chamber closed except for a segment-shaped opening provided by segmentation of said plate and a diametrically opposite opening beyond the periphery of the plate into the space within the portion of the flange, said heads being reversely arranged with the offset portion of the flange of one turned downwardly and the other turned upwardly, said body having in its lower and upper portions longitudinally-disposed inlet and outlet passages,
respectively, communicating at one end with the space within the downturned and upturned offset portions, said inlet and outlet passages terminating at locations between the ends of the body with downturned and upturned entrance and exit openings.

2. In an air separator, a body having a cylindrical opening therethrough and adapted to be supported with the axis of such opening disposed substantially horizontally, heads one for closing each of the two opposite ends of the opening in said body, a coalescing pack in roll form located inside said body intermediate the ends thereof and dividing the interior of the body into two cylindrical chambers, each head having an endless flange of annular form except for a single U-shaped outward offset therein and having a recess embordered by said flange and having also an annular groove the outside diameter of which is greater than the diameter of either chamber and less than the outside diameter of the annular part of said flange, thin segmented-circular plates one for each head, each plate being mounted in the annular groove in its head with its inner face in the same plane as the inner face of said flange, the inner face of the circular marginal portion of the plate in each head and the inner face of the flange of such head adapted to abut an end face of the body to close the adjacent chamber in the body except for the single segment-shaped opening provided by the segmentation of the plate, posts on each head to which its plate is fixed, the head at one end of the body having its offset extending downwardly and the head at the other end of the body having its offset extending upwardly, said body having an offset in the lower portion abutting at one end the downwardly extending offset in one head and extending longitudinally of the body to a point between the ends there, said body offset having an inlet passage with its entrance turned downwardly and its exit opening registering with the space within the offset portion of the flange in the last-named head, said body having in its upper portion an offset abutting at one end with the upturned offset in the other head and extending longitudinally and terminating at a point between the ends of the body, the last-named body offset having an outlet passage with its entrance communicating with the space within the U-shaped portion of the flange of the last-named head and its exit upturned.

3. An air separator, comprising, a body having a cylindrical opening therethrough and adapted to be supported with the axis of such opening substantially horizontal, heads fixed one to each end of said cylinder for closing said opening, one said head having therein an inlet passage for mixed liquid and air opening into the upper end of said opening, the other head having therein an outlet passage for air-free liquid connecting with said opening at the lower end thereof, a coalescing pack in roll form closely fitting in said cylindrical opening intermediate the ends thereof and dividing such opening into inlet and outlet chambers, said body having in its upper portion an outlet passage for separated air, said passage having a portion of relatively large diameter located with its axis at an acute angle to the axis of said opening and intersecting the uppermost portion of the periphery of said opening with an elliptical entrance located between said pack and the head having the outlet passage, the major axis of the elliptical opening being parallel to the axis of said cylindrical opening, said air outlet passage having a constantly open exit of very small diameter enabling free outflow of air but retarding the outflow of liquid, small air bubbles contained in the liquid in the inlet chamber being coalesced while passing through said pack into large bubbles which rise rapidly to the top of the outlet chamber and enter said elliptical opening and pass out through said air outlet passage.

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