

Sept. 22, 1942.

W. E. STEEN ET AL

2,296,543

DEAERATOR

Filed Aug. 3, 1940

3 Sheets-Sheet 1

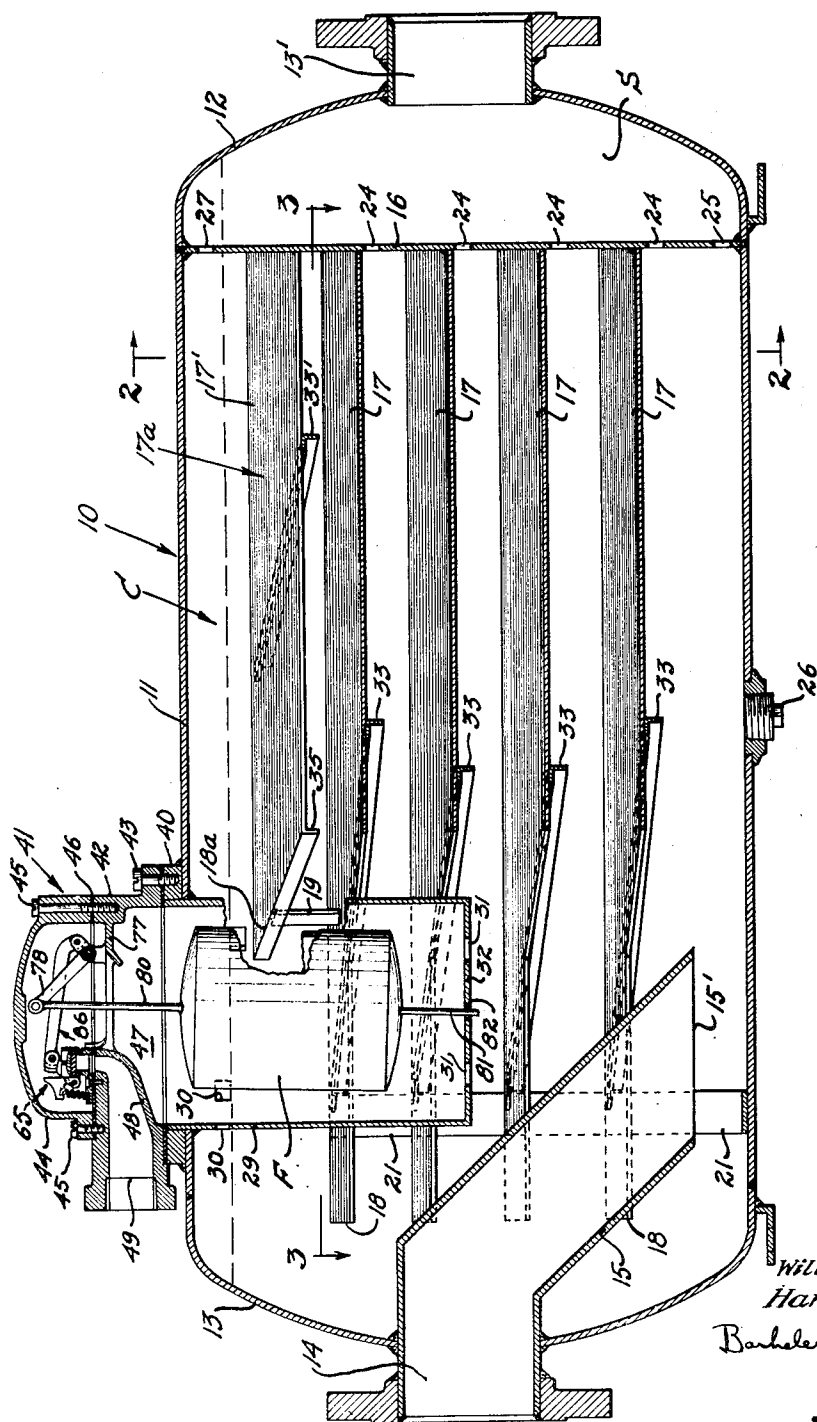


Fig. 1.

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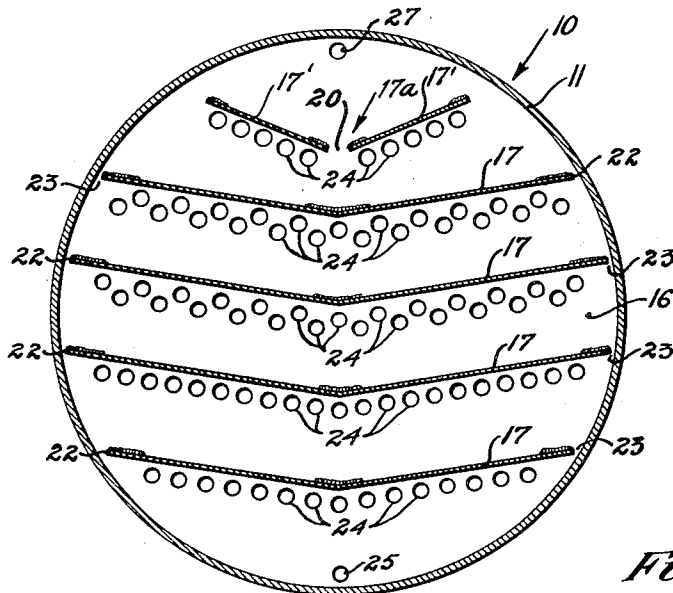


Fig. 2.

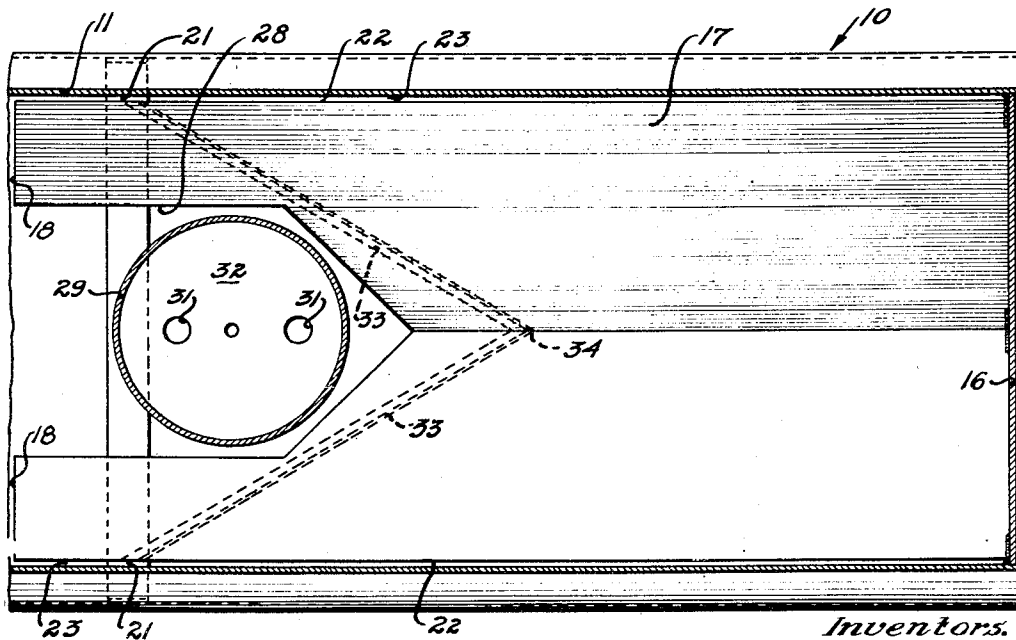


Fig. 3.

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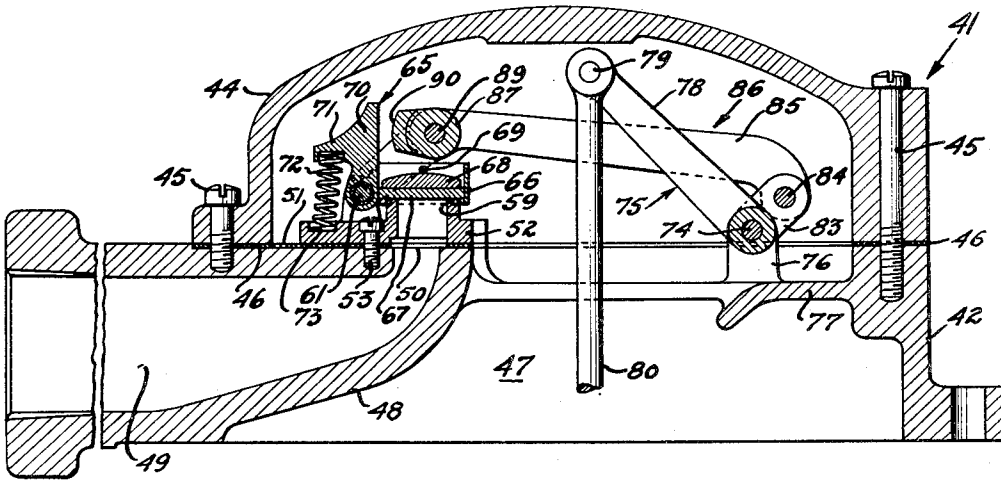


Fig. 4.

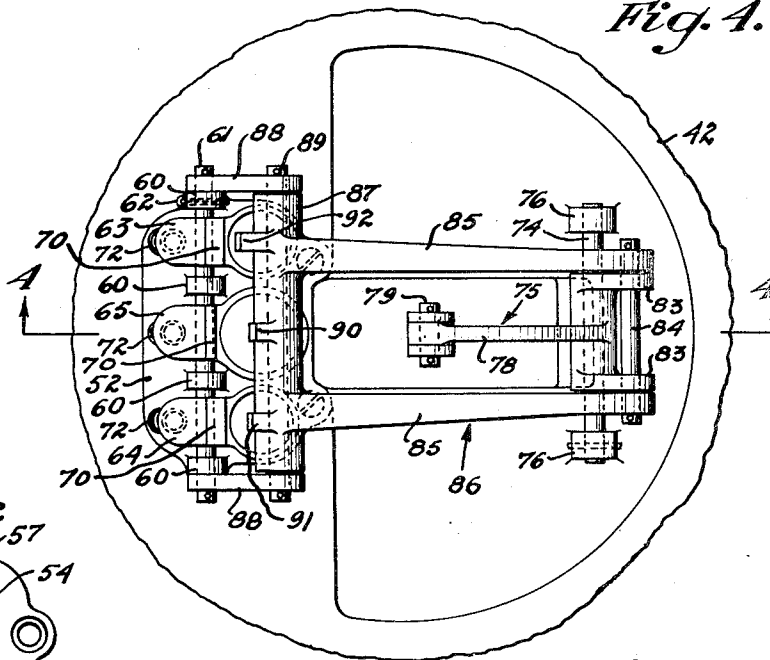


Fig. 5.

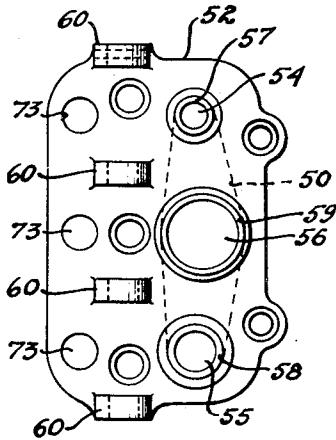


Fig. 6.

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UNITED STATES PATENT OFFICE

2,296,543

DEAERATOR

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8 Claims. (Cl. 183-2.5)

This invention relates to de-aerators, and is more particularly concerned with means for eliminating air and vapor entrained in fluids such as petroleum derivatives.

There are many occasions calling for such elimination and these are too well known to warrant discussion here. However, it may be said that the device here shown is useful to particular advantage in connection with the elimination of air or vapor from gasoline or fuel oil just ahead of a meter, for it is well understood that in the absence of such elimination, the metering cannot be accurate. It is distinctly to be understood, however, that the invention is not limited to this particular use.

The device is of such a nature that it takes into account the peculiarities of bubble-behavior, it having been found that much of the entrained air is in the form of bubbles which are too small to rise any appreciable extent while the fluid is flowing with any appreciable speed. On the other hand it is not feasible to provide an eliminator of such size that the fluid will be sufficiently quiescent to permit the smaller bubbles to rise to a point from which they may be exhausted.

Our device takes these considerations into account, being so fashioned that the small bubbles have to rise only a short distance individually, then intermingling in a manner to form larger bubbles which are capable of following the relatively long path through which certain of them must travel to reach the top of the fluid body.

How this is done, may be discussed to better advantage in the following detailed description, wherein there will also be described a novel valve and actuating means therefor, by which the air gathering at the top of the tank is smoothly and evenly discharged when it has gathered in any predetermined amount. It involves a plurality of orifices of varying size which are sequentially opened as the fluid level is depressed by the gathering air.

Generally, it is the object of the invention to provide a simple, sturdy and extremely efficient type of de-aerator.

Reference will be had to the accompanying drawings, in which

Fig. 1 is a longitudinal medial section through a device embodying the invention;

Fig. 2 is a section on line 2-2 of Fig. 1;

Fig. 3 is a section on line 3-3 of Fig. 1;

Fig. 4 is an enlarged fragmentary section of the air-exhaust valve shown in the same aspect as Fig. 1;

Fig. 5 is a plan view of Fig. 4, with the valve cap removed and

Fig. 6 is a fragmentary plan of the orifice plate of the valve.

Though this is not limitative, the de-aerator is here shown as made up of a horizontally arranged cylindrical tank or housing 10, the cylindrical body portion 11 being closed at its ends by caps 12 and 13. Inlet 13' and outlet 14 are coaxial with barrel or body member 11, though it will be noted that outlet 14 is in communication with the lower part of the housing and at a point below the lowermost separator member (to be described) through an angle pipe 15.

Spaced axially from inlet 13' and end wall 12, is a circular, vertically arranged header or distributor plate 16 which is peripherally welded or otherwise suitably secured to barrel 11. Welded or otherwise suitably secured to the inner face of header 16 are the ends of separator plates 17, which, at their other ends 18 stop short of end wall 13. The uppermost plate 17a is shorter than the other separator plates, its free end 18a being supported by posts 19 extending upwardly from the separator plate next below. In fact, the upper separating plate is preferably made in two sections 17' (Fig. 2) which are spaced apart at their inner edges at opposite sides of the vertical axial plane of the housing, the space between sections being indicated at 20.

The free ends of the other separator plates 17 are supported in vertically spaced relation by securing to band 21, as by welding, the band also being welded or otherwise suitably secured to the inner face of barrel 11.

Preferably, the separator plates incline oppositely and upwardly from the points at which they intersect the vertical axial plane of barrel 11, thus being given shallow, trough-like characteristics as viewed in cross section (Fig. 2). The side edges 22 of separator plates 17 throughout their longitudinal extent are spaced from barrel 11, the spaces as so defined being indicated at 23.

Header 16 is provided with distributor apertures 24, these apertures being arranged in rows immediately below each separator plate, it following that liquid within space S (defined between end 12 and header 16) will be admitted to the interior of barrel 11 at points immediately beneath the individual separator plates and air bubbles contained therein will, in large part, be delivered immediately beneath those separator plates. The apertures may either be in single rows, as shown in connection with the two lower

and the top separator plates (Fig. 2) or they may be in double rows, with the individual apertures staggered, as shown in connection with the other separator plates, but in any event it is highly desirable that they be quite closely adjacent the under sides of the separator plates. The aggregate cross-sectional area of apertures 24 is preferably slightly larger than the cross-sectional area of inlet 13'.

A drainage opening 25 through header 16 puts space S in communication with the lower part of the main chamber or compartment C, as defined by barrel 11 which, in turn, may be drained by removing plug 26; while an aperture 27 through header 16 puts the upper end of space or chamber S into communication with the interior of the barrel at a point above separator plate 17a, so air gathering at the top of space S may be discharged to the top of the chamber C and be exhausted therefrom in the manner to be described.

The free ends of separator plates 17 are slotted as at 28 to accommodate the well 29, which is in the form of a vertically arranged cylinder peripherally secured at its upper end to the outer face of barrel 11. The interior of well 29 is put into communication with chamber C through side wall openings 30 and openings 31 in bottom wall 32. Welded to the under side of the separator plates are downwardly extending baffles 33, these baffles being arranged in wedge-shaped form as viewed in plan, with the point 34 of the wedge pointing towards header 16. They are located so the ends of their legs are near the free ends of the separator plates while points 34 are approximately mid-way of the length of barrel 11, though as shown in Fig. 1 the baffles may vary in longitudinal extent. On the other hand, the baffles 33', applied to the under side of separator plate sections 17', are preferably much closer to header 16, but auxiliary baffles 35 at the free ends of sections 17' are more nearly in line with baffles 33. Baffles 33 and 33' may conveniently be in the form of angle irons welded to the under side of the separator plates.

As liquid enters chamber S, it is distributed through apertures 24 to chamber C along the under sides of separator plates 17. The bubbles in the spaces between separator plates will be delivered mostly directly to the under side of those separator plates, but in any event, they have but a very short distance to rise before striking the separator plate next above. The smaller bubbles tend to gather on the under side of the separator plates and form, together, larger bubbles. In their continued tendency to rise, the bubbles "roll" upwardly and radially outward along the under, inclined surfaces of the separator plates toward spaces 23. They pass upwardly through these spaces to the top of chamber C where they "break-surface," thus forming an air or gas body on top the liquid body. The baffles 33 tend to prevent the bubbles along the under face of the separator plates from reaching a point in line with the orifice 15' of outlet pipe 15, but rather guide those bubbles radially outward toward spaces 23. Orifice 15' is thus disposed at a level and a longitudinal location where the liquid will have been fully degassed, the outlet flow thus being in a condition to be accurately metered, if that be the next step in the handling of the liquid.

It will be seen that as the formerly entrained air or vapor is released to form an air or vapor body on top the liquid body, the liquid level will

be slowly depressed, and it therefore becomes necessary that the air or vapor body be exhausted when it reaches predetermined proportions. We have devised a particularly efficient valve for this purpose.

Attached to flange 40 which surrounds and is applied to the upper end of well 29 where it extends outside barrel 11, is a valve housing generally indicated at 41. Housing 41 is made up of a base portion 42 attached at 43 to flange 40, and a detachable cap portion 44 which is held to base 42 at 45, there preferably being a gasket 46 between the base and the cap.

The interior of housing assembly 41 constitutes an air dome 47 which is in direct communication with the open top of well 29. Fluid, of course, stands within well 29 at the same level as in chamber C, the fluid being admitted to the well through openings 31. Air within the top of chamber C is free to enter the top of the well and hence the dome through openings 30.

Base portion 42 has an internal boss 48 through which extends the exhaust or relief outlet passage 49, this passage opening to a horizontally disposed orifice 50, which orifice is also horizontally elongated as shown in Fig. 6. The orifice opens to the upper boss-face 51, an orifice plate 52 being bolted thereto at 53, there preferably, however, being interposed an extension of gasket 46.

Plate 52 has three orifices 54, 55 and 56, of progressively increased diameter, raised seats 57, 58 and 59 being provided about the respective orifices.

Upstanding from plate 52 are apertured bosses 60 which support shaft 61, the latter extending in parallel relation to orifice 50, as viewed in plan (Fig. 6). The shaft is pinned against rotation at 62, while mounted for individual rotation thereon are valve members 63, 64 and 65, adapted to coact, respectively, with seats 57, 58 and 59. These valve members are of identical construction so but one need be described in detail. Referring to Fig. 4 it will be seen that valve member 65 is of angular form, one arm being represented by cup 66 supporting disk stopper 67 in overlying relation with seat 59, a follower button 68 and pin 69 serving to hold the stopper disk 67 against dislodgment from cup 66 but allowing it sufficient freedom of movement to be self-adjusting to the seat.

Arm 70 of member 65 extends upwardly from shaft 61 and has a horizontal extension 71 to take the upper end of spring 72, the lower end of that spring being bottomed in recess 73. It will be seen that push-spring 72 tends always to rotate member 65 in a clockwise direction, as viewed in Fig. 4, and thus to hold the valve closed. The other valves are mounted in the same manner and have similar springs for urging them constantly toward closed position.

Mounted for oscillation on shaft 74 is a bell-crank 75, it being noted that shaft 74 is supported by the upright brackets 76 on the internal flange 77 of base 42. The long arm 78 of crank 75 is pivotally connected at 79 to rod 80, the latter carrying at its lower end the cylindric float F (preferably a hollow metal cylinder). The float may be guided in its vertical movement by a depending, coaxial pin 81 which extends through guide-bore 82 in well-bottom 32.

The two relatively short, integral arms 83 of bell-crank 75 are pivotally connected by shaft 84 with the two arms 85 of valve-pusher 86, this pusher having a cross-head 87 which lies parallel

to shaft 61. Links 88 pivotally connect shaft 61 and shaft 89, the latter being coaxial with and carried by cross-head 87. The links guide the forward end of member 86 in its movement as set up by oscillation of bell-crank 75.

The cross-head carries actuating lugs 90, 91 and 92 which are of progressively increased length and are opposed to the arms 70 of valve members 65, 64 and 63, respectively.

In Figs. 1 and 4, the valve and float are shown in the positions they occupy when there is no need for exhausting air from chamber C, the fluid level being sufficiently high to carry float F at an elevation where, through bell-crank 75, the cross head 87 is clear of valve-arms 70, and therefore the valve springs hold the valves closed.

However, when the fluid level in chamber C is depressed by an accumulation of air at the top of that chamber, the float descends, rotating bell-crank 75 in a counter-clockwise direction, as viewed in Fig. 4, and thrusting pusher 86 to the left, as viewed in that figure. Due to the clearance between the distal end of the pusher and the valve members, there is a range of float-rise and fall where there will be no valve actuation. However, as soon as the float drops sufficiently to thrust pusher 86 to the left an extent which engages the long arm 92 with the arm 70 of valve 63, any further descension of the float acts through the pusher and arm 92 to rotate valve 63 against its spring and to open position, thus allowing the air within dome 47 to exhaust through outlet 49. Further descension of the float will successively bring arms 91 and 90, on pusher 86, into contact with their respective valves 64 and 65 and thus successively open those valves.

It will be noted that the valve and pusher arrangement is such that the smallest orifice will be first opened, then the next larger orifice, and finally the largest orifice, this giving a smooth even opening instead of a sudden "pop-off." And also, in spite of the fact that the ultimate, aggregate exhaust opening is relatively large and the total, aggregate valve-stopper area is likewise large, this arrangement permits the valve, taken as a whole, to be opened very easily and with the application of relatively little force (represented by the weight of the float) in spite of the fact that the valves may be opening against relatively large pressure.

As the air is exhausted from the dome 47 and the top of chamber C, the fluid level in that chamber rises, causing a coincident rising of the float and the swinging of bell-crank 75 in a clockwise direction, as viewed in Fig. 4, withdrawing pusher 86 to the right, and thus allowing valves 65, 64 and 63 to close in sequence under the action of their springs.

Various changes in design, structure and arrangement may be made without departing from the spirit and scope of the appended claims.

We claim:

1. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, there being apertures through the header immediately below each separator plate, the side edges of the separator plates being spaced from the side wall of the housing whereby air or vapor bubbles may pass between

the side wall and edges to the top of the housing, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet near the other end of the housing.

2. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, there being a row of apertures through the header immediately below each separator plate and extending from side to side thereof, the side edges of the separator plates being spaced from the side wall of the housing whereby air or vapor bubbles may pass between the side wall and edges to the top of the housing, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet near the other end of the housing.

3. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, there being apertures through the header immediately below each separator plate, the side edges of the separator plate being spaced from the side wall of the housing whereby air or vapor bubbles may pass between the side wall and edges to the top of the housing, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet duct near the other end of the housing, the inner end of the duct being located near the bottom of the housing and the outer end of the duct opening to the outside of the housing of a higher level.

4. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, there being apertures through the header immediately below each separator plate, the side edges of the separator plates being spaced from the side wall of the housing whereby air or vapor bubbles may pass between the side wall and edges to the top of the housing, downwardly extending baffles on said separator plates and spaced longitudinally thereof from the header, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet near the other end of the housing.

5. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, there being apertures through the header immediately below each separator plate, the side edges of the separator plates being spaced from the side wall of the housing whereby air or vapor bubbles may pass between the side wall and edges to the top of the housing, downwardly extending baffles on said separator plates and spaced longitudinally thereof

from the header, said baffles extending from side to side of their respective separator plates, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet near the other end of the housing.

6. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, said separator plates having portions, at least, inclining upwardly toward the side wall of the housing, there being apertures through the header immediately below each separator plate, the side edges of the separator plates being spaced from the side wall of the housing whereby air or vapor bubbles may pass between the side wall and edges to the top of the housing, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet near the other end of the housing.

7. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, there being apertures through the header immediately below each separator plate, the side edges of the separator

plates being spaced from the side wall of the housing whereby air or vapor bubbles may pass between the side wall and edges to the top of the housing, downwardly extending baffles on said separator plates and spaced longitudinally thereof from the header, said baffles extending from side to side of their respective separator plates, and angling outwardly with respect to the separator plates and rearwardly with respect to the header, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet near the other end of the housing.

8. In a de-aerator for liquid flow lines, a housing, a header plate extending across the housing and spaced from one end wall thereof, there being a fluid inlet opening to the space between end wall and header, a plurality of vertically spaced separator plates extending substantially horizontally from said header toward the other end of the housing, said separator plates inclining upwardly and outwardly from each side of their longitudinal center lines, there being apertures through the header immediately below each separator plate, the side edges of the separator plates being spaced from the side wall of the housing whereby air or vapor bubbles may pass between the side wall and edges to the top of the housing, means for exhausting the air or vapor from the top of the housing, and there being a fluid outlet near the other end of the housing.

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