April 11, 1961 J. F. SEBALD 2,979,156

VACUUM DEGASIFIER

Original Filed Dec. 2, 1952 2 Sheets-Sheet 1

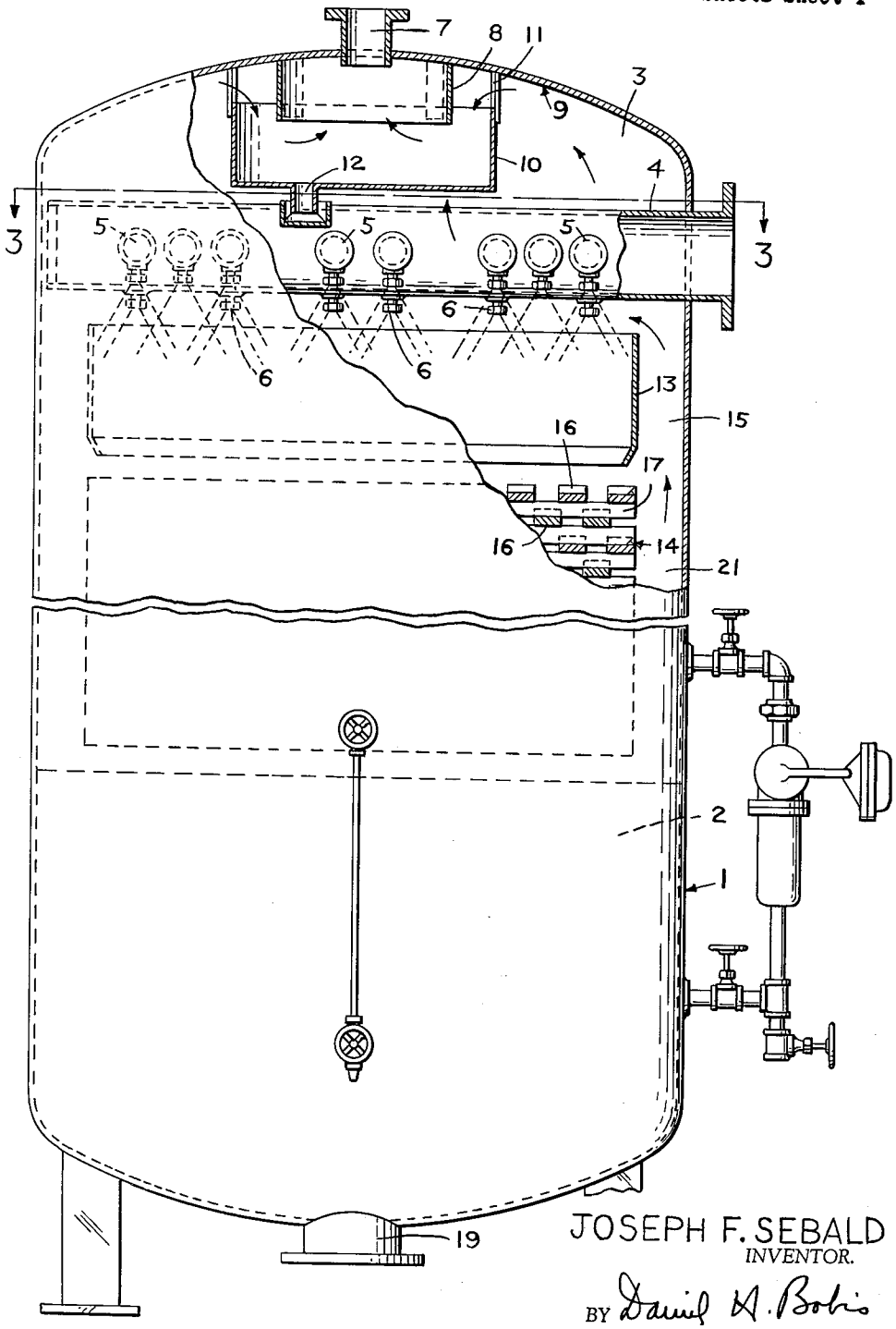



FIG. 1

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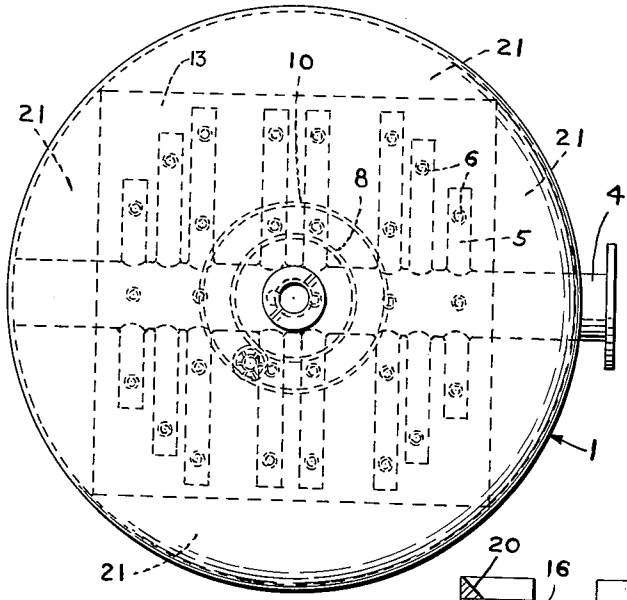



FIG. 2

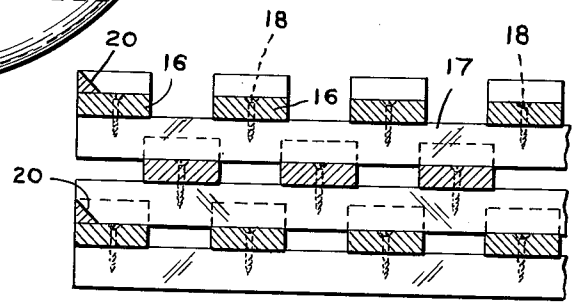



FIG. 4

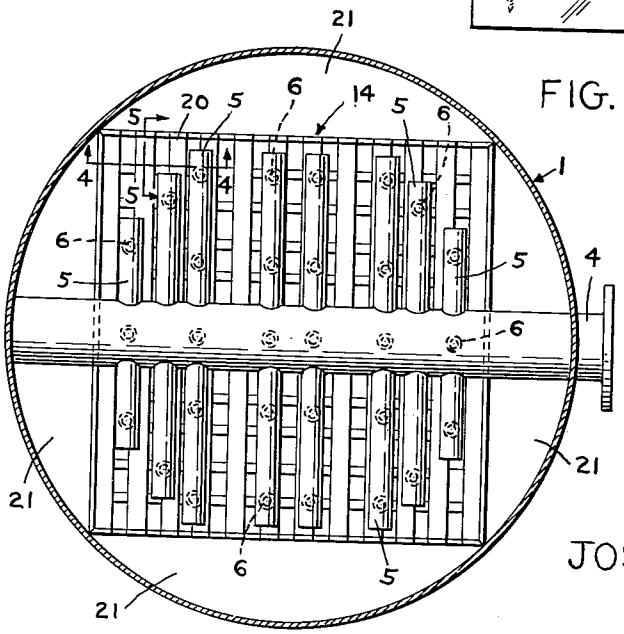



FIG. 3

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2,979,156

# VACUUM DEGASIFIER

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1 Claim. (Cl. 183—2.5)

This invention relates generally to the degasification of fluids and more particularly to means for maintaining a vacuum degasifying apparatus at substantially uniform total pressure within the apparatus so as to approach the desired equilibrium solubility of the dissolved oxygen and non-condensible gases to be removed.

In apparatus which is used for the degasification of liquids involving primarily the removal of oxygen and non-condensible gases therefrom, generally a tower maintained at low pressures corresponding to the desired equilibrium solubility relationships, is utilized which is divided into a water storage section and a desgasifying section and includes a venting arrangement.

In the degasifying section some means is generally provided such as inter-spaced trays or baffle arrangements or other type of packing arrangements over which the downwardly injected fluid which is to be degasified must pass whereby the fluid is broken up into droplet form, which increases the total surface area and reduces the ratio of volume to surface to allow the oxygen and non-condensibles to escape more easily from the fluid.

It has been found in connection with such packing arrangements that unless suitable vapor flow lanes are provided in and about the packing portion of the degasifying section of the tower and between the packing and the air outlet connections, in those systems applying the suction to the uppermost or venting end of the tower there will exist a pressure difference above and below the packing. Hence, for systems where there are no vapor flow lanes it is necessary to produce extremely low pressures at the outlet connections requiring very large vacuum pumps in order to compensate for the pressure differences resulting from the restricted gas and vapor flow passages through the packing in the tower.

The present invention accordingly defines and covers a packing arrangement for a degasifier which provides flow passages to maintain the degasifier at a substantially equal total pressure in the portion thereof throughout the packing and the containing vessel whereby a relatively small steam jet ejector or a relatively light vacuum pump can be used for withdrawing the oxygen and non-condensibles removed from the fluid being deaerated to obtain the necessary degree of purity of effluent as may be required for the specific industrial purpose.

It is an object of this invention to provide a degasifier with a substantially uniform total pressure throughout its entire vapor space.

It is another object of the present invention to provide a degasifier with a packing arrangement having vapor flow lanes therein in direct connection with the air and vapor outlet.

With this and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a vacuum degasifier of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claim.



In the drawings:

Figure 1 is a side elevation partly in section of the invention.

Figure 2 is a top view of the invention.

Figure 3 is a section taken on line 3—3 of Figure 1.

Figure 4 is a section taken on line 4—4 of Figure 3.

Referring more particularly to the drawings, Figure 1 shows a vacuum deaerator comprising an elongated fully encloser tower **1** having formed therein a water storage section **2** and a degasifying section **3**.

Raw water or other fluid is brought into the tower **1** through a raw water inlet pipe **4** from a source (not shown). The raw water inlet pipe **4** extends transversely of the vertical axis of the tower **1** near the upper end of the deaerating section **3** of the tower **1** and is provided with distributing conduits **5** positioned substantially perpendicularly thereto in a horizontal plane and in some suitable pattern such as is shown in Figures 2 and 3 of the drawings. This allows fluid to be discharged downwardly into the degasifying section **3** from spray valves **6** formed in spaced relation to each other on the distributing conduits **5** as is also clearly shown in Figures 1, 2 and 3 of the drawings.

Above the raw water inlet pipe **4** at the uppermost point is a vent outlet **7** which is connected to a suitable suction device (not shown) such as a steam jet ejector or vacuum pump both easily purchasable on the open market and well known in the art. They act to reduce the pressure in the tower **1** to a point consistent with the desired degree of purity of the effluent fluid to be obtained.

Surrounding the vent outlet **7** is an annular partition or baffle **8** which is connected to the inner wall **9** of the upper end of the tower **1**. The annular partition **8** extends down into a condensate trap **10** which is a shallow cylindrical pan-like vessel also connected to the inner wall **9** and having openings **11** so that vapor or gases will move in a convoluted flow from the degasifying space **3** to the vent outlet **7**, as is clearly shown in Figures 1 and 2 of the drawings.

A liquid sealed condensate return **12** is provided in the bottom of the condensate trap **10** to return condensate by gravity flow downwardly through the degasifying space **3** of the tower **1**.

The "vacuum producing" means will maintain the tower **1** at the reduced pressure consistent with required performance. Raw water will be sprayed out of the spray valves **6** in droplet form and will drop by gravity through a spray confining baffle **13** mounted in the degasifying space **3** below the raw water inlet pipe **4**, as is clearly shown in Figures 1 and 2 of the drawings, which directs the fluid on a packing arrangement generally designated **14** which provide means for increasing or maintaining the injected water in its droplet form.

The baffle **13** is, of course, mounted so that a vapor flow space **15** is maintained in the degasifying section **3**.

The packing arrangement **14** is substantially in gross appearance in rectilinear box-like form. However, it is not a solid but contains many convoluted vapor flow passages by reason of the manner of construction. Thus, referring to Figures 1 and 4, it is observed that the packing arrangement consists of a series of layers of spaced slats or trays **16**. The layers are spaced from each other by transverse spaced support members **17** which are joined to the layer of slats or trays **16** immediately above it by suitable means such as threaded members **18** all of which is clearly shown in Figure 4 of the drawings.

The various layers of slats or trays **16** are from layer to layer offset from each other so that every other layer has its slats or trays **16** in alignment with each other and

fluid will thus fall or drip from the slats of one layer onto those of the layer directly below it by gravity flow until the droplets join the fluid being stored in the storage space **2** of the tower **1**. A discharge outlet **19** is provided for the water storage at the lower end of the tower **1** from which degasified water can be removed by gravity or to which the suction of a pump (not shown) can be connected.

Where necessary about the outer periphery of the various layers of slats or trays a splash edging **20** is provided to redirect stray droplets of fluid inwardly towards the central portion of the packing, as is clearly shown in Figures 1, 3 and 4 of the drawings.

Figures 1, 2 and 3 further show that the packing arrangement **14** is square in the horizontal cross-section and when mounted in the cylindrically-shaped tower will provide vapor flow passages **21** between the inner wall **9** of the sides of the tower **1** and the outer periphery of the packing arrangement which will be open at the bottom thereof to the water storage space **2** and are continuous with the vapor flow space **15** about the baffle **13** at their upper end of the tower **1**.

The construction also provides horizontal flow passages in and through the packing arrangement which communicate with and lead into the vapor flow space passages **21** about the packing arrangement **14**.

This construction acts to provide uniform pressure throughout the apparatus promoting maximum degasification of the fluid for the specific pressure that is produced in the degasifying space by the pressure reduction apparatus.

Where there is a packing arrangement in the degasifying space which does not make provision for unrestricted vapor flow passages between the portion of the degasifying space above the packing and the spaces either within or below the packing, there will be during operation a significant difference in pressure in the space above the packing and the space below the packing due to the frictional engagement between the downflowing water and upflowing water vapor and non-condensible gases.

In packing arrangements with no provision for vapor flow passages if $P_t$ represents the pressure applied to the outlet or venting arrangement, then in the space above the packing arrangement the total pressure at the given temperature will be equal to $P_t$, while the pressure $P_t'$ will represent the pressure below the packing arrangement, which pressure will be greater than $P_t$ by an increment $\Delta P_t$ which is significant because the partial pressure of the vapor and non-condensible gases will depend upon the pressure and temperature conditions. $\Delta P_t$ represents the increment in pressure which occurs due to the frictional engagement between the downflowing water and upflowing water vapor and non-condensible gases where there are no vapor flow passages provided.

The effect of providing vapor flow passages, as in the present structure, is to make the value of $\Delta P_t$ approach zero, and as $\Delta P_t$ approaches zero the pressure $P_t'$ of the space below the packing arrangement will approach the pressure $P_t$ of the space above the packing arrangement, thus giving a uniform total pressure to the degasifying space and thereby producing the advantages and results of the present invention.

It is clear from the above that where vapor flow lanes are provided as against such equipment that does not have vapor flow lanes provided, the vacuum producing equipment would in the case where vapor flow lanes are provided be relatively light as compared with those used in equipment with no vapor flow lanes. This was clearly shown above as in apparatus where no vapor lanes are provided $\Delta P_t$ is significant and in such equipment where vapor flow lanes are provided this significant value is eliminated. Hence the equipment necessary for producing the vacuum is relatively light.

In operation raw water or fluid is led from a source not shown through the raw water inlet **4** into the degasifying space **3**, where it is discharged downwardly from the distributing conduits **5** and nozzles **6** through the baffle **13** onto the packing arrangement **14** whence it drips from layer to layer of the slats **16** releasing water vapor and non-condensible gases to the vapor collecting spaces. The effluent water is collected below the packing arrangement **14** in the water storage space **2** and will be drawn therefrom through the discharge outlet **19** for use.

While one form of the invention has been illustrated and described, it is obvious that those skilled in the art may vary the details of construction as well as the precise arrangement of parts and it is understood therefore that the invention is not to be limited to this arrangement but may be widely modified within the invention defined by the claim.

What is claimed is:

In a vacuum degasifier, a cylindrical tower forming a degasifying section in the upper end thereof and a water storage section at the lowermost end thereof, inlet means for delivering fluid to said tower at the upper end of said degasifying section for flow therein by action of gravity, a fluid directing element of substantially square horizontal cross-section mounted in said tower about the inlet means to direct fluid delivered from said inlets toward the center of said degasifying space, said fluid directing element mounted in spaced relation to the inner wall of said tower to form vapor flow spaces therebetween which vapor flow spaces communicate at their upper ends with said vent means, packing at substantially square horizontal cross-section in said degasifying section mounted therein in spaced relation to and between the outlet end of said fluid directing element and the water storage section to receive fluid from said inlet means, vertical vapor flow passages formed along the length of said packing and said vapor flow passages between the outer periphery of said packing and said tower, said vapor flow passages connected at their upper ends with said vapor flow spaces and opening at their lower ends into the degasifying space above said water storage section whereby substantially uniform total pressure may be maintained in said degasifying section, said packing including a plurality of stacked slats forming a plurality of stacked lateral passageways through the length of said packing, said passageways directly connected at one of their ends with said vertical flow passages to coact therewith to maintain substantially uniform total pressure in said degasifying section, and means for venting oxygen and non-condensible gases centrally located in the uppermost end of said tower and equidistantly spaced from said vapor flow spaces to coact therewith to provide for uniform flow of said non-condensible gases out of said vacuum degasifier.

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