

April 12, 1960

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2,932,361

LIQUID GAS CONTACT DEVICE

Filed Oct. 14, 1955

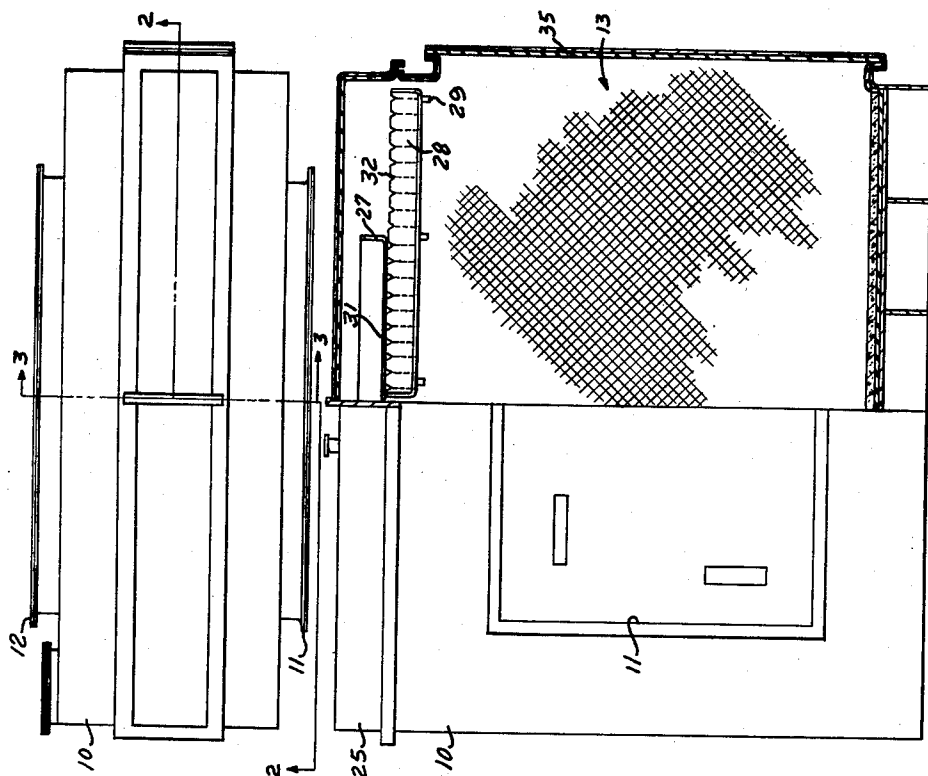


FIG-1

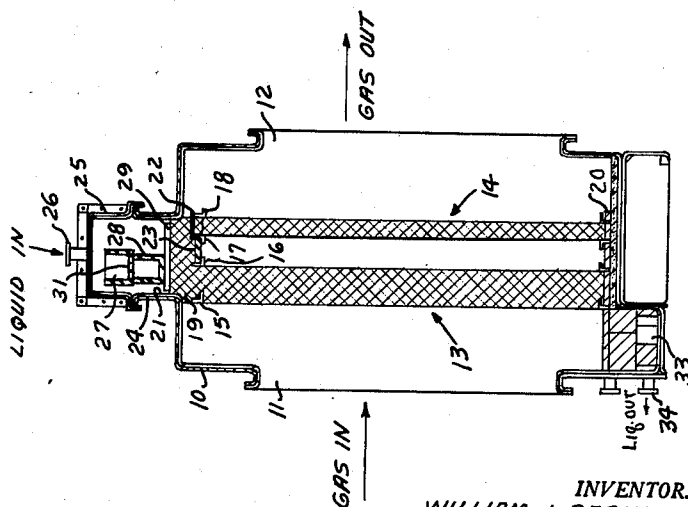


FIG-2

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1

2,932,361

LIQUID GAS CONTACT DEVICE

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Application October 14, 1955, Serial No. 540,528

6 Claims. (Cl. 183-26)

This invention relates to liquid gas contact apparatus, and particularly to such apparatus as it comprises a bed of packing material in which a gas and a liquid are brought into contact with one another for purposes of water cooling, air scrubbing and like purposes.

It is a general object of this invention to present an air washer or like device as described of relatively compact and unitary construction offering unusually high level performance in relation to the size and cost of manufacture thereof.

Another object of the invention is to introduce in devices of the kind described a principle of cross flow operation wherein the liquid and the gas flow through the packing bed at right angles to one another.

A further object of the invention is to achieve a cross flow operation as described while obviating any substantial amount of by-pass of the gas around the edges of the packing bed.

Still another object of the invention is to present a device of the kind described constructed for successful operation with corrosive fluids.

Other objects and structural details of the invention will appear from the following description when read in connection with the accompanying drawing, wherein:

Fig. 1 is a top plan view of a liquid gas contact device in accordance with the illustrated embodiment of the invention;

Fig. 2 is a view in longitudinal section, taken substantially along the line 2-2 of Fig. 1; and

Fig. 3 is a view in cross section, partly diagrammatic, taken substantially along the line 3-3 of Fig. 1.

Referring to the drawing, the device of the illustrated embodiment of the invention comprises a metal casing 10 of generally rectangular construction and formed at its front and back sides with oppositely disposed openings 11 and 12. These openings, together with the internal walls of the casing 10 define a flow passage for gas through the casing. Interposed in such flow path are beds 13 and 14 of packing material, in the former of which the gas is brought into contact with a liquid and in the latter of which excess moisture is removed from the gas prior to its leaving the casing by way of outlet 12. The packing bed 13 is shaped to conform to the lateral dimensions of the casing and is relatively shallow or short in relation to the length of the casing. It is comprised essentially of a large number of discrete saddle shaped elements which are hard, smooth surfaced objects made of a suitable inert material, for example chemical stoneware. All of the surfaces of the saddle elements are curved, there being no ledges or crevices to catch and collect foreign material. In forming the bed, the saddle elements are poured between opposing expanded metal grills of which only marginal angle bars 15 and 16 are shown, which confine the elements to the shape of the bed but do not materially restrict flow of air therethrough. The body of the packing bed thus is filled or substantially filled with the saddle elements which occupy random positions with respect to one another in the bed and define a maze of interconnecting irregularly shaped chambers and passageways, there being on account of the shape of the saddle elements a high proportion of open space in the bed as well as a very large contact area. The bed 14 may, as shown, be of less depth than the bed 13. It is similarly constructed and formed and mounted between grills which include angle

2

pieces 17 and 18. The side margins of the beds 13 and 14 extend to adjacent internal walls of the casing 10. The bottoms thereof rest on brick 20 built up from the bottom of the casing, with the lower edges of the bars 15-18 suitably anchored therein.

At its upper marginal edge, the packing bed 13 merges with or is formed with an upward extension 19 projecting into a transverse opening 21 in the casing 10 and offset toward the packing bed 14 to fill the opening 21. The offset part of the packing extension 19 overlies the upper marginal edge of the bed 14 and substantially merges therewith. One or more plates 22 hold the grill bars 17 and 18 separated. A plate 23 supports the packing extension and acts as a spacer between the beds 13 and 14. The extension 19 of the bed 13, it may be noted, serves to inhibit by-passing of the gas about the beds 13 and 14 by way of the opening 21. Thus, the pressure required to force the air through the relatively deep packing bed extension 19 is at least as great or greater than that required to pass the gas through the main body of the bed 13 and through the bed 14. There is no tendency, therefore, for the gas to short circuit around any part of the packing bed and its passage through the bed is evenly distributed over the entire area thereof.

In surrounding relation to the opening 21 in casing 10 is an upstanding flange portion 24 on which is removably seated a cover plate 25. The latter has an opening 26 for admission of liquid to the unit, the admitted liquid flowing into a feed box 27 which rests on distributor 28. The latter in turn rests on bars 29 suitably supported in the casing, as on clips (not shown) on the sides of the opening 26. The feed box 27 has spaced apart openings 31 therein while the distributor tray 28 is formed along one upper edge thereof with V-shaped notches 32 through which the liquid collecting in the tray 28 overflows and runs down the side of the tray on to the packing bed beneath. The tray 28 is arranged with the notched side thereof substantially centrally disposed over the packing bed 13. The overflowing liquid accordingly descends upon the upper marginal edge of the packing 19 and then down into the bed 13, in about the middle thereof, whence it descends by gravity through the bed and into a sump 33 at the bottom of the casing. From the sump 33 the liquid may leave the casing by way of an outlet 34 and be returned directly or indirectly to the inlet 26 for recirculation.

By reason of the arrangement of the distributor tray or trays 28, and of the V-cuts 32 therein, there is formed a large number of separated liquid streams which descend upon and enter the packing bed 13 at spaced points over the entire width of the bed. There is a further distributive effect in the packing bed, wherein the saddle elements break up and intermingle the several streams with the result that there is a uniform and even wetting of the packing bed with no opportunity offered for the liquid to form and follow channels therethrough. In the operation of the device, therefore, the liquid and gas are brought into intimate physical contact in the packing bed 13, with the gas flowing longitudinally through the bed and with the water descending downwardly or transversely therein at right angles to the direction of movement of the gas. The gas distributes itself evenly over the area of the packing bed, but in its passage through the bed is broken up into a multitude of small ribbon-like currents, and, as such, comes into contact successively with small currents of liquid traveling in thin films over each saddle element. A large surface area of gas comes into intimate contact with a large surface area of liquid under conditions of low surface tension. Used for purposes of air scrubbing or cleaning, the flowing liquid irrigates the packing bed which can be de-

scribed as providing for a labyrinth of smoothly flowing streams of liquid with an angular flow of turbulent air or gas streams. As the direction of each small ribbon of gas is changed by approximately 45°, which occurs at a rate of from eight to thirty-two times per foot of travel and in random directions, airborne solids in the gas stream tend to continue in the prior direction whereupon they impinge on and cling to the liquid film flowing over the packing pieces.

The bed 14 may be considered to be a dry bed. The gas leaving the bed 13 will be to a greater or lesser degree moisture laden and as it is caused to follow the labyrinth passages of the bed 14 the extensive contact with the unirrigated and relatively dry saddle elements in the bed results in collection of entrained moisture, and the gas as finally discharged from the outlet 12 is relatively dry.

For improved operation under conditions of corrosion, the shell of the casing 10 may be lined as shown with an acid resistant plastic membrane 35. The brick 20 may, moreover, be of acid proof construction and elements such as the spacer 22 and plate 23 may be made of non-metallic acid resistant materials. The upper end of the packing assembly comprising beds 13 and 14 and extension 19 may be suitably confined against longitudinal displacement, as by clips (not shown) mounted on the side wall of the casing. Such upper end of the packing assembly cooperates with upstanding flange portion 24 and cover 25 in the defining of a chamber containing the box 27 and tray 28. The described chamber constitutes a sealed enclosure, being supplied with liquid by way of inlet 26 and being otherwise closed to communication with the exterior of the device except through the bottom thereof which receives in relatively contacting relation the marginal bed portion 19.

What is claimed is:

1. A liquid gas contact device, including a longitudinally extending casing open at its ends for flow of a gas therethrough, a pair of spaced apart beds of packing material in said casing arranged for sequential flow of the gas therethrough, a transverse opening in said casing, said beds of material being positioned adjacent respective longitudinally spaced apart edges of said opening and marginal portions of said beds being bridged by packing material substantially received in and closing said opening as a by-pass for gas flow, and means for dripping liquid through said opening upon one of said beds of packing material.

2. A liquid gas contact device, including a longitudinally extending casing arranged for longitudinal flow of a gas therethrough, a pair of spaced apart beds of packing material therein arranged for sequential flow of gas therethrough, upper marginal edges of said beds being bridged by additional packing material substantially merging with the packing of said beds, a transverse opening in said casing in overlying relation to said additional packing material, and means received in said opening for dripping a liquid through said additional packing material onto the packing bed first encountered by the gas passing through said casing.

3. A liquid gas contact device including a casing presenting longitudinally extending internal walls defining a flow path for gas, means for dripping a liquid through said casing in cross-flow relation to the gas, a flat bed of packing material installed within said casing between said internal walls, said bed being arranged on edge and receiving the cross-flowing liquid on one marginal edge thereof, an integral extension of said bed extending from said one marginal edge in the direction of gas flow a distance at least equal to the length of the bed in said direction of gas flow and having a depth in the direction of liquid flow approximating the length of the bed beneath said extension, and a mist eliminator bed installed between said internal walls in parallel spaced relation to the first said packing bed, said integral ex-

tension of the first said packing bed terminating in overlying relation to said mist eliminator bed and supported thereby, said extension affording in itself an irrigated portion and an eliminator portion for gas passing there-through.

4. A liquid gas contact device, including a pair of generally vertical spaced apart beds of packing material arranged for sequential flow of gas therethrough, a generally horizontal bed of packing material extending between and substantially merging with the upper ends of said pair of beds, a sealed enclosure defining a chamber overlying said horizontal bed, said enclosure having portions of the walls thereof contacting the side ends of said horizontal bed, and means within said sealed enclosure and overlying one of said pair of beds for dripping a liquid through a portion of said horizontal bed into said one bed which said means overlies.

5. A liquid gas contact device, including a longitudinally extending casing open at its ends for flow of a gas therethrough, a lateral opening in the wall of said casing, means defining an upstanding sealed enclosure in surrounding relation to said opening, a liquid inlet to said enclosure, means to obtain a distributive dripping of the liquid from said enclosure through said casing in a plane transverse to the movement of the gas therethrough, a bed of packing material in said casing in said transverse plane to be irrigated by the dripping liquid, the periphery of said bed contacting said casing and in the region of said opening being enlarged to be received in and to close said opening, and a second bed of packing material in said casing longitudinally spaced from said transverse plane, the enlarged peripheral portion of the first said bed bridging this space between said beds and substantially merging with the second said bed, said beds and said merging peripheral portion forming in effect a single packing assembly having liquid irrigated and relatively dry mist eliminator portions.

6. A liquid gas contact device, including a longitudinally extending casing open at its ends for flow of a gas therethrough, a lateral opening in the upper wall of said casing, means defining an upstanding enclosure in surrounding relation to said opening, a liquid inlet to said enclosure, means to obtain a distributive dripping of the liquid from said enclosure downward through said casing in a plane transverse to the movement of the gas therethrough, longitudinally spaced apart open-work grills approximately transversely disposed in said casing and including a pair of grills having their upper edges on opposite sides of said lateral opening out of the plane thereof, packing bed means between said grills comprised of discrete particles poured between said grills, the periphery of the bed contacting the casing and in the region of said lateral opening filling said opening and extending outward in said sealed enclosure in contacting relation to the walls thereof, said longitudinally spaced apart grills further including a pair intermediate the one said pair, and a spacer between the upper edges of said intermediate pair of grills in supporting relation to the packing bed particles filling said lateral opening and defining beneath said spacer spaced apart beds of the packing material.

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