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APPARATUS FOR INTERPHASE CONTACT BETWEEN FLUIDS

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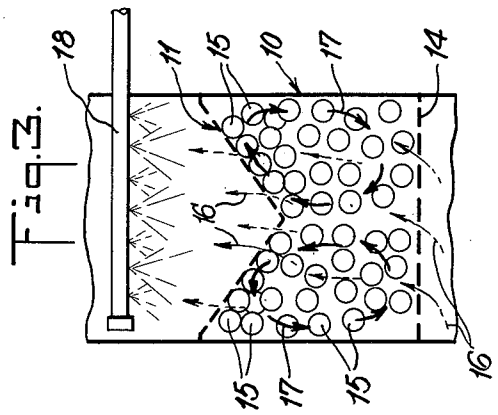


Fig. 3.

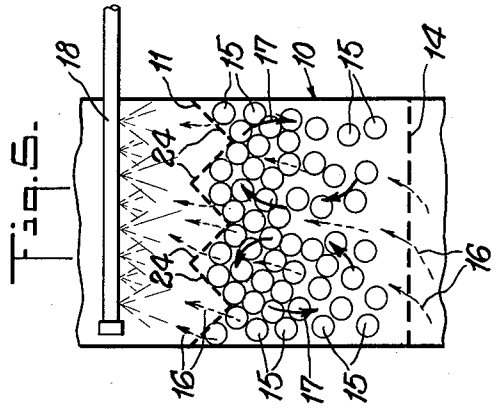


Fig. 5.

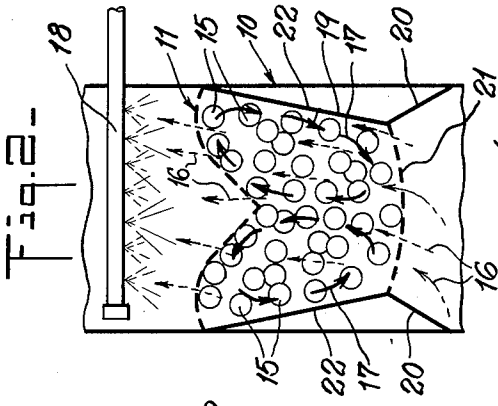


Fig. 2.

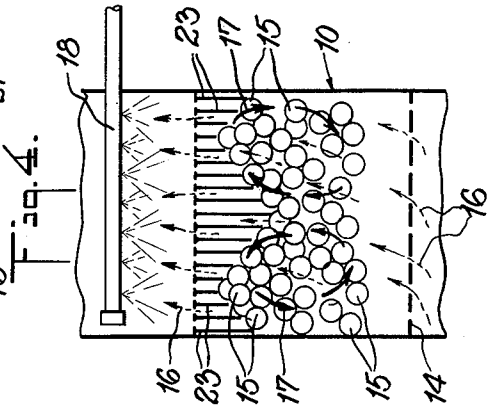


Fig. 4.

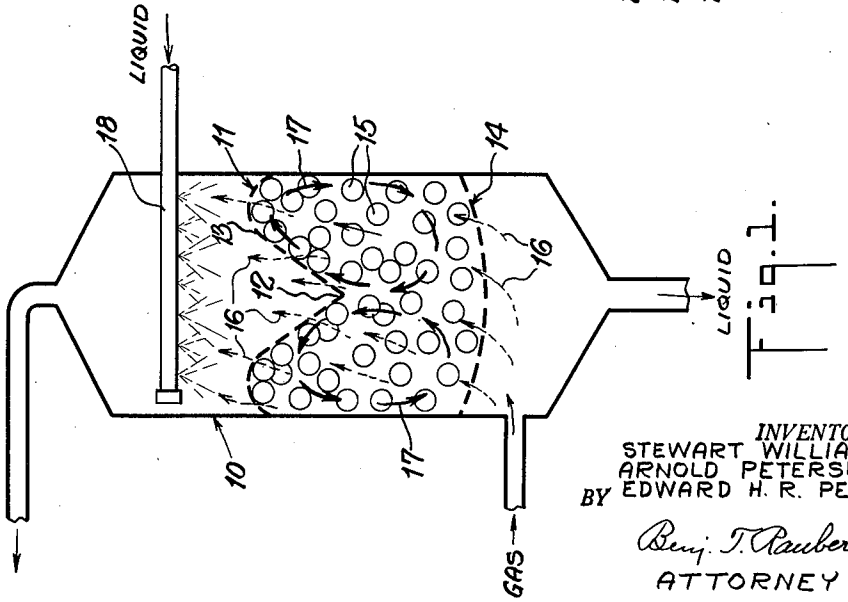


Fig. 1.

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APPARATUS FOR INTERPHASE CONTACT BETWEEN FLUIDS

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Our invention relates to improvements in an apparatus of A. W. Kielback described in Belgian Patent No. 581,-152 and South African Patent No. 2,704/59.

In the method described in the above patents an interphase contact between fluids is achieved, and more particularly methods and arrangements are described for effectuating mutual contact between gas and liquid in counter-current flow.

The above invention utilizes a vertical shell having one or several compartments composed of relatively horizontal upper and lower grilles between which appropriately weighted spheres are contained. Within the shell above the upper grille water or other absorbing liquid is introduced and gas or air containing the product to be collected, or any impurity to be removed, is introduced beneath the lower grille. The appropriately weighted spheres are partially suspended by the upwardly passing gases or air in more or less constant motion due to the counter-current air or gas and liquids reacting thereon.

The upwardly buoyed weighted spheres are said to form a loose and mobile bed and to obtain a rotating and turning movement of the spheres which results in a maximum of wetted surface of the spheres being exposed to the gas or air and due to the motion of the spheres tends to inhibit the collection of solid particles, such as tar, on the surface of these spheres. The proper rotation and motion of the spheres can be obtained only by a correct ratio between the weight of the spheres per cubic volume, the volume of liquid descending and the flow and velocity of gas passing upward.

If the amount of upwardly passing gas is excessive the spheres have a tendency to mat against the undersurface of the grille and at this point to remain relatively stationary. Such lack of motion tends to defeat the primary purpose of a floating bed of spheres. Consequently there is an increased tendency to collect tars or other substances and the free air flow of the gas is decreased with a result that the resistance to the passage of gas through the apparatus is increased.

Our invention provides apparatus in which the capacity for the flow of gas within the apparatus is increased relative to its size and in which the tendency of the spheres to rotate and to be violently agitated is also increased.

In our invention the upper grille against which the spheres are buoyed is provided with inclined surfaces so that as these spheres contact the slanting sides of the grille they move upwardly at an incline displacing spheres at the upper end of the inclined surface sidewise causing them to move downwardly and to thereafter inwardly and upwardly to the inclined surface. There is, therefore, created a circulation and agitation of the spheres which causes them to rotate individually so that water or other cleaning fluid supplied above the upper grille and descending to contact with the spheres coat the surfaces of the spheres uniformly and present the liquid coated surfaces to a maximum contact with the upwardly passing gas or air.

There may be inclined surfaces of various forms, some of which present a number of downwardly pointed ridges. In a preferred form of the invention the grille is inclined from a central point or ridge upwardly and outwardly to the wall of the container and is curved reversely downwardly. This causes a circulation of the weighted spheres upwardly at the center of the container, thence outwardly along the lower surface of the grille to the outer wall of the container whereupon they move downwardly and back to the center. In this preferred embodiment also the lower grille may be curved to present an upwardly concave curvature which facilitates the circulation of the downwardly descending spheres toward the center of the apparatus.

The various features of our invention are disclosed in the accompanying drawings in which

FIG. 1 is a vertical section of the apparatus embodying a preferred form of the invention;

FIG. 2 is a similar section through apparatus embodying a different form of the preferred embodiment;

FIG. 3 is another form of embodiment of the invention, and

FIGS. 4 and 5 are embodiments showing a number of oppositely inclined surfaces of the upper grille.

Referring more particularly to FIG. 1, the gas cleaning apparatus of our invention comprises a container **10** having a grille **11** extending upwardly from a center point or ridge **12** to a reversely curved portion **13** which merges with the wall of the container **10**. A lower grille **14** spans the container at a distance below the upper grille and is dished downwardly. A number of appropriately weighted spheres **15** is provided between the grilles **11** and **14** and kept in suspension by means of the passage of gas upwardly from the bottom or lower part of the container **10** through openings in the grilles, as indicated by the broken line arrows **16**. The air or gas then passes upwardly through the lower grille **14** and buoys the spheres **15** upwardly bringing them into contact with the sloping portion of the grille **11**. Upon contact with the sloping portion of the grille the spheres move upwardly and outwardly to the reversely curved portion **13**, thence downwardly along the inner surface of the container **10** and return to the central portion as indicated by the solid line arrows **17**.

Water is sprayed through a spray pipe **18** above the upper grille **11** and passing downwardly through this grille counter-current to the flow of air wets the spheres. It will be understood that the upwardly passing gas causes the spheres to react against the inclined surface of the upper grille to give them an outer component of motion which displaces spheres that collect beneath the reversely curved portion **13**. A collection of the spheres below the reversely curved part **13** of the grille causes them to move downwardly because of an increased number of spheres relative to the flow of gas along the inner surface of the container.

In FIG. 2 the container is shown as having an inner wall **19** which contracts upwardly at **20** to a throat portion **21** and then expands outwardly as at **22** to the wall of the container. This has the effect of increasing the upward flow of the gas centrally of the container and favoring a rapid circulation of the spheres.

In the embodiment shown in FIG. 3 the arrangement of the lower grille **14** and of the upper grille **11** in the container **10** is similar to that of FIG. 1, however, the upper grille **11** extends from the central part of the inner surface of the wall of the container without change of inclination, and the lower grille **14** is flat and horizontal.

In the embodiment shown in FIG. 4 the lower grille may be flat as in FIG. 3, or dished as in FIG. 1. The upper grille is provided with downwardly extending pins **23** of different lengths so as to form upwardly inclined points of contact with the spheres **15** and thus provide for an upward and sidewise movement of the spheres thereby obtaining in multiple a circulation similar to that of FIG. 1.

In FIG. 5 arrangement is similar to that of the preceding figures except that the upper grille **11** is made with a number of sections **24** of alternate inclination. In this embodiment of the invention the spheres move upwardly along the inclined surface of the grille toward the ridge part and thence drop downwardly to be recirculated due to a decreased buoyant effect of the air relative to the spheres at these elevated points on the grille.

The various modifications are all directed to the achievement by the same end, namely the prevention of a relatively consolidated mat of spheres against the upper grille basically by increasing the area of the upper grille, lowering the resistance of flow of gas and creating a more rapidly moving and rotating group of spheres. This results, among other advantages, in a greatly increased capacity of the apparatus.

For example in a container of equal size the use of the grille arrangement shown in FIG. 1 increased the capacity 9.6%. The resistance to flow was at the same time decreased 20%. Based upon the ratio of resistance to flow relative to the capacity, the reduction was in effect equal to 33.5% of the pressure that would have been required to obtain the same capacity as that of the embodiment of FIG. 4.

Having described our invention, what we claim is:

1. Apparatus for interphase contact between a liquid and a fluid which comprises a container having a pair of vertically spaced foraminous partitions dividing said containers into a lower chamber for the inlet of gas and withdrawal of liquid, an upper chamber for the supply of liquid and the withdrawal of gas and an intermediate chamber for interphase contact of said liquid and gas, said upper partition extending in a succession of oppositely inclined upwardly sloping areas from one wall of said container to the opposite wall to deflect spheres in said intermediate chamber upwardly and sidewise along the under surface of said partition, said container having a gas inlet below the lower partition and a gas outlet above the upper partition, a liquid supply element above the upper partition and a liquid outlet below the lower partition and spheres in said container between said partitions, said spheres being of a weight to be buoyed upwardly against the upwardly sloping areas of said upper partition and to move upwardly and transversely along said sloping areas.

2. Apparatus for interphase contact between a liquid and a fluid which comprises a container having a pair of vertically spaced foraminous partitions dividing said container into a lower chamber for the inlet of gas and withdrawal of liquid, an upper chamber for the supply of liquid and withdrawal of gas and an intermediate chamber for interphase contact of said liquid and gas, the upper partition having areas sloping upwardly, said upper partition comprising a flat horizontal foraminous plate and pins extending downwardly from said plate to ends lying in inclined planes to deflect spheres in said intermediate chamber upwardly and sidewise along the under surface of said partition, said container having a gas inlet below the lower partition and a gas outlet above the upper partition, a liquid supply element above the upper partition and a liquid outlet below the lower partition and spheres in said container between said partitions, said spheres being of a weight to be buoyed upwardly against the upwardly sloping areas of said upper partition and to move upwardly and transversely along said sloping areas.

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