Oct. 11, 1966 J. MORITZ 3,278,170

APPARATUS FOR PLACING GASES AND LIQUIDS INTO INTIMATE CONTACT

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Fig. 1

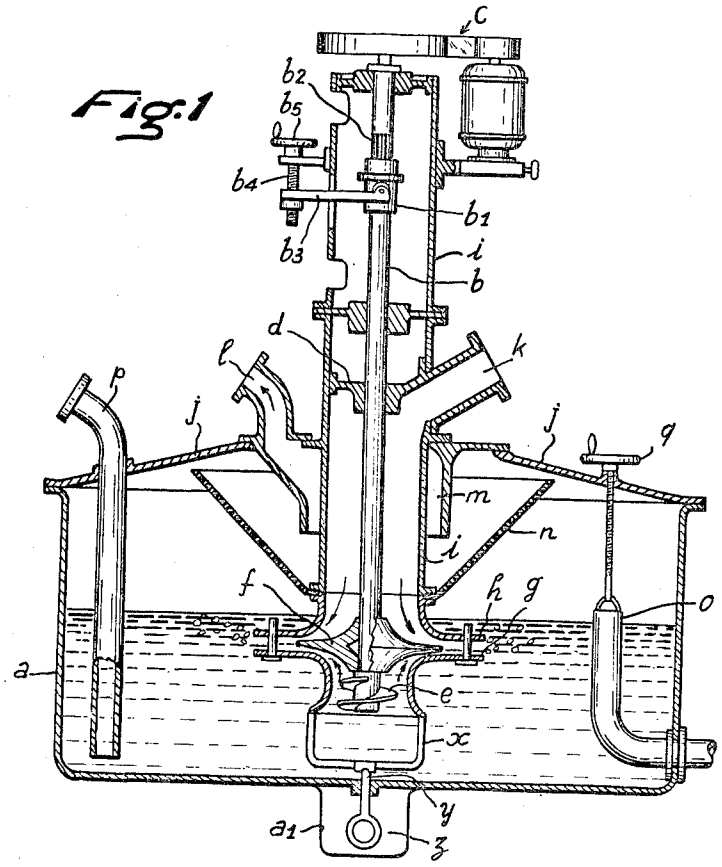


Fig. 2

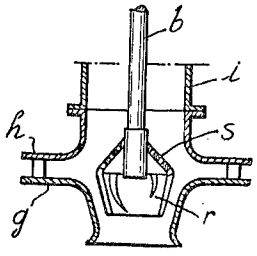
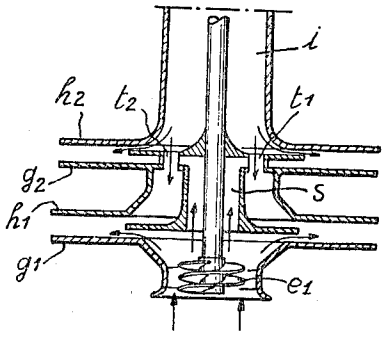


Fig. 3



INVENTOR

JEAN MORITZ

By Irwin S. Thompson

ATTY.

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Fig. 4

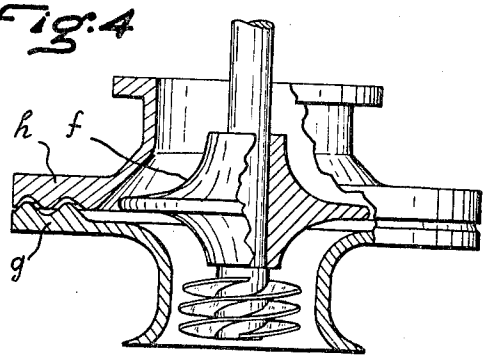


Fig. 5

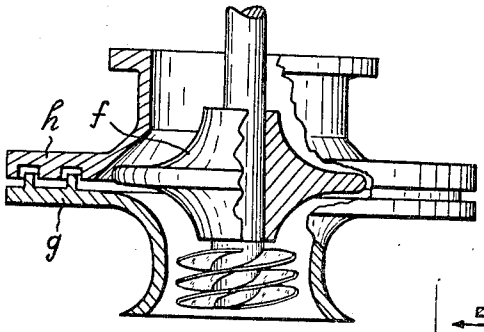


Fig. 7

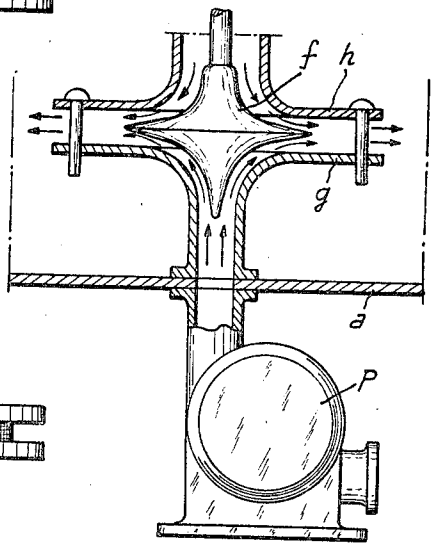
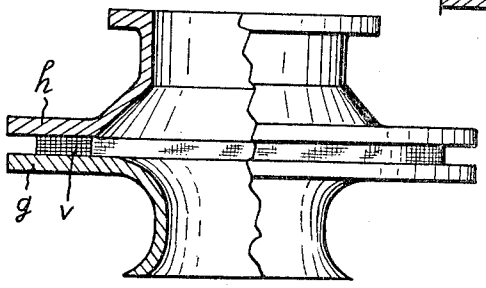


Fig. 6



INVENTOR

JEAN MORITZ

By Irwin S. Thompson

ATTY.

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APPARATUS FOR PLACING GASES AND LIQUIDS INTO INTIMATE CONTACT

Jean Moritz, 3 Rue de Pomereu, Chatou, Seine-et-Oise, France

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9 Claims. (Cl. 261—29)

This invention relates to an apparatus for placing gases and liquids into intimate contact, especially in the manufacture of sulphuric acid, and has the aim of providing an apparatus intended to mix gases and liquids intimately with an efficiency superior to that of the apparatuses known hitherto.

This apparatus is intended more particularly for contact between anhydride and acid and water in the manufacture of sulphuric acid.

The apparatus according to the invention comprises a container for the liquid with which gas is to be mixed, in combination with an annular outlet nozzle which is disposed in the container and which is comprised of two circular plates that are spaced apart and are coaxial about an upright axis with their radially outer edges defining between them an annular outlet orifice which is positioned to be immersed in the liquid in the container. A circular deflector is coaxial with and is spaced between the plates, the deflector having opposite upper and lower surfaces that converge radially outwardly. Means are provided for introducing a gas downwardly against the upper surface of the deflector, and means are also provided for projecting a liquid upwardly against the lower surface of the deflector, thereby to promote parallel flow of the liquid and the gas radially outwardly beyond the deflector.

In preferred embodiments of the invention, the deflector is carried by a shaft which extends through a gas supply conduit, this shaft being preferably the drive shaft of an impeller such as a helical screw which impels the liquid against the underside of the deflector. It is also preferred that liquid supply means be provided for the container, and also that baffle means be provided in the path of exiting gas so as to elongate the gas path. It is further preferred that an upright conduit be fixed in the container with the nozzle disposed coaxially with and intermediate the ends of the conduit, and that the container be closed but have a gas outlet. It is further preferred that the nozzle plates have confronting surfaces that converge radially outwardly, and that the deflector be spaced from the means that project liquid against its underside, in the direction of liquid flow toward the deflector means.

By way of example there will be described hereinafter a form of embodiment and variants, in accordance with the invention, with reference to the accompanying drawing wherein:

FIGURE 1 is a profile view in vertical axial section of the said form of embodiment, and

FIGURES 2 to 7 are partial profile views representing six variants.

In the drawing, the apparatus as represented in FIGURE 1 permits of ensuring the gas-liquid contact by reason of the formation of a liquid film which encounters the gas to be treated or to be absorbed, the liquid and gas then proceeding radially outwardly in the compression zone of a nozzle comparable to a Venturi nozzle, but of annular form.

The assembly comprises a tank a in which there is situated the liquid to be placed in contact with the gas.

At the center there is situated a vertical shaft b driven at the upper part by a mechanism c composed for example of pulleys, belts and motor. This drive can however be situated equally beneath the tank.

A packing gland d is placed at the passage of the shaft. At the lower end of the shaft, in the liquid, there is situated a helical turbine e or a suitably hooded centrifugal turbine, then a fixed annular fluid deflection member or deflector f, which may be adjustable in height, then on the periphery two fixed flanges g and h of adjustable spacing. A tubular jacket or conduit i maintains the whole on the cover j of the tank.

The adjustment of the height of the deflector f is effected by vertical displacement of the shaft b by means for example of a splined sleeve b^1 sliding on a similarly splined portion b^2 of the shaft b. The sleeve b^1 possesses a coaxial ring which bears upon a roller at the end of an arm b^3 which is movable vertically under the action of a worm b^4 operable by means of a hand wheel b^5.

The gas to be treated arrives through k and issues through l after having passed through a cylindrical circular collar m very close to the center, which is intended to compel the gas to travel a long path, and a conical perforated screen n can be placed in the path of the gas.

The acid or liquid in circulation in the apparatus enters at p and issues through a device o the height of which is regulable by the hand wheel q.

In a first variant represented in FIGURE 2, the helical turbine device can be replaced by a projection cone composed for example of a lower cone provided internally with helical vanes r and an upper inverted cone pierced with holes over the entire surface s. By the rotation of the shaft b the liquid, the level of which is in this case generally that of g, is projected into the interval from the base of the tube i until the moment when the gas-liquid mixture is compressed in passing through the space between the nozzles h and g.

The variation of the rotation speed adjusts the quantity of liquid placed in contact with the gas.

In the case of a great gas-liquid flow, FIGURE 3 represents a second variant comprising a device having two systems of nozzles in parallel, supplied like that in FIGURE 1. The helical pump e^1 sends liquid in parallel into the two sets of nozzles h^1–g^1 and h^2–g^2, passing through the concentric tube s, while the gas arriving from the tube i is divided towards the nozzle h^2–g^2 and passes through the passages t^1–t^2 to arrive at the nozzle h^1–g^1.

This same arrangement can be reproduced a plurality of times along the shaft in such manner as to increase further the passage sections and consequently the flows of gas and liquid.

The liquid film which forms in the nozzle encounters the gas in a more or less dense layer, and in order afterward to increase the contact time in the nozzle, the flanges h and g of this nozzle can be provided with sinusoidal baffles, as shown in FIGURES 4 and 5, which represent a third and a fourth variant respectively, the spacing of the two nozzles being possibly regulable from the exterior in order to modify the effectiveness.

With the aim of further improving the gas-liquid contact, FIG. 6 represents a fifth variant in which an annular flat coil v is placed between the two flanges h and g of the outlet nozzle. The coil v is composed either of an outer cage of metal gauze filled with concentric metal wires or wires placed in undulating coils, or by a cage of metal gauze filled either with rings of the "Raschig" kind or with various parallel fibers of textile materials, synthetic materials, glass, etc., of more or less fine diameter, these fibers having a capillary effect upon the liquid which they retain, thus improving the contact with the gas passing through the coil.

These latter arrangements can be used with the multiple nozzle arrangements as represented in FIGURE 3.

According to a sixth variant, represented in FIGURE 7, the helical or centrifugal turbine controlled by the rotation shaft *b* is replaced by a centrifugal pump P or other pump, which is placed outside the tank *d* and delivers the liquid for example to the bottom of the entry of the jacket.

In order to adjust the spacing of the flanges *h* and *g*, by way of example there is provided a mechanism comprising a stirrup *x* fast with a rod *y* passing through the bottom of the container *a* and operable vertically by means of an eccentric *z* lodged in a recess a^1 arranged below the container *a*.

I claim:

1. Apparatus for placing gas and liquid into intimate contact, comprising a container for the liquid, an annular outlet nozzle disposed in the container and comprised of two circular plates that are spaced apart and coaxial about an upright axis with their radially outer edges defining between them an annular outlet orifice which is positioned to be immersed in the liquid, a circular deflector coaxial with and spaced between the plates, the deflector having substantially smooth, unobstructed opposite upper and lower surfaces that converge radially outwardly, means for introducing a gas downwardly against said upper surface of the deflector, and means for projecting a liquid upwardly against said lower surface of the deflector thereby to promote parallel flow of liquid and gas radially outwardly beyond the deflector, said deflector being spaced from said projecting means in the direction of liquid flow toward said deflector.

2. Apparatus as claimed in claim **1**, and a gas inlet conduit, and a shaft disposed in the gas inlet conduit and supporting said deflector.

3. Apparatus as claimed in claim **1**, and an upright drive shaft, impeller means for the liquid disposed on the lower end of the shaft, said deflector being carried by the shaft above said impeller means.

4. Apparatus as claimed in claim **1**, and means for introducing liquid into the container.

5. Apparatus as claimed in claim **1**, and baffle means for elongating the path of travel of the gas in the container.

6. Apparatus as claimed in claim **1**, and an upright conduit fixed in said container, said nozzle being disposed coaxially with and intermediate the ends of the conduit, the container being closed but having a gas outlet.

7. Apparatus as claimed in claim **1**, said nozzle plates having confronting surfaces that converge radially outwardly.

8. Apparatus as claimed in claim **1**, said deflector being spaced from said projecting means in the direction of liquid flow toward said deflector.

9. Apparatus for placing gas and liquid into intimate contact, comprising a container for the liquid, and upright conduit fixed in said container, an annular outlet nozzle disposed coaxially with and intermediate the ends of the conduit, said nozzle being comprised of two circular plates that are spaced apart and coaxial about an upright axis with their radially outer edges defining between them an annular outlet orifice which is positioned to be immersed in the liquid, said nozzle plates having confronting surfaces that converge radially outwardly, a circular deflector coaxial with and spaced between the nozzle plates, the deflector having substantially smooth, unobstructed opposite upper and lower surfaces that converge radially outwardly, means for introducing a gas downwardly against said upper surface of the deflector, and means for projecting a liquid upwardly against said lower surface of the deflector thereby to promote parallel flow of liquid and gas radially outwardly beyond the deflector, said deflector being spaced from said projecting means in the direction of liquid flow toward said deflector.

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HARRY B. THORNTON, *Primary Examiner.*

ROBERT F. BURNETT, *Examiner.*

T. R. MILES, *Assistant Examiner.*