

United States Patent

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- [54] GAS WASHER**
1 Claim, 12 Drawing Figs.

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|------|----------------------|---|
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55/230, 55/238, 55/259, 261/79 A, 261/89 |
| [51] | Int. Cl..... | B01f 3/04 |
| [50] | Field of Search..... | 261/89,
18.2, 88, 79.1; 55/238, 230, 259 |

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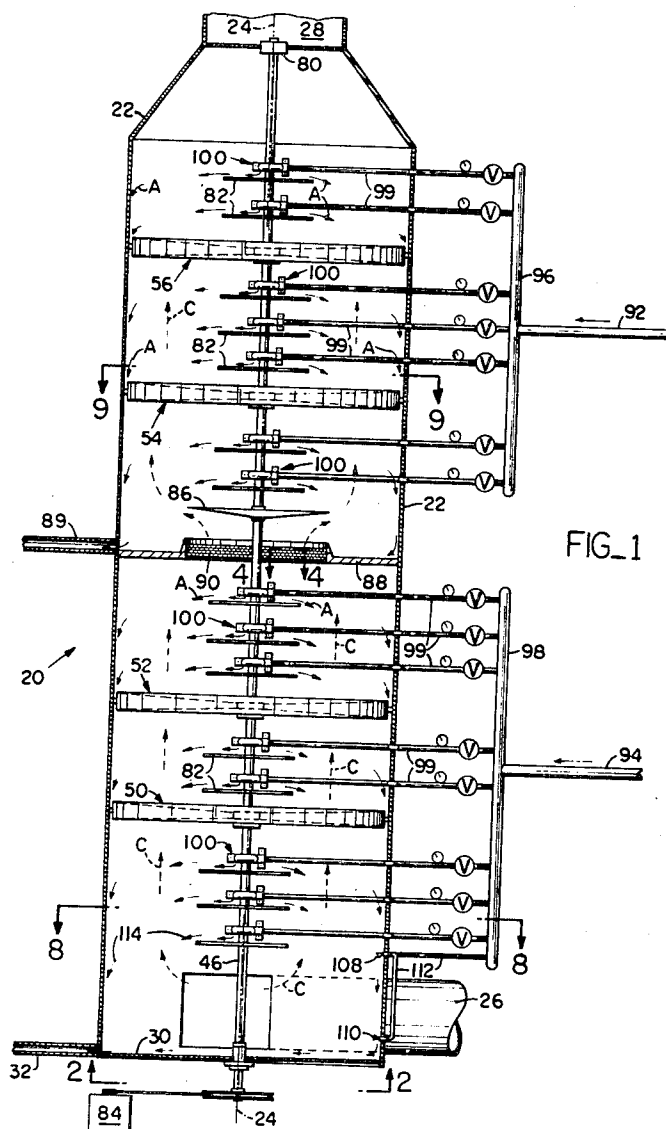
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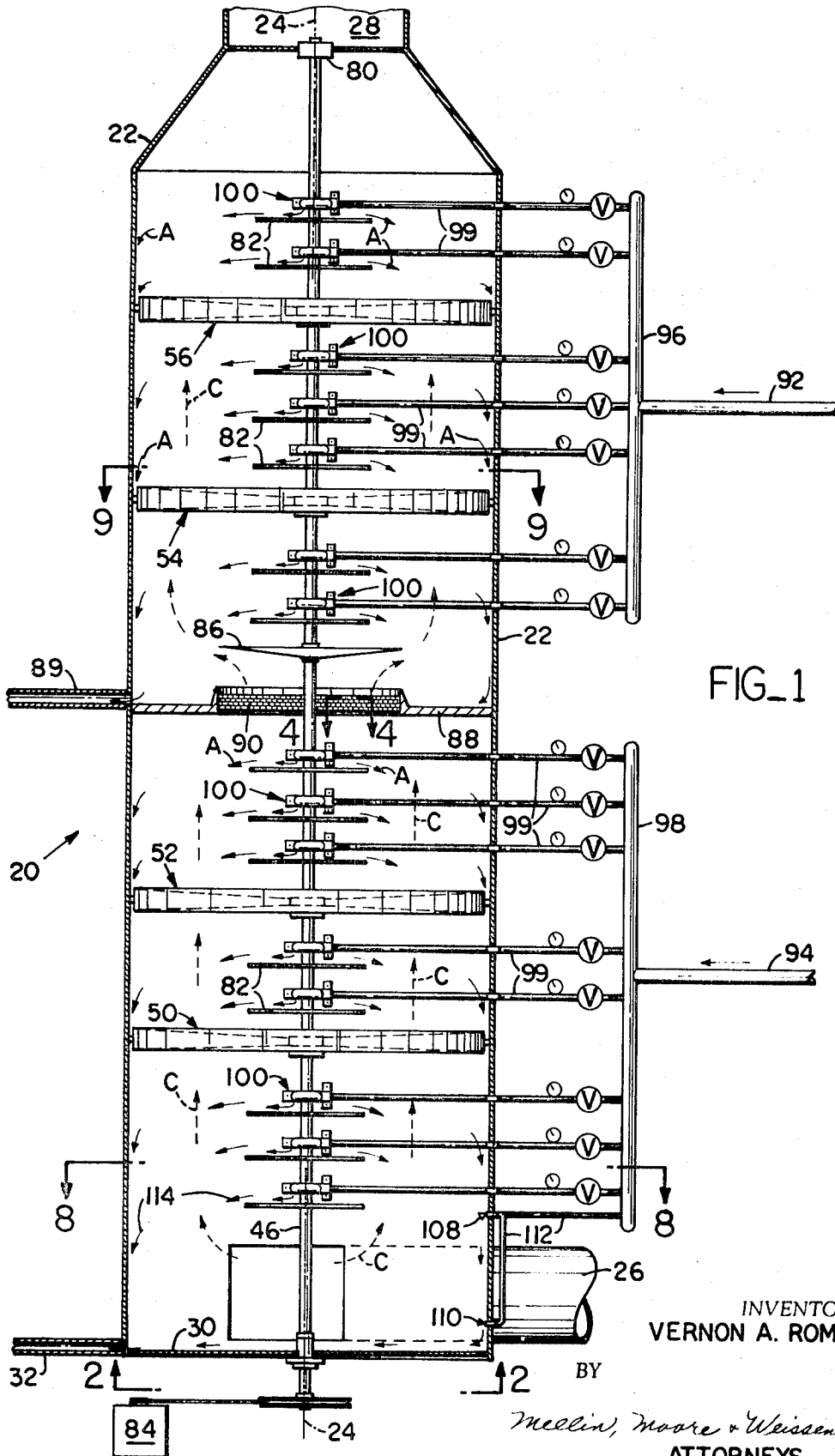
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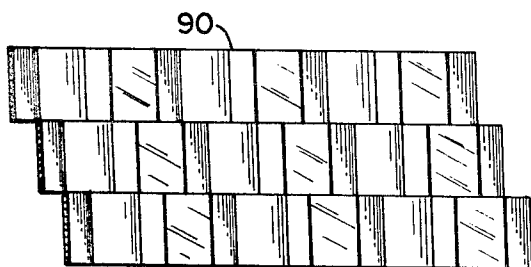
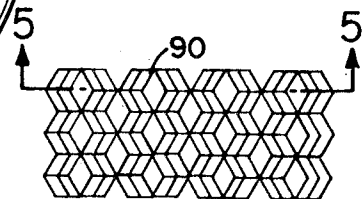
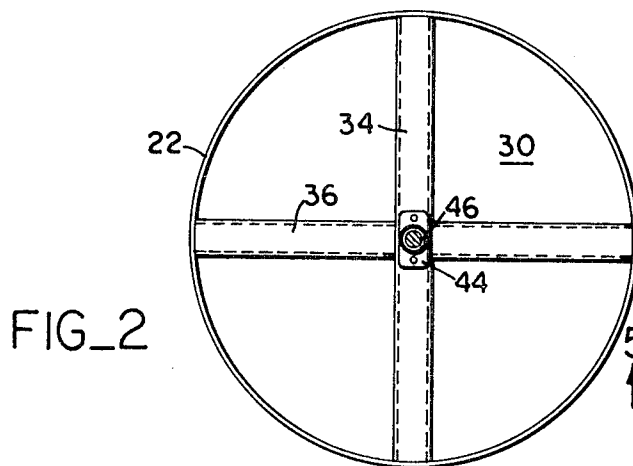
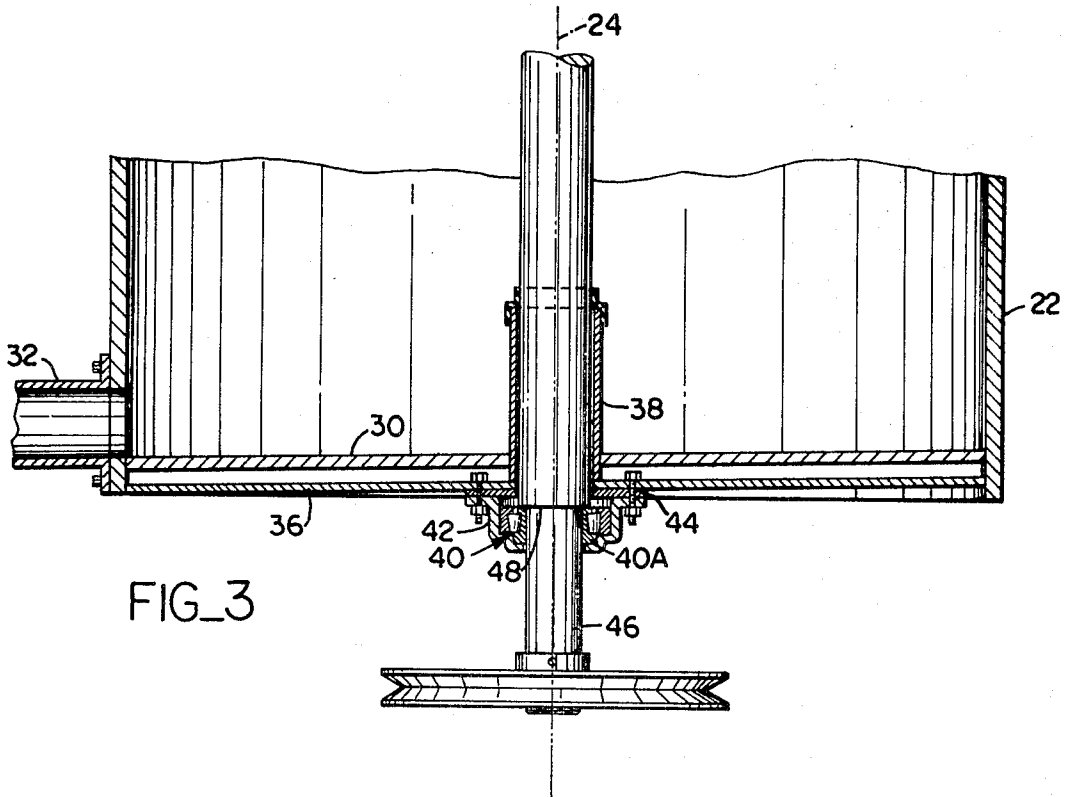
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ABSTRACT: A gas-washer includes means for providing a series of continuous sheets of liquid, through which gas is directed. The gas is exposed to each liquid sheet for a time sufficient so that gas, after passing through the liquid sheets, is effectively washed.







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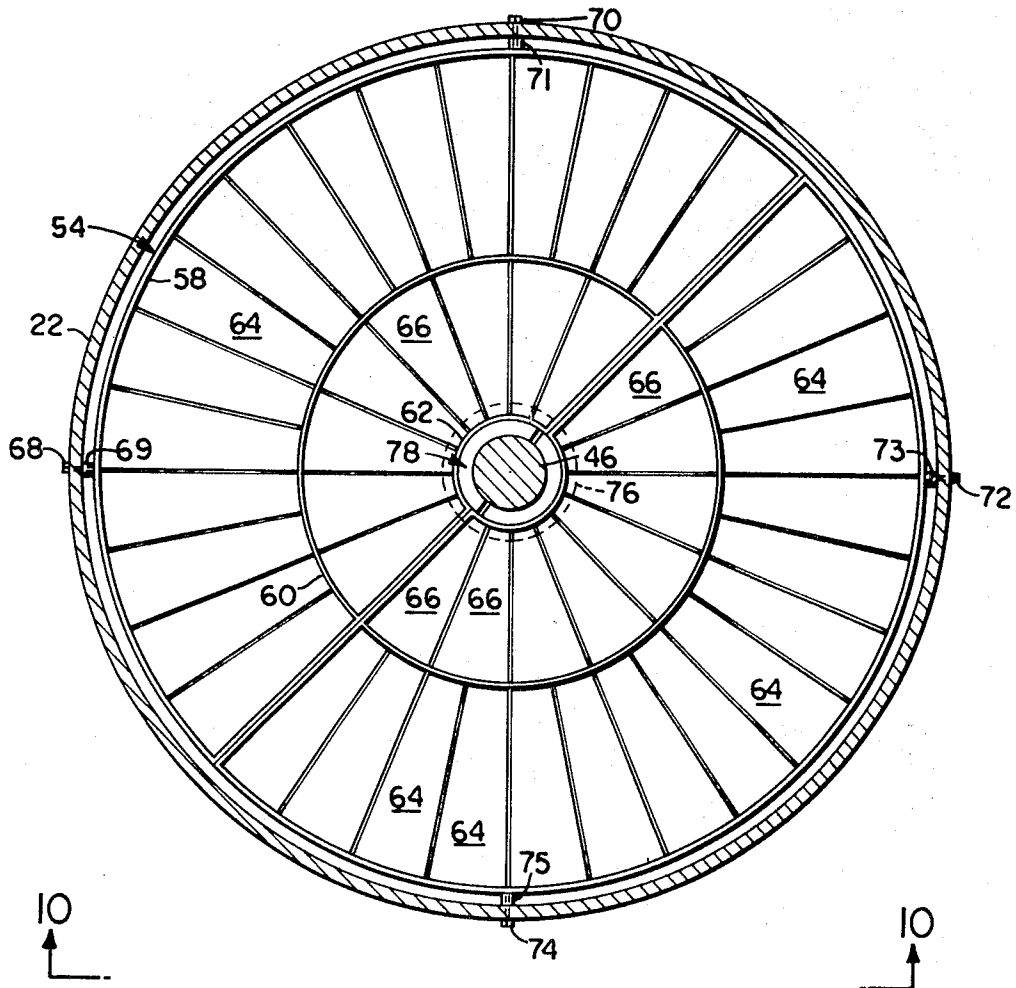


FIG. 9

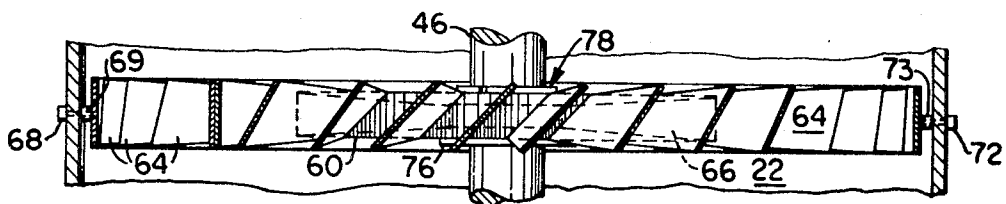


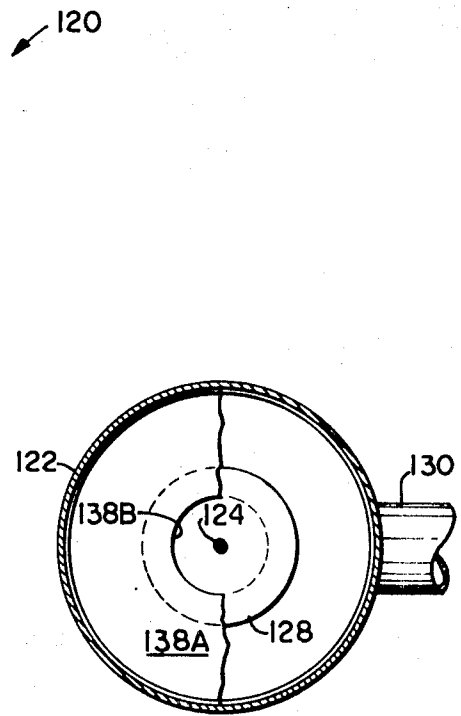
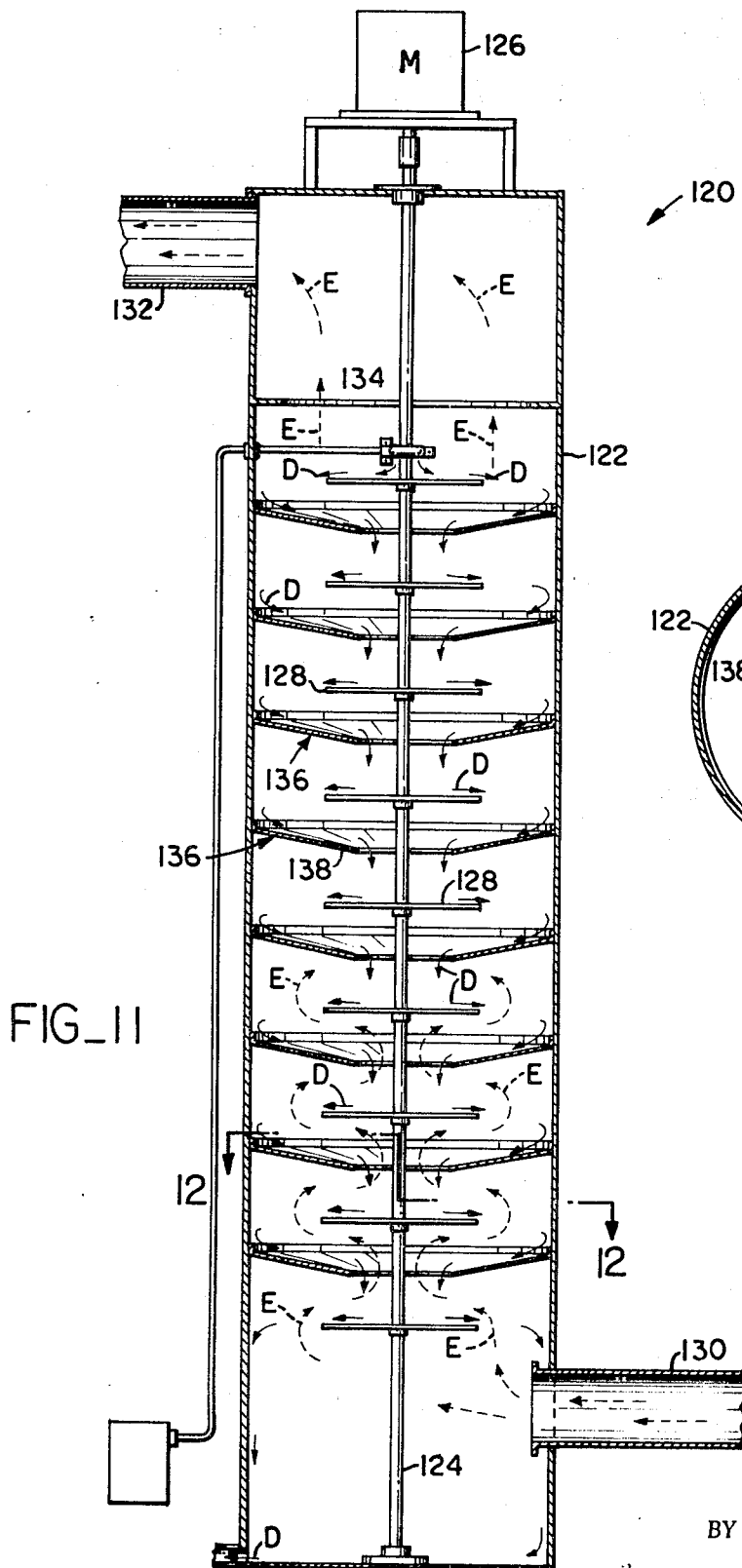
FIG. 10

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GAS WASHER

BACKGROUND OF THE INVENTION

This invention relates to gas-washing apparatus, and, more particularly, to apparatus wherein gas to be washed is passed through a plurality of continuous, unbroken liquid sheets.

Various devices for washing gas are, of course, well known. Generally, such devices utilize a number of liquid showers, or sprays, with each shower, hopefully, removing some of the foreign matter in the gas. While such devices have been found to wash a gas reasonably effectively, certain problems exist. Because of the individual jets in a spray or shower, there are open paths through the shower through which gas particles can pass without the liquid acting on them. Thus, it is not ensured that the gas particles will be properly washed.

It is an object of this invention to provide a gas-washer which maximizes the washing efficiency thereof by having the gas pass through a series of separate, continuous sheets of liquid. Such increased efficiency, in turn, results in the gas being effectively washed.

It is a further object of this invention to provide a gas-washer which, while fulfilling the above object, is extremely simple and economical in construction and operation, and requires a minimum of maintenance.

SUMMARY OF THE INVENTION

Broadly stated, the inventive gas-washer comprises a tubular vessel, and means for causing the gas to flow into and through the tubular vessel. Means are included for producing liquid sheets of continuous surface. Means are included for directing the flow of gas through the continuous liquid sheets.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of the invention will become apparent from a study of the following specification and drawings, in which:

FIG. 1 is a side elevation, partially in section, of a first embodiment of the inventive gas-washer;

FIG. 2 is a view taken along the line 2—2 of FIG. 1;

FIG. 3 is an enlarged sectional view of the bottom portion of the device of FIG. 1;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is a plan view, with portions removed, of a spray nozzle of the device;

FIG. 7 is a view with portions removed, of a spray line 7—7 of FIG. 6;

FIG. 8 is a sectional view taken along the line 8—8 of FIG. 1;

FIG. 9 is a sectional view taken along the line 9—9 of FIG. 1;

FIG. 10 is a view with portions removed, taken along the line 10—10 of FIG. 9;

FIG. 11 is a side elevation, partially in section, of a second embodiment of the inventive gas-washer;

FIG. 12 is a sectional view taken along the line 12—12 of FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Shown generally in FIG. 1 is a first embodiment of gas-washer 20. Such gas-washer 20 includes a tubular vessel or body 22 of generally cylindrical shape and having a generally vertical axis 24. At the base of the body 22 is an inlet 26 through which unwashed gas enters into the body 22 (FIG. 8). Such unwashed gas is then directed generally upwardly through the body 22, which has as its top an opening 28 for allowing the gas out.

The construction of the base portion of the body 22 is shown in FIGS. 2 and 3. The bottom 30 of the body 22 is angled slightly downward toward an outlet pipe 32, as shown in FIG. 3. The bottom 30 is braced by a pair of braces 34, 36, of

generally U-shaped cross section. A sleeve 38 is disposed through and fixed to the bottom 30 with its axis along vertical axis 24. A tapered bearing 40 is fixed to the brace 34 by bearing retainer 42, with a wedge plate 44 interposed between them to align the axis of rotation of bearing 40 with vertical axis 24 of body 22.

Disposed through a sleeve 38 and through bearing 40 along the vertical axis 24 is a longitudinal shaft 46. Such a shaft 46 includes a step portion 48 which rests on the inner race 40A of bearing 40, which supports the shaft 46, meanwhile allowing it to be rotated about vertical axis 24. The shaft 46 is kept in alignment with vertical axis 24 by means associated with gas deflectors 50, 52, 54, 56, one of which is shown in detail in FIGS. 9 and 10. Gas deflector 54 includes circular bands 58, 60, 62, with a plurality of angled blades 64 welded between bands 58 and 60, and another plurality of angled blades 66 welded between bands 60 and 62. The outer periphery of the deflector 54 is defined by circular band 58 and is dimensioned to fit just within the inner wall surface of the body 22, allowing a small gap therebetween all the way around the periphery. The deflector 54 is fixed to the body 22 by bolt means 68, 70, 72, 74 which pass through body 22 and threadedly engage with nuts 69, 71, 73, 75 fixed to band 58. The bolt means 68, 70, 72, 74 may be adjusted relative to the body 22 to ensure that there is a proper gap between the periphery of the deflector 54 and the inner wall surface of the body 22.

Fixed to the bottom side of band 62 is a ringlike plate 76 which supports a split nylon bearing 78. Shaft 46 is disposed through bearing 78, which keeps the shaft 46 in alignment with the vertical axis 24. The other deflectors 50, 52, 56, it will be understood, are similarly constructed, and align the shaft 46 in the same manner. A bearing 80 is included adjacent the top of shaft 46.

Fixed to the shaft 46 at spaced intervals along its length are discs 82, each of which is in generally perpendicular relation to said shaft 46. Means 84, such as a motor, are included for rotating the shaft 46, and the discs 82 along with it. A deflector plate 86 is also fixed to shaft 46, and is rotatable therewith.

An annular trough 88 is fixed within the body 22 about halfway up along its length. A separator 90 of generally honeycomb configuration, as shown in FIGS. 4 and 5, is disposed about the shaft 46 and around the inner periphery of annular trough 88. Each aperture in the honeycomb is in the order of one-eighth inch wide. Trough 88 feeds into an outlet pipe 89. Liquid under pressure is supplied to pipes 92, 94, into manifolds 96, 98, and then through tubes 99, which pass through the body 22. As shown in FIGS. 6 and 7, on the end of each tube 99 is clamped a nozzle 100. Each nozzle 100 is made up of halves 101, 102 which have flanges which bolt together to form an annular nozzle body 104. Shaft 46 is disposed through the center aperture 106 defined by annular nozzle body 104, and the nozzle body 104 has a plurality of downwardly disposed small apertures 107. Each disc 82 has a tube 99 and nozzle 100 which cooperates therewith, and each nozzle 100 flows liquid downwardly onto the top surface of the disc 82 immediately therebelow. A pair of spray heads 108, 110 connect to manifold 98 by tubes 112 and are positioned to spray liquid within the bottom portion of body 22 (FIG. 1).

In the operation of the gas-washer 20, shaft 46, and discs 82 are rotated. Liquid, which may be water, passes through pipes 92, 94, manifolds 96, 98, tubes 99, and the apertures 107 of nozzles 100 and down onto the top surfaces of discs 82, and through spray heads 108, 110. As the discs 82 whirl, the liquid flies off the outer periphery of each disc 82 and is thrown toward and onto the inner wall surface of the body 22 in a sheet of continuous surface. Such a sheet 114 is shown in FIGS. 1 and 8. The inner edge of the sheet 114 is defined by the outer periphery of the disc 82 which forms it, and the outer edge of the sheet 114 is defined by the inner wall surface of the body 22. Such liquid flows down the inner wall surface of the body 22, there being the small gap between the outer periphery of each deflector 50, 52, 54, 56 and the inner wall

surface to allow such downward flow. Such liquid flow is indicated generally by arrows A (FIG. 1).

Unwashed gas is introduced into gas inlet 26 tangentially so that it is introduced in a swirling manner, as indicated by arrows B (FIG. 8), and follows a path upwardly through the body 22, and path being defined by the inner wall surface of body 22 and the outer peripheries of discs 82. Thus, after being cooled to a certain extent by spray nozzles 108, 110, the gas passes through a plurality of liquid sheets, as sheet 114, in the path shown generally by arrows C. As the gas passes through these sheets, the gas particles are struck thereby and tumbled or spun in such a fashion as to be exposed for a relatively great length of time to the liquid. In such relatively great washing time, effective gas washing is achieved. The vanes of the gas deflectors 50, 52, 54, 56 change the direction of flow of the gas somewhat. In addition to the swirling induced by gas inlet 26, such gas deflectors aid in swirling the gas so that it is introduced to the sheets at a proper angle to be effectively acted upon thereby. Because of such gas deflectors 59-56, deflector plate 86 and trough 88, it is ensured that there are no regular paths for the gas to follow as it is washed. Liquid flowing down the inner wall surface 22 near the top thereof flows into trough 88, where it is collected. In then flows from the apparatus 20 from outlet pipe 89. Liquid flowing down the inner wall surface 22 below trough 88 collects at the bottom 30 of body 22 and flows therefrom through outlet pipe 32. As it may be desirable to use two different types of liquid at the top and bottom of the apparatus 20, it may be desirable to keep these liquids from mixing. The separator 90, because of the configuration described previously, allows the gas to pass upwardly therethrough, but collects the liquid vapor which may be flowing upward with the gas and condenses it, whereupon it drops back into the lower portion. Thus, the two liquids are kept separate during the washing operation.

The apparatus 120 shown in FIGS. 11 and 12 is similar in some way to the apparatus 20. It includes a generally cylindrical vessel or body 122, a rotatable shaft 124, and means 126 for rotating it, discs 128 fixed to the shaft 124, a gas inlet 130, and a gas outlet 132. However, in this embodiment a single nozzle 134 flows liquid down onto the top surface of the uppermost disc 128. Fixed to the inner wall surface of the body 122 are a plurality of receivers 136. Each receiver 136 is interposed between a pair of adjacent discs 128, and comprises a plate 138 extending from the inner wall surface of the body 122 in a continuous manner and defining a concave upper surface 138A. After the liquid flows from the uppermost disc 128 in a continuous sheet, as previously described, and down the inner wall surface of body 122 to an extent, the liquid flows onto and down the concave surface 138A of a plate 138, and down through an aperture 138B in the plate 138 and onto the next lower disc 128. The other discs 128 and receivers 136 act in the same way so that the liquid flows downward through the apparatus 120 as indicated by arrows D. Thus, while each of the discs 128 forms a sheet, only one nozzle 134 is needed. The overall flow of liquid is thus much less than in the previ-

ous embodiment.

In this embodiment, the unwashed gas enters the body 122 through inlet 130 and follows the tortuous path indicated by arrows E. The gas, of course, is washed in substantially the same manner as in the previously described embodiment of the apparatus.

It has been found that by providing means which produces a continuous sheet through which the gas is passed (rather than a spray of individual jets or streams), more effective cleaning of the gas is achieved that has been in the past. This is so mainly because there are no open paths through which gas can pass, which ensures that each particle of gas must be acted on as it passes through the apparatus. Besides working in a most effective manner, it will be seen that both embodiments of the apparatus are extremely simple and economical in construction and operation, and require a minimum of maintenance.

I claim:

1. A gas-washer comprising:

- a. a tubular vessel having a generally vertical axis;
- b. means causing said gas to flow into and through said tubular vessel;
- c. a rotatable shaft within said tubular vessel having a generally vertical axis and means for rotating said shaft;
- d. a first disc fixed to said shaft in generally perpendicular relation thereto and rotatable therewith and means for flowing a first liquid onto the top surface of said first disc so that said first liquid is thrown off the outer periphery of said disc and onto the wall of said tubular vessel in a sheet of continuous surface extending from the outer periphery of said disc to the wall of said vessel;
- e. a second disc fixed to said shaft in generally perpendicular relation thereto and rotatable therewith and means for flowing a second liquid onto the top surface of said second disc so that said second liquid is thrown off the outer periphery of said disc and onto the wall of said tubular vessel in a sheet of continuous surface extending from the outer periphery of said disc to the wall of said vessel;
- f. separator means interposed between said first disc and said second disc and extending across said tubular vessel to divide said tubular vessel into two chambers, said separator means being previous to said gas and impervious to both said first liquid and said second liquid in operation; said separator means comprising an annular disc surrounding said rotatable shaft with its outer periphery sealed liquid-tight to the inner wall of said tubular vessel and a flange about its inner periphery, and a honeycomb member filling the center of said annular disc and surrounding said rotatable shaft, whereby liquid entrained in said gas in passing from one of said chambers of said tubular vessel to the other is condensed on said honeycomb and liquid in said other chamber is prevented from flowing into said one of said chambers; and
- g. first and second liquid outlet means on opposite sides of said separator.

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