United States Patent [19]

Friedling et al.

[11] **3,778,979**

[45] **Dec. 18, 1973**

[54] **METHOD OF AND APPARATUS FOR CLEANING GASES**

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[22] Filed: **Mar. 30, 1971**

[21] Appl. No.: **129,447**

[30] **Foreign Application Priority Data**

May 14, 1970 Switzerland 7239/70

[52] **U.S. Cl.** ..... **55/227**, 55/239, 55/248, 55/257, 261/119 R

[51] **Int. Cl.** **B01d 47/02**

[58] **Field of Search** ..... 55/95, 239, 244–256, 55/228, 227, 257; 261/119 R

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[57] **ABSTRACT**

A method of cleaning gas contaminated by dust and like particles utilising an apparatus comprising a nozzle defined by a liquid surface and the surface of a wall and through which the gas is forced so that some of it takes up liquid, a channel extending downstream from said nozzle to a chamber formed above said wall and providing a turbulent zone in which the gas becomes wetted throughout, an opening being formed in the wall to communicate said chamber with the upper part of the nozzle whereby wetted gas is returned from the chamber to the upper part of the nozzle to wet that portion of the gas which passes through the nozzle without contacting the surface of the liquid.

3 Claims, 8 Drawing Figures

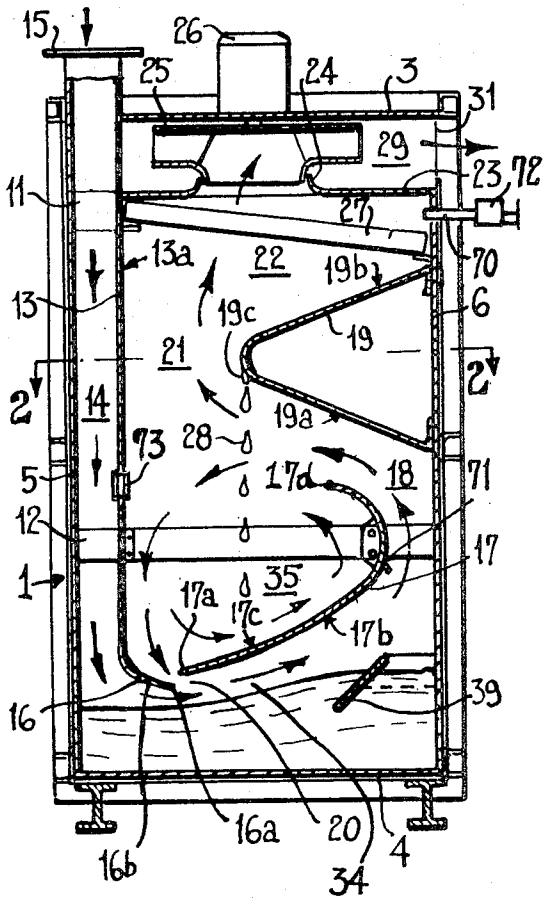


Fig. 1.

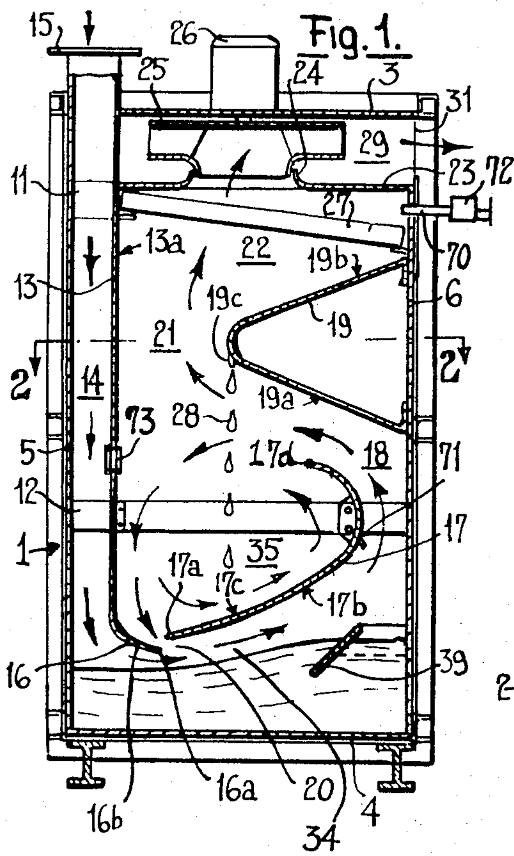


Fig 3.

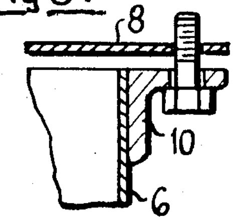


Fig. 2.

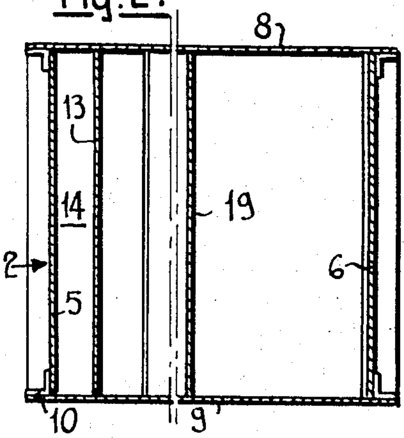


Fig. 4.

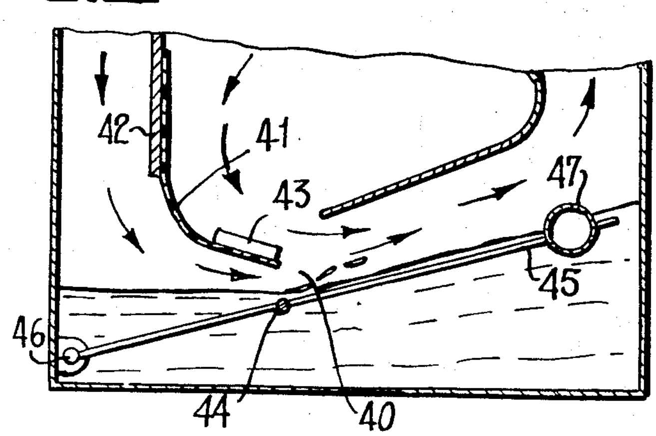
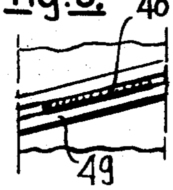


Fig. 5.



Inventors:

Fig. 6

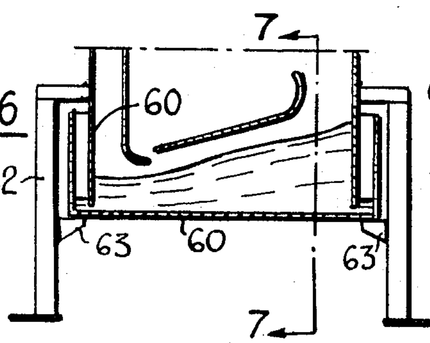
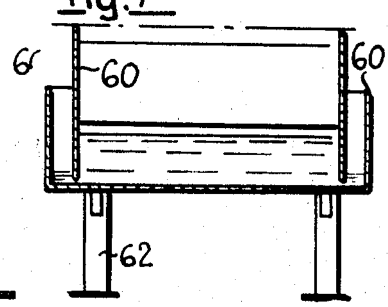


Fig. 7



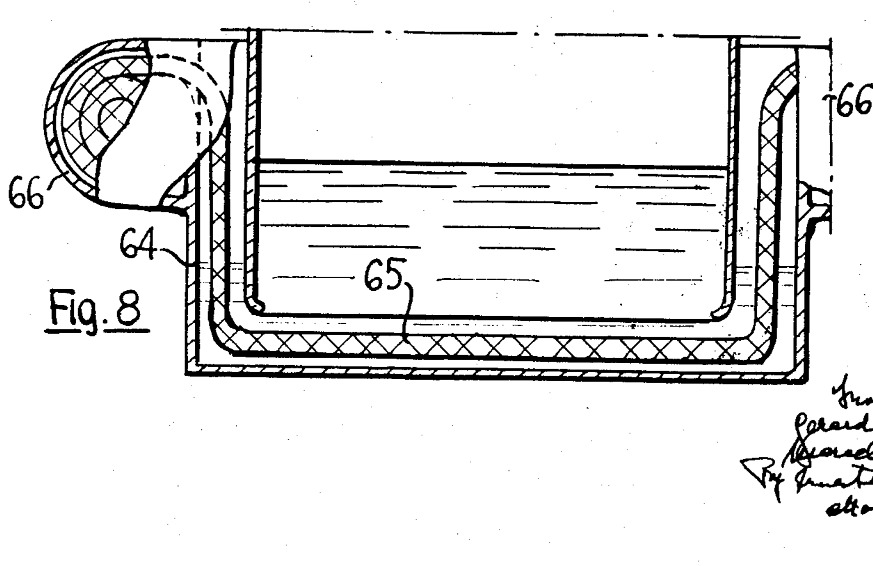


Fig. 8

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METHOD OF AND APPARATUS FOR CLEANING GASES

BACKGROUND OF INVENTION

This invention relates to a method of an apparatus for cleaning gases.

Various kinds of apparatus for cleaning gases contaminated by dust and like particles are known in which means are provided for making a flowing gas come into contact at high speed with a liquid surface in a turbulent zone so that liquid is mixed with the gas to wet particles suspended in it. Only some of the gas, that is the gas moving near the liquid becomes adequately wetted so that a number of chambers, baffles and the like must be provided downstream in which the gas must be given considerable agitation to ensure that it becomes wetted throughout. Such an apparatus is therefore bulky so that it occupies a large amount of ground space; it is also expensive to produce. All this considerably limits the possibility of installation. Also, in use the fact that a gas has to follow a relatively long and twisting passage results in considerable pressure losses, thus increasing power consumption.

The present invention has for its object to obviate or minimise these disadvantages.

SUMMARY AND DESCRIPTION OF INVENTION

According to this invention there is provided a method of cleaning a gas contaminated by dust and like particles which includes forcing the gas through a nozzle defined by a liquid surface and a wall surface so that liquid is taken up by some of the gas, passing the thus partially wetted gas into a turbulent zone in which the gas becomes wetted throughout, and returning some of the thus wetted gas into the upper part of the said nozzle to wet that portion of the gas which passes through the nozzle without contacting the surface of the liquid.

According to this invention there is also provided an apparatus for carrying out the above method, such apparatus comprising a nozzle defined by a liquid surface and the surface of a wall and through which the gas is forced so that some of it takes up liquid, a channel extending downstream from said nozzle to a chamber formed above said wall and providing a turbulent zone in which the gas becomes wetted throughout, an opening being formed in the wall to communicate said chamber with the upper part of the nozzle whereby wetted gas is returned from the chamber to the upper part of the nozzle to wet that portion of the gas which passes through the nozzle without contacting the surface of the liquid.

Apparatus in accordance with preferred embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an elevation in axial section through an apparatus in accordance with one embodiment;

FIG. 2 is a section on the line 2—2 in FIG. 1;

FIG. 3 is an enlarged fragmentary view, illustrating a detail of the apparatus as shown in FIGS. 1 and 2;

FIG. 4–5 are fragmentary views illustrating possible detail modifications;

FIG. 6 is a partial view in axial section through an apparatus in accordance with a third embodiment;

FIG. 7 is a section on the line 7—7 in FIG. 6, and

FIG. 8 is an enlarged sectional view illustrating a modification of the apparatus as shown in FIGS. 6 and 7.

DESCRIPTION OF SHOWN EMBODIMENTS

The apparatus shown in FIGS. 1 to 3 comprises an outer casing indicated generally by the reference numeral 1 which in shape is a right rectangular prism, and which comprises a main body part 2 with top and bottom horizontal walls 3 and 4, vertical walls 5 and 6, and two thin sheet metal side members 8 and 9 which are bolted to angle-iron frame elements 10 disposed at the sides of the body 2, that is in the manner indicated in FIG. 3. A vertical partition 13 supported by cross-members 11, 12 extending between the walls 5 and 6 bounds on the left-hand side of casing 1 (that is as seen in FIGS. 1 and 2) a vertical channel 14 which is connected at its upper end with a gas inlet tube 15. The partition 13 terminates at its lower end in an inwardly curved part 16 spaced from the bottom wall 4. The cross-member 12 bears a curved deflector 17 which on the right-hand side of the casing 1 bounds a channel 18. This channel terminates at its upper and below an inclined member 19*a* which forms part of a baffle 19 secured to the wall 6. At its lower end 17*c* the deflector 17 approximately prolongs the curved lower end part 16 of the partition 13, but the edge 17*a* thereof is spaced from the inner edge 16*a* of the partition so as to leave a gap 20 between them. The baffle 19 forms a constriction 12 between it and the inside surface 13*a* of the partition 13. The constriction 21 leads into a chamber 22 in the upper part of the casing 1. A horizontal wall 23 extending between the vertical wall 6 and the partition 13 has therein a flared inlet 24 for a centrifugal fan rotor 25 driven by an electric motor 26 mounted on the top wall 3. A drip separator 27 mounted in chamber 22 is inclined downwardly towards the wall 6 and serves to return collected liquid on to an upper inclined wall 19*b* of the baffle 19. Liquid flows down the wall 19*b* to the inner end 19*c* thereof from which it falls in the form of a curtain of drips 28. Fan rotor 25 intakes gas which has been cleaned in the top chamber 22 and outputs gas to a chamber 29 for exhausting through a side aperture 31.

The lower part of the casing 1 forms a vessel which is filled with water to a reference level determined by an overflow orifice (not shown); the reference level is initially slightly above the inner edge 16*a* of the partition 13; in other words when operation of the apparatus is started the edge 16*a* is immersed in water.

When the fan 23 is operated a negative pressure is produced inside the casing 1 and contaminated gas is drawn in through the inlet tube 15 and down through the channel 14. The flowing gas then causes the formation of and passes through a horizontal nozzle 34 between the water surface and a wall made up by the bottom surface 16*b* of the curved part 16 at the lower end of the partition 13 and the bottom surface 17*b* of the deflector 17. Gas velocity in the nozzle 34 is high, that is to say about 25–30 m/sec, and this causes surface turbulence on the water so that the gas takes up drops of water. The water-laden gas is directed against the wall 6, sucked up through the channel 18 into the upper part of the apparatus, passing around the baffle 19 and through the drip separator 27. The gas thus follows an S-shaped path. Water and particles which collect on the inside surface of the wall 6 fall down into the right-

hand side of the water-filled lower part of the casing **1** behind an inclined wall **39** which retains the floating particles away from the main gas flow.

The top free edge **17***d* of the curved deflector **17** serves to trigger a vortex in the gas flow, the vortex being produced in a space or chamber **35** behind the deflector **17** in that part of the apparatus into which the curtain of drips **28** from the baffle **19** falls. The direction of rotation of the vortex in the chamber **35** is such that on reaching the gap **20** it is moving in the same general direction as gas passing through the nozzle. Moreover, the gap **20** is disposed in the narrow part of the nozzle **34,** so that some of the water-laden gas in the chamber **35** is induced by venturi effect into the upper zone of the nozzle **34.** Since this gas is derived from a very moist zone (in the chamber **35**), it effectively helps to wet from above gas flowing through the nozzle **34,** the upper zone of such gas being, of course, away from the surface of the water. Introducing moist gas into the upper zone of the gas flowing through the nozzle **34** makes the lower surface **17***b* of the deflector **17** an important factor in the extraction of particles from the gas. Returning some of the gas in this way also helps to raise flow velocities in the downstream part of the nozzle **34** and therefore to increase carrying-off of drips of water and thus wetting of the gas flowing through the nozzle. The increased vortex produced in chamber **35** by reaspiration of moist gas through the gap **20** also aids the collection of particles on the upper surface **17***c* of the deflector **17,** and on the surface **13***a* of the partition **13.**

The presence of the gap **20** is found to improve humidification and to reduce the dimensions of the apparatus required for a given rate of gas flow.

Additional water is supplied, as required, through a supply line **70** extending into the chamber **22** in the upper part of the casing **1** above the level of the baffle **19,** this water being added to the curtain of drips **28.** Fins, such as that marked with the reference numeral **71** may also be provided to cause drops of water to fall back into the flowing gas.

The supply line **70** has therein a control valve **72.** Preferably the valve **72** is automatically controlled by a differential pressure responsive device **73** disposed in the partition **13** so as to be partly in the channel **14** and partly in the chamber **35.** The device **73** allows water to be supplied when the upstream/downstream pressure difference in the nozzle **34** drops below a predetermined minimum, and to cut off the supply of water when such pressure difference has been restored to a value sufficient for the gas to flow at the required velocity in the nozzle. If this pressure difference is maintained substantially constant, the nozzle gas velocity too remains substantially constant at a value suitable for taking up and carrying away water. This ensures satisfactory operation of the apparatus despite considerable fluctuations in the rate of gas flow, the latter often depending upon factors external to the apparatus.

The overall ground space required for the apparatus is small, the main gas flow directions falling and rising on either side of the nozzle **34** bounded by the water surface. The apparatus can easily be cleaned after removal of the two side members **8** and **9.** Since these webs are made of thin sheet metal and are devoid of stiffening, adequate sealing-tightness between the inner wall side edges and the webs can readily be provided, the negative pressure produced in the apparatus keeping the webs in engagement with the edges of the wall **6.**

In the modification, as shown in FIG. **4** a nozzle **40** is bounded above the surface of the water by a flexible sheet **41** secured to a vertical partition **42.** The member **41** which may, for instance, be made of rubber, takes an aerodynamic shape corresponding to the gas pressure in the nozzle zone; weights **43** can be added to the member **41** to vary this pressure. The member **41** drops if the water level drops, and so gas velocity is automatically maintained at a high enough value despite any momentary drop in the water level.

Another feature of this modification is that a cross-rod **44** extends between arms **45** pivoted in brackets **46** and carrying floats **47.** The arms **45** and floats **47** are so arranged that the rod **44** will be disposed immediately below the level of the water at the place of maximum gas velocity. A thin layer of water above the rod **44** is constantly removed by the flowing gas.

In the modification, as shown in FIG. **5,** the rod **44** is replaced by a transverse strip **48** adjustably disposed in guides **49.**

In the apparatus in accordance with another embodiment of this invention, as shown in FIGS. **6** and **7,** water is received in a receptacle **60** into which the lower end of a casing **61,** supported on legs **62,** extends. The receptacle **60,** which is supported on releasable support members **63,** can be lowered for cleaning. Sealing-tightness between the receptacle **60** and the casing **61** is provided by water in the receptacle **60;** the water must be at a high enough level for a pressure difference corresponding to the negative pressure in the casing **61** to be produced between the outside level and the inside level.

In the modification shown in FIG. **12,** a receptacle or the like **64** has in the bottom thereof a lining strip **65** movable between two drums, reels or the like **66** and made, for example, from a very fine open-pored synthetic plastics material such as polyurethane foam. Particles which collect in the water are deposited in the pores of the lining strip **65,** which can be moved or replaced without interrupting the operation of the apparatus. The lining strip **65** can, if required, be of the endless kind and go through a cleaning facility between leaving and re-entering the receptacle **64.** The strip may have a non-porous lower surface whereby not even very fine particles can pass through it.

We claim:

1. An apparatus for cleaning a gas contaminated by dust and like particles, comprising

an outer casing in the shape of a right rectangular prism the lower end of which forms a vessel having liquid therein,

a vertical inlet channel through which the contamined gas to be cleaned is passed downwardly, said channel being defined by one wall of said casing and a vertical partition disposed within and extending the whole width of said casing, the lower end of said partition being inwardly curved to constitute an inwardly curved part extending toward an opposite wall of said outer casing,

a deflector disposed within and extending the whole width of said casing, said deflector arranged substantially in prolongation of said curved part but spaced from said curved part to form a gap therebetween, said curved part and said deflector being spaced above the liquid in said vessel and coopera-

tively constituting a substantially horizontal nozzle therebetween having a narrowmost portion adjacent said gap, said deflector having an curved upwardly part, and an outlet channel from said nozzle being formed between said upwardly curved part of said deflector and said opposite wall of the casing, said inwardly curved part of said vertical partition and said deflector defining a chamber in communication with said outlet channel,

said upwardly curved part of said deflector having a top free edge for triggering in said chamber a rotating vortex and directing a portion of the latter to enter said gap, moving thereat in a same general direction as the contaminated gas passing through said nozzle for wetting a portion of the incoming contaminated gas which passes through the nozzle without contacting the surface of the liquid,

a baffle on said opposite wall of the outer casing and extending into said casing above said chamber towards said vertical partition and forming a constriction therebetween and between said upwardly curved part in said casing so that gas flowing up through said casing is forced to follow an S-shaped path, and said baffle being oriented over said chamber so that liquid collecting thereon will drop off said baffle into said chamber,

a drip separator disposed above said baffle in said casing, and

a rotor means at an outlet portion of said casing for drawing the gas through said apparatus.

2. The apparatus, as set forth in claim **1**, wherein said inwardly curved part of said partition is flexible.

3. The apparatus, as set forth in claim **1**, further comprising

a pressure responsive means disposed partly in said inlet channel and partly in said channel for controlling the level of said liquid in said vessel.

* * * * *