United States Patent

Deane

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[54] **AIR POLLUTION CONTROL DEVICE**

[72] Inventor: **Clifford T. Deane,** South Charleston, W. Va.

[73] Assignee: **Vortex Air Corp.**

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[52] **U.S. Cl.** **55/230,** 261/25, 261/87, 261/88

[51] **Int. Cl.** **B01d 47/08**

[58] **Field of Search** 55/230; 261/25, 87, 88

[56] **References Cited**

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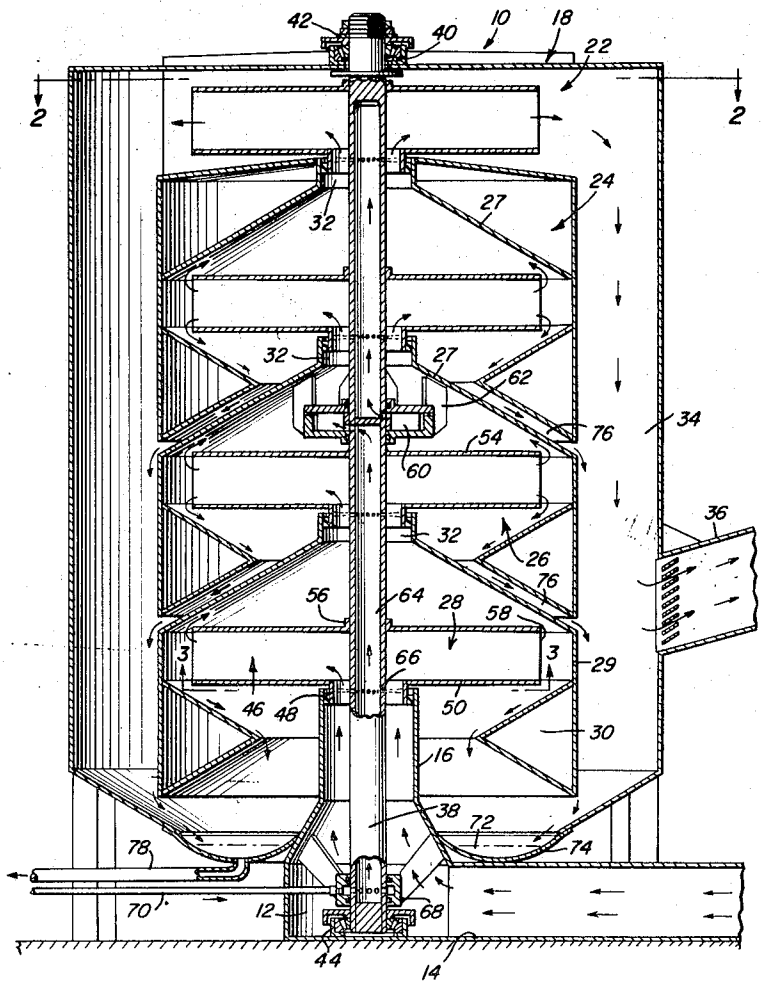
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Primary Examiner—Tim R. Miles
Assistant Examiner—Steven H. Markovitz
Attorney—Clarence A. O'Brien and Harvey B. Jacobson

[57] **ABSTRACT**

Air polluting smoke particles are substantially removed from the upflow of smoke through a vertical series of housing sections into which water under pressure is injected closely below impeller blade assemblies. The blade assemblies are driven by a fluid motor through which the pressurized water is conducted to produce turbulence and mixing of the smoke with the water. The heavier water and smoke particles are flung radially outwardly to form a slurry which is baffled and collected from downwardly converging walls of the housing sections.

9 Claims, 3 Drawing Figures

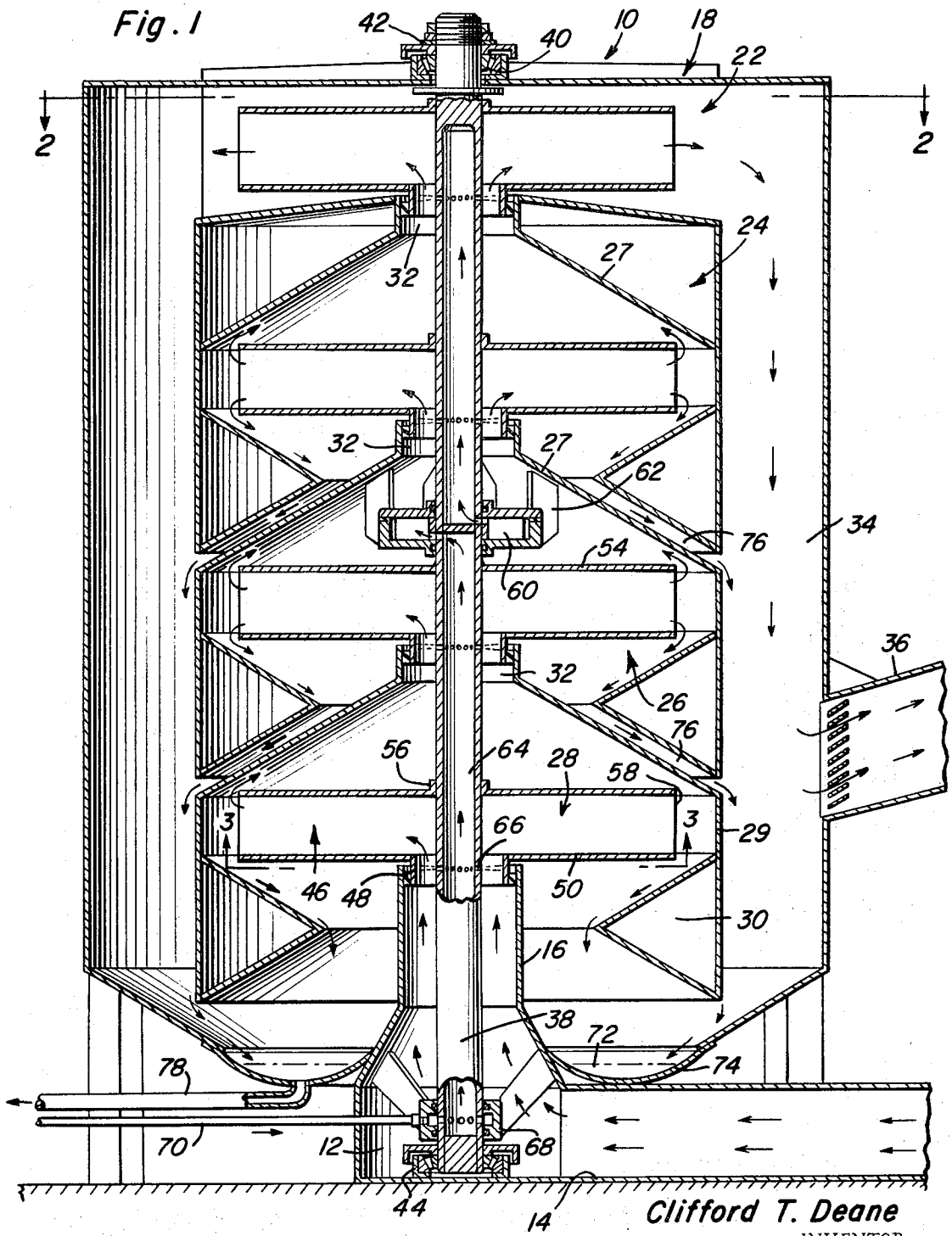


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Fig. 1



Clifford T. Deane

INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson

Attorneys

Fig. 2

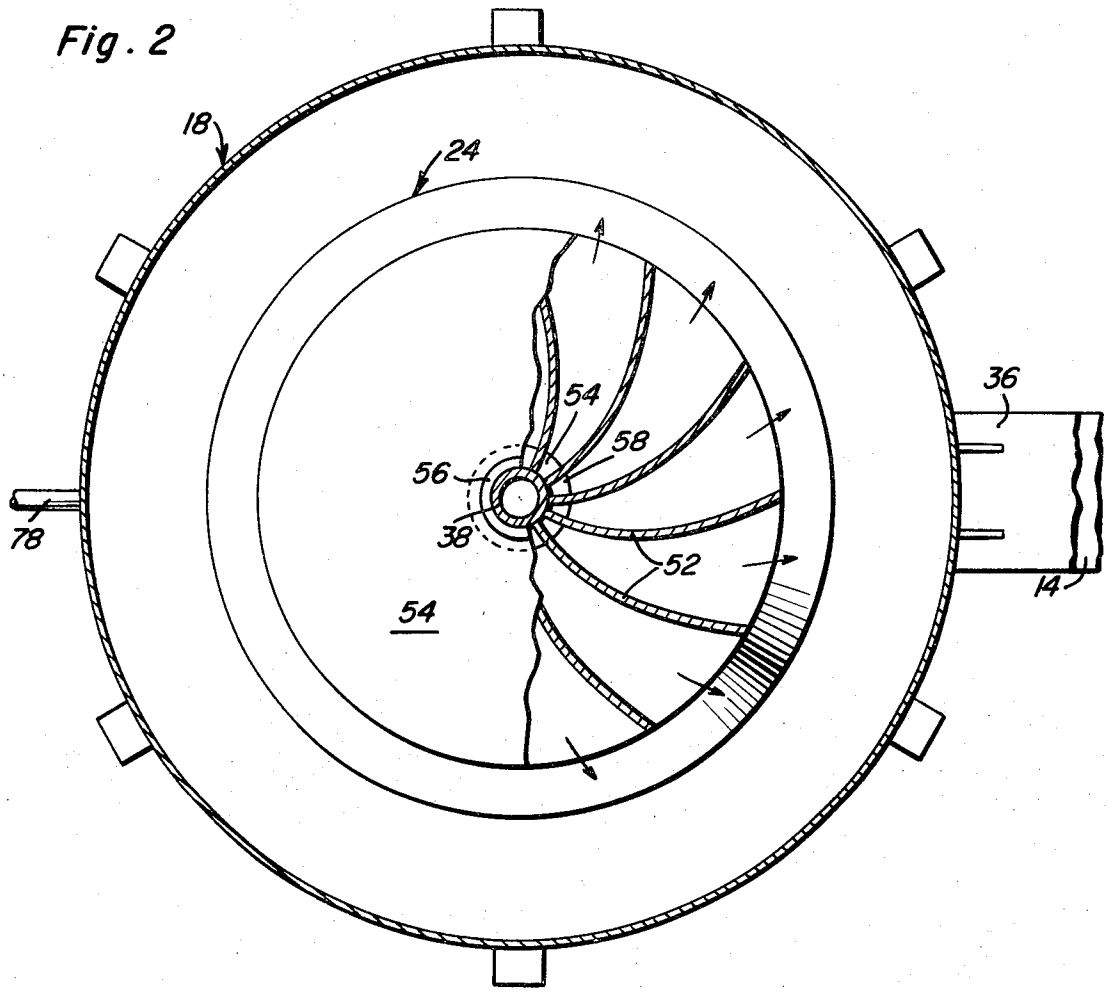
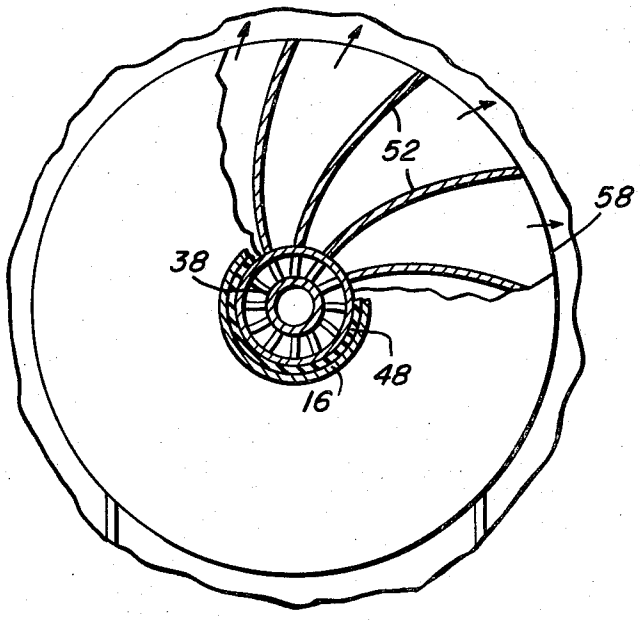


Fig. 3



Clifford T. Deane
INVENTOR.
BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

AIR POLLUTION CONTROL DEVICE

This invention relates to the removal of solid contaminants from gaseous exhausts into the atmosphere and more particularly to the separation of solid particles from the exhaust emerging from industrial installations.

The smoke emerging from industrial smokestacks has been a source of air pollution to which much effort has been directed in seeking some method of alleviating the problem. Various proposals have been made and employed for removing the polluting solid particles from the smoke and in most cases, the apparatus employed involves filters of some sort. Operation of such apparatus requires monitoring and frequent replacement of the filters in order to maintain operating efficiency.

It is therefore an important object of this invention to provide apparatus for removing solids from smoke by a separation method that avoids the use of filters.

In accordance with the present invention, the smoke ordinarily received at the lower end of a smokestack from a plenum chamber, is conducted upwardly through a vertical series of treating zones within which the smoke is mixed with a liquid under pressure such as water. Mixing is accomplished by a plurality of vertically spaced impellers into which the smoke and liquid are drawn. The heavier solid and liquid particles of the resultant mixture are baffled and collected as a slurry along downwardly converting walls and conducted away therefrom so that a substantially non-polluting gas remains before being discharged to the atmosphere. The liquid is introduced into the treating zones through orifice openings in a rotating, hollow shaft on which the impeller blade assemblies are mounted. The liquid which is under pressure, also acts as the motivating fluid for a fluid motor through which rotation is imparted to the shaft and the impeller blade assemblies.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. **1** is a side sectional view through a smokestack installation and smoke cleaning apparatus in accordance with the present invention.

FIG. **2** is a transverse sectional view taken substantially through a plane indicated by section line **2—2** in FIG. **1**.

FIG. **3** is a transverse sectional view taken substantially through a plane indicated by section line **3—3** in FIG. **1**.

Referring now to the drawings in detail, FIG. **1** illustrates smoke cleaning apparatus generally denoted by reference numeral **10** in accordance with the present invention. Industrial exhaust gas and vapors are received within a plenum chamber generally referred to by reference numeral **12**. The smoke cleaning apparatus is mounted above the plenum chamber **12** to which the smoke is fed through a duct **14**. The plenum chamber has an upper outlet duct **16** projecting into the apparatus **10**.

The smoke cleaning apparatus **10** includes a housing **18** enclosing a plurality of vertically spaced treating

zones or stages. In the illustrated embodiment, four stages **22, 24, 26** and **28** are employed. It will of course be appreciated that any number of such stages and associated components may be utilized depending upon the operating requirements. Each of the stages **24, 26** and **28** includes a top conical wall **27** that is imperforate as shown, an annular housing section **29** and a baffle formation **30**. An inlet opening **32** is formed in each top wall **27** through which the upflowing smoke is conducted in series through each of the stages. The lower end of the lowermost stage **28** is in communication with the gas outlet **16** of the plenum chamber **12**. Accordingly, the smoke flows upwardly through the vertical stages from the plenum chamber and emerges from the upper stage **22** into the annular passage **34** substantially less noxious and odorous from which it is injected into the atmosphere through outlet duct **36**.

A hollow or tubular shaft **38** extends vertically and centrally through the housing rotationally supported at its upper end by a thrust bearing assembly **40** mounted on top of the housing **18**. The vertical position of the hollow shaft is adjusted by means of an adjusting nut **42** threadably mounted on the upper end of the shaft. The lower end of the shaft is rotatably supported by the thrust bearing assembly **44** on the bottom of the plenum chamber. Fixedly mounted for rotation with the hollow shaft **38**, are a plurality of impeller blade assemblies **46** axially located on the shaft within each stage. Each impeller blade assembly includes a lower inlet shroud **48** centrally opening into a lower circular plate **50** on which a plurality of helical impeller blades **52** are mounted as more clearly seen in FIGS. **2** and **3**. The blades are also connected to a top plate **54** having a central hub portion **56** fixed to the shaft **38**. The radially outer rim **58** of the impeller assembly is open for discharge of fluid in response to rotation of the impeller assembly. Also, mounted on the shaft within an intermediate stage **26**, is a radial, fluid motor **60** as shown in FIG. **1**. Suitable support for the motor is provided by the spider frame assembly **62**.

A liquid **64** under pressure such as water is conducted upwardly through the hollow shaft **38** and forms the motivating fluid for the fluid motor **60**. Accordingly, in response to the flow of water under pressure through the fluid motor interconnecting upper and lower sections of the hollow shaft **38**, rotation will be imparted to the shaft **38** and the impeller blade assemblies mounted thereon. The water is discharged from the shaft into the housing through vertically spaced series of orifice openings **66** located closely below the radially inner inlets **48** of the impeller blade assemblies. Water is supplied to the lower end of the rotating hollow shaft **38** through a rotary seal assembly **68** by means of a water supply conduit **70** connected to a suitable source of water under pressure.

It will be apparent that as the water emerges from the orifice openings **66**, the fluid motor **60** is rendered operative to impart rotation to the impeller blade assemblies. A vacuum pressure is thereby created at the radially inner portions **48** of the impeller assemblies so as to inwardly draw the water discharged from the orifices **66** together with the smoke. The water is accordingly mixed with the upflowing smoke or gas from the plenum chamber **12**. The rotating impeller blade assemblies therefore change the laminar flow of the gas

into turbulent flow for intimate mixing with the water. The heavier portions of the mixed gas and water, namely the solids entrained in the gas and the water, are flung radially outwardly by the centrifugal action of the impeller blades. Thus, the gas entering the lower inlet end of the apparatus **10** undergoes successive treatment in the stages for removal of solid particles by mixing with the water to form a slurry that flows downwardly on the baffles **30** onto the walls **29**. Thus, the gas with reduced solid particle content continues upwardly into the inlet **32** of the next stage until the gas, substantially free of solid particles, emerges from the upper stage **22** for discharge to atmosphere from passage **34** through duct **36**. A slurry **72** consisting of the water and solid particles collects in the well **74** at the lower end of the housing. The slurry collects along the downwardly sloping walls **27** in passages **76** and into outlet passage **34** which delivers the slurry into the well **74** from which it is conducted by conduit **78** to a suitable location for disposal, treatment or use in some other process.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In combination with a plenum chamber from which a gas having particulate solids entrained therein is withdrawn into an updraft flow, means for removing the particulate solids from the gas, comprising plural housing means enclosing a plurality of treating zones, converging wall means fixedly mounted within the housing for directing an axial inflow and outflow of the gas relative to said treating zones, said wall means including a plurality of vertically spaced conical wall sections between which a plurality of said treating zones are formed, impeller means rotatably mounted within the treating zones for inducing flow of the gas radially outward to maintain the gas in a state of turbulence, means for injecting a liquid into the axial inflow of the gas entering the impeller means for mixing with the particulate solids to form a slurry, and means mounted by the housing within said treating zones below the impeller means for baffling downflow of said slurry emerging from the impeller means with said radially outward flow of the gas, each of said conical wall sections and the baffling means of an adjacent one of the treating zones forming an outward passage conducting the slurry radially outward.

2. The combination of claim **1** wherein said liquid injecting means includes a tubular shaft extending through the treating zone, a supply conduit connected to the shaft and orifice means in the shaft for discharging an inflow of the liquid into the treating zone.

3. The combination of claim **1** wherein the housing encloses an annular outlet conduit in fluid communication with the outflow passage.

4. The combination of claim **3** wherein said liquid injecting means includes a tubular shaft extending through the treating zones, a supply conduit connected to the shaft and orifice means in the shaft for discharging the liquid in parallel into the impeller means in each of the treating zones.

5. The combination of claim **4** including fluid motor means mounted on the tubular shaft for imparting rotation to the impeller means in response to flow of the liquid into the treating zones.

6. In combination with a plenum chamber from which a mixture of gas and particulate solids are withdrawn into an updraft flow, means for substantially separating the particulate solids from the mixture comprising a housing having an outlet portion and an inlet portion opening into the plenum chamber, impeller means rotatably mounted within the housing for maintaining the upflowing mixture in a state of turbulence, means for injecting liquid under pressure into the upflowing mixture, and means for withdrawing a slurry of said particulate solids and the liquid from the housing, the impeller means including a plurality of blade assemblies from which the slurry is centrifugally discharged, said housing enclosing vertically spaced stages respectively including each of said blade assemblies, each stage having an upper wall formed with an opening communicating with the blade assemblies of a following one of the stages, an annular housing section connected to the upper wall and a lower baffle formation, said slurry withdrawing means including a vertical annular outlet conduit and a plurality of passages between the upper walls and the baffle formations of adjacent stages in fluid communication with said outlet conduit.

7. The combination of claim **6** wherein said means for injecting liquid includes a tubular shaft extending vertically through the housing on which the impeller means is mounted, a supply conduit connected to the shaft, and orifice means in the shaft for discharging the liquid adjacent to the impeller means.

8. The combination of claim **7** including fluid motor means mounted on the tubular shaft and driven by the inflow of liquid for imparting rotation to the impeller means.

9. The combination of claim **2** including fluid motor means mounted on the tubular shaft and driven by the inflow of liquid for imparting rotation to the impeller means.

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