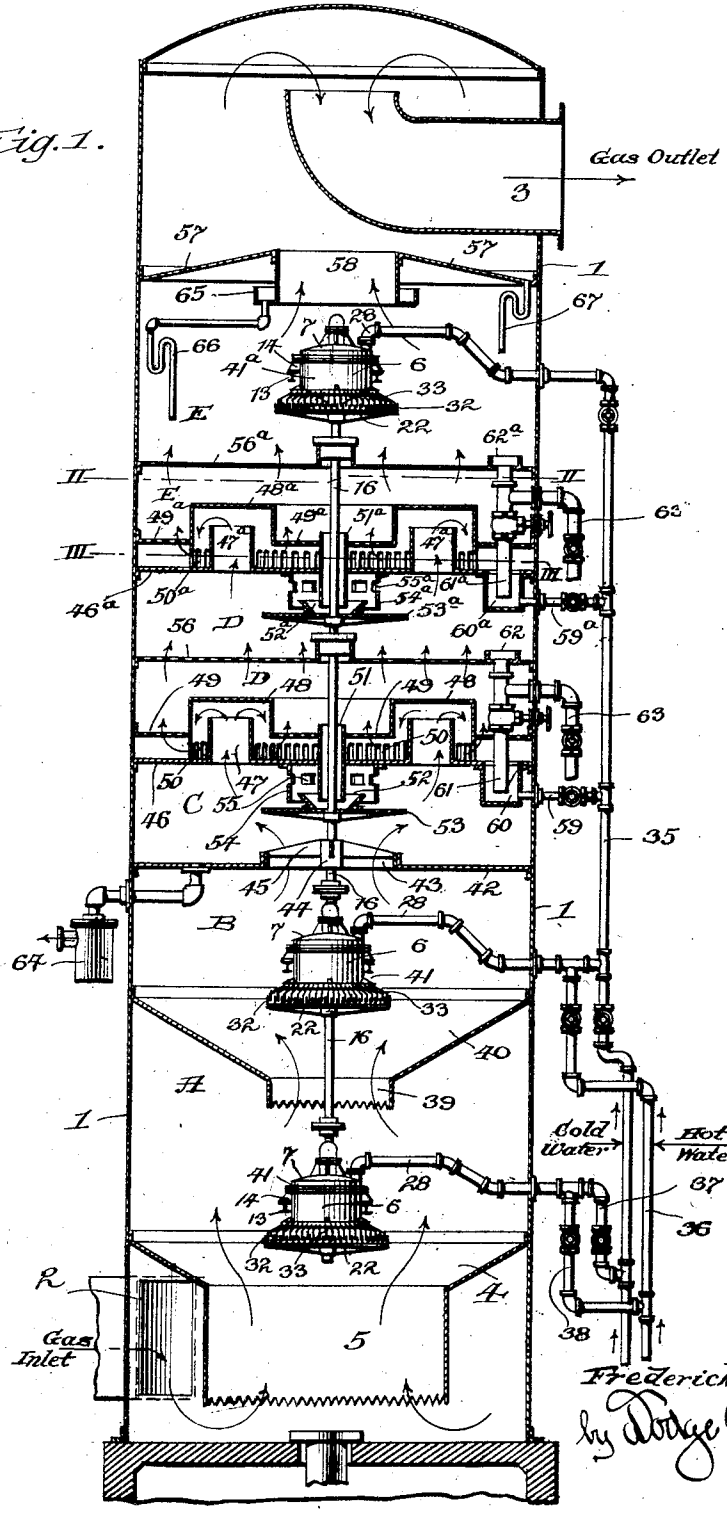
Aug. 9, 1932. F. H. WAGNER 1,870,351

DUST CONDENSER

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Fig. 1.



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DUST CONDENSER

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Fig. 5.

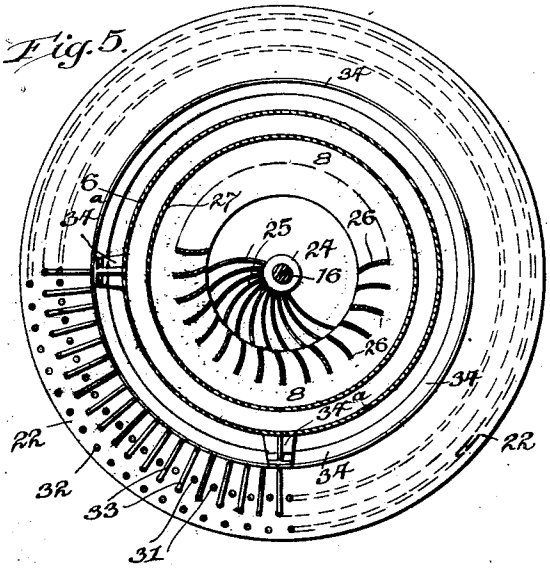


Fig. 2.

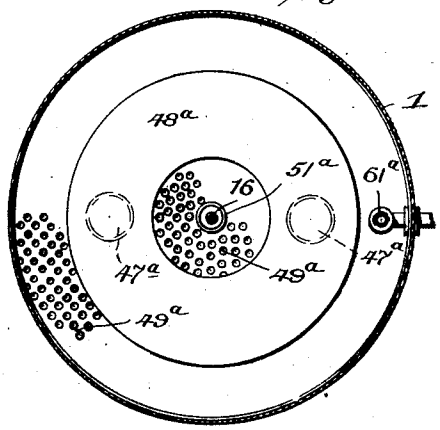


Fig. 4.

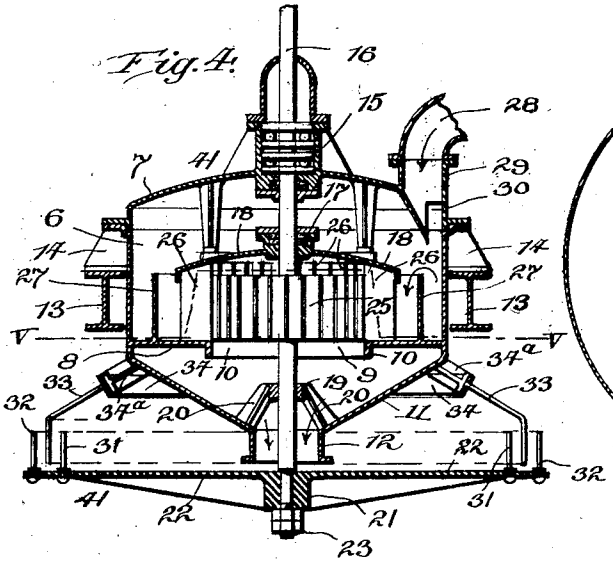
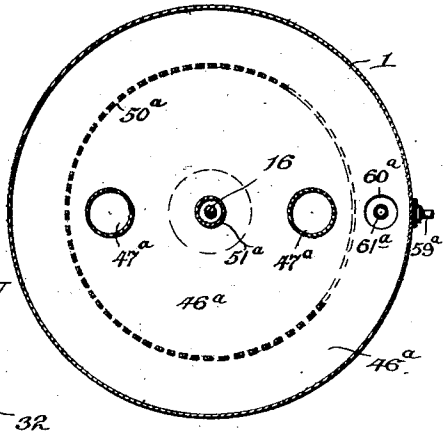


Fig. 3.



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DUST CONDENSER

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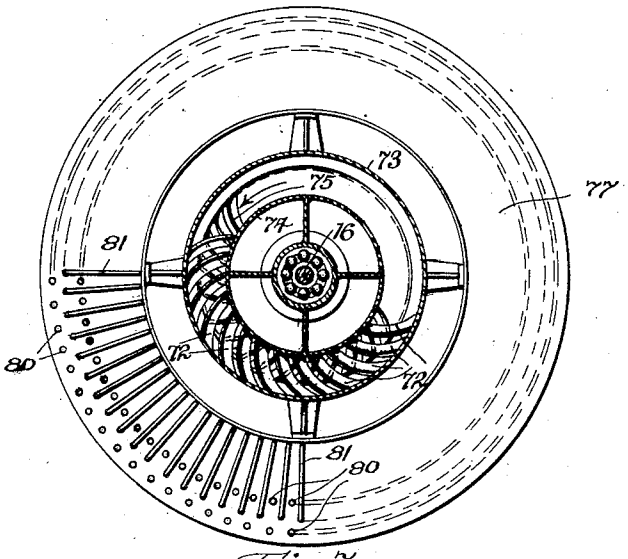


Fig. 7.

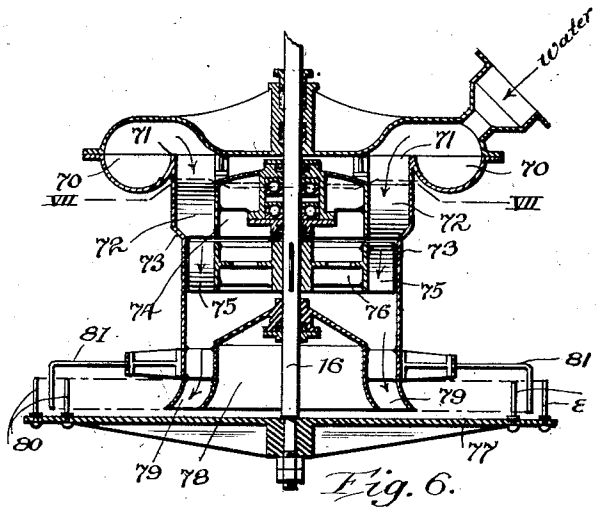


Fig. 6.

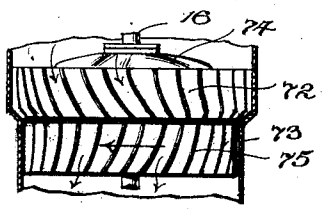


Fig. 8.

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UNITED STATES PATENT OFFICE

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DUST CONDENSER

Application filed October 7, 1930. Serial No. 487,076.

This invention pertains to dust condensers and has for its main object the provision of means for saturating or supersaturating gases with water in order that when the water vapor condenses out of the gas it will condense on the dust particles as the nucleus and thus remove it from the gas in the outflowing water. For this purpose the apparatus is divided into two sections, a lower humidifying section and an upper or condensing section.

Humidification may be accomplished with either hot or cold water, depending upon the initial temperature of the gas, such water being sprayed in the form of a fine mist into the gas space.

A further object of the invention is to provide means for spraying the water, such means taking the form of turbines, and associated elements, driven through the pressure of the incoming water used for saturating and condensing purposes.

With these and other objects in view reference will be had to the annexed drawings wherein,

Figure 1 is a vertical sectional view with parts in elevation,

Figure 2 a transverse horizontal sectional view taken on the line II—II of Figure 1,

Figure 3 a like view on the line III—III of Figure 1,

Figure 4 an enlarged vertical sectional view of one of the turbo-spraying units,

Figure 5 a horizontal sectional view thereof taken on the line V—V of Figure 4,

Figure 6 a vertical sectional view of a modified form of a turbo-spraying element,

Figure 7 a horizontal sectional view on the line VII—VII of Figure 6, and

Figure 8 a detail elevation illustrative of the turbo blade arrangement.

Reference will first be had to the construction disclosed in Figures 1 to 5 wherein 1 is the shell or casing of the apparatus having a tangential gas inlet 2 at its base and a gas off-take main 3 at its top. From the gas intake 2 the gas is forced upwardly through the casing coming into contact with various water sprays and contact plates which tend to first saturate or supersaturate the gas with water and thereafter to condense the water vapor out of the gas carrying the dust particles with it.

Located in the lower portion of the shell or casing is a frusto-conical member 4 extending inwardly from the walls of the casing and carrying a downwardly extending open cylindrical element 5, the lower edge whereof is preferably serrated or notched. The gas passing upwardly through this member comes into contact with the mist or vapor thrown outwardly by the first turbo-sprayer. This element is preferably of the form shown in Figures 2 to 5 inclusive. It comprises a cylindrical casing 6 closed by a top 7. At the base of the cylindrical element there is formed an inwardly extending shelf or false bottom 8 having a centrally disposed opening 9 defined by a flange 10 formed as an extension of the element 8. Also extending downwardly from the lower end of the cylindrical member 6 is an inverted conical-shaped member 11 having a centrally disposed nozzle or discharge element 12 formed as a continuation thereof. The casing 6 and its allied parts is supported in any suitable manner, as by I-beams 13 secured to the casing 1 and taking against brackets 14 secured to the casing 6.

Cover 7 carries a ball bearing 15 through which extends a shaft 16, the shaft passing through a stuffing box 17 formed upon the upper face of a closure element 18 for the blades of the turbo-sprayer. The shaft also extends through a hub 19 carried at the inner ends of arms 20 extending upwardly from the member 11. The shaft at its lowermost end is reduced in diameter and passed through a hub 21 formed as an integral portion of the spreader plate 22. The latter is secured to and rotates with the shaft by nuts 23.

Secured to a hub 24, see Figure 5, are a series of curved blades or buckets 25, the outer ends whereof terminate adjacent a series of the reversely curved blades 26, the latter being stationary and secured in place between the members 8 and 18. Extending upwardly from the member 8 and standing in spaced relation to the member 6 and the outer edges of the fixed blades 26 is an an-

nular member 27. This member is employed to secure a substantially even distribution of the inflowing water introduced under pressure through the inlet pipe 28, which water, as will presently appear, may be either hot or cold according to requirements.

The pipe 28 is connected to a flange 29, the inner portion whereof has an opening 30 which deflects the water downwardly into the space between the member 27 and the member 26 and consequently the water will first fill this space and then overflow the top thereof, passing into contact with the blades 25 and, through centrifugal action which inheres due to the rotation of said members, will be thrown outwardly into contact with the outermost fixed blades 26. From these the water passes downwardly into the frusto-conical member 11 through the discharge nozzle 12 and onto the distributor plate 22. The water, as it passes outwardly from the nozzle, is in a turbulent condition and is thrown latterly across the plate 22 due to centrifugal action. The plate is provided adjacent its periphery with a series of upstanding beater arms 31 and 32 which are designed to cooperate with fixed arms 33 located between the same. Said arms 33 are bent inwardly above the upper ends of the pins or arms 31 and are attached to a ring-shaped member 34 which is supported by brackets 34ª extending outwardly from the casing 6 of the turbo-sprayer. These fixed arms and the arms or pins 31 and 32 which rotate with the plate 22 tend to disrupt the water or atomize it as it passes outwardly toward the casing 1 and through the upgoing gas stream which it saturates or supersaturates.

Pipe 28 is connected into the cold water and hot water mains 35 and 36, respectively, through valve branches 37 and 38. Thus by manipulating the valves the temperature of the water, which is atomized by the turbo-sprayer or humidifier, may be regulated according to the temperature of the in-coming gas. The gas thus treated passes through the central opening or flange 39 extending downwardly from the inverted frusto-conical partition or wall 40. Said member 40 and the member 4 form in effect a chamber A in which the lowermost turbo-sprayer is located.

The gas passing from the chamber A through the flange 39 passes into a second humidifying chamber B where there is located a second turbo-sprayer denoted generally by 41. It is of a form similar to that heretofore described in connection with the former similar element.

The upper portion of chamber B is defined by a horizontally disposed plate 42 having a central opening 43 formed therein. A bearing 44 supported by arms 45 is located in the opening and the shaft 16 extends therethrough.

The plate 42 forms the lower portion of a third chamber C, the upper wall 46 whereof is provided with a plurality of upstanding offtake pipes 47. The upper ends of said pipes are open and stand in spaced relation to cap pieces 48 which extend upwardly from the perforate plate 49. Said plate, as will be seen upon reference to Figure 1, stands in spaced relation to the plate 46 and the gas which passes downwardly about the members 47 must pass through slots 50 formed in the downwardly extending flange of the combined perforate plate member 49 and the cap pieces 48.

Extending downwardly from the perforate plate 49 and through the plate 46 at the center of the apparatus is an overflow pipe 51, the upper end whereof stands slightly above the level of the perforate plate 49. The lower end of the overflow pipe 51 extends into a cup-shaped member 52 carried by the shaft 16 and beneath it is a disk or plate 53.

The pipe 51 and the cup 52 form a gas seal and in view of the flared formation of the cup it will tend to throw any liquid outwardly against the inner surface of an annular dependent member 54 secured to the under face of the plate 46 and provided at its upper portion with a series of perforations 55. The water thrown against the inner wall of the annular or circular member just mentioned will drop down upon the plate 53 which, due to its rotation will be sprayed into the gas space by centrifugal force and through the gas stream passing upwardly through the chamber C.

The cross partition or wall 46 forms in effect the lower wall of a fourth chamber D, the upper wall whereof is formed by a member similar in form and construction to the member 46 and denoted by 46ª. There are associated with this member 46ª elements similar to those just described and like parts will be denoted by like reference numerals with the exponent *a*. Extending transversely of the chamber D is a plate 56 through which the upcoming gas is forced to pass.

A fifth chamber E is formed between the element 46ª and the transverse partition 57, the latter being provided with a central opening 58. The perforate plate or diaphragm 56ª extends transversely of the chamber and the upgoing gas must pass therethrough.

In the upper portion of the chamber E there is provided a turbo-sprayer denoted by 41ª, the construction of which follows that heretofore described and acts to throw a mist of water outwardly toward the wall of the casing and transversely of the stream of upcoming gas. The gas passing from the outlet 58 finally enters the upper end of the main 3 and is discharged to any suitable point.

The cold water main 35, heretofore referred to, extends upwardly to the top of the apparatus and is connected into the uppermost turbo-sprayer 41ª. It is also provided with

valved laterals 59 and 59ª opening into wells or pockets 60 and 60ª, respectively. Also extending into these wells are valved pipes 61 and 61ª, respectively, said pipes at their upper ends opening into weirs 62 and 62ª thus insuring the retention of a layer of water upon the perforate plates 56 and 56ª at all times. Valved draw-off pipes 63 and 63ª open into the pipes 61 and 61ª so that the water may be drawn off from the perforate plates should occasion so require.

Plate 42 is provided with a trapped draw-off 64. Any water which may collect upon the outer portion of the cylindrical member 58 will pass into a gutter 65 formed around its lower edge and into a trapped draw-off pipe 66. As will be noted, the plate 57 inclines downwardly from its center toward the outer wall of the casing and a trapped draw-off 67 is provided at the lower portion of this plate.

The operation of the apparatus thus far described is as follows:

The gas under pressure enters the inlet tube and passes upwardly to the outlet taking the course indicated by the arrows. Water is caused to pass into the turbo-sprayers and initially through the pipes 59 and 59ª to place water on the plates 46 and 46ª. The turbines will, of course, through the action of the water, be set in motion and the water passing from the blades onto the plate 22 is thrown outwardly therefrom and is broken up by the fingers carried by the plate and those extending downwardly from the shell or casing of the turbine. This water may be cold or hot, or any temperature between cold and hot, according to the condition of the gas entering the apparatus.

In the chamber A the gas comes into contact with the spray thrown outwardly by the plate 22 where it is partially saturated then upwardly into the chamber B where it is subjected to further treatment which may supersaturate it. It then passes upwardly into the chamber C and is subjected to the spray thrown outwardly by the plate 53 before it passes upwardly through the up-take pipes 47. The gas from these pipes passes through the perforations 50 and up through the perforate plate 49 into the lower portion of the chamber D.

Inasmuch as the plate 46 has water thereon the gas will, by reason of its velocity, pick up such water and carry it through the openings in the plate 49 upon which a body of water is maintained by reason of the gas pressure. Thus in passing through this portion of the chamber D the gas is subdivided and brought into intimate contact with the water. It is again sub-divided and brought into intimate contact with the water in passing through the perforate plate 56 upon which a body of water is maintained due to the pressure of the gas and the presence of the weir 62. After passing through the plate 56 it is again subjected to a water mist or spray thrown outwardly by the plate 53ª.

The same action inheres in the lower part of the chamber E between the plate 46ª and the perforate plate 56ª as obtains between the plates 46 and 56, respectively. In the upper portion of the chamber E the gas is subjected to final spraying action or mist brought about by the turbo-sprayer 41ª which is fed with cold water at all times. After being thus cooled, and the water vapor condensed, the gas passes through the opening 58 into the outlet chamber. Any condensed water, due to impingement against the under surface of the plate 57, will run outwardly to the wall 1 or be collected in the gutter 65, finally passing to the trapped opening. In the chamber in which the gas outlet 3 extends the gas will impinge against the roof or top of the apparatus where it drops out additional entrained water and then reverses its travel and passes outwardly through the main 3. Such water will pass down to the plate 57 and be carried therefrom through the trap 67 out of the gas stream. The cold water distributed by the turbo-sprayer 41ª gathers on the upper surface of the bubble plate 56ª where it is sustained by the pressure of the gas from beneath and flows off through one or more overflows 61ª, the latter delivering the water to the well or pocket 60ª from which it passes onto the plate 46ª. The water passes downwardly through the pipe 51ª into the cup-shaped member 52ª, whence as above described, it overflows and is redistributed in the lower portion of the chamber D in the form of mist. Pipe 51 carries the water to chamber C wherein it is again sprayed, the water finally passing outwardly through the trap 64 associated with the plate 42.

From the foregoing it will be seen that the incoming gas is saturated with water. It is thereafter broken up into fine bubbles and streams and forced to pass through bubble plates upon which a body of water is maintained. It is likewise caused to pass through various zones of mist or spray which tend to further saturate it or condense the water according to the temperature of the water introduced into the apparatus. It is finally subjected to the action of a cold spray or mist which has the effect of cooling and condensing the water vapor and withdrawing it from the gas, such vapor condensing upon the particles as the nucelus and thus removing the dust from the gas.

In Figures 6, 7 and 8 a modified form of turbine for driving the spray plate and its disintegrating fingers is illustrated. In this instance the incoming water passes into an annular channel 70 and over a rim or flange 71 to the curved blades 72. These blades are fixed between the outer casing 73 and an

inner bell-shaped member 74. The water discharges from the blades 72 to a series of underlying blades 75 which are reversely curved. These blades are connected to a frame 76 keyed to the shaft 16. The water passing from the blades 72 reacts against the blades 75 and causes a rotation of the frame 76 and the shaft 16 with its allied parts.

The casing 73 extends downwardly to the spray or diffusing plate 77 inwardly of which there is a second bell-shaped member 78 thus forming a channel 79 between said casing 73 and the lower portion of the member 78. The liquid discharged from the turbine is, as in the prior forms, gathered and discharged onto the atomizing plate. As in the other structure the plate carries a plurality of pins 80 cooperating with fixed pins or arms 81 supported by suitable brackets extending from the casing.

Under both constructions it will be noted that there is no heavy shaft employed as is common in the well known scrubbers of today wherein a series of inverted frusto-conical members are employed as pumping and spraying elements. Furthermore no outside source of power, other than the water employed in cleaning the gas, is necessary to effect the spraying of the water which of course is a point of manifest advantage both as to structure and cost of operation.

What is claimed is:

1. In a gas cleaning apparatus, the combinations of a casing having a gas inlet and a gas outlet; a shaft extending vertically in the casing; a turbine for driving the shaft; means for introducing fluid to the turbine to actuate the same; means for gathering the fluid passing from the turbine; and means attached to the shaft for receiving the fluid discharged from the turbine and atomizing the same transversely of the casing, whereby the fluid performs the dual function of driving the turbine and spraying the gas.

2. In a gas cleaning apparatus, the combination of a casing having a gas inlet and a gas outlet; a shaft extending vertically in the casing; a turbine for driving the shaft; means for introducing fluid to the turbine to actuate the same; means for gathering the fluid passing from the turbine; and a plate likewise attached to the shaft and to which the discharge from the turbine is directly passed whereby such discharge will be thrown outwardly and through the upgoing gas stream.

3. A structure as set forth in claim 2, wherein means is provided adjacent the outer portion of the plate for disintegrating the water as it passes from said plate.

4. In a gas cleaning apparatus, the combination of a casing having a gas inlet and a gas outlet; a shaft extending vertically in the casing; a series of curved blades secured to the shaft and extending outwardly therefrom; a series of fixed blades located adjacent the outer ends of the first named blades; a casing surrounding said elements in spaced relation thereto and having a discharge opening at its lower end; means for introducing fluid into the upper portion of the casing, said fluid passing between the fixed blades and contacting the reversely curved blades secured to the shaft; and a spreader plate secured to the shaft upon which the fluid passes from the discharge opening of the casing.

5. An apparatus as set forth in claim 4, wherein means is provided between the inlet for the fluid and the outer portion of the fixed blades for securing a substantially even distribution of the fluid to said blades.

6. An apparatus as set forth in claim 4, wherein the spreader plate is provided with a series of upstanding fingers or arms coacting with a series of fixed fingers to disintegrate the fluid as it is discharged from the plate.

7. In a gas cleaning apparatus, the combination of a casing having a gas inlet and a gas outlet; a shaft extending vertically in the casing; means carried by the shaft and located in the lower portion of the casing for atomizing water therein; at least one chamber located above said means, the lower wall whereof is provided with at least one vertical uptake; a hood overlying the upper end of the uptake and standing in spaced relation thereto; a perforate plate associated with said hood and beneath which the gas passes from the hood; a perforate plate extending transversely of the chamber above the hood; means for maintaining a body of liquid upon said plate; and means carried by the shaft for spraying liquid transversely of the chamber at a point above the perforate plate.

8. In a gas cleaning apparatus, the combination of a casing having a gas inlet and a gas outlet; a shaft extending vertically in the casing; means carried by the shaft and located in the lower portion of the casing for subjecting the incoming gas to a liquid spray; a chamber located above said lower portion, the lower wall of said chamber being defined by a plate having a centrally located opening and the upper wall by a plate having at least one uptake pipe; a hood overlying the upper end of said pipe and standing in spaced relation thereto; a perforate plate associated with said hood and extending transversely of the casing, said plate having a downwardly extending portion formed with openings adjacent the upper plate of the chamber; a pipe extending from a point above said perforate plate downwardly to a point within the chamber; a cup-shaped element into which the lower end of the pipe extends; and a spreader plate car-

ried by the shaft and associated with said cup acting to throw the liquid passing from the cup outwardly through the upcoming gas stream.

9. In a gas cleaning apparatus, the combination of a casing having a gas inlet and a gas outlet; means located in the lower portion thereof for atomizing water into the upcoming gas stream; at least one chamber located within the casing above said atomizing means; a driven shaft extending through said chamber, the lower wall of the chamber being provided with a plurality of uptake pipes and the upper wall being of similar form; a perforate plate extending transversely of the chamber and dividing the same into upper and lower portions; means for introducing liquid into the upper portion of the chamber; means carried by the shaft for spraying such liquid transversely of the chamber and above the perforate plate; a second perforate plate associated with the lower wall of the chamber, said perforate plate having cap pieces overlying the uptake pipes and likewise having openings in its lower marginal portion; means for maintaining water at a given level upon the perforate plate first mentioned; and means for maintaining water upon the lower wall of the chamber.

In testimony whereof I have signed my name to this specification.

FREDERICK H. WAGNER.