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3 SHEETS—SHEET 1.

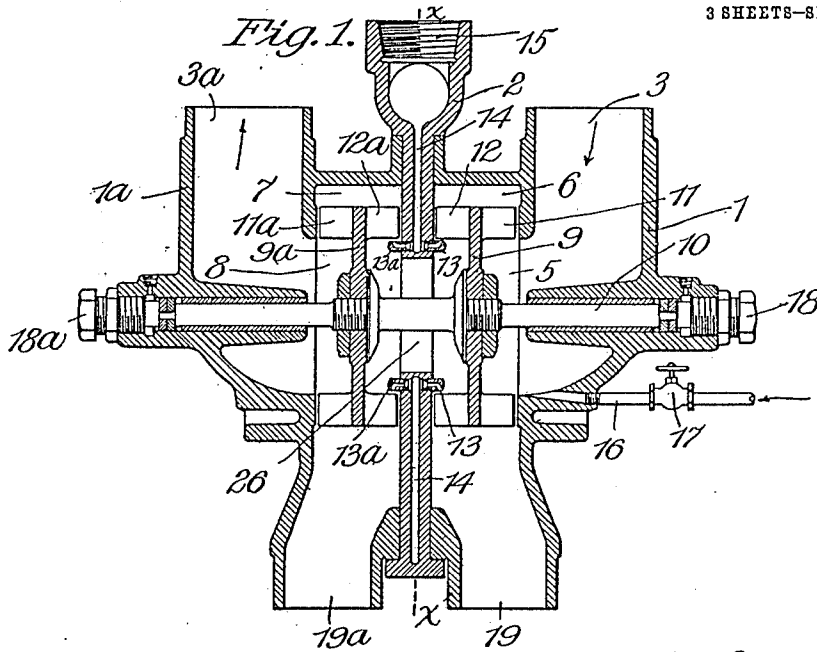


Fig. 2.

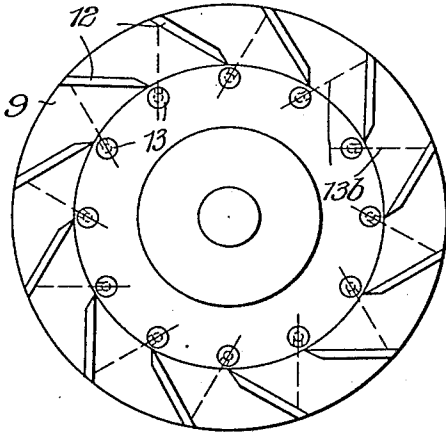
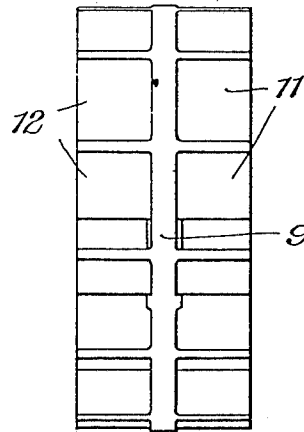


Fig. 3.



Witnesses

Witnesses
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GAS CLEANING APPARATUS.
APPLICATION FILED MAY 22, 1908.

1,005,819.

Patented Oct. 17, 1911.

3 SHEETS—SHEET 2.

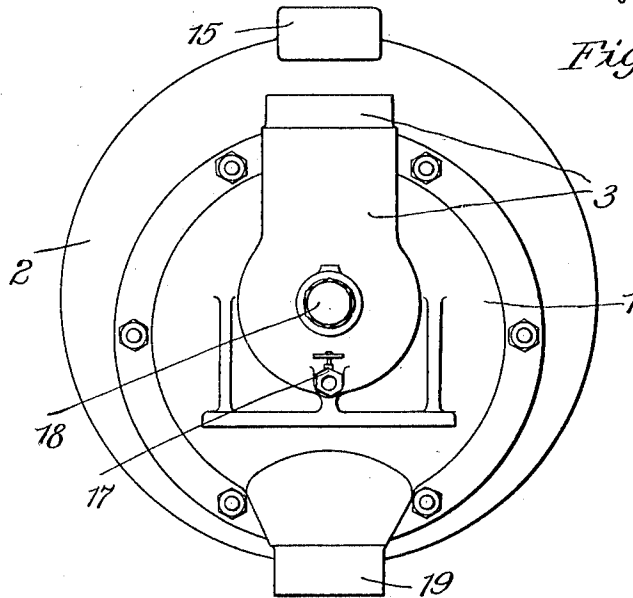


Fig. 4.

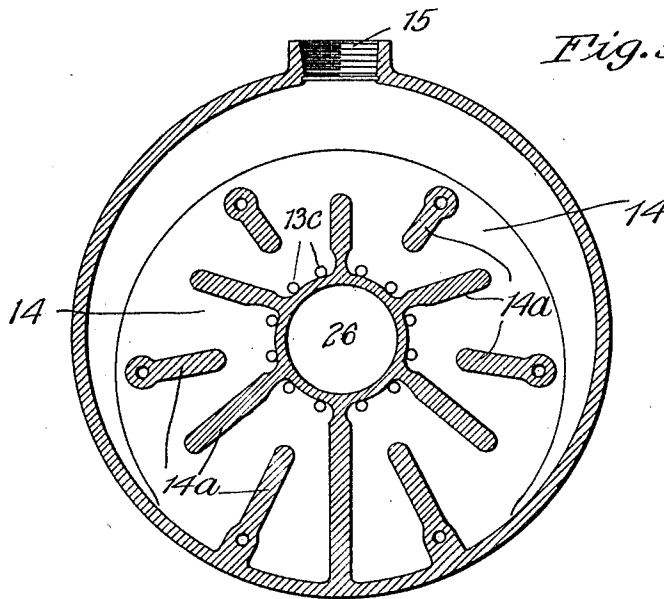


Fig. 5.

Witnesses

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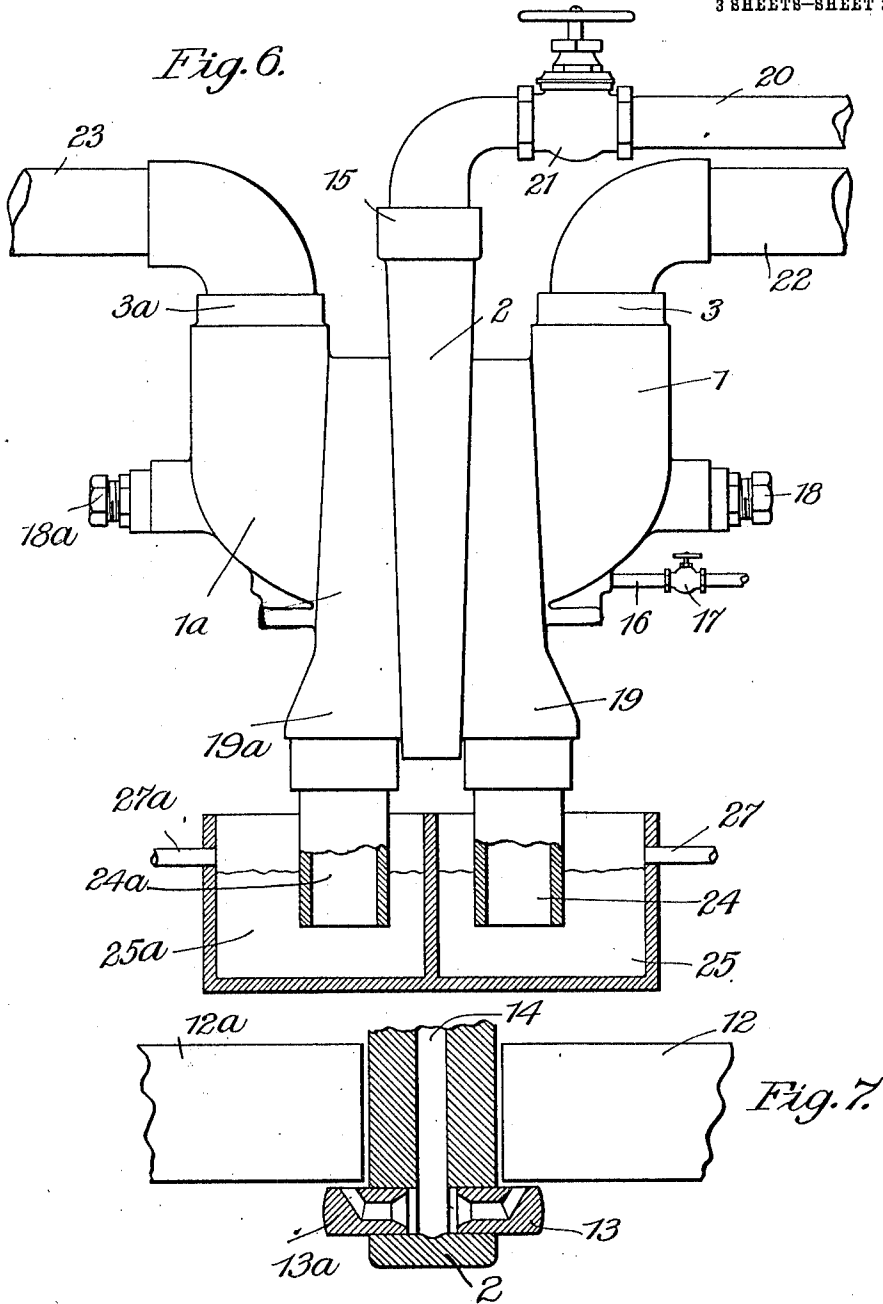
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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

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GAS-CLEANING APPARATUS.

1,005,819.

Specification of Letters Patent.

Patented Oct. 17, 1911.

Application filed May 22, 1908. Serial No. 434,319.

To all whom it may concern:

Be it known that I, ORVILLE H. ENSIGN, a citizen of the United States, residing at Madison, in the county of Dane and State of Wisconsin, have invented a new and useful Gas-Cleaning Apparatus, of which the following is a specification.

My invention relates to an improved means for cleaning gas as delivered from gas producers.

As generally manufactured gas contains a great deal of impurity that is necessarily removed before the gas can be used to advantage for lighting, heating, power production, or other similar purposes. And in the production of gas by means of devices adapted to decompose oil and thus transform it into its gaseous compounds, the need for removing undesirable impurities or undesirable compounds from the resultant gaseous mixture is particularly great. For instance, lamp black is found in large quantities in the gas produced by many of the processes for making gas from hydrocarbon oils, and this lamp black seriously interferes with the use of the gas if it is not removed therefrom.

My invention further contemplates removing lamp black, dust or similar substances from gas without changing the pressure upon the gas, that is, delivering the gas from the cleaning apparatus at the same pressure as it is delivered thereto, which so far as I am aware has not previously been accomplished in the art.

My invention consists broadly in a casing of suitable design and construction, adapted to be divided into several compartments by means of liquid spray, and in connection with this construction means for directing or passing the gas from a suitable supply connection from one compartment to another in the casing through the separating walls of spray by which the lamp black, dust, and similar impurities are entrapped and washed from the gas out of the casing. In this particular embodiment of my invention, I have shown rotating wheels adapted to be driven by liquid under pressure as the means for producing the separating walls of spray, these wheels being so constructed as to be driven by such liquid when delivered from suitable nozzles, which nozzles are so formed as to properly spray the liquid against and between driving vanes secured to the wheels.

In the particular embodiment of my invention shown these vanes serve not only as a driving means for these wheels, but also as a means for directing and passing the gas from one compartment in the casing to another and finally to the compartment connected with the delivery pipe from the gas cleaning apparatus.

The several drawings illustrating my invention are as follows:

Figure 1 is a vertical sectional view taken through the center of my gas cleaning apparatus, Figs. 2 and 3 are face and edge views of one of the wheels used in my apparatus, Fig. 4 is an outside end view of the apparatus shown in Fig. 1, Fig. 5 is a vertical cross sectional view through the center of the apparatus taken along the dotted line $x-x$ in Fig. 1, Fig. 6 is an outside face view of the apparatus complete and shows the supply and delivery connections for the gas and the supply connections for the water supplied to the device. In this view there is also shown in section, the outlet connections and receptacles for the water and dirt delivered from the apparatus, and Fig. 7 shows in enlarged detail view, the construction of the nozzles used to direct the liquid under pressure upon the driving vanes of the wheels.

Similar numerals refer to similar parts throughout the several views.

Referring to Figs. 1 to 4 inclusive, my device consists essentially of two similar members 1 and 1^a, formed of cast metal adapted to support between them a third member 2. Each of the casings 1 and 1^a has formed thereon pipe connections 3, 3^a, leading to compartments 5 and 8 inside of wheels 9 and 9^a. These wheels 9 and 9^a consist in disks supporting a plurality of vanes 11, 12, and 11^a and 12^a, on each side near the periphery thereof. These vanes are displaced obliquely relative to the radii of the disks and are adapted to rotate the disks by the action of jets of water delivered against them by the nozzles 13, 13^a, supported by the member 2 just inside of the vanes 12, 12^a, carried on the inner faces of the disks 9, 9^a. The disks 9, 9^a are suitably supported upon a shaft 10 having bearings in the members 1, 1^a of the casing, which are also equipped with take-up screws 18 and 18^a for accurately adjusting the shaft 10 and wheels carried thereby to the proper position longi-

tudinally of the machine, and these take-up devices also serve to take-up any wear that may occur longitudinally on the shaft 10. The member 2 is cored out so that its interior 14 will connect the supply opening 15 with all of the nozzles 13, 13^a, located near the inner edge of the member 2. The construction of these nozzles and their connection to the member 2 are better shown in Fig. 7. The distribution of the liquid, water generally being used, is secured in the connecting passage 14 by suitable partitions 14^a extending as shown in Fig. 5 across this passage or opening 14 from one wall to the other, as a result of which the water is directed inward radially toward all of the openings 13^c in which the nozzles 13 and 13^a are secured.

The members 1 and 1^a of the casing are so conformed around the wheels 9 and 9^a that a compartment 6 is formed around the wheel 9 and a similar compartment 7 is formed around the wheel 9^a, the members 1, 1^a and 2 being brought as close to the ends of the vanes 11, 12, and 11^a, 12^a, as it is practical to construct the machines. The disks of the wheels 9 and 9^a and the inner vanes 12, 12^a carried by these disks, together serve to form an inner compartment 26 in the machine.

The nozzles 13 and 13^a are all adjusted to throw the water in the same direction relatively to the vanes adapted to be engaged by such water, the direction of the jets out of these nozzles being indicated by the dotted lines 13^b in Fig. 2. The outlet openings of the nozzles 13 and 13^a are designed in such a way that the jets delivered thereby shall be in the form of spray as one vane after another passes by any particular nozzle. The vanes carried by the disks are so designed that the jets of spray delivered from the nozzles are always intercepted by these vanes and that there is no free path between the vanes so that the spray may be thrown into the compartments 6 and 7 surrounding the wheels 9 and 9^a. As a result of the construction described, the jets of spray delivered to the two sets of vanes 12 and 12^a as acted upon by these vanes when rapidly revolving constitute in effect partitions between the compartments 6 and 26 and the compartments 7 and 26.

The water used to drive the wheels 9 and 9^a is thrown by the revolving vanes against the outside walls of the compartments 6 and 7 and delivered therefrom into the outlet openings 19 and 19^a, from which suitable connections 24 and 24^a deliver the water and associated dust and dirt into the receptacles 25 and 25^a, as shown in Fig. 6. The connections 24 and 24^a are preferably made with the receptacles 25 and 25^a below the level of the water maintained in these receptacles in order that the compartments 6 and 7 may

be closed and not open to atmospheric pressure, otherwise the gas passing through the machine would escape through these connections 24 and 24^a and a considerable portion would be lost. The water delivered to the receptacles 25 and 25^a passes to suitable overflow and outlet pipes 27 and 27^a, as indicated, and the dirt and refuse delivered to these receptacles may be cleaned out as required.

In Fig. 6 I have shown the supply and delivery passages 3 and 3^a as connected with supply and outlet connections 22 and 23 respectively for the gas and I have shown the water supply connection 15 connected to a pressure main 20 through a regulating valve 21 by means of which the required amount of water may be admitted to the wheels 9 and 9^a. A second water connection 16 is made from a suitable pressure main through the regulating valve 17, the purpose of this connection being to wet the vanes 11 to prevent the accumulation of dust and dirt or similar substance upon them as the gas passes between them.

The operation of my device is as follows: The uncleaned gas which may here be assumed to contain lamp black, although similar foreign substances may be removed with equal facility, is supplied by the pipe 22 to the connecting passage-way 3, and thus to the compartment 5 inside of the vanes 11 of the wheel 9. Owing to the rapid rotation of the wheel 9, the vanes serve to engage the gas and pass it through them into the compartment 6, in which the pressure on the gas is somewhat greater than in the compartment 5, due to the action of the vanes 11. The pressure in the compartment 6 operates to cause the gas to be engaged by the vanes 12 and as a combined result of the greater pressure in the compartment 6 and the action of the vanes 12, the gas is passed between the vanes 12 and through the water spray contained between these vanes into the compartment 26. The finely divided condition of this water spray makes it practically impossible for the gas to pass through it without having the dust and dirt and particles of lamp black engaged by the water and thus removed from the gas. The gas in the compartment 26 is engaged by the vanes 12^a in a manner similar to that described for the vanes 11, and is passed thereby into the compartment 7, where the pressure on the gas is again increased and this increase in pressure and the action of the vanes 11^a serve to together pass the gas from the compartment 7 into the compartment 8, and therefrom into the outlet connection 3^a, and thus to the outlet pipe 23, from which the gas may be conveyed to any desired receptacle.

Owing to the nature of lamp black, if the vanes 11 were not wet the lamp black

would cling upon the dry surfaces and finally cut down the area between the vanes and clog the machine, but when these vanes are kept wet by the water supplied from the pipe 16, the lamp black is prevented from accumulating on the vanes but is mixed with the water and thrown from the vanes and passes off through the outlet opening 19 as described.

It will be observed that the action of the vanes upon the gas is balanced as it passes through them, that is, while there is an increase in pressure in passing from an inner compartment to an outer compartment, there is a corresponding reduction in pressure in passing from an outer compartment to an inner compartment, and therefore the resultant effect of the whole cleaning operation is to leave the gas in practically the same condition of pressure as it was supplied to the machine. In this connection I wish to point out that while a large part of the separation of the gas from dust or impurity is accomplished by means of the water spray, that since the inner surface of the casing surrounding the compartments 6 and 7 is continually wet from the water delivered from the nozzles 13 and 13^a, the centrifugal action of the vanes 11 and 12^a carried by the wheels 9 and 9^a in forcing the gas outward from the compartments 5 and 26 into the compartments 6 and 7 will project the dust and dirt more violently against the outer wall than it will the gas owing to the fact that the gas is lighter than the impurities carried by it, and thus the wet inner surface of the casing retains in considerable measure the dust and other impurities projected against it.

My apparatus is essentially different in its operation from apparatus which has been used heretofore in which a revolving element is driven by outside means, this revolving element in turn serving to impart a centrifugal action to the gas to be cleaned which may or may not be mixed with water. In devices of this class the vanes on the rotating element strike forcibly against the gas and water, if water is used, the effect of the water being to retard the rotation of the revolving element and cling to the vanes leaving the space between the vanes comparatively clear. In my apparatus the vanes are located close enough together so that the water directed against each vane by any of the nozzles is reflected and sprayed into the opening between the vane struck and the succeeding vane, which action facilitates the forming of liquid spray between the vanes. The tendency of the liquid to cling to the vane struck thereby is avoided since the vane reacts from the liquid to cause rotation of the revolving element from which the liquid does not adhere in large quantity to the first vane struck, but is formed in a spray be-

tween this vane and the next vane, upon which latter vane it accumulates and is given a tangential velocity serving to throw it outward. In the operation of my apparatus I find it desirable to use a spouting velocity of the water at the nozzles which is considerably more than the rim velocity of the rotating element although there is no fixed ratio between these two quantities which need be used to produce satisfactory results. By having the spouting velocity of the water jets considerably greater than the rim velocity of the rotating element the spraying action between the vanes above described is facilitated.

In the operation of my device, I find that there may be a considerable variation in the speed of the rotating wheels relatively to the flow of gas through the machine without seriously impairing the thoroughness with which the dust and impurity are removed from the gas. I find it desirable, however, to have the speed of the rotating wheels comparatively high since the cleaning operation is effected more perfectly, and the efficiency of the machine is somewhat greater if the gas is caused to travel some distance with the rotating wheels while it is entrapped between the vanes carried by said wheels.

While I have described my machine as driven by water under pressure, and while this forms an excellent medium for entrapping and removing the dust, dirt, lamp black and similar substances from the gas, I do not, however, limit myself to the use of water since any similar liquid may be advantageously used both to drive the wheels and to remove the dust and other similar substances.

While I have shown my invention in the particular embodiment herein disclosed, I do not, however, limit myself to this construction but desire to claim broadly any equivalent means for accomplishing the result described that will suggest itself to those skilled in the art.

What I claim is—

1. In a gas cleaning machine, the combination of a casing comprising two or more compartments, rotatable mechanism between the compartments, and means for projecting liquid against the rotatable mechanism to form a partition of spray completely separating the compartments from each other.

2. In a gas cleaning machine, the combination of a casing comprising two or more compartments, movable mechanism between the compartments for passing the gas from one compartment to the other, and means for producing liquid spray across all passages between the compartments adjacent to such mechanism.

3. As a means for cleaning gas, the combination of a casing containing a plurality

of concentric cylindrical compartments, and mechanism for effectively separating such compartments by means of liquid spray.

4. In a gas cleaning machine, the combination of a casing comprising two compartments, rotatable mechanism between the compartments, vanes carried by such mechanism, and means for projecting liquid obliquely against such vanes.

5. As a means for cleaning gas, the combination of a casing containing a plurality of concentric cylindrical compartments, supply and outlet connections for the casing, and rotary mechanism for producing annular partitions of liquid spray to separate such compartments and for passing the gas from one compartment to another through such spray without difference in pressure between the gas supplied to and the gas delivered from the casing.

6. Gas cleaning mechanism consisting in the combination of a casing, a revoluble member inside of the casing, driving vanes carried by such member, means for directing liquid under pressure against such vanes to rotate such member, such vanes and directing means so constructed as to produce a spray against the vanes to divide the interior of such casing into a plurality of compartments, and means for directing the gas through such compartments.

7. Gas cleaning mechanism consisting in the combination of a casing, a revoluble member inside of the casing, driving vanes carried by such member, means for directing liquid under pressure against such vanes to rotate such member, such vanes and directing means so constructed as to produce a spray between the vanes to divide the interior of such casing into a plurality of compartments, means for supplying gas to one of such compartments and for delivering gas from another of such compartments, and means for passing the gas from one compartment to another through the spray without difference in pressure between the gas in the supply and delivery compartments.

8. Gas cleaning mechanism consisting in the combination of a casing, a revoluble member inside of the casing, two sets of vanes carried by such member, means for directing liquid under pressure against such vanes to rotate such member, such vanes and directing means so constructed as to produce a spray between the vanes to divide the interior of such casing into three compartments, and means for supplying gas to one of such compartments and for delivering gas from another of such compartments, one set of vanes serving to pass the gas from the supply compartment to an intermediate compartment and the other set of vanes serving to pass the gas from the intermediate compartment to the delivery compartment.

9. Gas cleaning mechanism consisting in

the combination of a casing, a revoluble mechanism inside of the casing, two sets of vanes carried by such mechanism, means for directing liquid under pressure against such vanes to rotate such mechanism, such vanes and directing means so constructed as to produce a spray between the vanes to divide the interior of such casing into three compartments, and means for supplying gas to one of such compartments and for delivering gas from another of such compartments, one set of vanes serving to pass the gas from the supply compartment to an intermediate compartment and to increase the pressure on the gas, and the other set of vanes serving to pass the gas from the intermediate compartment to the delivery compartment and to decrease the pressure on the gas.

10. Gas cleaning mechanism consisting in the combination of a casing, revoluble members inside of the casing, driving vanes carried by each of such members, means for directing liquid under pressure against such vanes to rotate such members, such vanes and directing means so constructed as to produce a spray between the vanes to separate the interior of such casing into a plurality of compartments, and means for passing the gas through such compartments.

11. Gas cleaning mechanism consisting in the combination of a casing, revoluble members inside of the casing, two sets of vanes carried by each of such members, means for directing liquid under pressure against such vanes to rotate such members, such vanes and directing means so constructed as to produce a spray between the vanes to separate the interior of such casing into a plurality of compartments, such vanes serving to pass the gas through such compartments.

12. Gas cleaning mechanism consisting in the combination of a casing, revoluble members inside of the casing, two sets of vanes carried by each of such members, means for directing liquid under pressure against such vanes to rotate such members, such vanes and directing means so constructed as to produce a spray between the vanes to divide the interior of such casing into a plurality of compartments, such vanes adapted to pass the gas through such compartments and to increase the pressure on the gas as it passes through the vanes in a direction away from the axis of such members and to decrease the pressure on the gas as it passes through the vanes in a direction toward the axis of such members.

13. A gas cleaning device consisting in the combination of a casing, a revoluble disk supported on bearings in the casing, a set of vanes disposed on each side of the disk, nozzles for directing liquid under pressure against such vanes, the vanes so placed on the disk that the liquid is sprayed between

and against them from the nozzles, means for supplying gas into the casing on one side of the disk and within one set of vanes, such set of vanes serving to pass the gas into a compartment in the casing surrounding both sets of vanes, the other set of vanes serving to pass the gas into a compartment within such other set of vanes and on the other side of the disk, and means for delivering gas from the casing.

14. A gas cleaning device consisting in the combination of a casing, a revoluble disk supported on bearings in the casing, a set of vanes disposed on each side of the disk, nozzles for directing liquid under pressure against such vanes, the vanes so placed on the disk that the liquid is sprayed between and against them from the nozzles and that such liquid always strikes the vanes, means for supplying gas into the casing on one side of the disk and within one set of vanes, such set of vanes serving to pass the gas into a compartment in the casing surrounding both sets of vanes, the other set of vanes serving to pass the gas into a compartment within such other set of vanes and on the other side of the disk, and means for delivering the gas from the casing.

15. A gas cleaning device consisting in the combination of a casing, a revoluble disk supported on bearings in the casing, a set of vanes disposed on each side of the disk, nozzles for directing liquid under pressure against such vanes, such nozzles so disposed that the liquid projected therefrom has no free path between the vanes into the compartment surrounding them, means for supplying gas into the casing on one side of the disk and within one set of vanes, such set of vanes serving to pass the gas into a compartment in the casing surrounding both sets of vanes, the other set of vanes serving to pass the gas into a compartment within such other set of vanes and on the other side of the disk, and means for delivering the gas from the casing.

16. A gas cleaning device consisting in the combination of a casing, a revoluble disk supported on bearings in the casing, a set of vanes disposed on each side of the disk and having practically the same inclination, nozzles for directing liquid under pressure against such vanes, the vanes so placed on the disk that the liquid is sprayed between and against them from the nozzles, means for supplying gas into the casing on one side of the disk and within one set of vanes, such set of vanes serving to pass the gas into a compartment in the casing surrounding both sets of vanes, the other set of vanes serving to pass the gas into a compartment within such other set of vanes and on the other side of the disk, and means for delivering the gas from the casing.

17. A gas cleaning device consisting in

the combination of a casing, revoluble disks supported on bearings in the casing, a set of vanes extending from each side of each disk near its periphery, nozzles for directing liquid under pressure against such vanes, the vanes so disposed on the disks that the liquid is sprayed against and between them from the nozzles, means for supplying gas into the casing, one of the sets of vanes on each disk adapted to pass the gas from a compartment within such set of vanes into a compartment surrounding both sets of vanes, the other set of vanes on each disk adapted to pass the gas from the compartment surrounding such vanes into a compartment surrounded by such other set of vanes, and means for delivering the gas from the casing.

18. A gas cleaning device consisting in the combination of a casing, revoluble disks supported on bearings in the casing, a set of vanes extending from each side of each of the disks near its periphery and having practically the same inclination, nozzles for directing liquid under pressure against such vanes, the vanes and nozzles so disposed relatively that the liquid projected from the nozzles has no free path between the vanes into the compartments surrounding them, means for supplying gas into the casing, one of the sets of vanes carried by each disk serving to pass the gas from a compartment within the vanes to a compartment surrounding such vanes and to increase the pressure on the gas, the other set of vanes carried by each disk serving to pass the gas from a compartment surrounding both sets of vanes to a compartment surrounded by such other set of vanes and to decrease the pressure on the gas, each disk serving to separate the compartments surrounded by the two sets of vanes carried by such disk, the several sets of vanes constituting means for passing the gas successively through the several compartments contained within the casing and to deliver the gas from such casing.

19. In a gas cleaning apparatus, the combination of a casing containing a plurality of compartments, means for directing the gas through such compartments, means for projecting liquid spray into the casing between the compartments, and rotary means for receiving the spray thus projected and deflecting it to produce a secondary spray, the spray initially produced and the secondary spray together constituting a cleaning medium separating the compartments through which the gas is caused to pass.

20. In a gas cleaning apparatus, the combination of a casing containing a plurality of concentric compartments, means for directing the gas through such compartments, means for projecting liquid spray into the casing, and rotary means for receiving the

spray thus projected and deflecting it to produce a secondary spray, the spray initially produced and the secondary spray together constituting a cleaning medium separating the compartments through which the gas is caused to pass.

21. In a gas cleaning apparatus, the combination of a casing containing a plurality of concentric compartments, means for directing the gas through such compartments, means for projecting liquid spray into the casing, and rotary means driven by the spray thus projected for receiving the same and deflecting it to produce a secondary spray, the spray initially produced and the secondary spray together constituting a cleaning medium separating the compartments through which the gas is caused to pass.

22. In a gas cleaning machine, the combination of a casing comprising two compartments, rotatable mechanism between the

compartments, a set of vanes carried by such mechanism and obliquely inclined to radii thereof, and means for projecting liquid simultaneously against all the vanes.

23. In a gas cleaning machine, the combination of a casing comprising two compartments, rotatable mechanism between the compartments, a set of vanes carried by such mechanism, and means for simultaneously projecting a liquid jet against each vane.

24. In a gas cleaning machine, the combination of a casing comprising two or more compartments, rotatable mechanism between the compartments, a set of vanes carried by such mechanism, and nozzles one for each vane for projecting liquid against such vanes.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."