Sept. 24, 1935. N. L. SNOW ET AL 2,015,355

DEDUSTING APPARATUS

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Fig. 1.

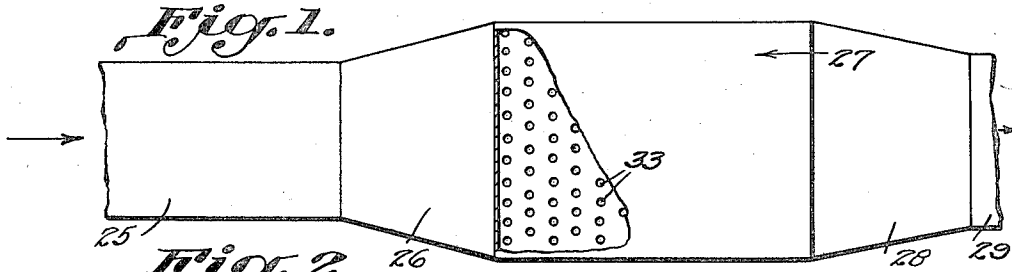


Fig. 2.

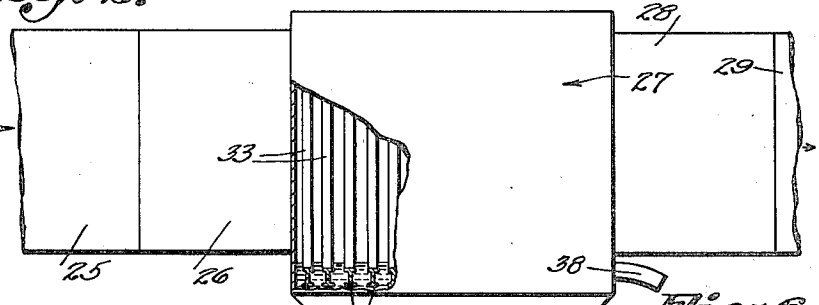


Fig. 11.

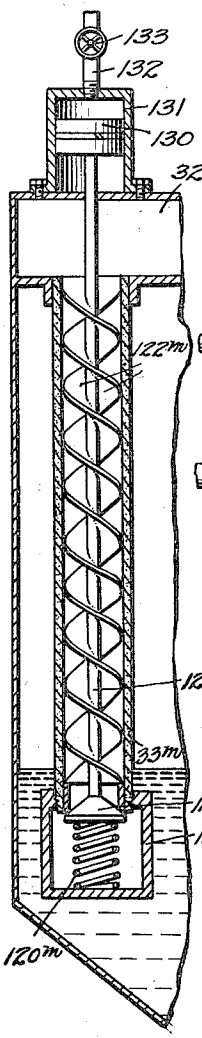


Fig. 3.

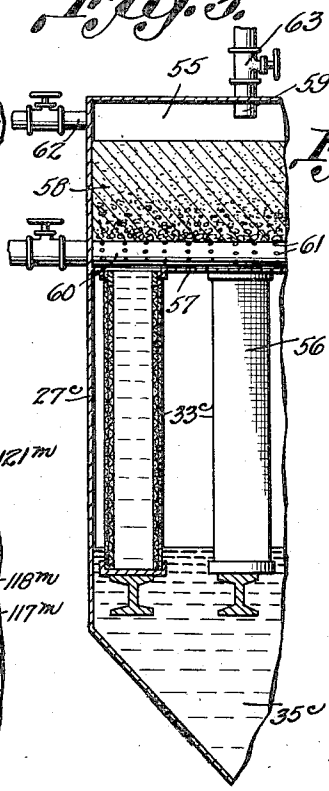


Fig. 4.

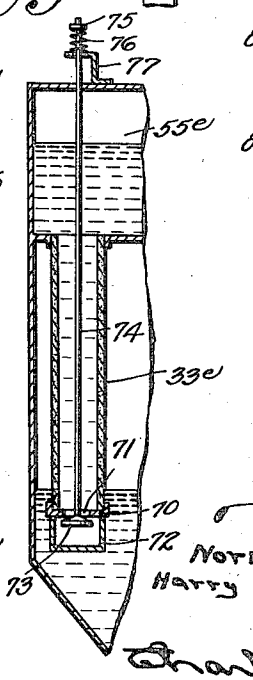
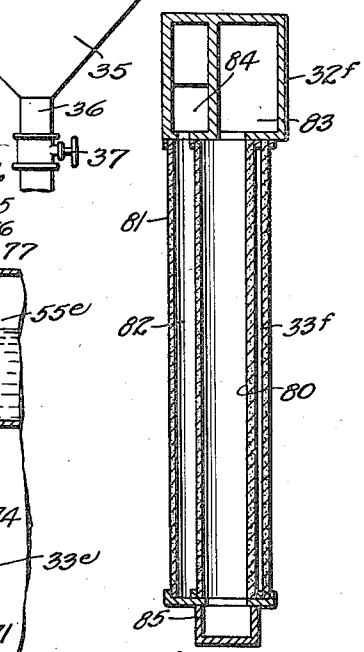


Fig. 6.



Inventor:

Norman L. Snow

Harry E. Brelsford

Charles B. Belknap

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DEDUSTING APPARATUS

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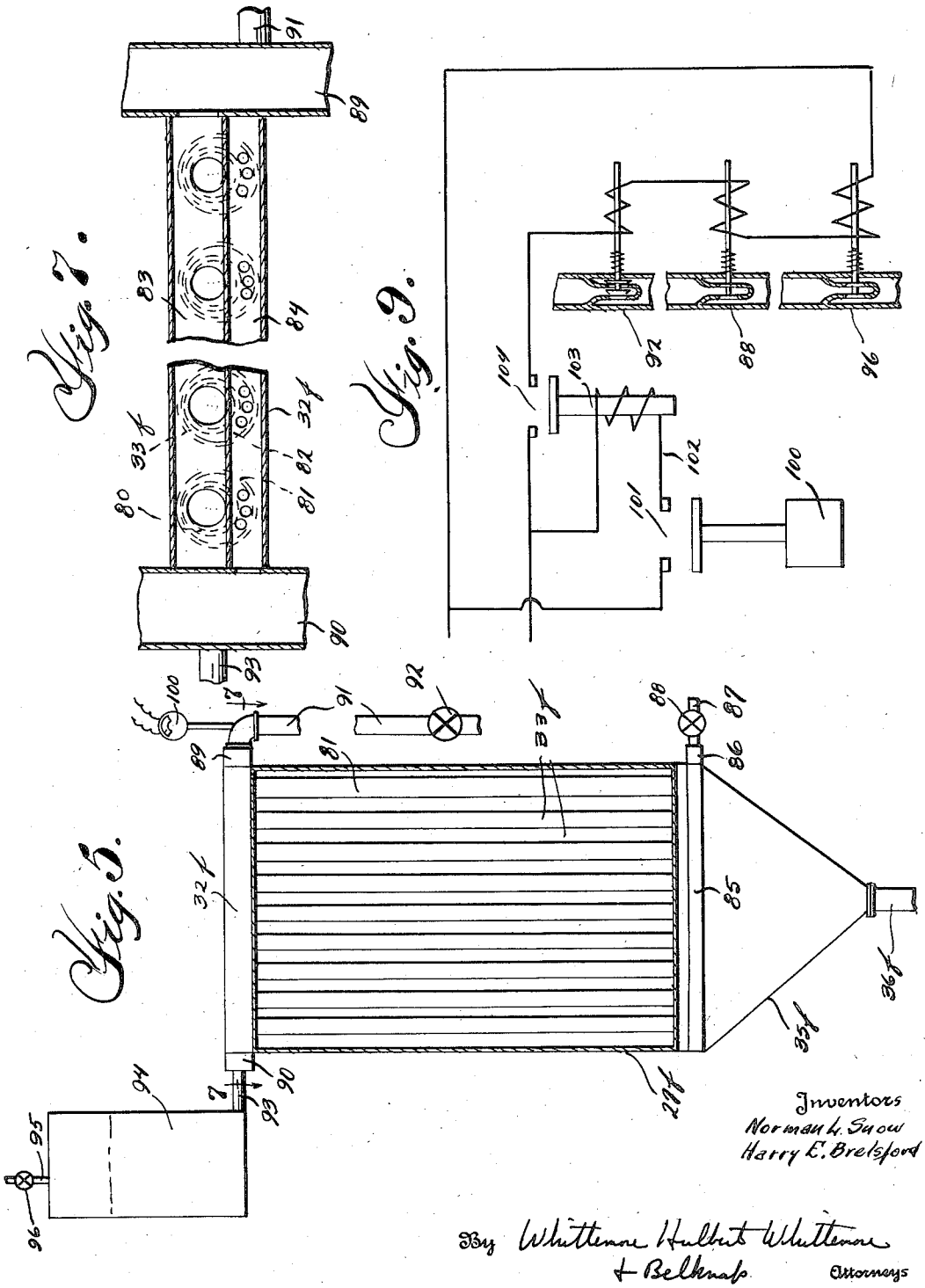

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DEDUSTING APPARATUS

Filed March 25, 1932 3 Sheets-Sheet 3

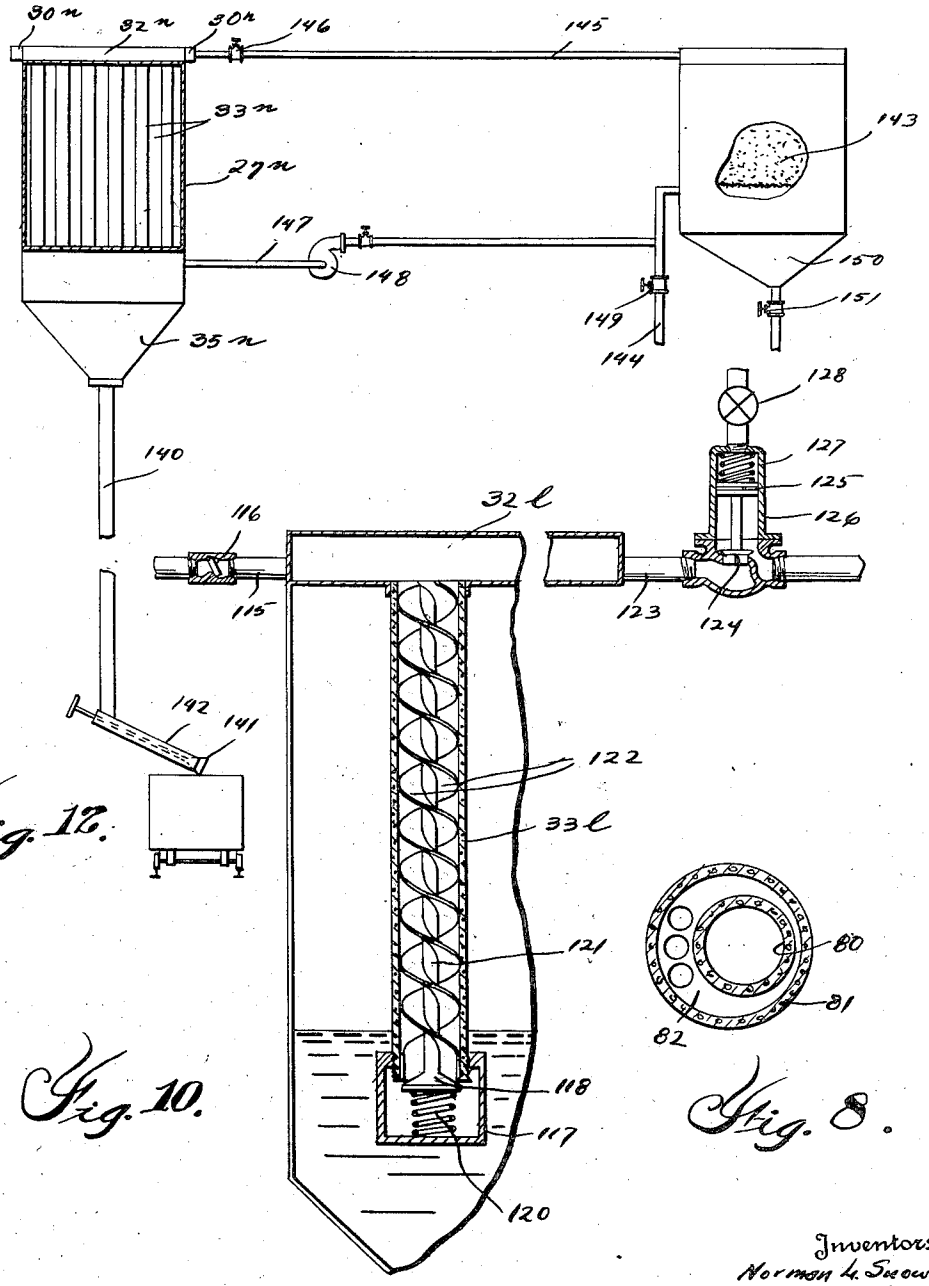

Fig. 12.

Fig. 10.

Fig. 8.

Inventors
Norman L. Snow
Harry E. Brelsford

By Whittemore Hulbert Whittemore & Belknap Attorneys

UNITED STATES PATENT OFFICE

2,015,355

DEDUSTING APPARATUS

Norman L. Snow, New Canaan, Conn., and Harry E. Brelsford, Birmingham, Mich., assignors to Diamond Power Specialty Corporation, Detroit, Mich., a corporation of Michigan

Application March 25, 1932, Serial No. 601,198

25 Claims. (Cl. 183—8)

This invention relates to an apparatus adapted to be installed in a gas passage to remove the dust and the like from such gases as are discharged from boilers, industrial furnaces and other dust producing sources.

The invention is directed more particularly to an apparatus of the above mentioned character which includes elements disposed in the path of flow of the gas and means for wetting the surfaces of these elements so that the dust or the like will be collected on the elements.

One of the primary objects of this invention is to provide an element of the above mentioned character which will be of a porous nature whereby a liquid may be caused to pass through the element to wet the surface thereof with which the gas contacts.

The invention has as a further object to provide means for treating the liquid such as water or the like which is supplied to the porous elements to remove the impurities from this liquid to prevent these elements from becoming clogged and inoperative.

Still further the invention contemplates the provision of means for effecting a cleaning of the porous elements so that the same will always be in such a condition that the wetting liquid may pass through the same.

Numerous other objects and advantages of the invention will become more apparent as the following description proceeds, particularly when reference is had to the accompanying drawings, wherein:

Fig. 1 is a plan view with parts broken away of an apparatus constructed in accordance with the teachings of this invention;

Fig. 2 is an elevational view with parts broken away of the apparatus shown in Fig. 1;

Fig. 3 is a fragmentary sectional view through a dedusting apparatus showing associated with the same a means for cleaning the liquid supplied to the porous elements;

Fig. 4 is a view similar to Fig. 3 showing associated with the element means for effecting a cleaning of the same;

Fig. 5 is a semi-diagrammatic view of a dedusting apparatus utilizing a slightly modified form of element;

Fig. 6 is a vertical sectional view through one of the elements forming a part of the structure shown in Fig. 5;

Fig. 7 is a sectional view taken substantially on the line 7—7 of Fig. 5;

Fig. 8 is a sectional view through the element shown in Fig. 6;

Fig. 9 is a diagrammatic view showing the wiring diagram forming a part of the structure shown in Fig. 5;

Fig. 10 is a semi-diagrammatic sectional view showing a slightly modified form of porous element and cleaning means for the same;

Fig. 11 is a view similar to Fig. 10 showing a modified form of actuating mechanism for the cleaning means; and

Fig. 12 is a semi-diagrammatic view of a dedusting apparatus showing means for supplying a liquid to the same.

Referring then particularly to the drawings wherein like reference characters designate corresponding parts throughout all views, there is diagrammatically illustrated in Figs. 1 and 2 a gas passage **25** adapted to receive the gases from a boiler, industrial furnace or other dust producing source. This gas passage discharges into the tapered end **26** of a casing designated generally by the reference character **27**. The gases are cleaned as they pass through the casing and are discharged therefrom through the tapered end **28** which communicates with a passage **29** which may lead to a stack or the like (not shown).

Disposed in the casing **27** are porous tubular elements **33**, these porous elements being preferably supported at their lower ends on I-beams **34** which extend transversely of the casing and are fixed thereto in any desired manner. It will be noted, by reference to Fig. 1 of the drawings, that these porous elements are arranged in rows transversely of the casing **27** and that the elements in one row are preferably staggered relative to the elements in the next adjacent rows so that the gases passing through the casing are compelled to contact with the outer surfaces of one or more of the elements **33**.

A liquid such as water or the like is supplied to the interiors of the porous elements **33** as will hereinafter be more fully described and passes through these elements to provide films of liquid on the outer surfaces of these elements. This liquid flows down the elements, carrying with it dust and the like which is removed from the gases, and this dust laden liquid is received in the hopper-shaped bottom **35** of the casing **27**. A discharge pipe **36** is provided for the hopper, this pipe being controlled by a suitable valve **37**.

The lower ends of the porous elements are preferably maintained partly submerged in the water, the water level being maintained at the

point indicated, by a suitable overflow pipe **38**. It will be understood that the heavier dust particles in the liquid in hopper **35** will settle to the bottom of this hopper and into the discharge pipe **36** so that the water discharged through pipe **38** will be partly clarified. This water may be discharged as waste.

As thus far described it will be apparent that water or the like supplied to the interiors of the porous elements **33** will pass through the walls of these porous elements, wetting the exterior surfaces thereof, so that the dust particles and the like in the gases passing through the casing **27** will be collected by the film of water on the exterior surfaces of the porous elements. The dust laden liquid will flow down the tubular elements and into the hopper **35**, the dust particles settling into the discharge **36** and the partly clarified liquid being drawn off by way of pipe **38**. Thus the gases discharged from the casing **27** will be freed from dust particles and the like and may be either discharged to the atmosphere or to any point of use.

Both the porous elements **33** and the casing **27** may be formed in various ways as will be more apparent as the following description proceeds. The showings in Figs. 1 and 2 are semi-diagrammatic only and it is to be understood that any of the porous elements and casings which are about to be described may be incorporated in the structure shown in Figs. 1 and 2.

In Fig. 3 there is disclosed one form of casing which may be utilized. In this figure of the drawings the casing designated by the reference character **27c** is divided into upper and lower compartments **55** and **56**, respectively, by a horizontally disposed partition **57**. The porous elements **33c** are arranged in the portion **56** of the casing, and their lower ends are submerged in the water which is in the portion **35c** of the casing. The upper ends of the porous elements project through openings formed in the plate **57** to receive water or the like which is supplied to the portion **55** of the casing.

In this form of construction the portion **55** of the casing is filled with sand or other granular material as designated by the reference character **58**. This material is of graduated sizes, the coarsest being in the bottom, the particles gradually decreasing in size to a very finely divided material at the top of the bed. This bed constitutes a filter bed which will filter water supplied to the chamber **55** by way of pipe **59** so that all suspended material in this water will be removed from the same prior to the flow of the water into the elements **33c**. Thus these elements will not become clogged with sediment or the like.

For the purpose of cleaning the filter bed, one or more pipes **60** are disposed adjacent the upper surface of the wall **57** and thus at the bottom of the filter bed, and these pipes are provided with discharge openings **61** directed upwardly toward the filter bed. Thus, should the filter bed become clogged with sediment, water under pressure may be supplied to the pipes **60** and discharged through the openings thereof upwardly through the filter bed to wash the same, this water with the sediment contained in the same being discharged by way of the pipe **62**. It will be obvious that some of the water discharged from the pipes **60** will pass downwardly into the porous elements **33c** so that the outer surfaces of these elements will be maintained in a moist condition. After the filter bed has become cleansed as indicated by a clearing of the water which passes out through the pipe **62**, then the supply of water to the pipes **60** may be cut off and the valve **63** in pipe **59**, which valve is preferably closed during the cleaning operation, may again be opened.

Thus it will be apparent that in this form of invention, means is provided for supplying cleaned water to the porous elements to prevent clogging of the same. The water passes through a filter bed which may be readily cleaned by reversing the flow of water through the same when the necessity for this arises.

In Fig. 4 there is disclosed a porous element **33e** mounted for communication with a chamber **55e**. The element **33e** is in this form of construction supported on a plate **70** which is provided with an opening **71**. The plate **70** is in turn supported on the header **72** which is provided at its top with an opening and thus communicates with the interior of the tubular element by way of port **71**. If desired, plate **70** may constitute a part of header **72**.

For closing the port **71** there is provided a valve member **73** mounted on the lower end of a stem **74** which passes upwardly through the porous element and which is provided at its upper end with a washer **75** which constitutes an abutment for a spring **76**. The other end of the spring engages a suitable fixedly mounted plate **77** through which the valve stem loosely passes, the arrangement being such that the spring **76** normally holds the valve in a position to close opening **71**.

In this form of construction, should any matter be deposited from the water on the interior wall of the tubular porous element, the same may be flushed off by suddenly opening valve **71**, thus permitting the water to rush downwardly out of the porous element carrying with it the deposited matter. It is contemplated that this structure might be used wherever water containing sediment such as sand or other particles which would not strongly adhere to the interior of the tube, was supplied to the tube.

In Figs. 5 to 9, inclusive, a further modified form of construction is disclosed as comprising a casing **27f** provided with a hopper section **35f** and a discharge pipe **36f**. Disposed across the top of the casing are headers **32f**, and depending from each of these headers are a plurality of porous elements **33f**.

Each porous element comprises an inner porous element **80**, this element being eccentrically mounted within an outer porous element **81** to provide a chamber **82** between these two elements. Each header **32f** is divided into compartments **83** and **84**. The interior of each element **80** is in communication with the compartment **83** of its respective header, while each chamber **82** is in communication with the compartment **84** of its respective header. Further, the interior of each element **80** is in communication at its lower end with a header **85**, there being a plurality of these headers provided which communicate with a header **86** disposed along one lower longitudinal edge of the casing **27f**. A discharge pipe **87** communicates with the header **86**, this pipe being controlled by a valve **88**.

Carried by the casing adjacent the top thereof are headers **89** and **90**, the former communicating with the chambers **83** of the headers **82** and the header **90** communicating with the chambers **84** of these headers. A pipe **91** controlled by a valve **92** supplies water to the header **89**, while a pipe **93** connected to the header **90** communicates

In Fig. 12 there is diagrammatically illustrated a system which includes a casing 27^n in which are arranged porous elements 33^n, water being flowed down into these elements from headers 30^n and 32^n.

The solid matter collected by the water falls into hopper 35^n and from there into a standpipe 140 in which the solid matter packs, forcing the water from the same and into the upper part of the hopper. The discharge of the solid matter from the lower end of the standpipe may be controlled by a suitable valve 141 disposed at the end of a discharge 142 which is arranged at the lower end of the standpipe. If desired, the solid matter may be discharged from the standpipe into a furnace or the like to provide for fusing of the solid matter in the manner disclosed in our application Serial No. 572,676, filed November 2, 1931.

The reference character 143 designates a filter container, to the lower end of which water is supplied by a pipe 144. The water passes upwardly through the filter, the clear or purified water passing off from the top of the filter by pipe 145 which communicates with the header 30^n. A valve 146 controls the flow of water through this pipe.

If desired, the partly clarified water from the upper part of the hopper may be passed through the filter and then returned to the header 30^n, and for this purpose there is provided the pipe 147 which is tapped into the hopper adjacent the upper end thereof. A pump 148 in this pipe draws the water from the hopper and forces the same into the pipe 144 at a point above valve 149. It will be obvious that valve 149 may be actuated to regulate the quantity of fresh water supplied to the filter so that this, combined with the water returned from the hopper 147, will be sufficient to supply the header 30^n. Solid particles removed from the water will settle into the hopper 150 of the filter and may be discharged therefrom by way of valve controlled discharge conduit 151.

In operation, it will be apparent that the porous elements will be supplied with pure water and that dust collected by the flowing water will be packed in the standpipe 140. The partly clarified water will be added to whatever fresh water is necessary, and this will be passed through the filter and then supplied to the deduster casing for supply to the porous elements.

From the above it will be apparent that the invention provides a dedusting apparatus which includes means providing wetted surfaces in the path of the gas flow. For this purpose porous or like elements are provided, together with means for cleaning these elements and/or cleaning the water prior to its supply to these elements. Further, the degree of flow of water through the walls of the elements may be varied to give the desired results in the moistening of the exterior surfaces of the elements.

While the invention has been described with some detail, it is to be understood that the description is for the purposes of illustration only and is not definitive of the limits of the inventive idea. The right is reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

What we claim as our invention is:

1. In an apparatus of the class described, a gas passage, a porous cylindrical element vertically disposed in said gas passage, a reservoir above said element, said reservoir being provided with an inlet opening and an outlet opening communicating with said element, means for supplying water to said reservoir by way of said inlet, a filter bed in said reservoir between the inlet and outlet openings thereof to filter the water prior to its passage to the said element and means for washing said filter bed to clean the same.

2. In an apparatus of the class described, a cylindrical porous element vertically disposed in a gas passage, a reservoir disposed above said tubular porous element, said reservoir having an outlet communicating with the upper end of said porous element and having an inlet by which water may be supplied to said reservoir, a filter bed within said reservoir disposed between the said inlet and outlet openings, and means associated with said reservoir for discharging a cleansing fluid through said filter bed in a direction counter to the normal flow of water therethrough for cleansing said filter bed.

3. In an apparatus of the class described, a tubular porous element vertically disposed in a gas passage and provided with open upper and lower ends, means normally closing the lower end of said element, a means for supplying water to the upper end of said element whereby said water will pass through the porous wall of said element to wet the outer surface thereof and means operable from outside the gas passage during the normal use of the apparatus to open the lower end of said element to flush the same.

4. In an apparatus of the class described, a tubular porous element vertically disposed in a gas passage, a valve closing the lower end of said element, means for supplying water to the upper end of said element, whereby said water may pass through the wall of said element to wet the outer surface thereof, and a header disposed below said element to receive the water therefrom upon the opening of the valve closing the lower end of said element.

5. In an apparatus of the class described, a pair of tubular porous elements disposed one within the other, the inner element being of less diameter than the outer element to provide a space between said elements, means for supplying water to the inner of said elements, said water passing through the wall of said inner element into the space between said elements and then through the wall of said outer element to wet the outer surface thereof, and means for temporarily causing the water to pass in a reverse direction through the wall of said inner element to cleanse the same.

6. In an apparatus of the class described, a pair of tubular porous elements disposed one within the other to provide a chamber between the outer surface of one of the elements and the inner surface of the other element, means for supplying water to the interior of the inner element whereby said water will flow through the wall of said inner element into the space between said elements and then through the wall of said outer element to wet the outer surface thereof, a container for receiving the overflow from the space between said elements, and means for periodically providing for a back-flow of the water from said container to said space and through the wall of said inner element in a direction counter to the normal passage of water therethrough to clean said inner element.

7. In an apparatus of the class described, a pair of porous elements, means for normally passing water through one of said porous elements and

with a reservoir 94. A pipe 95 controlled by a valve 96 may be tapped into the upper end of reservoir 94 to supply compressed air to this reservoir for a purpose which will hereinafter be more fully described.

During normal working conditions the valve 88 is closed and the valve 92 is opened to admit water to header 89 and thus to compartments 83 of the headers 82^f. This water flows downwardly to the interior of cylinders 80 and then passes through the porous walls of these cylinders to the chambers 82. A part of this water passes from each chamber 82 through the porous wall of its respective element 81 to wet the outer surface of this element and thus the outer surface of its respective porous element. Some of the water, however, passes upwardly through chamber 82 into compartment 84, thence to header 90 and into reservoir 94. If valve 96 is closed, the water rising in reservoir 94 causes the air in the reservoir above the water to become compressed. If, now, the wall of element 80 becomes clogged with impurities, it is contemplated that valve 92 be closed and valve 88 opened to permit a back-flow of the water from the reservoir 94 down into the chamber 82, a part of this water passing outwardly through cylinder 81 and the remainder of the water passing inwardly through element 80 to the interior thereof, cleaning out the pores of this element. This water carrying the sediment from element 80 is discharged into header 85 and thence to header 86 and out discharge pipe 87.

To effect an automatic actuation of this flushing or washing of the element 80, there may be provided a pressure gauge 100 in communication with the pipe 91. It will be obvious that should element 80 become clogged, pressure in pipe 91 would increase, and this increase in pressure would actuate gauge 100, causing the same to close switch 101 in a circuit 102. This circuit controls a timing relay 103 which closes a circuit designated 104, this circuit being suitably connected to a source of electrical current (not shown). Arranged in circuit 104 are the solenoid valves 92, 88 and 96, the arrangement being such that when the circuit 104 is broken, valve 92 is open and valves 88 and 96 are closed. Upon energization of circuit 104, however, incident to an actuation of relay 103, valve 92 is closed and valves 88 and 96 are opened, thus permitting the back-flow of water in the manner above described, the valve 96 permitting the entrance of air under pressure into reservoir 94 to more forcibly effect the back-flow of the water. If desired, the valve 96 may be eliminated and the pressure built up in the chamber 94 be relied upon to give the desired force to the backflow of the water.

It will be apparent that if desired the valves 92, 88 and 96 might be operated hydraulically rather than electrically, the object being to provide means for effecting a back-flow of the water at intervals to effect a cleansing of the inner element 80 which constitutes a filter for the water prior to the passing of this water into the chamber 82. It will be obvious that during the back-flow of the water a portion thereof will pass through the element 81 to keep the outer surface thereof wet at all times. Further, the water flowing down the outer surface of element 81 will carry with it the collected dust into the hopper 35^f for discharge by way of the pipe 36^f.

In Fig. 10 a further modified form of construction is disclosed as comprising a header 32^l from which depends a porous tubular element 33^l, the wall of which may be formed in any of the manners previously described. Water is supplied to the header by way of a supply pipe 115 and disposed in this supply pipe is a check valve 116.

Disposed adjacent the lower end of the porous element is a header 117, communication between this header and the interior of the porous tube being controlled by a valve 118 which is normally held in closed position by a spring 120. A stem 121 is fixed to the valve and extends longitudinally of the porous element, and secured to this stem are helices 122 which loosely engage the inner surface of the porous element.

Connected into the header 32^l is a supply pipe 123 for water under a pressure greater than that supplied by pipe 115. A valve 124 controls the flow of water through this pipe, and this valve is connected to a piston 125 reciprocable in a cylinder 126. A spring 127 disposed within the cylinder tends to urge the valve to closed position, while a valve 128 controls the exhaust from the space in the cylinder above the piston.

In operation water is normally supplied to the header 32^l by way of pipe 115, the valve 124 being closed. This water passes through the wall of the porous element to wet the outer surface thereof in the manner described with reference to the previous constructions. As solid matter deposits on the inner surface of the porous element, the pressure within header 32^l rises, and this pressure may be utilized, if desired, to cause valve 128 to open to permit the pressure above piston 125 to exhaust. The pressure from the supply pipe then acting on the lower end of piston 125 causes valve 124 to open, supplying water under high pressure to the header 32^l.

This water under high pressure forces valve 118 downwardly, causing the helices to scrape the interior of the porous element, the deposits being thus scraped from the walls and flushed out of the porous element into the header 117. After the element has been cleaned, the valve 128 may be closed, with the result that pressure building up in the cylinder by leakage past the piston 125 will, together with the spring 127, cause a closing of the valve 124. After this, normal operation may be automatically resumed, the water flowing into the header by way of pipe 115.

In Fig. 11 a similar arrangement is shown as comprising a porous element 33^m having its lower end adapted to communicate with a header 117^m. Valve 118^m is normally held in closed position by spring 120^m, and fixed to the stem 121^m are the helices 122^m.

The valve stem passes upwardly through header 32^m and is secured to a piston 130 in a cylinder 131. A pipe 132 supplies high pressure fluid to the cylinder above the piston, and the flow of this fluid through this pipe is controlled by a valve 133 which may be electrically, hydraulically or otherwise actuated in dependence upon the pressure in the header 32^m.

In operation, when the pressure rises in the header by virtue of the depositing of sediment and the like on the interior of the wall of the element 33^m, valve 133 will be caused to open, and fluid pressure will be admitted to the cylinder above the piston. This will depress the piston, valve 118^m and the helices, causing the latter to scrape the inner wall of the porous element, the material scraped from the element being flushed therefrom and to the header 117 by water from the header 32^m.

then through the other of said porous elements to wet the surface of said second element most remote from said first mentioned element, and means for periodically causing a flow of water through said first mentioned element counter to the normal flow of water therethrough to cleanse said first mentioned element.

8. In an apparatus of the class described, a pair of tubular porous elements disposed one within the other to provide a chamber between the outer surface of the one and the inner surface of the other, headers communicating with the upper and lower ends of said inner element, a header communicating with the upper end of the space between said elements, means for supplying water by way of one of said first mentioned headers to said inner element whereby the water will flow through the wall of said inner element into the space between said elements and then partly through the wall of said outer element and partly into the header communicating with the space between said elements, means normally preventing the discharge of water from the header communicating with the lower end of said inner element, and means automatically operating to periodically cut off the supply of water to the header communicating with the upper end of said inner element and to provide for the discharge of water from the header communicating with the lower end of said inner element whereby the water from the header communicating with the space between said elements may flow backwardly through the wall of said inner element and out by way of said header communicating with the lower end of said inner element.

9. In an apparatus of the class described, a vertically disposed tubular porous element, means for supplying water to the interior of said element, means movable longitudinally of said element for scraping the interior of said element to remove sediment therefrom, and means to actuate the scraping means in dependence upon the pressure of the water supplied to the interior of said element.

10. In an apparatus of the class described, a vertically disposed tubular porous element, means for supplying water to the upper end of said element, a valve normally closing the lower end of said element, a stem for said valve extending longitudinally of said element, helices on said stem for engaging the inner surface of said element, and means for moving said stem longitudinally of said element to open the valve and to cause said helices to scrape the sediment from the inner surface of said element.

11. In an apparatus of the class described, a vertically disposed tubular porous element, means for supplying water to the upper end of said element, a valve normally closing the lower end of said element, a stem for said valve extending longitudinally of said element, helices on said stem for engaging the inner surface of said element, and means for moving said stem longitudinally of said element to open the valve and to cause said helices to scrape the sediment from the inner surface of said element, said last mentioned means including a piston connected to said stem and fluid pressure means for actuating said piston.

12. In an apparatus of the class described, a casing disposed intermediate the ends of a gas passage, a plurality of tubular porous elements vertically disposed in said casing, means for supplying water to the upper ends of said element whereby said water will pass through the walls of said elements to wet the outer surface thereof, the water flowing down the outer surfaces of said elements and collecting in the bottom of said casing, a standpipe communicating with the bottom of said casing for receiving solid particles collected by the water flowing down the outer surfaces of said elements, means for maintaining a predetermined level of water in the lower end of said casing, means for withdrawing from said casing the partly clarified water from which the solid particles have settled into the standpipe, means for filtering the water drawn from said casing, and means for returning the filtered water to said casing and for supply to the upper ends of said porous elements.

13. In an apparatus of the class described, a baffle element vertically disposed in a gas passage, a reservoir disposed above said baffle element, said reservoir having an outlet opening for supplying a dust collecting fluid to the upper end of said baffle element and having an inlet by which a dust collecting fluid may be supplied to the reservoir, a filter bed within the reservoir between the inlet and outlet openings, and means associated with said reservoir for discharging a fluid through said filter bed in a direction counter to the normal flow of fluid therethrough for cleansing said filter bed.

14. In an apparatus of the class described, a porous baffle element, means for flowing a dust collecting fluid through said porous element, and means for periodically reversing the flow of fluid through said porous element to clean the same.

15. In an apparatus of the class described, a tubular porous element, means for supplying a dust collecting fluid to the interior of said element, and pressure actuated means for cleaning the interior of said element.

16. In an apparatus of the class described, a baffle element disposed in a gas passage, means to supply a liquid to said baffle element to wet the same, and means actuated upon a predetermined increase in the pressure of the wetting liquid to effect a cleaning of said baffle element.

17. In an apparatus of the class described, a gas passage, dust-collecting means in said gas passage in the path of the gas flow therethrough, means to supply a liquid to the dust-collecting means to wet the surfaces thereof which are contacted by the gas, the arrangement being such that the liquid normally flows in a definite path through the supply means and to the surfaces of the dust-collecting means adapted to be wetted, and means for temporarily causing the liquid to flow in a path different from its normal path of flow to clean one of said first two mentioned means.

18. In an apparatus of the class described, a porous dust-collecting means disposed in a gas passage, means to supply a liquid to said dust collecting means to wet the same, and means for temporarily causing the liquid to flow differently than it normally flows in wetting the dust collecting means to cause the liquid to clean one of said first two mentioned means.

19. In an apparatus of the class described, a baffle element disposed in a gas passage, means to supply a liquid to said baffle element to wet the same, and a pressure actuated means arranged to be actuated upon a predetermined change in the pressure of the wetting liquid to effect a cleaning of said baffle element.

20. In an apparatus of the class described, a gas passage, a tubular element disposed in said gas passage, a reservoir above said element, said

reservoir being provided with an inlet opening and an outlet opening communicating with said element, means for supplying a dust-collecting liquid to said reservoir by way of said inlet opening, a filter bed in said reservoir between the inlet and outlet openings thereof to filter the liquid prior to its discharge to the said element and means for washing said filter bed to clean the same.

21. In an apparatus of the class described, a tubular element disposed substantially vertically in a gas passage and provided with open upper and lower ends, means normally closing the lower end of said element, means for supplying a dust-collecting liquid to the upper end of said element, means providing for the flow of the liquid from the interior of said element to the exterior thereof to wet the latter and means operable from outside of the gas passage during the normal use of the apparatus to open the lower end of said element to flush the same.

22. In an apparatus of the class described, a tubular element disposed substantially vertically in a gas passage, a valve closing the lower end of said element, means for supplying water to the upper end of said element, means providing for the passage of the water from the interior of said element to the exterior thereof to wet the latter, and a header disposed below said element to receive the water therefrom upon the opening of the valve closing the lower end of the element.

23. In an apparatus of the class described, a tubular porous element disposed within an outer tubular element, the inner element being of less diameter than the outer element to provide a space between said elements, means for supplying a liquid to the inner of said elements, said liquid passing through the wall of said inner element into the space between said elements, means providing for the flow of the liquid from the space between said elements to the exterior of the outer element to wet the outer surface of the outer element, and means for temporarily causing the water to pass in a reverse direction through the wall of the inner element to cleanse the same.

24. In an apparatus of the class described, a tubular element, means for supplying water to the interior of said element, means providing for the flow of the water from the interior of the element to the exterior thereof to wet the outer surface of the element, means for scraping the interior of said element to remove sediment therefrom, and means to actuate the scraping means in dependence upon the pressure of the water supplied to the interior of said element.

25. In an apparatus of the class described, a casing disposed intermediate the ends of a gas passage, a plurality of tubular elements vertically disposed in said casing, means for supplying a liquid to the upper ends of said elements, means providing for the flow of the liquid from the interiors of said elements to the exteriors thereof to wet the outer surfaces of said elements the liquid flowing down the outer surfaces of said elements and collecting in the bottom of said casing, a standpipe communicating with the bottom of said casing for receiving solid particles collected by the liquid flowing down the outer surfaces of said elements, means for maintaining a predetermined level of liquid in the lower end of said casing, means for withdrawing from said casing the partly clarified liquid from which the solid particles have settled into the standpipe, means for filtering the liquid drawn from said casing, and means for returning the filtered liquid to said casing and for supply to the upper ends of said elements.

NORMAN L. SNOW.
HARRY E. BRELSFORD.