Oct. 13, 1936. R. B. RATHBUN 2,057,446

FILTER FOR REMOVING SOLIDS FROM GASES

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Fig. 1

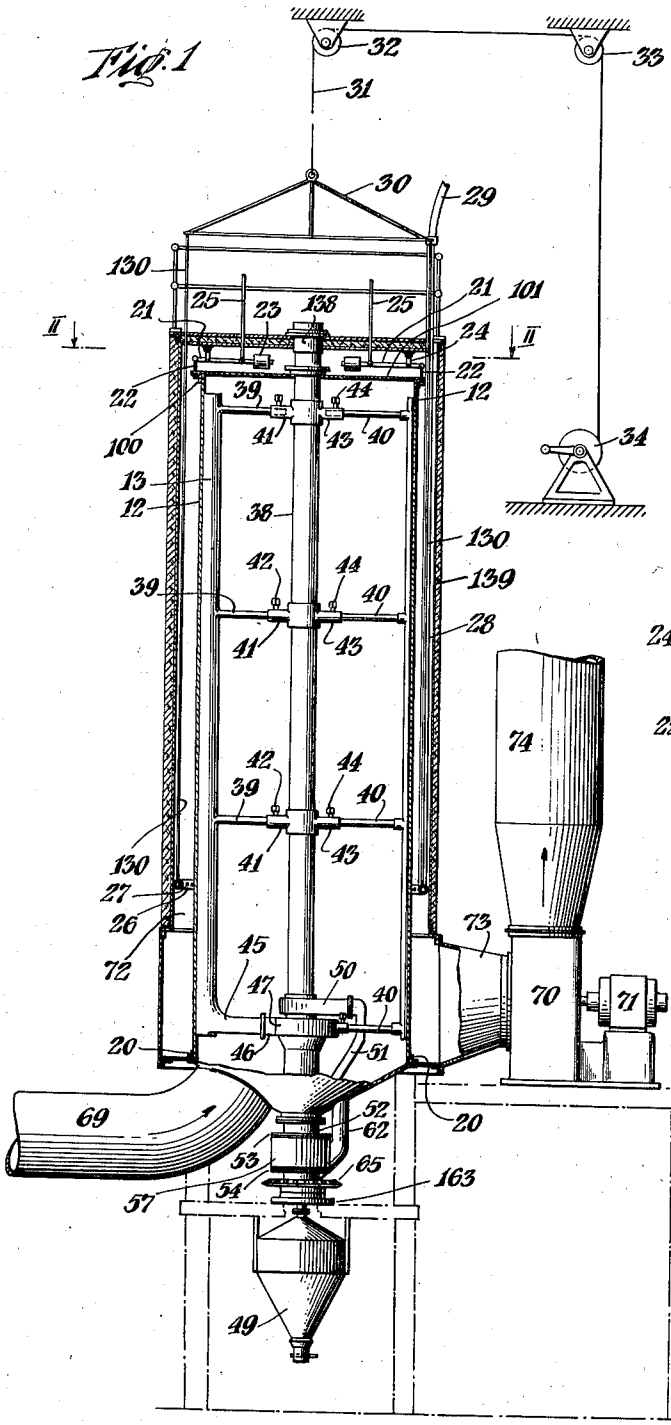
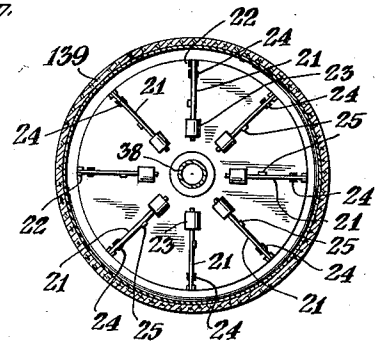


Fig. 2



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Fig. 3

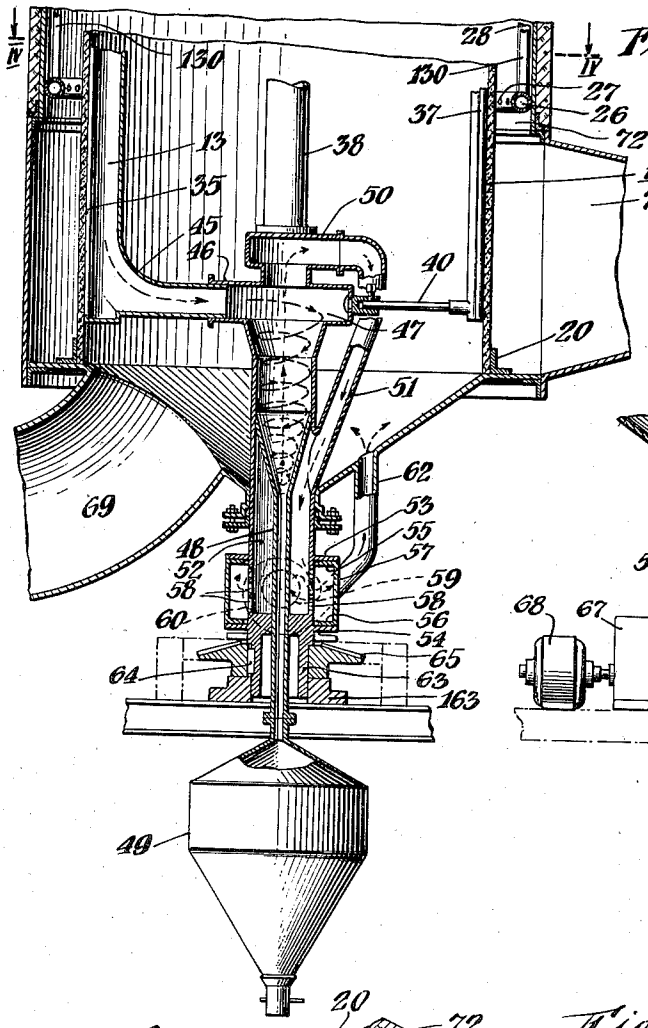


Fig. 5

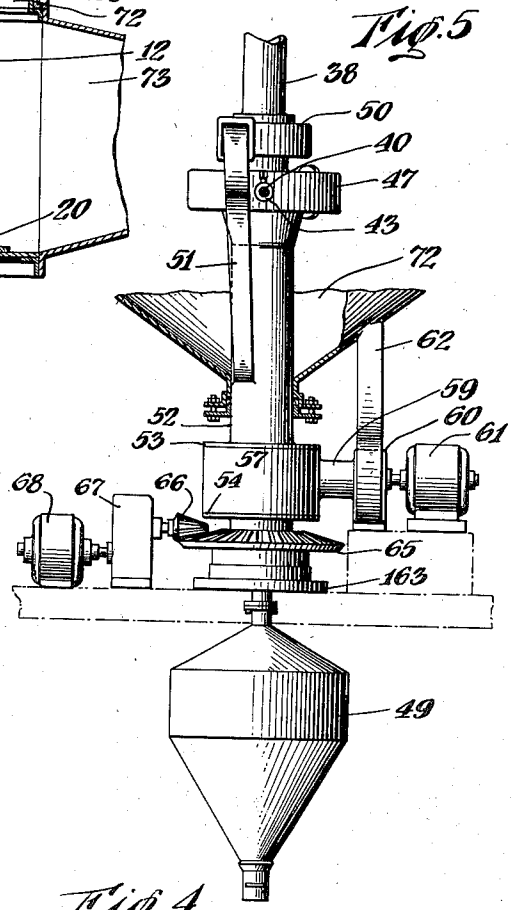
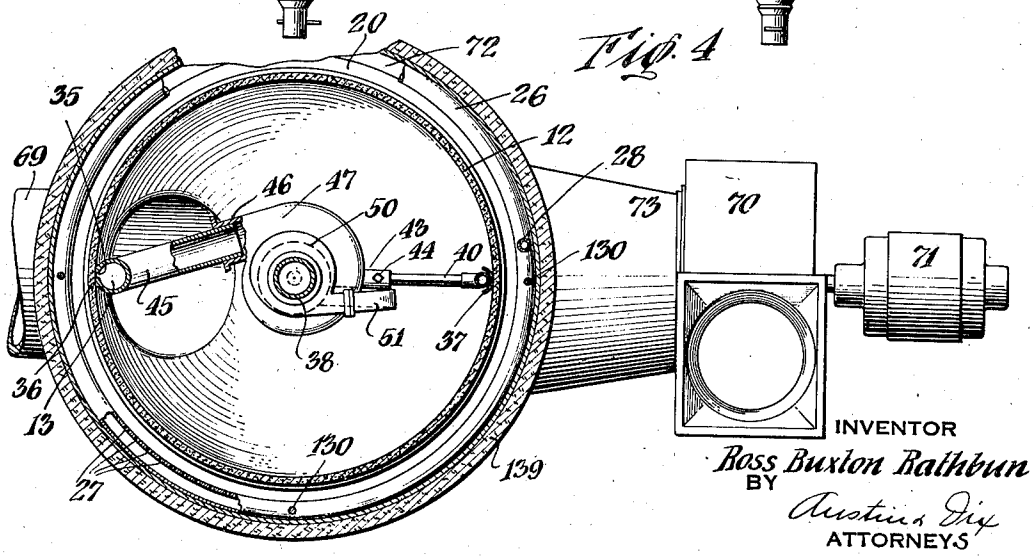


Fig. 4



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Fig. 7

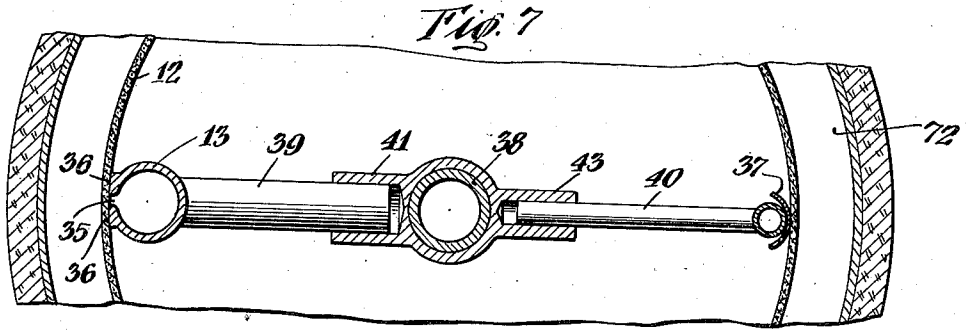


Fig. 6

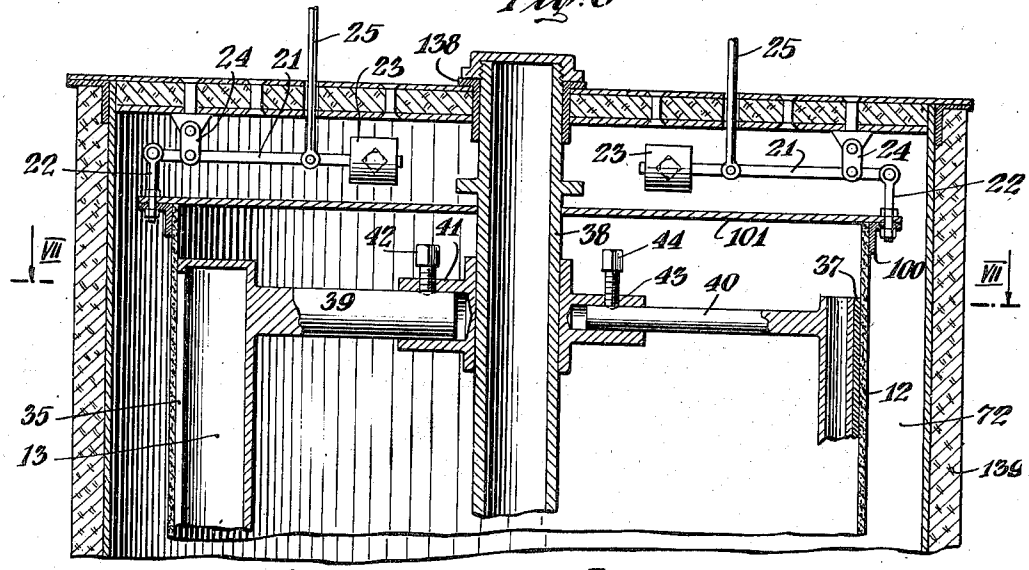


Fig. 8

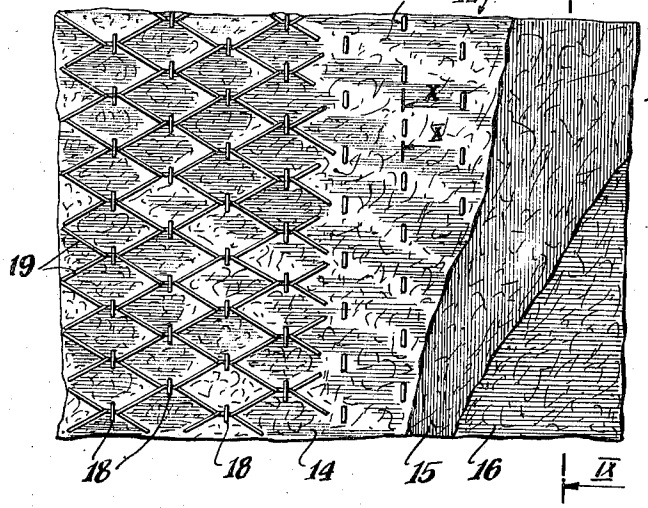


Fig. 9

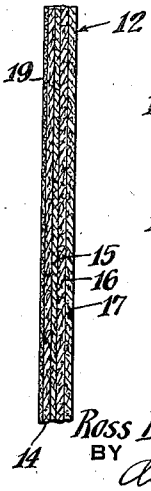
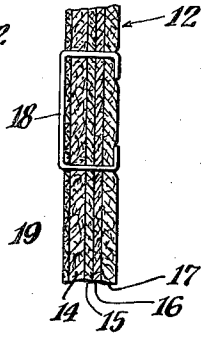


Fig. 10



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2,057,446

FILTER FOR REMOVING SOLIDS FROM GASES

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Application November 16, 1933, Serial No. 698,300

7 Claims. (Cl. 183—61)

The invention relates to filters for removing solids from fluids in which the former are suspended. The invention is particularly useful in connection with the separation of fume from gas, for instance in connection with such separation which is necessary in the smelting and refining of metals.

According to one form of practising the invention, the fume containing gas is passed into the interior of a substantially cylindrical porous bag to deposit the fume on the inner surface of the bag. The bag may comprise a series of concentric fabric elements, as, for instance, a plurality of layers of steel wool. These layers are preferably stapled together at intervals, the staples being loosely bent to permit play between the layers. A wire netting may be stapled to the outside of the bag for additional strength.

A suction member may be provided within the bag for removing the deposited fume therefrom and this suction member may take the form of a single nozzle extending the entire length of the bag and rotatable about the axis of the bag. It is preferred to employ a single opposed shoe bearing upon the bag at a part thereof which is diametrically opposite to the position of the nozzle. The nozzle is preferably exhausted into a centrifugal dust collector in which the fume therefrom is deposited and from which the substantially fume-free gas is recycled to the interior of the filter bag.

Other means may be employed for removing the deposited fume from the filter bag. For instance, a surrounding ring may be employed for projecting a fluid against the outside of the bag and it is preferred to make this ring adjustable in the direction of the axis of the bag in order that jets of fluid projected from the ring may reach the entire outer bag surface.

Apparatus may also be employed for applying tension to the bag from its top and in addition there may be employed apparatus for vibrating the bag by oscillating the same in the direction of its axis.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 is an elevation of an apparatus constructed in accordance with the invention, parts thereof being broken away to show its interior;

Fig. 2 is a section on the line II—II of Fig. 1;

Fig. 3 is an enlarged section through the lower part of the apparatus illustrated in Fig. 1;

Fig. 4 is a section on the line IV—IV of Fig. 3;

Fig. 5 is an elevation of the apparatus as viewed from the right in Fig. 3 showing in greater detail some of the parts;

Fig. 6 is a vertical cross section of the upper part of the apparatus viewed in Fig. 1 on an enlarged scale;

Fig. 7 is a fragmental section on the line VII—VII of Fig. 6;

Fig. 8 is a fragmental elevation of the filter bag partially broken away to show its construction;

Fig. 9 is a cross section on the line IX—IX of Fig. 8; and

Fig. 10 is an enlarged fragmental cross section of the bag section shown in Fig. 8, taken on line X—X.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit.

Like reference characters denote like parts in the several figures of the drawings.

In the drawings accompanying and forming part of this specification, certain specific disclosure of the invention is made for purposes of explanation, but it will be understood that the details may be modified in various respects without departure from the broad aspect of the invention.

Referring now more particularly to the drawings, it will be seen that they show a substantially cylindrical filter bag 12 and a single nozzle 13 extending substantially the entire length of the bag 12. The fume-laden gas enters the interior of the filter bag 12 from the pipe 69, passes through the bag and enters the exterior chamber 72, whence it is exhausted from the apparatus. In passing through the filter bag 12 the gas deposits its burden of fume and enters the exterior chamber 72 substantially free of fume. Main suction blower 70 serves to draw the gas-laden fume through the bag.

The bag preferably comprises a plurality of layers 14, 15, 16 and 17 of steel wool held together by staples 18 at intervals in both directions (see Fig. 8). The staples are loosely bent to permit play between the layers and it will be seen by referring to Fig. 10 that although the staples hold the layers together effectively, they do not pinch them one against the other so as to prevent a sliding motion of one layer with respect to its neighbor. Further, it is preferred to dispose the separate layers of steel wool so that the strands in any layer will lie at right angles to those in an adjacent layer. Such an arrangement produces more effective filtering, greater ease in cleaning the bag and greater strength in the bag itself. This construction is best illustrated in Fig. 8. How-

ever, if desired, each layer may be made up of matted steel wool fibres running in natural haphazard directions, without regard to the directions of the fibres in the several layers.

It has been found advisable to form the outer and inner layers 14 and 17 of the bag of coarser steel wool fibres than the intermediate layers 15 and 16. This results in greater resistance to wearing and scraping of the bag both by the cleaning nozzle on its inside and by any handling or accidental contacts with its outside. Finally, a covering of wire mesh 19, stapled by staples 18 or otherwise fastened to the outside of the bag provides greater strength and rigidity and produces a more durable and satisfactory filter bag.

The bag may be rigidly connected to the surrounding framework at its open lower end, for instance, by an annular angle section 20; and it is preferably supported by resilient means at its top. This means applies tension to the bag at its top but does not hold it rigidly. As here illustrated, (see Fig. 6) the resilient tension support comprises a plurality of levers 21, each having one end attached to a tie-rod 22 which in turn is fastened to the bag top and each lever 21 also having a counter weight 23 upon the end thereof which is distant from the end to which the tie-rod 22 is fastened. A pivot support 24 carries each lever 21 at a point intermediate its ends. The top of the bag includes a ring 100 of angle section having metal plate 101 forming the end wall of the bag.

Means may be provided for vibrating the bag in the direction of its axis. A variety of apparatus for this purpose will readily suggest itself to those skilled in the art. Such apparatus is here illustrated by vertical rods attached to the levers 21. Any known or convenient means for reciprocating these vertical rods 25 may be employed to vibrate the filter bag as described. The simplest method of oscillating the rods 25 is, of course, to grasp them in the hand and move them up and down.

By vibrating the filter bag in the direction of its axis some of the fume adhering to its inner surface will be displaced. Furthermore, the separate layers of which the bag is formed, will receive some displacement with respect to each other.

The second means for removing fume from the inner surface of the filter bag 12 and to some extent from between the layers of which the filter bag is composed, is provided in an annular fluid ring 26 (Fig. 1) which surrounds the filter bag 12 at a slight interval therefrom. The ring 26 has a series of perforations 27 at its inner face through which air or other fluid under pressure in the ring 26 will be forced from the outer surface of the filter bag 12 through the bag wall. A fluid supply pipe 28 is connected to the ring 26 and a flexible hose 29 is provided for supplying a fluid under pressure to the supply pipe 28. Thus, fluid under pressure coming from the hose connection 29 and passing through the supply pipe 28 to the annular ring 26 will be forced through the openings 27 against the outer surface of the porous filter bag through which it will then tend to pass. Fluid passing through the bag toward its inside will pick up fume which has been deposited on the inner surface of the bag or between the fibres thereof and will carry it to the interior of the bag, thus cleaning the bag.

Apparatus is provided for controlling the position of the fluid ring 26 with respect to the filter bag 12. As here illustrated this apparatus comprises a frame member, generally designated by the numeral 30, attached by rods 130 to the annular ring 26 about its periphery. The frame member 30 is shown as suspended by a cable 31 from pulleys 32 and 33, the cable being operated by a windlass 34 by means of which it is wound or unwound to elevate or lower the annular ring 26.

A single nozzle 13, to which reference has already been made, is provided for removing fume directly from the interior surface of the bag. The nozzle 13 extends substantially the entire length of the bag (see Fig. 1). A longitudinal slot 35 extending the entire length of the nozzle has its edges 36 in contact with the inner surface of the filter bag. In order to maintain the edges 36 in proper contact with the bag surface, an opposed shoe 37 is disposed in contact with the filter bag 12 at a part thereof diametrically opposite to that at which the nozzle 13 contacts. Both the nozzle and the shoe are carried by a longitudinal axle member 38 from which arms 39 and 40 extend to the nozzle and shoe respectively. Thus, by turning the axle 38, the nozzle and the shoe are turned in contact with the interior surface of the bag. The length of the arms 39 and 40 is preferably such that the nozzle and shoe will stretch the bag into slightly elliptical form, thereby assisting in maintaining the contact.

Means is provided for adjusting the position of the nozzle 13 and the position of the shoe 37 radially of the bag. As here shown, this means for adjusting the nozzle comprises a plurality of sockets 41 fastened to the axle 38 into which the arms 39 fit, combined with a set screw 42 in each socket 41 for clamping the end of the corresponding arm 39 therein. Similar means is shown for adjusting the position of the shoe, this means comprising sockets 43, into which the ends of the shoe arms 40 fit, together with the set screws 44 for fixing the extent to which the arms 40 project within the sockets 43. Obviously by loosening the set screws 42 and 44 and by moving the arms 39 and 40 outward and then tightening the set screws, the pressure of nozzle and shoe upon the bag may be increased. By reversing this operation, the pressure of nozzle and shoe may be lessened. It is noted that the arms 39 are of solid construction and do not carry gas from the nozzle 13 to the axle 38.

The nozzle is exhausted through a hollow member 45 adjacent its lower end, in the embodiment shown. This hollow member 45 fits into a sleeve 46 in a centrifugal separator 47 of well-known construction, to which it delivers the fluid which is drawn through the bag by the nozzle 13 (see Fig. 3). Member 45 will slide lengthwise in sleeve 46 slightly when the position of nozzle 13 is adjusted. The centifugal separator 47 is disposed within the filter bag 12, and turns with the axle 38 and the shoe 13.

In the centrifugal cyclone separator 47, the fume-laden gas enters tangentially and is whirled about, as indicated, depositing the particles of fume, which pass downwardly through a hollow stem 48 into a dust collector 49 below the rest of the apparatus. The carrying fluid, now substantially freed of its burden of fume, passes upward into a chamber 50 above this centrifugal separator, whence it is carried tangentially into a flue 51 which connects with a lower fluid chamber 52 which surrounds the hollow stem 48 adjacent the base of the apparatus. The lower fluid chamber 52 has external flanges 53 and 54 thereon which contact with flanges 55 and 56 respectively of a stationary circular fluid box 57 which surrounds

the lower part of the fluid chamber 52. Apertures 58 (see Fig. 3) in the walls of the fluid chamber 52 permit fluid to pass therefrom into the fluid box 57.

It is observed that the fluid chamber 52 revolves with the nozzle 13 and the centrifugal separator 47, whereas the fluid box 57 remains stationary.

A duct 59 connects the fluid box 57 with a centrifugal blower 60 which is operated by a special motor 61. A flue 62 leads from the centrifugal blower 60 to the interior of the bag 12, thus recycling the gaseous output of the cyclone separator back into main gas path.

From the foregoing it will be clear that the suction applied to the interior of the filter bag 12 by the nozzle 13 is the result of the exhausting action of the centrifugal blower 60 acting through the duct 59, the fluid box 57, the fluid chamber 52, the flue 51, the chamber 50 and the centrifugal separtor 47.

The walls of the rotating fluid chamber 52 terminate in a base member 63 which is keyed as at 64 to a bevel wheel 65. The base member 63 is journalled in stationary bearing 163. A pinion bevel 66 meshes with the bevel wheel 65 and is driven through a train of gears 67 by a motor 68 which turns the axle 38 together with the nozzle 13 and the shoe 37. It will be understood that the upper end of the axle 38 is journalled in bearing 138 secured to the top wall of the main housing 139 in which the filter bag is suspended.

Thus, in operation the fume-containing gas to be cleaned is passed to the interior of the filter bag 12 through supply pipe 69, and is drawn through the bag by the suction of the main centrifugal blower 70 operated by a motor 71. The centrifugal blower 70 is connected with the exterior chamber 72 wherein the filter bag is disposed by a flue 73, and exhausts the filtered fluid into an exhaust flue 74. In passing through the filter bag, the fume is deposited on its interior surface from which it may be removed by vibrating the bag, by passing fluid through it from a surrounding annular fluid ring, or by suction from a rotating nozzle in contact with the inner surface of the bag.

The apparatus which has been described is simple, rugged and easy to operate and maintain. The operations described may be carried on continuously or intermittently in accordance with the requirements of the particular plants to which the invention is applied.

This application is a continuation in part of application Serial No. 625,707, filed July 29, 1932, which matured as Patent No. 1,995,651 on March 26, 1935.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In a filter for removing solids from fluids, a substantially cylindrical filter bag, a single nozzle extending substantially the entire length of said bag in contact therewith, and an opposed shoe in contact with said bag at a part thereof diametrically opposite to that with which said nozzle contacts, and extending throughout substantially the length of said bag, said shoe tending to maintain perfect contact at all times between said nozzle and said bag.

2. In a filter for removing solids from fluids, a substantially cylindrical filter bag, a single nozzle within said bag extending substantially the entire length of said bag in contact therewith, an opposed shoe in contact with said bag at a part thereof diametrically opposite to that at which said nozzle contacts, and engageable with a substantial portion of the length of said bags, said shoe tending to maintain perfect contact at all times between said nozzle and said bag, and means for supporting the nozzle and for adjusting the position of said nozzle radially of said bag to control the pressure of said nozzle upon said bag, in combination with means for supporting the shoe and for adjusting the position of said shoe radially of said bag to control the pressure of said shoe upon said bag.

3. In a filter for removing solids from fluids, a substantially cylindrical filter bag, a single nozzle extending substantially the entire length of the bag, a contact shoe, means mounting said nozzle and said shoe to engage said bag at substantially diametrically opposite portions, said nozzle and said shoe having their outermost portions disposed at a distance slightly greater than the normal diametral distance across said bag, means for creating a suction in said nozzle, and means for rotating said nozzle and shoe as a unit relative to said bag.

4. In a filter, a filter medium, a rotatable vacuum cleaning assembly comprising a suction head cooperating with said filter medium and a centrifugal separator having its inlet communicating with said suction head, and means for journalling said assembly so that the centrifugal separator rotates bodily about its axis.

5. In a filter for removing fume from gas in which it is suspended, a housing, a filter medium in said housing, a rotatable vacuum cleaning assembly comprising a suction head cooperating with said filter medium, a centrifugal separator having its inlet communicating with said suction head, a solid-delivering outlet in the lower part of said separator, a clean gas outlet in the top thereof, a casing surrounding said solid-delivering outlet and having communication with said clean gas outlet, means mounting said assembly principally within said housing for rotation about the axis of said separator, an auxiliary housing surrounding said casing and having communication therewith, and a suction pump connected to said auxiliary housing.

6. In a filter for removing suspended solids from gases, a housing, a filter element defining a filter chamber, means on the inside of said chamber for passing a gaseous cleaning current through said filter element for entraining solids deposited on said filter element, and means principally located within said housing and in the path of the gases to be filtered for separating the entrained solids from said gaseous current.

7. In a filter for removing suspended solids from gases, a housing, a filter element in said housing and defining therewith a filter chamber, a nozzle disposed in said chamber and engaging said filter element, a gas and solid separator disposed principally within said chamber, means mounting said nozzle and separator for rotation as a unit, and means for drawing a gaseous current through said nozzle and separator to remove the solids deposited on said filter element and to separate the removed solids from said gaseous current.

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