United States Patent

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[54] FILTER ASSEMBLY AND SYSTEM FOR THE REMOVAL OF COAL DUST

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[52] **U.S. Cl.** **55/233**, 55/257, 55/260, 261/36, 261/98, 261/123

[51] **Int. Cl.** **B01d 47/02**

[58] **Field of Search** 55/233, 238, 257, 259, 404; 261/29, 36, 94, 95, 96, 97, 98, 123

[56] **References Cited**

UNITED STATES PATENTS

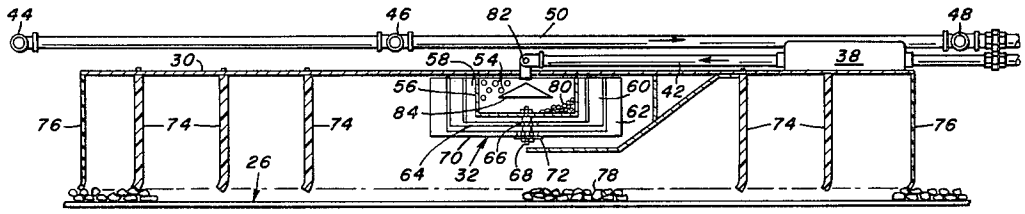
223,911	1/1880	Hinsdale	261/123
920,295	5/1909	Emerson	261/123
1,097,870	5/1914	Moscicki	261/96
1,682,546	8/1928	Bangert	261/97
1,950,020	3/1934	Bleibtreu et al.	55/238
2,539,344	1/1951	Carraway	261/29 X
2,793,710	5/1957	Robinson	55/257
2,819,887	1/1958	Eversole et al.	261/94
3,122,594	2/1964	Kielback	261/94
3,353,336	11/1967	Caballero	55/257 X

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[57] **ABSTRACT**

Described is a filter assembly, particularly adapted for use in a system for the removal of coal dust particles from air in a mine. In one embodiment of the invention, dust-laden air is passed through a filter assembly containing a filter bed comprised of slag particles, preferably blast furnace slag, that is continuously washed by means of a water spray. The water and dust particles washed from the filter bed form a slurry which flows from the filter bed onto a conveyor where it is conveyed out of the mine. The dust-laden air, after it passes through the filter bed, passes back into the atmosphere as filtered air substantially free of dust particles. In another embodiment of the invention, the dust-laden air is passed through a liquid bath, preferably a continuously circulating stream of water, whereby the coal dust will become trapped within the water while clean air bubbles upwardly out of the water and to a clean air duct.

4 Claims, 6 Drawing Figures



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SHEET 1 OF 2

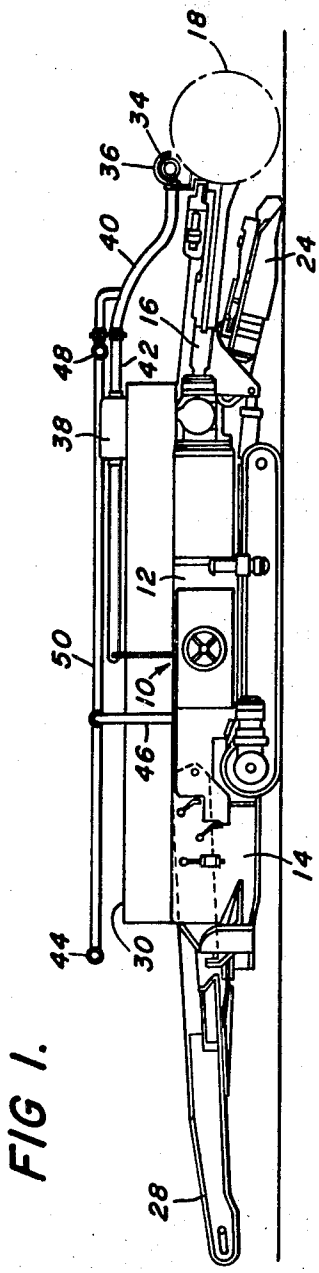


FIG 1.

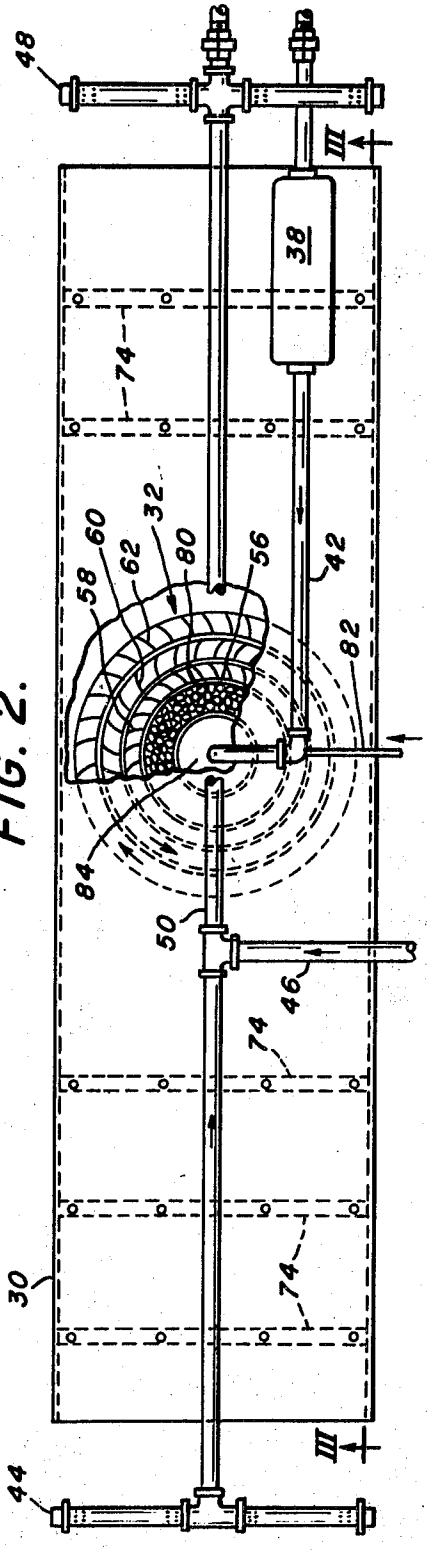


FIG. 2.

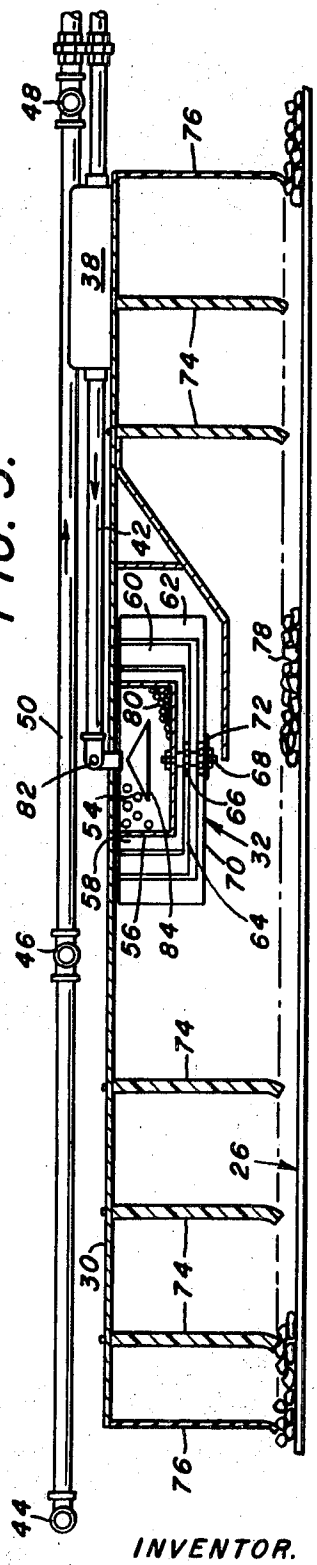


FIG. 3.

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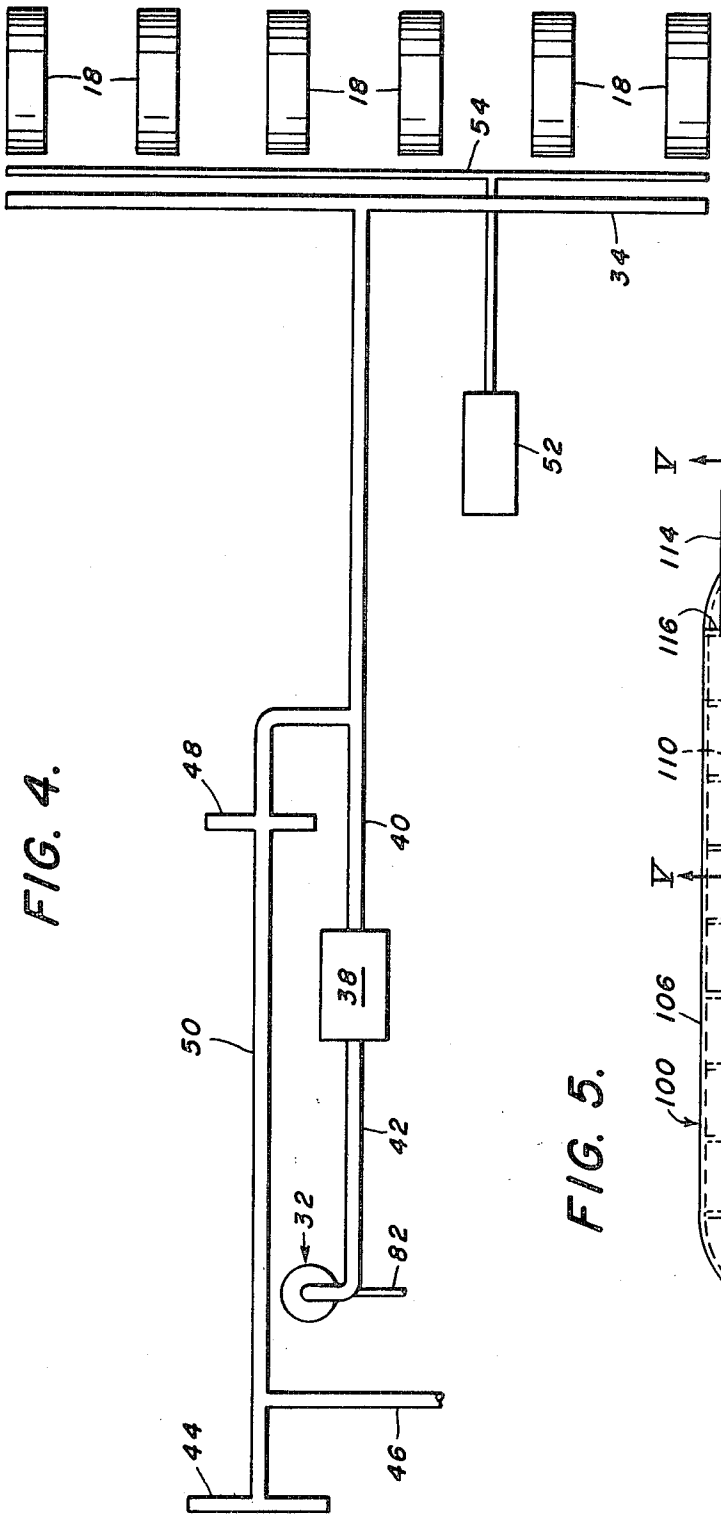


FIG. 4.

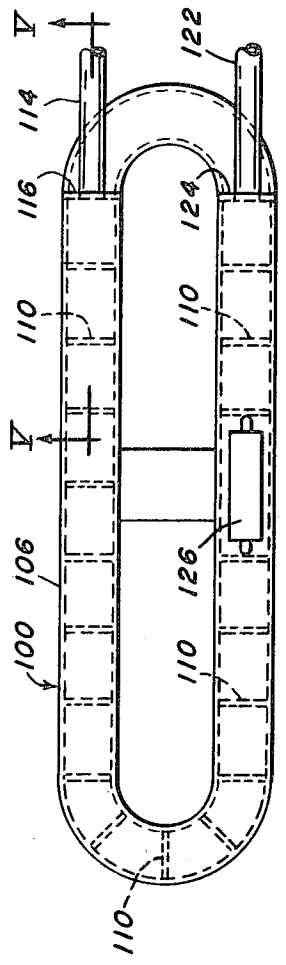


FIG. 5.

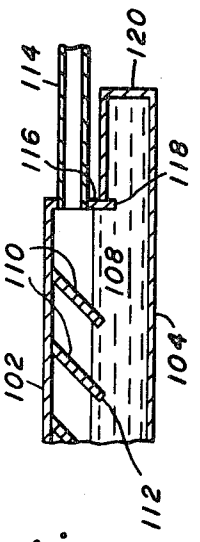


FIG. 6.

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FILTER ASSEMBLY AND SYSTEM FOR THE REMOVAL OF COAL DUST

BACKGROUND OF THE INVENTION

Underground mining of coal has, in recent years, become highly mechanized. Self-powered vehicular-type coal mining machines have been developed which can be guided up to the mine face to dig into and break up the coal. Most machines of this type are designed to continuously dig and reduce the coal deposits to conveyable lumps which the machine itself continually conveys rearwardly for loading and removal from the mine. Other machines simply cut the coal at the face of the mine; and the cut coal is subsequently removed.

Incidental to the operation of mining machinery is the continuous production of fine coal particles which permeate the atmosphere of the mine. Aside from the fact that dust-laden air of this type is highly inflammable and creates the danger of explosion, such an environment is highly detrimental to the health of personnel working in the mine, particularly as regards lung disease.

In the past, attempts to deal with this problem have been largely confined to providing, on the mining machine, apparatus for directing a plurality of water jets or sprays toward the mine face. Dust particles, as they form, are thereby laden with water to cause them to gravitate downwardly to the mine floor. This method, however, is inefficient and, after the resulting coal slurry dries on the floor of the mine, vehicular traffic and the like can stir it up, creating the possibility of explosion and a health hazard.

In an effort to overcome the aforementioned problems, devices such as that shown in U.S. Pat. No. 3,387,889 have been devised for sucking the dust-laden air from the vicinity of the forward end of the mining machine and continuously directing it to a filter in which a liquid is passed through the moving stream of air to precipitate the dust particles therefrom, after which the water containing the dust particles is caused to flow onto the coal which is conveyed on the mining machine to a loading means or other conveyor at the rear thereof. As will be appreciated, the amount of coal dust generated in a mining operation is excessive; and difficulties are encountered in attempting to satisfactorily filter it without clogging of the filter apparatus itself.

SUMMARY OF THE INVENTION

As an overall object, the present invention seeks to provide a new and improved filter apparatus and coal dust removal system for removing coal dust from air in a mine and for depositing the thus-removed coal dust as a slurry onto coal which is conveyed on a mining machine to a loading means or conveyor.

More specifically, an object of the invention is to provide a filter assembly and coal dust removal system wherein the dust-laden air is caused to flow through a filter medium, preferably a bed of slag, where the dust particles from the dust-laden air are removed, and filtered air is exhausted from the system substantially free of coal dust.

Another object of the invention is to provide a coal dust removal system for removing coal dust from air wherein the dust-laden air is caused to pass through a bath of liquid, preferably a continuously circulating stream of water, whereby the coal dust particles from the dust-laden air are removed and the filtered air exhausted from the system is substantially free of coal dust.

Briefly, and in accordance with the broad principles of the invention, there is provided in combination with a coal mining machine a coal dust removal system for the removal of coal dust from air in a mine. The system comprises a housing mounted on the mining machine and a filter medium is disposed within the housing. Air intake means are provided which are preferably disposed about the mining machine at various locations. The air intake means are adapted to permit dust-laden air to enter therein. Pump means having intake and outlet sides is provided and the intake side of the pump means is connected in communication with the air intake means whereby the pump means is capable of creating a subatmospheric pressure within the air intake means. Means are provided for connecting the outlet side of the pump means with the housing whereby dust-laden air is introduced into the housing and through the filter medium. The filter medium is adapted to remove coal dust particles from the dust-laden air whereby filtered air exhausted from the system is substantially free of coal dust as compared to dust-laden air entering the air intake means.

In one form of the invention, the filter medium is contained in a filter assembly mounted within the housing and the system further comprises dust removal means comprising means to direct a continuous liquid flow onto the filter medium to continuously wash coal dust particles therefrom.

In another form of the invention, the filter medium comprises a bath of liquid, preferably water, contained in the housing whereby the coal dust will become trapped within the water while filtered air bubbles upwardly out of the water and to a clean air duct.

The above and other objects, features and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of a mining machine in combination with a coal dust removal and conveyance system constructed in accordance with the invention;

FIG. 2 is a top plan view on an enlarged scale of a portion of the system with some parts omitted and illustrating the filter assembly of the invention;

FIG. 3 is a view taken substantially along line III—III of FIG. 2;

FIG. 4 is a schematic view of the overall system of FIG. 1;

FIG. 5 is a diagrammatic plan view of another form of the invention particularly adapted for use on coal mining machines of the type which simply cut the coal at the face of the mine and thereafter are removed so that other apparatus may be brought in to remove the cut coal; and

FIG. 6 is a view taken substantially along line VI—VI of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, there is illustrated in FIG. 1, a mobile or vehicular coal mining machine **10**. The machine **10** generally comprises a central body portion or chassis **12** having a laterally positioned control compartment **14**. The machine **10** has a pair of forward-extending pivotal parallel arms **16**, only one of which can be seen in FIG. 1, which support at the respective outer ends thereof a plurality of rotary power-driven cutter heads **18** that operate to dislodge coal from the mine face downwardly to be picked up by a gathering conveyor **24**.

A mining machine such as machine **10** usually comprises three separate conveyors: gathering conveyor **24**, a substantially longer central conveyor which is represented in FIG. 3 at **26**, and a rear loading conveyor **28**.

Those skilled in the mining art will realize that the machine **10** is only representative of various designs for such machines in the industry and this being so it is unnecessary herein to deal in further detail therewith except to point out that one form of the invention is particularly adapted for use with mining machines of the general type as thus far described which includes a conveyor means extending longitudinally from the front to the rear of the mining machine.

Also, the systems of the present invention are specifically constructed to be securably mounted on mining machines, either permanently or removably, and are positioned with respect to the various parts of the mining machines so as not to interfere with the operation of the various movable machine parts.

As shown in FIG. 1, there is mounted above the central conveyor 26, a longitudinally elongated housing 30, and mounted within the housing 30 is a filter assembly, shown generally at 32 (FIGS. 2 and 3). Positioned at the front end of the mining machine 10 adjacent the power-driven diggers 18 is an air intake means 34 in the form of a duct or pipe. The air intake means or duct 34 extends transversely of the longitudinal axis of the mining machine and is mounted on the arms 16 for movement therewith. Suitable air intake openings are provided along the length of the duct 34 and the opposite ends thereof are open to permit dust-laden air to enter therein. The duct 34 has a shield 36, constructed of suitable net or mesh, to protect it from damage and to prevent the entrance of substantially large particles which may be swept into the airstream entering therein. The duct 34 is connected in communication with the intake side of a pump means or blower 38 by means of a conduit or duct 40. The conduit 40 is semirigid or flexible to allow movement thereof in accordance with the arms of the mining machine. The duct 34, as well as other pipes or conduits to be described, can be semirigid or flexible as required. The outlet side of the blower 38 is connected to the housing 30 by means of a conduit 42 (FIG. 2) which opens into the filter assembly 32.

Other air intake means in the form of conduits are disposed about the mining machine at a plurality of locations. An air intake duct 44 extends transversely of the mining machine 10 above the conveyor 28; another duct 46 extends downwardly in the vicinity of the control compartment 14; and still another duct 48, extends transversely of the mining machine 10, forwardly of the blower 38 and rearwardly of the duct 34. Other air intake ducts may be provided as desired. These ducts 44, 46 and 48 are all connected with a longitudinally extending pipe 50 which is connected in communication with duct 40 such that each of the intake ducts are each connected in communication with the intake side of the pump 38.

The overall arrangement of the system is best seen in FIG. 4. The cutters 18 are represented in block form at the right side in FIG. 4. Also, seen in FIG. 4, is an air compressor 52 which is connected with a transversely extending pipe 54. The compressor 52 may be located at any convenient location on the mining machine 10 and the pipe 54 is preferably located at the forward end of the mining machine in the vicinity of the duct 34. The purpose of the compressor 52 and pipe 54 is to provide air under pressure in the vicinity of the duct 34, the air exiting from the pipe 54 through suitable openings provided along its length, to contain the dust-laden air in the vicinity of the cutters 18, thereby preventing it from drifting back toward the operator's compartment and insuring that the air will be drawn into the duct 34.

In operation, dust-laden air from the vicinity of the front end of the mining machine 10 enters the duct 34 by reason of the subatmospheric pressure created therein by the blower 38. Dust-laden air also enters the ducts 44, 46 and 48 for the same reason. The dust-laden air passes through the blower 38, through the conduit 42 and is introduced into the filter assembly 32.

The filter assembly 32, preferably comprises a cylindrical container 56 having an open top. The sidewalls of the container 56 have a plurality of apertures 54 extending therethrough. A plurality of radially extending, spaced-apart, curved peripheral baffles 58 are provided on the outside surface of the container 56 which extend from the bottom end of the container to the top end thereof. Surrounding the peripheral baffles integral with the container 56 are additional baffle means 60 and 62. The baffles 60 and 62 are radially spaced from the baffles 58. The baffles 60 are each comprised of a curved plate; each is spaced from the others and each extends upwardly and parallel to the sidewalls of the container 56 from a disclike member 64 rotatably mounted on the bottom of the container 56 by means of a bearing 66 and shaft 68, which shaft 68 is nonrotatably secured to the bottom end of container 56. Similarly, the baffles 62 are each comprised of a curved plate; each is spaced from the others and each extends upwardly and parallel to the sidewalls of the container 56 from a disclike member 70 rotatably mounted on the bottom end of the container 56 by means of a bearing 72 and the shaft 68. The direction of the curvature of the plates 58 and 62 is substantially the same, however, the direction of the curvature of the plates 60 is opposite the plates 58 and 62. As a result of this, the baffles 60 will rotate in a direction opposite the direction of rotation of the baffles 62. Rotation of the baffles 60 and 62 is effected by air exiting through the apertures 54 in the sidewalls of the container 56. The baffles 58, 60 and 62 reduce the velocity of the air exiting from the apertures and tend to circulate the air within the housing 30. If desired, braking means such as a pair of friction plates may be provided between the members 64 and 70 to reduce the speed of rotation of the baffles 60, 62 relative to each other. These friction plates will absorb energy from the air exiting from the apertures and further reduce its velocity.

It may be pointed out that the housing 30 has a plurality of secondary filter elements 74 therein which extend transversely of the housing 30. These may be comprised of nylon bristles or they may be formed of any other suitable material. Their purpose is to trap and filter dust particles not removed in the filter assembly 32 and they tend to increase the overall effectiveness of the system. The opposite ends of the housing 30 have transversely extending curtain members 76, preferably comprised of rubber, to help contain dust particles within the housing 30. The secondary filter elements 74 and the curtain members 76 are preferably flexible and extend downwardly from the top of the housing 30 to the coal 78 which is being conveyed on the conveyor 26.

A filter media 80 is provided in the container 56, and in accordance with the invention, the filter media is comprised of blast furnace slag ranging in size of about 1¼ inches. Expanded or lightweight slag particles are preferred as the particles have a pronounced cellular structure which consists of many nonconnecting cells surrounded by thin walls, thereby presenting a large surface area for more effective filtering action. However, other forms of blast furnace slag such as air-cooled and granulated slag may be used as the filter media 80 even though the cellular structure of these latter types of slag is not as pronounced as the expanded type of slag.

In order to prevent clogging of the filter by coal dust collected in the filter media 80, a water flow conduit 82 is concentrically mounted within the portion of conduit 42 which opens into the container 56. A continuous flow of water in the form of a spray emerges from the conduit 82 to thoroughly soak the slag 80 and continuously wash dust particles therefrom. An internal baffle means 84 is provided in the container 56 to divert the flow of water and dust-laden air entering therein to the outside portions of the container 56. The water and dust particles washed from the filter bed 80 form a slurry which passes through the apertures 54 and the slurry flows downwardly onto the coal conveyor 26 for removal. The dust-laden air introduced into the container and the filter bed 80 passes through the apertures as filtered air. As stated above, dust particles not removed in the filter assembly 32 tend to be trapped in the secondary filter means 74. The filtered air escapes from the housing 30 to enter the atmosphere of the mine.

The above-described system and filter assembly has been described in conjunction with a mining machine, however, it should be understood that the system and filter assembly described may be placed at various locations in a mine to pick up floating coal dust as an independent unit and means such as a conduit may be provided to deposit the formed slurry at any convenient location. Further, the system and filter assembly described may be employed in other industries, aside from the mining industry, in which dust particles are created and must be removed from the atmosphere.

Referring now to FIGS. 5 and 6, an alternate form of the invention is shown. In this embodiment of the invention the housing 30 takes the form of an annular tank 100 having top, bottom and sidewalls 102, 104, and 106, respectively. The

tank **100** may, if desired, be mounted on the type mining machine **10**, however, this form of the invention is particularly suited for mining machines which have no conveyor means and merely cut the coal at the face of the mine with the cut coal being subsequently removed by other apparatus. Also, this form of the invention can likewise be utilized as a unit independently of a mining machine.

As shown, the housing or tank **100** is partially filled with a liquid **108**, preferably water. A plurality of baffles **110** extend downwardly from the top walls of the tank and into the water **108** with their bottom edges **112** being disposed below the level of the water. An air inlet duct **114** is provided through which dust-laden air is introduced into the tank **100**. The air inlet duct **114** would be connected to the output side of a blower means such as blower **38** by means of a connecting duct, such as duct **42**, in the above-described embodiment of the invention. The wall portion **116**, through which the duct **114** passes, extends down into the water with its lower end **118** being disposed below the level of the water. The portion of the tank designated as **120** is of a reduced height as compared to the remaining portion of the tank and is completely filled with water. A clean air exhaust duct **122** is provided in the wall portion **124**. The wall portion **124** also extends down into the water. A submersible pump **126** is provided in the tank in order to continuously circulate the water in the tank.

In operation, dust-laden air is introduced into the tank through the air inlet duct **114**, and due to the fact that the duct **114** is connected to the output side of a blower, air enters the tank under pressure and is forced into the water. The water acts as a filter medium and the dust particles contained in the air are trapped in the water. The baffles **110** prevent the air from circulating through the tank in the space above the water. The air can, however, bubble upwardly out of the water between the baffles, but must reenter the water and make its way to the exhaust duct **122** before it can escape from the tank.

Preferably, the top **102** of the tank is removably secured to the sidewalls **104** of the tank in order that the tank may be periodically cleaned out by removal of the top **102**.

The foregoing description of the invention has been presented only to illustrate the principles thereof. Accordingly, it is desired that the invention be not limited by the embodiments described, but, rather, that it be accorded an interpretation consistent with the scope and spirit of its broad principles.

I claim as my invention:

1. A filter assembly for use in the removal of dust particles from dust-laden air comprising in combination a container having sidewalls and a plurality of apertures extending through said sidewalls, a filter bed disposed in said container and adapted to remove dust particles from dust-laden air passed therethrough, means for introducing dust-laden air into said container and into said filter bed, means to direct a continuous liquid flow onto said filter bed to continuously wash dust particles therefrom, said liquid and said dust particles washed from said filter bed forming a slurry which passes through said apertures in said container and said dust-laden air introduced into said container and into said filter bed passing through said apertures as filtered air substantially free of dust particles, and means surrounding the container and forming generally radially extending tortuous paths for impeding the flow of air from the container.

2. A filter assembly as defined in claim 1 wherein said filter bed is comprised of a plurality of expanded particles of blast furnace slag which consists of many nonconnecting cells surrounded by thin walls, thereby providing a large surface area for more effective filtering action.

3. A filter assembly as defined in claim 1 wherein said container has a plurality of spaced-apart curved peripheral baffle means integral with the sidewalls thereof which extend radially therefrom, said filter bed is comprised of a plurality of particles of expanded blast furnace slag and said dust-laden air introduced into said container passes through said blast furnace slag and exits through said apertures as filtered air and said filtered air passes through said plurality of baffle means.

4. A filter assembly as defined in claim 3 wherein said filter assembly further includes

additional baffle means surrounding said peripheral baffle means and each of said additional baffle means being radially spaced from said peripheral baffle means,

said additional baffle means being radially spaced from each other and each of them comprising a plurality of spaced-apart curved plates extending upwardly and parallel to the sidewalls of said container from a disclike member rotatably mounted on said container.

* * * * *