June 11, 1968 S. C. ZIEMBA ET AL 3,387,889

COAL DUST REMOVAL AND CONVEYANCE SYSTEM

Filed Nov. 3, 1966 2 Sheets-Sheet 1

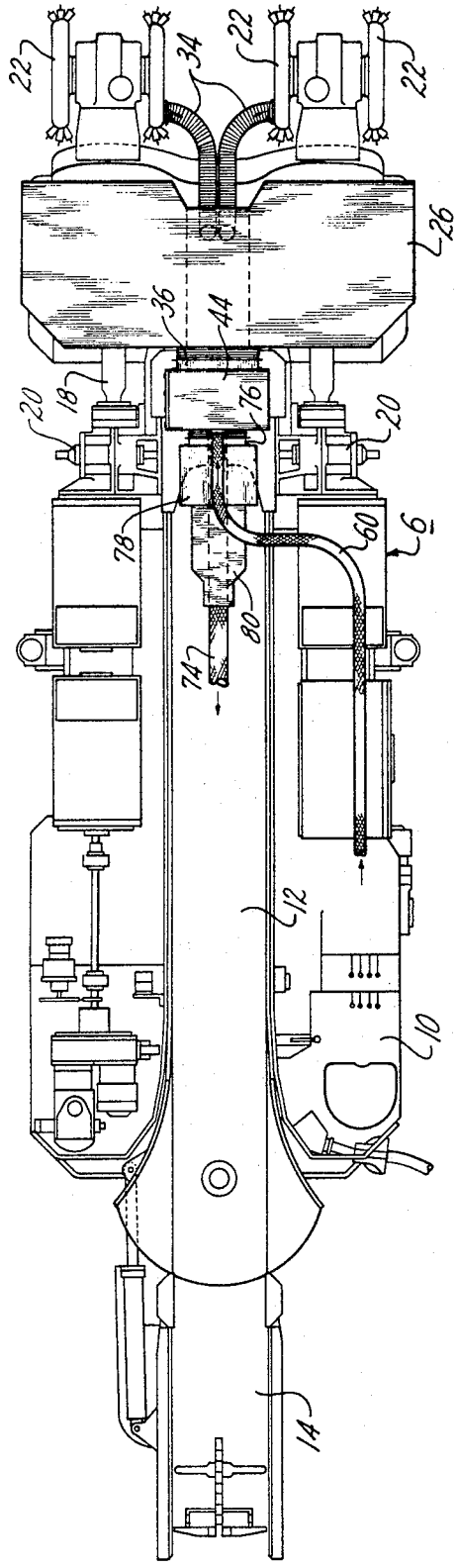

Fig. 1

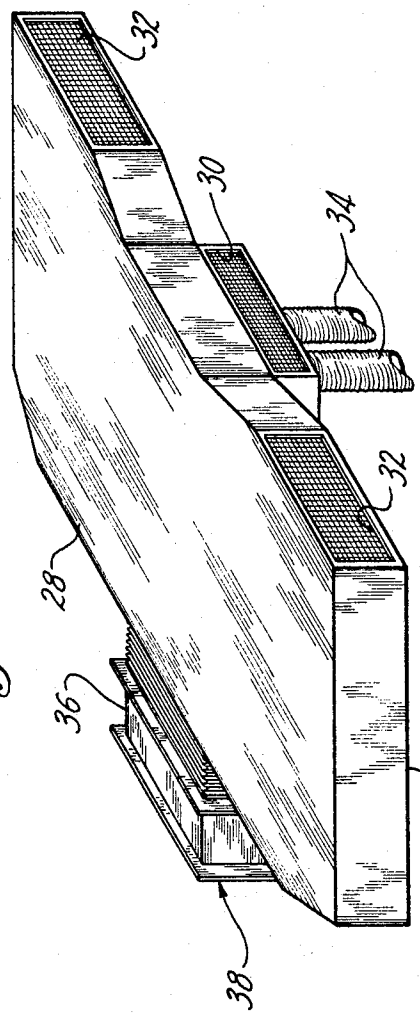

Fig. 3

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COAL DUST REMOVAL AND CONVEYANCE SYSTEM

Filed Nov. 3, 1966 2 Sheets-Sheet 2

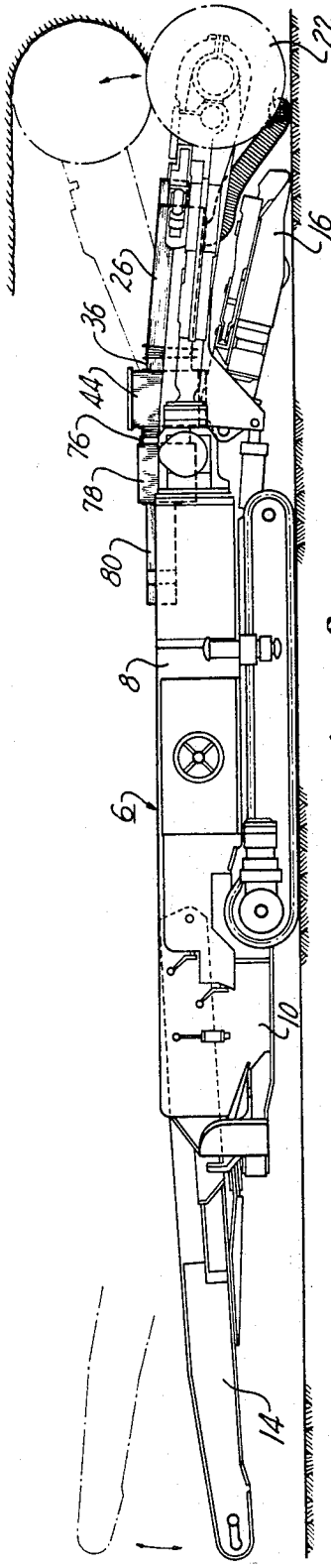

Fig. 2

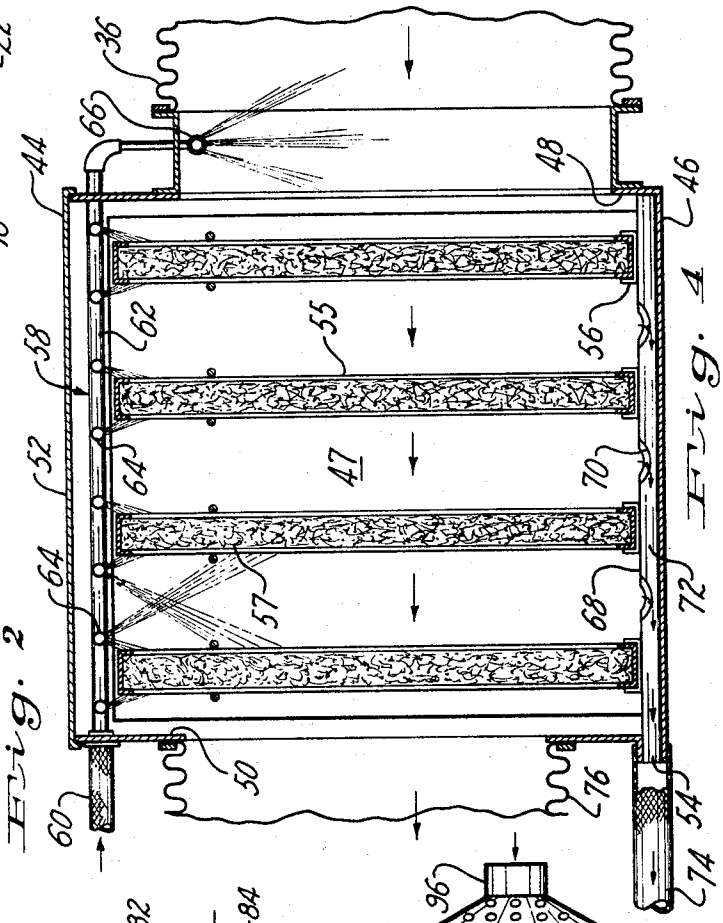

Fig. 4

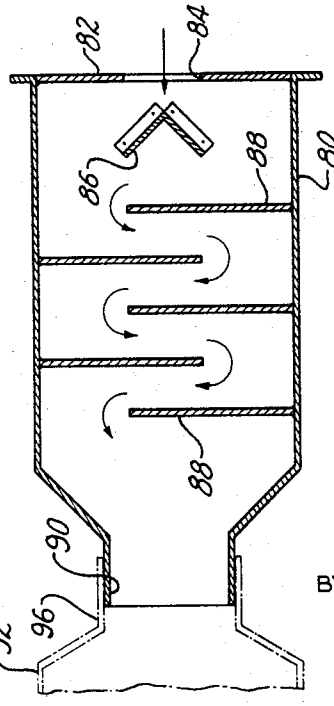

Fig. 5

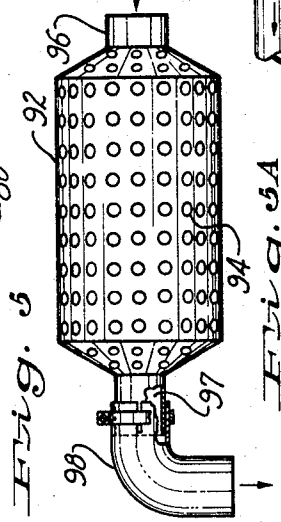

Fig. 5A

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COAL DUST REMOVAL AND CONVEYANCE SYSTEM

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ABSTRACT OF THE DISCLOSURE

This invention generally relates to apparatus and a method for reducing atmospheric pollution, and more particularly pertains to a systematic means for removal of air-borne coal dust particles from the vicinity of a mine face.

The invention broadly comprises a method in which a plurality of devices are adaptably-arranged in series communication whereby a unitary system is formed to continuously convey dust-laden air away from the mine face and reduce it to a slurry-like consistency. The system is purposely constructed to be mounted and carried on a vehicular-type mining machine in a manner which does not limit the operability of the machine but instead cooperatively operates therewith to better enable the machine to effectively serve its intended function.

The system of the invention includes a duct-like air flow chamber with specifically positioned openings adjacent the cutter heads or rotatable diggers of the mining machine and a motor-actuated air pump or blower unit for creating a sub-atmospheric pressure area within the duct-like chamber so that dust-laden air at the forward end of the mining machine will be forced by atmospheric pressure into the chamber and rearwardly toward the blower unit.

An air and dust separating device or filter tank is disposed between the chamber and the blower unit as a means of separating the suspended coal dust particles from the air flow so that relatively cleaner air is directed outwardly through the blower unit while the fine dust particles are collected and conducted from the filtering tank via another exit.

After the dust-laden air is moved from the forward end of the mining machine, through the air flow chamber and thence to the filtering tank where a substantial amount of the coal dust is filtered out, the air flow then moves through the blower unit and is preferably then conducted through a baffle chamber wherein the direct air flow is caused to follow a winding tortuous path through spaced-apart baffles. The baffle chamber serves to somewhat reduce the direct force of the air flow and to collect dust particles which may have inadvertently passed with the air flow from the filtering tank.

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 stratified coal deposits. The most modern of such machines is designed to continuously dig and reduce the coal deposits to conveyable lumps which the machine itself continuously conveys rearwardly for loading and removal from the mine.

Incidental to the operation of the mining machine is the continuous production of fine coal particles which permeate the atmosphere of the mine. Not only has such an environment long been recognized as detrimental to

the health of personnel working in the mine, but it tends to seriously limit visibility and thus restrict the efficiency of the mining operation.

In the prior art, the 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. Although this method has succeeded to the extent that, in its absence, the magnitude of dust in proportion to the air in the mine tunnel would be greatly increased, the invention disclosed herein is directed to more effectively deal with the coal dust problem whether used separately or in operative combination with the aforementioned water spray method.

It has therefore been a primary objective of this invention to devise a method of reducing the amount of coal dust suspended in the atmosphere near a mine face during the operation of a mining machine.

It has been a further objective of this invention to devise apparatus to implement the foregoing method, with such apparatus being constructed to be utilized simultaneously and in combination with a mining machine.

A still further objective of this invention has been to devise a system that is not only capable of atmospheric dust removal but is also capable of recovering such dust and reducing it to an easily handled form.

An ancillary objective of the invention has been to introduce apparatus for manufacture that can be adaptably mounted for operation on the type of mining machine currently being used in conventional practice.

Description of the invention

Without intended limitation thereto, the ensuing detailed description is of a preferred embodiment of a coal dust removal and conveyance system to be utilized in combination with a vehicular-type mining machine. The invention resides in the construction, arrangement and combination of the various parts of the system whereby the objectives and salient features contemplated are attained as hereafter more fully described and as specifically set forth in the appended claims.

In the drawings:

FIGURE 1 is a top plan view of a mining machine in combination with a coal dust removal and conveyance system constructed in accordance with this invention;

FIGURE 2 is a side elevation view of the combined mining machine and coal dust removal and conveyance system as first shown in FIGURE 1;

FIGURE 3 is a pictorial or perspective view of a preferred form of the air flow chamber of the system first shown in FIGURES 1 and 2;

FIGURE 4 is a side view in vertical section of a filtering tank which constitutes an element of the system of this invention;

FIGURE 5 is a top plan view in horizontal section illustrating the preferred internal construction of an air flow baffle box or baffle chamber that constitutes a major element of this invention; and

FIGURE 5A is an elevational view, partially in section, of an air flow muffler to be employed in conjunction with the baffle chamber shown in FIGURE 5.

The method of this invention broadly comprises "vacuuming" the coal dust laden air from the vicinity of the fore end of a mining machine and continuously directing it through a "wash down" step 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 on to the coal which is conveyed centrally-longitudinally on the mining machine to a loading means at the rear thereof, and the

substantially cleaner flow of air is released back to the atmosphere.

In FIGURES 1 and 2, there is shown a mobile or vehicular coal mining machine 6 specifically constructed to have, in accordance with prevalent practices, a low form or silhouette to enable its use in a mine where overhead space is limited. The machine 6 broadly comprises a track-mounted central body portion or chassis 8 having a laterally positioned control compartment 10. The machine 6 has a pair of forward-extending pivotal parallel arms 18 which support at the respective outer ends thereof a plurality of rotary power driven cutter heads or disc-like diggers 22 that operate to dislodge coal from the mine face downwardly to be picked up by a gathering conveyor 16. The area of the mine face that can be "worked" by the cutter heads 22 of the machine 6 is quite large inasmuch as the arms 18 supporting the cutter heads 22 are joined to the main body 8 of the machine 6 by means of pivots 20 and thus may be moved through a large arc while the machine remains stationary. The pair of arms 18 can thus be swung in unison to raise or lower the cutter heads 22.

The longitudinal or centrally-disposed conveyor 16 of a mining machine such as machine 6 usually comprises three separate conveyors: a fore end gathering conveyor 16, a substantially longer central conveyor 12 that is disposed horizontally and substantially the entire length of the machine 6, and a rear loading conveyor 14.

The system of this invention is specifically constructed to be securably mounted on the mining machines, either permanently or removably, and is positioned with respect to the various parts of the machine 6 so as to not interfere with the operation of the various movable machine parts.

Thus, in the preferred embodiment shown in the drawings, an air intake chamber 26 is constructed to conform to and thus replace a substantially planar rigid fender that normally is attached to extend horizontally over the area intermediate the length of the pair of parallel arms 18 and above the gathering conveyor 16. As shown in FIGURE 3, the air intake chamber 26 has a duct-like body portion 28 that may be rigidly constructed of sheet metal in a gauge similar to that of the fender which it replaces so that the chamber may serve a dual purpose. The body portion 28 of the air intake chamber 26 has a wide and substantially flat configuration, and, as viewed in FIGURE 1, has an upwardly-facing surface that is conformed to the shape of the replaced fender.

The body portion 28 is provided with three forwardly-facing air intake openings: a central intake opening 30 provides a means of taking dust-laden air inwardly from the area generally between the forward ends of the arms 18; and laterally positioned openings 32 are provided to permit dust laden air to enter the chamber 26 from a location rearwardly adjacent the cutter heads 22. Additional air intake inlets are provided by means of downwardly extending flexible ducts or tubes 34. The outer extended ends of the tubes 34 are preferably positioned at points below the level of the central air intake opening 30 and may be adjustably mounted to the machine so as to be re-positionable as desired in order to increase the overall effectiveness of the system.

The air intake openings 30 and 32, and the outer intake ends of the tubes 34 are preferably screened with a suitable rigid net or mesh to prevent the entrance of substantially large particles which may be swept into the air stream entering the chamber 26.

The air flow from the vicinity of the front end of the mining machine 6 which enters the openings in the forward end of the chamber 26 is directed rearwardly and out of the chamber 26 through a duct section or tube-like coupling portion 36 which has a flanged open end 38 to permit the coupling portion 36 to be secured to the front wall of a filter tank 44. The coupling portion 36 is preferably constructed either of a flexible material or a horizontally-pivoted hinged arrangement to permit the chamber 26 to follow the vertical swinging of the arms 18, while the adjacent filter tank 44 remains stationary.

A person skilled in the mining art will realize that the mining machine 6 shown in the drawing is only representative of various designs for such machines in the industry. Therefore, it is understood that this invention may be modified to structurally complement a mining machine differing in size or design from the machine illustrated. For example, on a mining machine of smaller size it may be found desirable to depart from the configuration shown for the air intake chamber 26 in FIGURE 3 and substitute in lieu thereof a plurality of elongated ducts or pipes beginning as funnel-like ends located at respective points adjacent to the machine cutter heads and leading rearwardly to converge and form a single plenum chamber at the forward input end or front side of the filter tank 44. All or portions of such elongated pipes could be semi-rigid or flexible to allow movement thereof in accordance with the arms of the mining machine to which they would be mounted.

With reference to FIGURE 4, the filter tank 44 comprises a rectangular-shaped housing 46 having an air intake opening 48 and a rearwardly-disposed air exhaust opening 50. The dust laden air flow is conducted from the chamber 26 and out through the duct section 36 and thence through a filtering chamber 47 defined by the housing 46. A plurality of transversely-extending spaced-apart parallel filtering leaves 55 are provided within the filter chamber 47, and the air flow entering through the opening 48 must pass successively through the filtering leaves 55 as it progresses through the filter chamber 47 and outwardly through the opening 50.

Each filtering leaf 55 may be constructed of corrosion resistant rigid mesh screening and be filled with a closely-packed filtering material or medium such as glass wool. Provision for separably mounting the filtering leaves 55 may be made by use of rigid channel members 56 that may extend horizontally to receive the bottom edge of each filtering leaf 55 and vertically-upwardly along the respective side walls (not shown) of the tank 46 so as to enable each filtering leaf 55 to be slid downwardly-inwardly into its mounted position by way of the upper open end of the tank 46.

A filter washing system 58 which is part of a means for removing from the filter tank the dust collected on the filter, is contained within the filter tank 46 for providing, at a selected rate, a continuous flow of water to wash down, over and through the filters 55. The system 58 comprises one or more horizontal water flow conduits 62 having orifices or spray heads 64 spaced along the length thereof for furnishing a flow of water to the outer vertical surfaces and between the upper frame members of each filter or leaf 55 to thoroughly soak the glass wool packed therein so as to precipitate the coal dust downwardly toward the floor of the housing 46.

A flexible inlet conduit 60 is provided to conduct a water flow from an external source and inwardly through the horizontal conduit 62. It is further provided that the conduit 62 may be extended outwardly from the housing 46 and downwardly into the duct section 36 so as to provide a spray head 66 for initially wetting down the dust laden air moving into the filtering chamber 47. The force of the air flow moving through the duct section 36 tends to carry the downwardly-cascading water from the spray head 66 into the housing 46 for removal along with the slurry of water and fine coal particles to be drained from the bottom of the filtering tank 44.

In the form of the invention chosen for illustration in the drawings, it is preferred that the filter washing system 58 be removably-contained across the upper portion of the tank 46 so that water flow conduits such as 62 may be lifted away or removed from the tank 46. Provision of mounting slots (not shown) extending downwardly from the upper edges of the respective front and back walls of

the tank 46 will permit such removal. Removal of the parts of the filter washing system 58, along with the lid 44, from the tank 46 is required to enable removal, replacement or cleaning of the filter leaves 55 mounted within the filter chamber 47.

The housing 46 is provided with a false bottom or inner secondary floor 68 spaced parallel to and a distance above the bottom of the housing 46 to define a drain passage 72. A plurality of drain openings 70 are provided in the secondary floor 68 so that the slurry of water and coal particles may drain downwardly into the passage 72 and be carried outwardly through a main drain opening 54 that connects with an outlet hose 74. Then, as shown in FIGURE 1, the outlet hose 74 may be directed rearwardly to drain onto the coal being carried therebeneath on the conveyor means 12. Thus, the peculiar construction of the bottom portion of the filter tank 44 serves, in cooperation with the filter washing system 58, as the preferred means of removing collected dust from the filter tank 44.

It should be noted that the filtering tank 44 is either provided with a rearwardly-slanted bottom or is mounted in a rearwardly-tilted orientation so that the sediment flow or slurry continuously collected in the drain passage 72 will move by force of gravity outwardly through the drain opening 54 of the housing 46. A slanted bottom or rearward tilting of the filtering tank 44 will also tend to compensate for irregularity of the mine floor which at times will cause the front end of the mining machine 6 to be disposed at a lower level as compared to the machine's rear portion.

It is contemplated that the filter tank can be alternatively mounted to be pivotal to a limited extent on a horizontal transverse axis through or beneath the bottom surface of the tank 44. Such mounting would permit selective tilting of the filtering tank 44 and, thus, provide a greater means of control of gravity flow therefrom of the sediment flow that moves out through the outlet hose 74. In such an alternate arrangement, the tube-like coupling 76 would preferably be of a construction similar to that described heretofore with respect to the tube-like coupling 36 extending rearwardly from the chamber 28. Thus, the blower 78 would be substantially rigidly mounted to the mounting machine, with the filtering tank 44 being pivotally supported so that it could be selectively tilted to or away from the blower 78 as conditions dictated.

The substantially cleaner air flow that is emitted through the exhaust opening 50 of the housing 46 moves then through a duct section or tube-like coupling 76 to the intake side of the blower 78. From the output side of the blower 78 the air flow is then directed through the baffle chamber 80 as shown in FIGURE 5.

The baffle chamber 80 is a totally enclosed housing 82 having an input opening 84 at one end thereof and an output or exhaust opening 90 at its opposite end. Immediately inwardly adjacent the opening 84, an angular baffle plate 86 extends vertically from the top to the bottom of the housing 82 and serves to divert the incoming air flow in two directions. Thereafter the air flow moving through the housing 82 is caused to move around the ends of a plurality of spaced-apart transversely extending baffle plates 88. The air flow entering the opening 84 and proceeding through the baffle chamber 80 is extremely moist as a result of its treatment in the filter tank 44 and thus, as the air flow follows the tortuous path outlined by the baffles 88, fine coal dust particles remaining in the air flow will tend to impinge and adhere to the baffle plates 88 and the inside surface of the housing 82. The baffle chamber 80 may be provided with an access opening to permit it to be periodically washed out by means of a high pressure hose when the system is not in use.

Inasmuch as a flow of filtered air from the baffle exhaust opening 90 may be objectionable due both to the associated noise of the rushing air stream and the movement of the air stream toward the operator's compartment 10 of the mining machine 6, it is preferred that a means be provided to muffle the sound and also divert the air flow away from the operator. One such means of accomplishing the foregoing objectives is shown in FIGURE 5A, and comprises a cylindrical hollow chamber 92 having an input opening 96, which may be connected in flow communication with the exhaust opening 90 of the baffle box 80 (FIGURE 5). Small perforations 94 are provided in spaced-apart relation over the entire side wall of chamber 92 so that a considerable portion of the air flow which enters through the input opening 96 will be emitted as separate streams from the chamber 92 via the side wall perforations 94. An exhaust opening 97 is disposed oppositely to the input opening 96 to allow the remaining portion of the filtered air flow to pass outwardly therethrough. A means such as a rotatable or selectively-repositionable elbow 98 may be mounted in flow communication to the output opening 97 to divert the air flow in a direction other than toward the operator's compartment 10 of the mining machine 6.

Having heretofore disclosed a method and one type of apparatus for the removal and conveyance of suspended coal dust such as produced in the operation of a mining machine, it is understood that only an illustrative embodiment of the invention has been shown herein for the purpose of demonstration and that various changes may be made in the construction shown by those skilled in the art without departing from the spirit and disclosed concepts of the invention as particularly pointed out and defined in the appended claims.

What is claimed is:

1. In combination with a mobile coal mining machine of the type having forward-extending pivotal arms supporting rotary power-driven diggers that dislodge coal from the mine face downwardly to be picked up by a conveyor means extending centrally-longitudinally from the front to the rear of the vehicle, a coal dust removal and conveyance system mounted on the vehicle, said system comprising: an air intake chamber mounted adjacent the forward end of the mining vehicle and having at least one air intake opening disposed generally toward the power-driven diggers to permit dust-laden air to enter said air intake chamber, a pump means having its intake side connected in communication with said air intake chamber whereby said pump means is capable of creating a sub-atmospheric pressure area within said air intake chamber, filtering means mounted to receive an air flow from said air intake chamber and adapted to remove coal dust particles from said air flow whereby the filtered air flow exhausted from said system is substantially free of coal dust as compared to the air flow which enters said intake chamber, and dust removal means adapted to act cooperatively with said filtering means to remove collected coal dust from said filtering means.

2. A coal dust removal and conveyance system as defined in claim 1 wherein, said filtering means comprises at least one filtering leaf mounted across the path of the air flow moving from said intake chamber and toward said pump means; and said dust removal means comprises means to direct a continuous liquid flow onto said leaf to continuously wash coal dust particles therefrom, and means to remove said liquid, after said washing, from said tank and to direct said liquid onto the conveyor means of the coal mining machine.

3. A coal dust removal and conveyance system as defined in claim 2, further comprising: means to spray liquid into said air flow at a point prior to said filtering means whereby said air flow is substantially wet when it arrives at said filtering means.

4. A coal dust removal and conveyance system as defined in claim 1 wherein said air intake chamber comprises a substantially transversely elongated hollow fender supported on the forward-extending pivotal arms so as to extend above the forward end of the conveyor means.

5. A coal dust removal and conveyance system as defined in claim 1 wherein said air intake chamber is joined in communication with said filtering means by a tube-like section capable of flexing to permit said air intake chamber to follow the movement of and be carried with the pivotal arms of the coal mining machine.

6. A coal dust removal and conveyance system as defined in claim 1 wherein said filtering means comprises a substantially rectangularly shaped filtering tank defining an internal filtering chamber, said tank having an air intake opening on the forward side thereof leading to said air intake chamber and an air exhaust opening through the rear wall of said tank, a plurality of transversely-extending substantially equidistantly spaced-apart parallel filtering leaves extending across said internal filtering chamber whereby the air flow moving inwardly through said air intake opening and across said chamber toward said exhaust opening must pass successively through said filtering leaves; and said dust removal means comprises means to direct separate water flows downward on each of said filtering leaves whereby coal dust collected on said leaves from said air flow will be washed downwardly to the floor of said filtering tank, and means to collect said separate water flows in the bottom portion of said filtering tank and direct them outwardly from said filtering tank.

7. A coal dust removal and conveyance system as defined in claim 1 wherein, said air intake chamber comprises a plenum chamber in flow communication with the intake side of said filtering means, a plurality of pipes branching from said plenum chamber, with each of said pipes extending forwardly and terminating as an open intake end adjacent one of said power driven diggers.

8. A coal dust removal and conveyance system as defined in claim 1 further comprising: a baffle means positioned to receive said filtered air flow from said filtering means, said baffle means including a closed housing having an input opening positioned in flow communication with said filtering means and an exhaust opening facing in a direction other than toward said filtering means, a plurality of spaced apart baffles within said chamber, each

of said baffles comprising a planar plate extending from a side wall of said housing and transversely through said housing for a substantial distance so as to extend across space between said input opening and said exhaust opening, with adjacent baffles extending from respectively opposite side walls and thereby effecting a path of successive curves through which said filtered air flow must pass when moving through said baffle means.

9. A coal dust removal and conveyance system as defined in claim 1, further comprising: means to divide a substantial portion of said filtered air flow into a substantially large plurality of separate air streams, and means to divert the remaining portion of said filtered air flow in a direction away from the operator's position on the mining machine.

10. A method of reducing atmospheric coal mine pollution caused by suspended coal dust particles generated by the action of power driven mining apparatus comprising:

(a) collecting, by means of suction applied near the point of dust generation, the coal dust laden air;

(b) directing said air as a continuous air flow through a filtering means;

(c) passing a continuous flow of water transversely across and through said air flow within said filtering means to remove coal dust particles from said air flow;

(d) returning a substantially clean air flow to the atmosphere in the mine; and

(e) diverting said water flow, with coal dust particles therein, to coal being loaded for removal from the mine.

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