Aug. 2, 1932. M. I. DORFAN 1,870,042

COAL CLEANING AIR TREATMENT METHOD AND APPARATUS

Filed Nov. 15, 1929 2 Sheets-Sheet 1

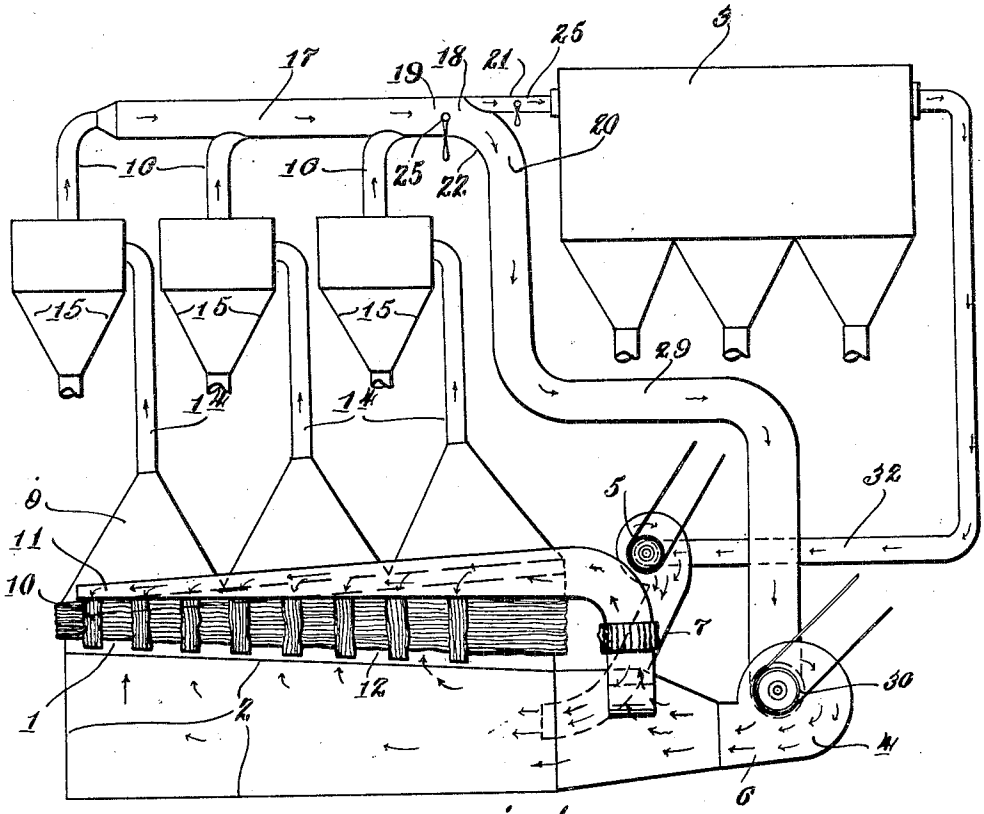


Fig. 1.

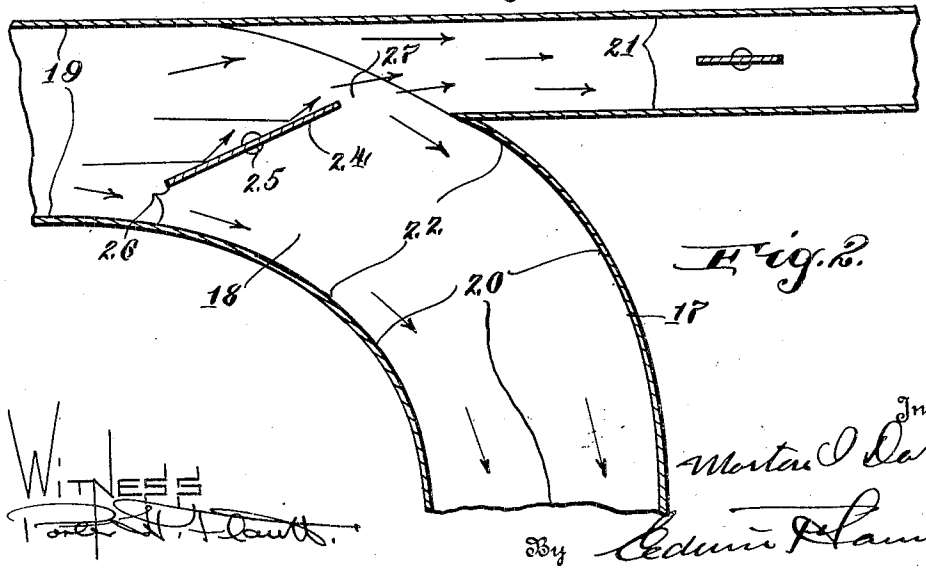


Fig. 2.

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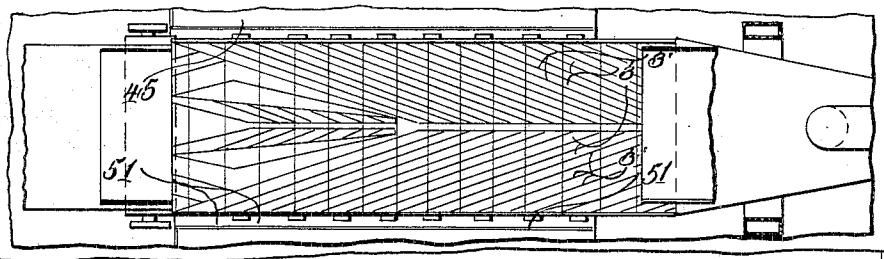


Fig. 4.

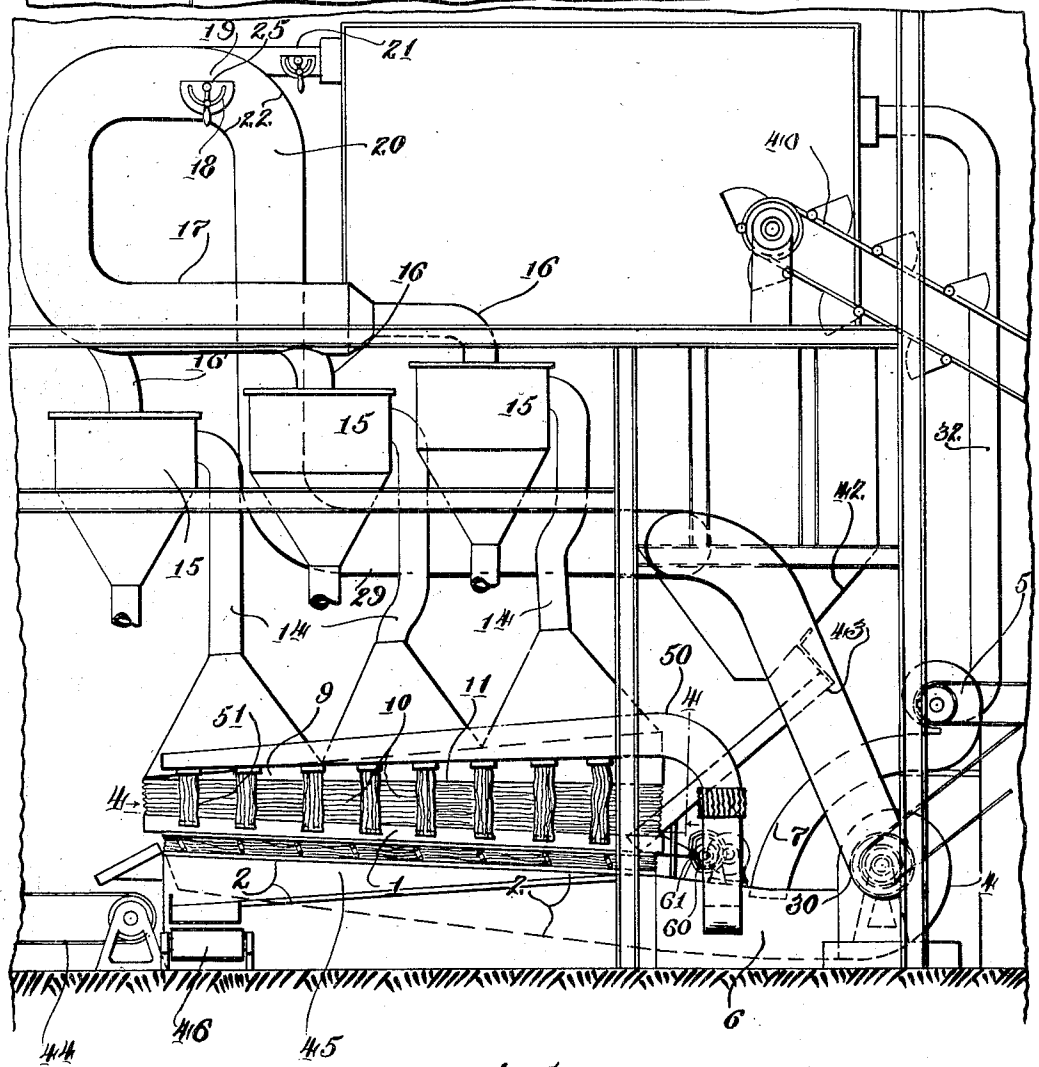


Fig. 3.

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1,870,042

UNITED STATES PATENT OFFICE

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COAL CLEANING AIR TREATMENT METHOD AND APPARATUS

Application filed November 15, 1929. Serial No. 407,321.

In the dry cleaning of coal by the air flotation method, the coal to be cleaned which is usually unsized, though both sized and unsized coal may be treated in the same apparatus, is passed along a perforated inclined table, provided with diverging riffles, large volumes of air being passed upwardly through the table partially suspending the coal and assisting in its passage up the inclined table. The waste material being heavier and thus less easily supported by the air draft, the higher specific gravity of the waste material serves to hold it in contact with the riffles whereby it is separated and carried to the sides of the table whence it is removed in any convenient manner as by means of a secondary air draft passed downwardly against the sides of the table. Part of this air is, in accordance with the present existing practice, carried up with the primary air and part of it is turned outwardly into the room. While the system is described in connection with the cleaning of coal in connection with which it has been developed, it may be applied to the cleaning of various other solid materials.

The primary air, which is passed upwardly through the table, is turned into a stack of large cross section whereby its velocity is reduced in order to cause the solid matter to settle, the portions of it which are thus precipitated being removed by means of conveyors or some other device is used whereby a small portion of the dust is precipitated. This practice is well known and need not be more specifically discussed.

The entire system is generally regarded as extremely ineffective and inefficient so far as the removal of dust from the discharged air is concerned, the whole country in the vicinity of such coal cleaning plants being thickly covered with the dust thus released, which not only interferes with the growth of all sorts of vegetation, but disfigures buildings and clothes and is found to be extremely harmful to the health of those living in the vicinity.

While the use of dust collectors of the cloth screen air filtration type would seem to be an obvious remedy, they have not been adopted on account of their bulk and expense. A coal cleaning plant which may be used as an illustrative example requires for primary air introduced through the table 165,000 cubic feet per minute with an additional 35,000 cubic feet of secondary air. If all of these were passed through the dust collector, the dust collecting plant alone would cost from $150,000 to $200,000, which is more than the cost of the coal cleaning apparatus itself. The invention provides an efficient dust collecting apparatus for this plant for forty or fifty thousand dollars.

The object of the present invention is to evolve a method and apparatus whereby the large volume of air used in the dry cleaning of coal by the flotation or similar methods may be relieved of its content of solid matter so that the discharge of this solid matter or dust into the air in accordance with the present existing practice may be avoided.

In accordance with the method of the invention which is believed to solve the problem in a satisfactory manner, either the volume represented by the primary air or the entire volume of primary and secondary air is first passed through a primary dust collector which may be of the cyclone type settling chamber or any preferred type which handles large volumes of air at comparatively small cost, separating a considerable proportion of the suspended solid matter. The entire volume of air thus treated is then separated in any desired proportion in accordance with the present preferred practice of the invention about one-eighth of the entire volume is separated from the main volume of air to be cleaned by producing a stratified flow in such a manner as to cause the smaller volume of air thus separated to carry the bulk of the solid matter. This step may be accomplished by what is known as skimming, i. e., utilizing the momentum of the solid particles to separate them from the main body of the air, together with a comparatively small portion of the air being treated, which flows in the direction of motion of the particles while the main body of air is deflected.

The relatively small volume of dust laden air is then treated in and by means of any

preferred type of air filtration dust collector and returned to the flotation air chamber beneath the cleaning table together with the main body of air from which it was separated, which it thus dilutes with a fixed proportion of completely cleaned air. Practically all the suspended solid particles are thus removed from the entire volume of air which is cleaned and used repeatedly and continuously after the manner described. In this way the entire volume of air is kept in motion, the release of dust is entirely avoided and by the continuous motion of the air not only is this object accomplished, but the power required to move the air is conserved and reduced as compared to the amount required if volumes of outside air corresponding to the quantities passed through the table per second must be continuously drawn in and accelerated to the requisite velocity.

In the accompanying drawings I have illustrated an apparatus by means of which the method of the invention may be practiced, which apparatus is also considered to embody inventive ideas identical with the method of the invention.

In the drawings:

Figure 1 is a diagrammatic view of the entire apparatus shown in elevation.

Figure 2 is an enlarged diagram of the skimmer whereby a small portion of the air heavily dust laden is separated from the main volume of relatively pure air, the plane of the section being parallel to the plane of Figure 1.

Figure 3 is an elevation of the entire apparatus in which the coal cleaning features are shown a little more in detail than in Figure 1.

Figure 4 is a section on the line 4—4 of Figure 3 showing the table in plan.

Referring to the drawings by numerals, each of which is used to indicate the same or similar parts in the different figures, the construction shown comprises a coal cleaning table 1, which is illustrated as inclined upwardly to the left in Figures 1 and 3. The apparatus diagrammatically shown in Figure 1 also includes a flotation air chamber 2 beneath the table, the air being passed upwardly through the table by way of a series of perforations 3 between the riffles or ribs 3' which diverge from the center toward the edges in the direction of feed i. e., in the direction of the upward incline. In the operation of the plant shown, air is supplied to the chamber 2 in any suitable manner as by means of a main blower 4 and clear air blower 5 which may be of considerably smaller dimensions and capacity than the blower 4 in that in accordance with the preferred practice it is required to deliver a much smaller volume of air. Both of the blowers 4 and 5 deliver into the flotation air chamber 2 by way of air delivery pipes or passages 6 and 7, respectively. Overlying the cleaning table 2 is a hood 9 having a curtain or curtains 10 depending from its bottom edge at 11, which curtains are so located as to entrap or impound whatever proportion of the air from the table it is desired to put through the cleaning process to be described. As shown, the bottom edges of the curtains overlie the corresponding edges of the table at the sides. The primary air or flotation air is more easily and completely impounded in this way than the secondary air which is blown downwardly against the table. In this connection it will be understood that the hood and/or curtains may be varied to any desired degree to carry off all or any desired proportion of the air used.

In accordance with the construction shown the entire volume of air circulated through the apparatus is propelled by the blowers 4 and 5, and the dust laden air from the coal cleaning table is treated as follows in the practice of the invention in the preferred manner. From the hood 9 dust laden air is carried by way of any suitable passage or passages 14 to the primary dust collector or battery of dust collectors 15, which, as already suggested, may be of the cyclone type or any preferred type, which is adapted to handle large volumes of air at comparatively small cost. In this way a portion of the suspended solid matter is removed. The entire volume of air thus treated is delivered from the primary dust collectors 15 by way of delivery pipes 16 to the main dust laden air pipe 17 through which the entire volume of dust laden air passes at a high velocity. The air pipe 17, in turn, delivers to the skimmer 18, Figure 2, which comprises an intake portion 19 continuous with the passage 17 and a delivery portion 20 at a sharp angle thereto, the angle shown being approximately a right angle. The portions 19 and 20 are shown as connected by a curved portion 22. The skimmer illustrated also comprises a skimming pipe 21, leading off from the curved portion 22 in alignment with the intake portion 19 and the air pipe 17 and a skimming plate 24, mounted in the curved portion 22 of the skimmer on suitable journals 25 so that it may be adjustably rotated or swung about said journals, the normal adjustment of the skimming plate being substantially as shown at a suitable angle to the intake 19 and inclined toward the skimmer pipe 21 in the direction of flow of the dust laden air current toward the latter, as indicated by the arrows in the drawings, Figure 2.

In accordance with the operation of this device as understood, a considerable portion of the solid particles instead of taking the course of the main air current, i. e., following the curve 22, are projected directly into the skimming pipe 21, and of the remainder a

very large proportion of these which tend to follow the curved path of the air draft in the direction of the curved portion 22 of the apparatus come in contact with the plate 24 by which they are deflected into the skimmer pipe 21, but said skimmer plate being in turn of considerably less dimensions than the corresponding dimensions of the cross section of the pipe where it is located leaves the passages 26 and 27 of considerable area between its edges and the walls of the curved pipe 19, 20, 22 through which considerable volumes of air from which the bulk of the dirt and dust have been removed are passed directly to the skimmer discharge 20 whence they are carried by the skimmer discharge pipe 29 to the intake 30 of the main or primary blower 4 by which the main body of the air is discharged into the air flotation chamber 2 and circulated through the apparatus.

Referring now to the relatively small volume of air which may be about one-eighth of the entire amount handled, which has been separated and passed into the skimming pipe 21 by the action of the skimmer 18, this body of air would, in accordance with the ordinary practice, carry the greater portion of the dust content of the entire volume.

This concentrated dust laden atmosphere is delivered by the skimming pipe 21 to a suitable dust arrester 3, which is preferably of the most approved cloth filtration type, a good example of which is described in the applicant's copending application No. 359,503. The air from the skimming pipe 21 being treated in this dust arrester 3 practically the entire content of suspended solid particles is removed and the clear air thus obtained is carried to the clear air blower 5 by the suction pipe 32. The blower 5 in turn delivers the clear air from the pipe 32 to the flotation air chamber 2, the clear air blower discharge pipe 7 being connected thereto to deliver its entire content to said chamber.

Figure 3 shows some of the details and features of the coal cleaning apparatus in connection with the air circulating and dust separating or arresting apparatus described in connection with Figure 1. In Figure 3 the coal cleaning table 1 is shown as fed by a belt conveyor 40, which discharges into hopper 42, which, in turn, delivers to a chute 43, which discharges the coal on to the flotation cleaning table 1. This table is reciprocated in any suitable manner as by means of cam 60 of operating follower 61 on the table. In this way the coal arrested by the lifting tendency of the primary air is moved along the table and up the incline. The clean coal is delivered from the table to a delivery conveyor 44. The heavier refuse from the table carried by the inclined riffles to the sides of the table is delivered into chutes 45, by which it is discharged into a suitable receptacle, or it may be removed in any suitable and convenient manner. The dust separating apparatus of Figure 3 is identical with that described in connection with Figure 1, but Figure 3 further shows secondary air ducts 50 leading from flotation air chamber 2 upwardly and forwardly in the direction of coal feed and having nozzles 51 directed downwardly against the edges of the table. The air from these nozzles may be passed into the hood with the primary air and cleaned as described if desired.

I have thus described specifically and in detail the method of cleaning air employed in the dry cleaning of coal and an apparatus combined and arranged for this purpose, the description being specific and in detail in order that the manner of practicing the method of the invention and combining and arranging the apparatus may be clearly understood, however, the specific terms herein are used descriptively rather than in a limiting sense, the scope of the invention being defined in the claims.

What I claim as new and desire to secure by Letters Patent is:

1. The method of treating air used in the cleaning of coal by the air contact method which consists in subjecting the entire volume of air as it recedes from cleaning contact with the coal to a preliminary cleaning step, then separating a relatively small volume of air containing the main portion of the dust from the main volume of air, cleaning the air thus separated by filtration, diluting the main body of air with the cleaned air, passing the entire body of air thus reunited in cleaning contact with a new body of coal and repeating the process continuously, keeping substantially the entire volume of air in continuous circulation and presenting fresh uncleaned coal with corresponding continuity.

2. The method of treating air used in the dry cleaning of coal which consists in passing the air over the coal which is fed continuously into the air draft, subjecting the dust laden air immediately after its contact with the coal to a preliminary cleaning step whereby a portion of the dust is separated from the entire volume of the air, separating a relatively small volume of air containing more than half of the bulk of the suspended solid particles from the main volume of the air, cleaning the small volume of dust laden air by filtration and passing both the filtered air and the main volume of air in cleaning contact with an uncleaned portion of the coal.

3. The method of treating air used in the cleaning of coal which is continuously presented to an air draft, which consists in separating from the main volume of air after it has been passed in contact with the coal a relatively small portion of the air containing the main portion of suspended solid mat-

ter from the coal, filtering said relatively small portion of dust laden air diluting the main body of air with the cleaned air maintaining the entire body of air in continuous circulation and returning it into cleaning contact with a quantity of coal later presented to the air draft.

4. The method of treating air used in the cleaning of coal by passing an air draft in contact with the coal which consists in passing the entire volume of air immediately after its contact with the coal at high speed through a conduit and suddenly deflecting the main body of air, a relatively small portion of the air and the bulk of the solid particles continuing in substantially the original direction of flow whereby the bulk of the solid matter is separated from the main volume of air, together with a relatively small portion of the air volume, thus segregating a small volume of air which is heavily dust laden filtering the heavily dust laden volume of air and returning it to and with the main volume of air into contact with a new portion of coal to be cleaned.

5. The method of treating air used in the cleaning of coal by passing an air draft in contact with the coal which consists in subjecting the entire volume of air to a preliminary cleaning step, then passing the entire volume of air at high speed through a conduit and suddenly deflecting the main body of air, a relatively small portion of the air and the bulk of the solid particles continuing in substantially the original direction of flow whereby the bulk of the solid matter is separated from the main volume of air, together with a relatively small portion of the air volume, thus segregating a small volume of air which is heavily dust laden filtering the heavily dust laden volume of air and returning it to and with the main volume of air into contact with a new portion of coal to be cleaned.

6. Continuously operating apparatus for treating air in connection with the continuous operation of cleaning coal, comprising means for impounding the air discharged from the coal cleaning apparatus, preliminary air cleaning means, means connecting said first mentioned means to said preliminary air cleaning means to conduct thereto the entire volume of air impounded, an air skimming device connected to said preliminary cleaning means and adapted to separate from the main volume of air a relatively small volume of air, together with the greater portion of the suspended solid matter carried by the entire volume of air, means for filtering said relatively small volume of air removing the solid particles therefrom, and means for returning said main volume of air and said small volume of cleaned air to the coal cleaning apparatus.

7. Continuously operating means for cleaning air used in the continuous operation of cleaning coal by means of an air draft which consists of preliminary cleaning means, an air skimming means, means for conducting the discharged air from the coal cleaning apparatus through said preliminary cleaning means to said skimming means whereby a relatively small volume of air containing the bulk of the suspended solid matter in the air is separated from the main volume of air, means connected to said skimming means for filtering said relatively small volume of air, removing the solid particles therefrom, and means for returning the main volume of air and said small volume of air thus filtered into cleaning contact with a new uncleaned body of coal.

Signed by me at Hagerstown, Maryland, this 9th day of October, 1929.

MORTON I. DORFAN.