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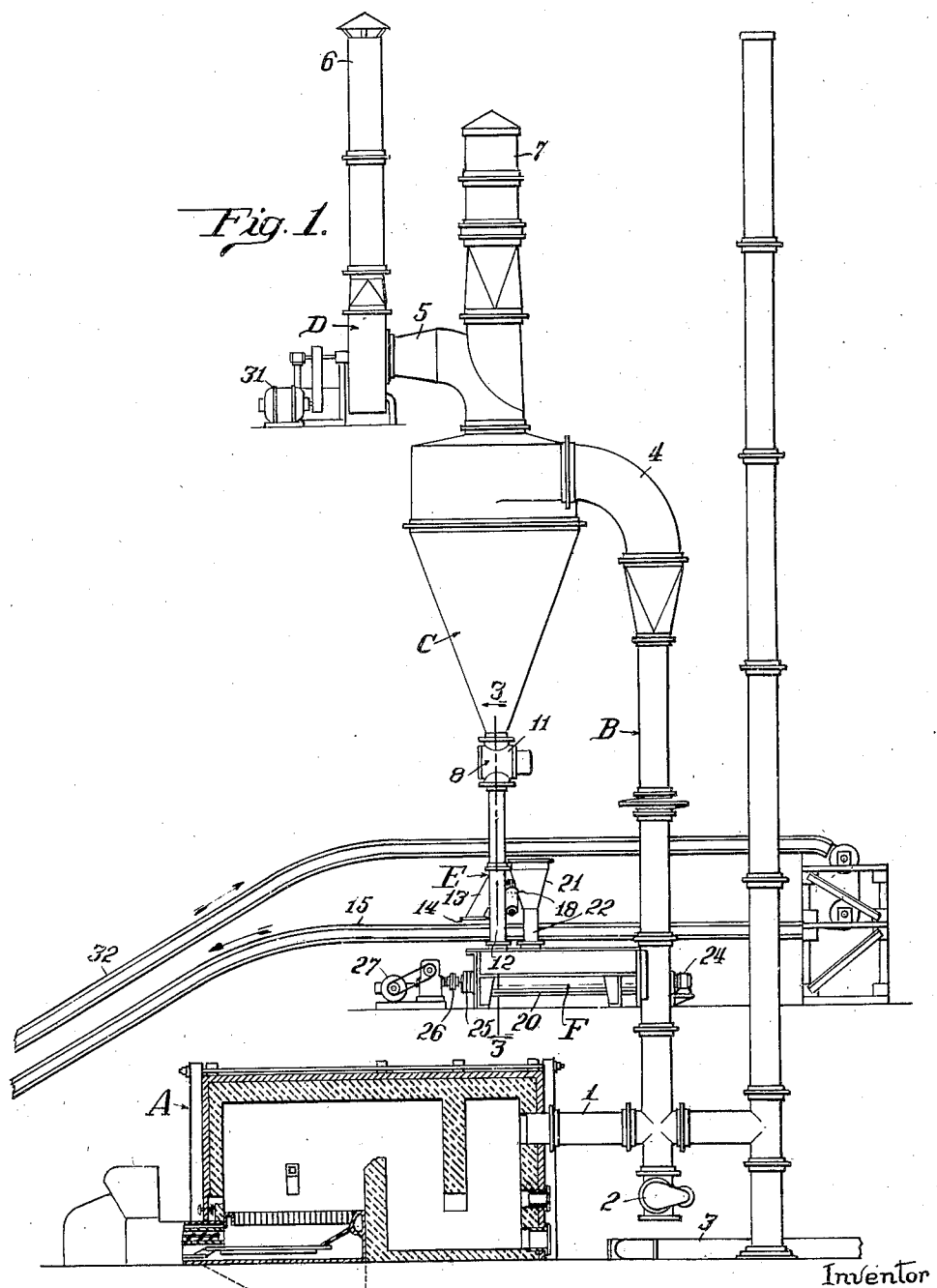
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2,296,159

DRYING APPARATUS

Filed Jan. 29, 1940

2 Sheets-Sheet 1



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Fig. 2.

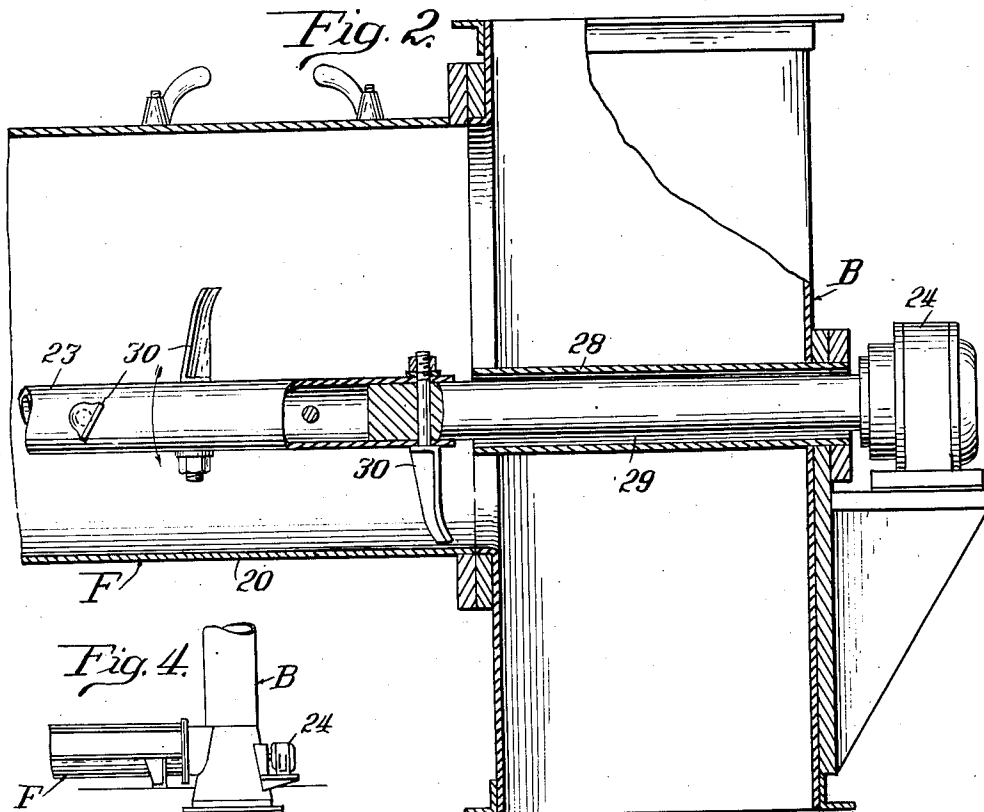


Fig. 4.

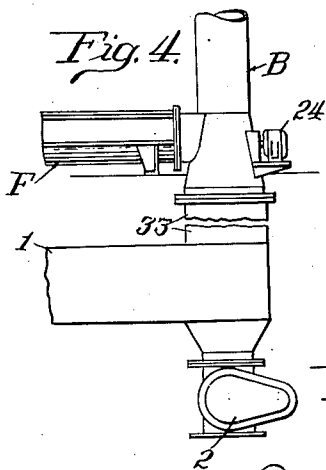
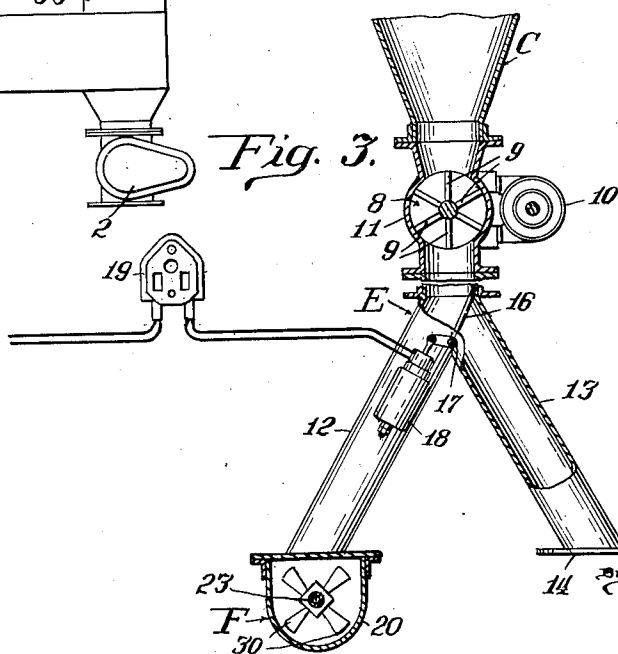


Fig. 3.



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DRYING APPARATUS

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4 Claims. (Cl. 34-57)

This invention relates to new and useful improvements in drying apparatus and is particularly directed to apparatus for drying screened material as for example coal upon its removal from the mine. Such material is not in pulverized condition but consists of particles of different sizes and weights of from about $\frac{1}{4}$ " down to the lowest mesh. Such material carries with it moisture that must be removed before it can be satisfactorily handled or used.

The primary object of this invention is to provide a novel drying apparatus adapted to receive the wet or moist material, dry it and separate it to a certain degree.

Another object is to provide such an apparatus in which the material is directed into a conduit filled with ascending hot gas which will carry some of the material with it and deliver it in a dried condition so that even the very fine material is reclaimed for use.

Still another object of this invention is to provide such a drying apparatus in which some of the material descends through the ascending hot gas to be dried and then delivered for use.

A further object is to provide a flexible means of controlling the moisture content of the treated material by automatically controlling the amount of dried material returned to the system.

Another object of the invention is to provide mechanism for mixing dried and wet material before delivery to the hot gas which mechanism is provided with a bearing portion extending through the hot gas conduit and having novel cooling means for the shaft.

Other objects and advantages will become apparent from the following detailed description.

In the drawings:

Fig. 1 is a diagrammatic elevation view showing drying apparatus assembled in accordance with this invention.

Fig. 2 is an enlarged sectional view of the delivery end of the mixing mechanism and a portion of the hot gas conduit.

Fig. 3 is an enlarged sectional view taken along line 3-3 of Fig. 1.

Fig. 4 is an elevational view showing another form of hot gas conduit construction.

In general the drying apparatus comprises a furnace A, a hot gas conduit B leading from the furnace, a separator or cyclone collector C for separating the material from the hot gas, a fan D for creating an upward draught of the hot gases through the conduit B, a divider E for returning some of the dried material to the wet

material the amount to be varied as desired, and a mixer F for mixing the dried material and wet material and delivering the mixture to conduit B.

As can readily be seen the furnace is the source of the hot air or gases which are directed upwardly through conduit B by means of exhaust fan D.

The furnace A may be any desired type of heater, the details of which are here unimportant.

The vertical conduit B is joined to the hot air escape of furnace A by means of conduit 1. The lower end of conduit B is provided with a rotary air valve 2 of the usual well known type adapted to rotate to deliver material descending through conduit B to conveyor 3 but to prevent air entering the conduit. Such an air valve is shown in Fig. 3 of the drawings. The upper end of conduit B is joined tangentially to cyclone C by means of elbow 4. Between its upper and lower ends conduit B is joined to mixer F as will hereinafter be more fully explained.

The cyclone C is of the usual well known type of separator and will separate the dried material from the hot moist air or gas, the material being delivered to the lower end of cyclone C, the gases escaping through the upper end by means of pipe 5 to the fan D and upwardly into the atmosphere through vent 6. A relief valve 7 is provided for safety purposes to automatically relieve a build-up of pressure in the apparatus.

An air valve 8, see Fig. 3, is provided at the lower end of cyclone C. This valve comprises a plurality of blades 9 rotatable by means of motor 10 in curved casing 11 whereby material from cyclone C is delivered through the valve but the infiltration of air to the cyclone is prevented. The valve 2 hereinbefore described is of similar construction.

Below air valve 8 is positioned divider E which comprises two diverging conduits 12 and 13, the first leading to mixer F and the second to point of delivery 14 of dried material to conveyor 15. At the point of divergence is positioned a damper or valve 16 pivoted about its axis 17 so as to be moved to completely close conduit 13, as shown in Fig. 3 or to be moved to its other extreme position to close conduit 12. This movement of damper 16 is caused by motor 18 which is located on the outside of conduit 12 and is controlled by any desired means such as timer 19 that may be adjusted to any desired frequency of operation.

The mixer F comprises a casing 20, into which

a wet feed hopper 21 discharges through an inlet 22 adjacent to the dry feed conduit 12. These inlets are preferably positioned at one end of the mixer which is termed the receiving end. The other end of the mixer opens into conduit B.

A shaft 23 is rotatably positioned longitudinally of the mixer and extends through the conduit B where it is mounted in bearing 24 secured to the outer surface of conduit B. The other end is mounted in bearing 25 adjacent the receiving end of mixer F. Suitable means 26 connects the shaft for rotation by motor 27. A sleeve 28 surrounds and is spaced from the portion of shaft 23 that extends in conduit B. The air space 29 formed thereby connects with the atmosphere adjacent bearing 24. Secured to shaft 23 are blades 30 arranged in screw thread alignment so as to act as conveyor means for moving the material from the receiving end of mixer F to the delivery end as well as for mixing the wet and dried material.

In operation: Motor 31 operates fan D to create a forced draft which will draw the hot gases up through conduit B.

Wet material is transported on conveyor 32 to wet feed hopper 21 which directs it into mixer F. The motor 27 causes shaft 23 to rotate so that blades 30 will tend to separate the wet material to some extent and will also convey it to the delivery end of the mixer where it will be forced into conduit B. The upwardly ascending hot gases under forced draught will at once pick up the lighter moist material, will very quickly dry it by absorbing the moisture and will transport it to the separator C. Here the dried material is separated from the moisture laden gas and delivered to the bottom of the separator. The gas escapes through the fan and vent 6 to the atmosphere.

At the bottom of the separator or cyclone C the material passes through air valve 8 to either conduit 12 or 13 depending upon the position of damper 16. That portion of the dried material passing to conduit 12 is again directed to the mixer F for mixture with wet material delivered to hopper 21 so as to prevent lumping and caking of the wet material and to aid in the proper drying of all material treated by presenting larger surfaces of moist or wet material.

It is apparent that some of the wet material introduced into mixer F will be of too great size and weight to be carried away by the hot blast in conduit B. This material will drop through the ascending gas to be thoroughly dried and will be delivered through air valve 2 onto conveyor 3. These larger sizes usually are drier than the smaller sizes and so require less contact with the hot gases.

The portion of shaft 23 positioned in conduit B is subjected to the ascending hot gases but is cooled by outside air drawn by the upwardly flowing gases into the space 29 between the shaft and sleeve 28.

The timer 19 is adjustable to regulate the frequency of introduction of dried material to the mixer and the amounts necessary may be determined by the character of the material treated. Larger sizes of coal for example are usually of such low moisture content that they do not require conditioning by the addition of dried material. The smaller the material is the wetter it is and the greater its tendency to pack or lump in which case the addition of greater amounts of dried or conditioned material is necessary.

Fig. 4 illustrates a modification of a part of

the drying apparatus in which the only change from the construction hereinabove described is the enlargement of that portion 33 of the hot gas conduit between the mixer and pipe 1. This construction is used under certain conditions and effects a different result due to the fact that as the diameter of the hot air conduit is increased the velocity of the gases of the ascending gas decreases. As the velocity decreases the carrying capacity of the hot air or gas decreases and more of the larger particles of material being treated drop through the ascending gas and are delivered through air valve 2. Thus by deliberately enlarging that portion of the ascending gas conduit more of the larger particles are induced to descend to be dried and delivered for use. Thus the amount of material falling through the ascending hot gas will vary directly with the diameter of the gas conduit leading upwardly to the mixer.

I claim:

1. In a drying apparatus comprising a mixing chamber, a hot air conduit, a rotatable shaft extending through the chamber and the hot air conduit, and bearings supporting the shaft adjacent its ends, the improvement that comprises a sleeve member surrounding and spaced from the portion of the shaft positioned within the hot air conduit and extending at one open end to the outer air whereby the shaft is cooled during operation.

2. In a drying apparatus of the type comprising a hot air conduit, means for causing an induced draft upwardly through the conduit, a rotatable shaft extending through the hot air conduit, and bearings supporting the shaft adjacent its ends, the improvement that comprises a sleeve member surrounding and spaced from that portion of the shaft within the conduit and open at one end to the outer air and at the other end to the interior of the conduit to provide a passageway leading from the outer air through the space between the sleeve and the shaft to the interior of the conduit whereby outer air will be drawn in around the shaft by the draft in the conduit to keep the shaft cool in operation.

3. Apparatus for drying coal of mixed weights and sizes comprising a vertical drying conduit, a mixer discharging into said conduit at a height intermediate the length of the conduit, a source of hot gas, a pipe discharging hot gas from the source into the conduit at a point above the lower end of the conduit and below the inlet for coal from the mixer, a separator, means for causing the hot gases to flow upwardly through the drying conduit carrying the lighter coal particles into the separator, means for discharging a selected portion of the dried coal from the separator back into the mixer, means for feeding wet coal into the mixer, means in the mixer for mixing the wet and dried coal and introducing same into the upwardly flowing hot gases in the conduit, the lighter particles of coal being carried up in the gas stream into the separator and the heavier portion falling back through the gas stream to the lower end of the conduit, and a controllable outlet at the lower end of the conduit for recovering the larger dried portions of the coal.

4. Apparatus for drying coal of mixed weights and sizes comprising a vertical drying conduit, a mixer discharging into said conduit at a height intermediate the length of the conduit, a source of hot gas, a pipe discharging hot gas from the source into the conduit at a point above

the lower end of the conduit and below the inlet for coal from the mixer, a separator, means for causing the hot gases to flow upwardly through the drying conduit carrying the lighter coal particles into the separator, means for discharging a selected portion of the dried coal from the separator back into the mixer, means for feeding wet coal into the mixer, means in the mixer for mixing the wet and dried coal and introducing same into the upwardly flowing hot gases 10

in the conduit, the portion of the drying conduit below the mixer being of a larger diameter than the portion above the mixer, the lighter particles of coal being carried up in the gas stream into the separator and the heavier portion falling back through the gas stream to the lower end of the conduit, and a controllable outlet at the lower end of the conduit for recovering the larger dried portions of the coal.

CHARLES WILLIAM GORDON.

CERTIFICATE OF CORRECTION.

Patent No. 2,296,159.

September 15, 1942.

CHARLES WILLIAM GORDON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 8, strike out "of the gases" and insert the same after "velocity" in line 9; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of October, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)