May 27, 1952 G. A. VISSAC 2,598,199

APPARATUS FOR DRYING WET GRANULAR MATERIALS

Filed March 19, 1948 2 SHEETS--SHEET 1

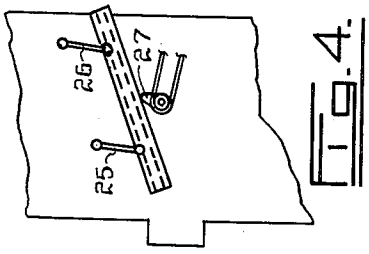


FIG. 4.

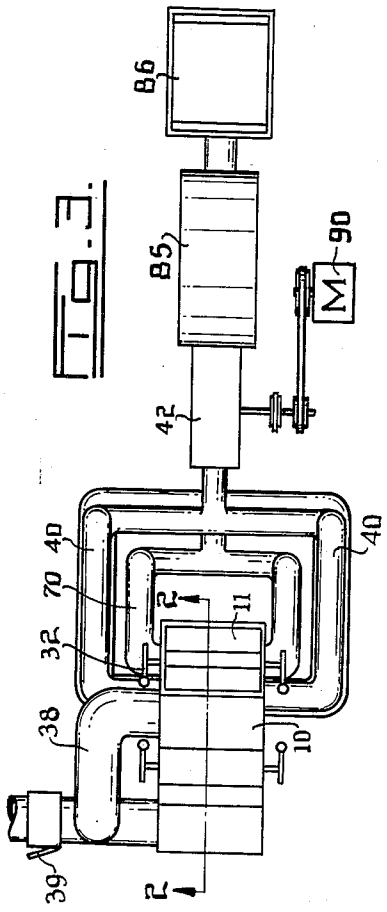


FIG. 3.

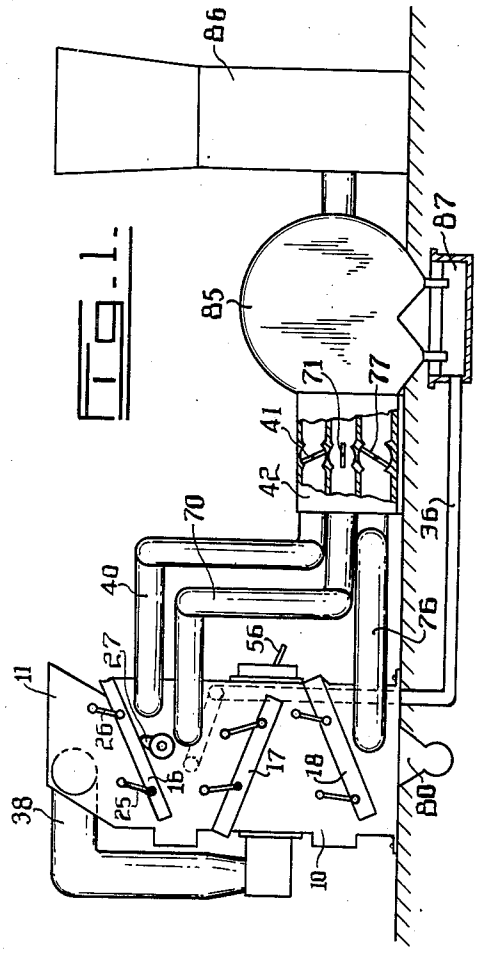


FIG. 1.

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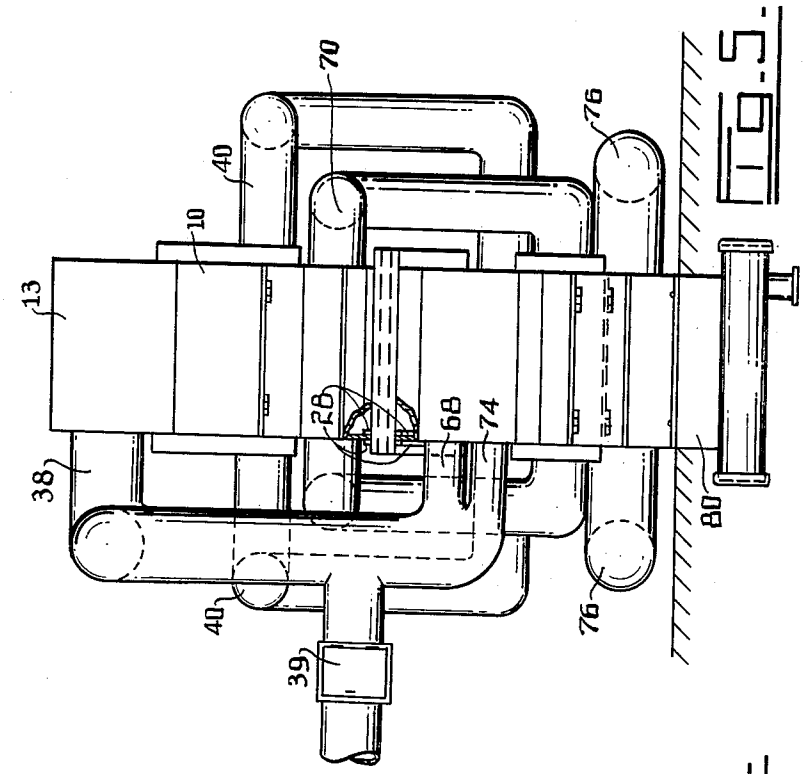


FIG. 1.

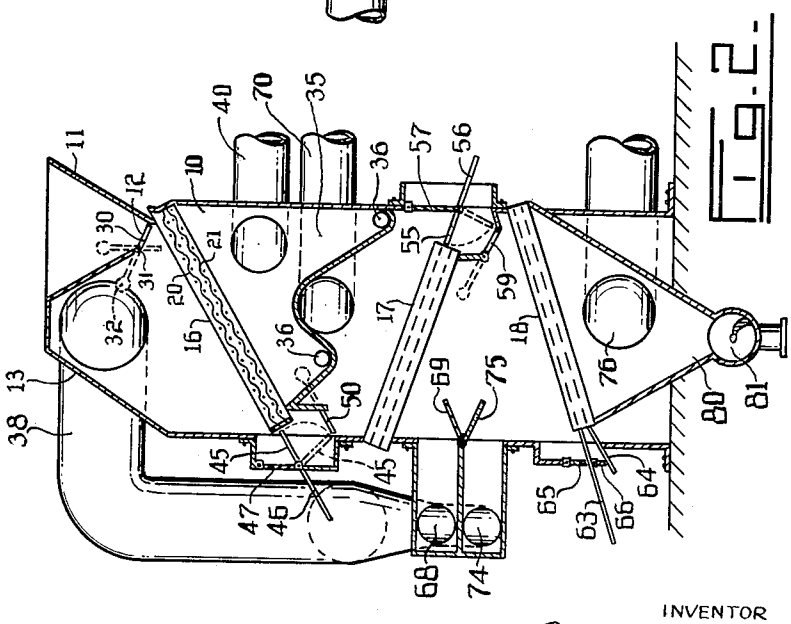


FIG. 2.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR DRYING WET GRANULAR MATERIALS

Gustave Andre Vissac, Vancouver, British Columbia, Canada

Application March 19, 1948, Serial No. 15,758

2 Claims. (Cl. 209—238)

1

This invention relates to a method of drying wet granular materials, such as coal, and apparatus for carrying out this method.

An object of the present invention is the provision of methods and apparatus for removing moisture from granular materials of different mixed sizes.

Another object is the provision of apparatus for drying granular materials of different sizes selectively according to the requirements of each size.

A further object is the provision of apparatus for drying and sizing granular materials, particularly coal, in one operation, thus eliminating the necessity of screening plants as ordinarily used today.

A still further object is the provision of apparatus of the type described utilizing up-draft and down-draft currents of hot gases for drying purposes in such a way as to utilize the advantages of each type of drying and to reduce their disadvantages to a minimum.

Yet another object is the provision of drying apparatus using a down-draft current of hot gases in the first stage to squeeze out excess moisture and then to use up-draft currents in one or more later stages to evaporate the remaining moisture.

Attempts have been made to dry wet granular materials of different mixed sizes, but the trouble has always been that these often result in larger sizes being over-dryed while the smaller sizes are still wet. This is due to the fact that the surface moisture is proportionally larger on the smaller pieces than on the larger ones. For example, 1' x 1' x 1'=1 cu. foot with a total area of 864 square inches, and a volume of 1728 cubic inches. On the other hand, however, 1728 pieces of coal of one cubic inch each provides a total area of 10,368 square inches. From this, it will be seen that the smaller pieces have twelve times the surface area of the larger piece so that the surface moisture would be twelve times as great.

In the existing dryers, there is no way of retaining the smaller particles for a longer period than the larger ones in order to ensure complete drying thereof. Furthermore, in the well known shaker screen type of dryer, the coal bed soon becomes stratified and the various layers do not receive the same amount of drying.

In existing vertical dryers, the coal does not come into contact with the hot gases sufficiently to ensure efficient drying, and no provision is made for drying the various sizes according to their individual surface moisture contents.

In down draft screen type dryers, a substantial

2

amount of surface moisture is removed mechanically by the compression of the material bed. This is a very economical way of drying and is far cheaper and more efficient than evaporation, but, unfortunately, the fines removed with the water constitute a further drying problem.

In the up-draft type of dryer, all the drying is done by evaporation. This type is more efficient on fine coals or small particles, but its capacity is low and accordingly it is not very efficient when treating very wet materials.

The present method of drying wet granular materials consists of passing the material over sloping shaking screens in a plurality of individual stages, and directing hot gases through the material in each stage, said gases being directed downwardly through the material in at least the first stage and upwardly therethrough in at least one succeeding stage. The hot gases are preferably directed in pulsating currents in order to prevent clogging of the screens and packing of the beds in the down-draft stage or stages, and in order to ensure reasonable movement of the material in the up-draft stage or stages. It is also preferable to remove any completely dried material at the end of each stage in order to avoid overheating and fires.

The apparatus for carrying out this invention consists of a plurality of shaking screens mounted in a suitable casing for receiving and agitating the material to be dried. The discharge end of each screen is positioned over the upper end of the next screen and the openings in each screen may be smaller than those of the screen above. These screens may be placed one after the other, but it is preferable to arrange them one above the other in a vertical casing or tower. Suitable means is provided for directing a current of hot gases individually through each screen. The current for at least the first screen is directed downwardly, while that of one or more of the succeeding screens is directed upwardly. In each case, it is preferable to use a pulsating current of hot gases. Furthermore, it is convenient to form each screen with spaced parallel decks. With this arrangement, it is possible to remove any completely dried material at the discharge end of each screen.

One type of apparatus for carrying out this method is illustrated, by way of example, in the following drawings, in which

Figure 1 is a side elevation of the apparatus,

Figure 2 is a vertical section taken on the line 2—2 of Figure 3,

Figure 3 is a plan view of the apparatus,

Figure 4 is an enlarged detail showing one form of mounting for one of the screens, and

Figure 5 is a view of the end of the apparatus shown at the left of Figure 2.

Referring more particularly to the drawings, 10 is a closed vertical casing or tower having a hopper 11 at the top thereof with a discharge opening 12 leading into the casing. A hood 13 closes the top of the casing. A plurality of sloping shaking screens, in this case, screens 16, 17, and 18, are movably mounted in the casing one above the other, the slope of the latter two being less than the first. It will be noted that the lower or discharge end of each screen is located over the upper end of the next succeeding screen and that these screens alternately slope in opposite directions.

Each screen preferably has spaced parallel decks formed of wire mesh, perforated plates, or wedge wire screen surfaces, and the openings of each deck may be smaller than those of the deck above. For example, each screen has two decks, such as decks 20 and 21 of the screen 16. The openings in the deck 21 are smaller than those in the deck 20, while the openings in the upper deck of screen 17 may be smaller than those of the deck 21 of the screen 16. However, the openings in the various decks may be arranged in relation to each other in any desired manner.

These screens are movable independently of the casing 10 and any suitable means may be provided for shaking or vibrating them. For example, each screen may be supported by suitable oscillatable hangers 25 and 26, and has a cam 27 bearing against the bottom thereof. As each cam is rotated by a suitable source of power, not shown, the screen is vibrated and oscillated to shake the material thereon. Each screen has sliding seals 28 between it and the casing 10. These seals may be made reasonably airtight, although it is preferable to leave them fairly loose in order that a certain amount of cool air flows into the casing at these points. As cold air must be admitted anyway, this is not harmful and it tends to protect the seals from the effect of the hot gases.

The upper end of screen 16 is located immediately below the discharge opening 12 of the hopper 11. This discharge opening is controlled by a feed gate 30 hingedly mounted at 31 and having a counterbalance 32 which keeps said gate closed until a predetermined weight of material is piled thereon. When the desired weight of material has accumulated, the gate swings open to allow said material to slide on to the upper deck of the screen.

A hopper 35 is located below screen 16 and above screen 17. Discharge pipes 36 extend from the bottom of this hopper and any fine material and water passing through the screen 16 may be flushed by a suitable flow of water into this pipe and directed to a sump. Alternatively, a screw conveyor, not shown, may be mounted in the bottom of the hopper for removing the fine material therefrom. This material may be recirculated until dried. Hot gases are supplied to the hood 13 above screen 16 by a pipe 38 from a suitable source, not shown. The temperature of these gases may be adjusted by means of an auxiliary cold air intake louvre 39. A pipe 40 connects the area below said screen to a pulsator 41 of a pulsating unit 42.

A hinged baffle 45 is adapted either to direct material from the upper deck of the screen 16 on to a chute 46 outside the casing 10, or down on to the next screen 17. In Figure 2, the baffle 45 is shown in full lines arranged to direct the material on to the chute 46, while it is shown in broken lines in the position it would assume when directing said material to the next screen. A swinging gate 47 may be arranged above this baffle to permit material to pass out of the casing 10 without losing too much heat. A counterbalanced swinging gate 50, similar to the gate 30, may be located beneath the discharge end of screen 16. This gate also will not swing open until a predetermined weight of material is accumulated thereon, and it helps to prevent the hot gases from passing around the end of the screen.

Another hinged baffle 55 is located at the lower end of screen 17 and is adapted either to direct material from the upper deck of said screen on to a chute 56 leading out of the casing 10, or down on to the upper end of screen 18. A swinging gate 57 is located above this baffle. Another counterbalanced swinging gate 59 is mounted below the discharge end of the screen 17, and it swings open only when a predetermined quantity of material has gathered thereon.

Chutes 63 and 64 extend from the upper and lower decks, respectively, of the screen 18 out through the side of the casing 10. Swinging gates 65 and 66 are mounted above the chutes 63 and 64.

Hot gases from a pipe 68 are directed by an adjustable baffle 69 upwardly through the screen 17, said gases being removed from above the screen by a pipe 70 which extends to a pulsator 71 of the unit 42. Similarly, hot gases from a pipe 74 are directed by an adjustable baffle 75 downwardly through the screen 18, said gases being removed from the area below said screen by a pipe 76 which extends to a pulsator 77 of the unit 42. A sump 80 is located beneath the screen 18 and has a screw conveyor 81 in the bottom thereof by means of which the fines are removed from the casing 10.

The pulsators 41, 71, and 77 are located at 45° in relation to each other, and are driven by a common source of power 90. The pulsating unit 42 discharges into an expansion chamber 85, to which an exhaust fan 86 is connected. A sump 87 is located beneath the chamber 85. The pipe 36 leading out of the hopper 35 in the casing 10 may extend to and discharge into this sump. The fine particles which accumulate in the sump 87 are pumped out into a settling tank in the usual manner.

In operation, the wet granular material, which may be coal, is fed into the hopper 11. When sufficient weight has accumulated on the gate 30, it swings open and the material slides on to the upper end of the screen 16. This gate may be omitted, but it helps to ensure the material spreading laterally across the screen. The larger particles move down the upper deck of the screen and if they are dried sufficiently, the baffle 45 may be set to direct them on to the chute 46 out of the vertical casing. If these particles are not dried sufficiently, the baffle may be set to direct them on to the next screen along with the particles which pass over the lower deck of the screen. The hot current of gas directed downwardly through this screen presses the excess moisture out of the material and it, along with the very fine particles, passes through the lower deck into the hopper 35, whence they are directed through the pipe 36 into the sump 87, or

are recirculated for further drying in any suitable manner.

This process is repeated as the material passes over screens 17 and 18. The larger particles from the upper deck of screen 17 may be either directed out of the casing or down on to the screen 18. The fine particles passing through the bottom of the screen 17 may be either directed out of the casing or down on to the screen 18. The fine particles passing through the bottom of the screen 17 move through the upward flow of hot gases and this is the most efficient method of drying fines. The particles passing over the upper and lower decks of screen 18 are separately directed out of the casing, while the very fine particles pass through this screen dropping into the hopper 80 whence they are removed by the screw conveyor 81.

With this arrangement, the flow of hot gases for each screen is completely independent of that of the other screens. It is preferable to use a pulsating flow in each case. The fan 86 draws the hot gases through the apparatus and the respective screens, while the pulsators create a pulsating flow. By setting the pulsators at 45° in relation to each other, the screens are alternately connected to or shut off from the exhaust fan.

The down-draft of gases through the screens has a tendency to clog the screens with fine material whereas the pulsations prevent this clogging as the material is intermittently released from the screen and shaken out of its openings. Thus, the benefits of the down-draft are obtained while reducing the disadvantages to a minimum. The pulsating up-draft is also beneficial since it permits the material intermittently to settle on to the vibrating screen at which time it is given a forward impulse, and said upwardly flowing current of hot gases unplugs the screen and dries the material thereon.

With the apparatus described, it will be seen that granular material of different mixed sizes may be dried without the larger particles being overheated or the smaller ones under-dried. Each screen forms a stage in the rying process and the larger particles may be removed at the end of any stage while the smaller ones are subjected to further drying until they have been dried to the desired degree. While three screens or stages have been described, it will be understood that any desired number of screens or stages may be used to suit the type of material or the state of the material to be dried.

What I claim as my invention is:

1. Apparatus for drying wet granular material of mixed different sizes, comprising a casing, a plurality of sloping shaking screens in the casing for receiving and agitating the material, the discharge end of each screen being positioned over the upper end of the next screen and each screen having spaced parallel decks with the openings in each deck of each screen smaller than those of the deck above, means for directing a pulsating current of hot gases through the material on each screen, said gases being directed downwardly through at least the first screen and upwardly through at least one other screen, and means for receiving the material from the upper deck of each screen selectively to direct it out of the casing or down on to the next screen.

2. Apparatus for drying wet granular material of mixed different sizes, comprising a casing, a hopper at the top of the casing, an automatic gate controlling the hopper outlet, a plurality of shaking screens in the casing one above the other sloping alternately in opposite directions for receiving and agitating the material, the discharge end of each screen being positioned to deliver material to the upper end of the next screen and each screen having spaced parallel decks with the openings in each deck of each screen smaller than those of the deck above, means for directing a pulsating current of hot gases downwardly through the material on the first screen, means for removing from the casing the material and moisture passing through the first screen, means for directing a pulsating current of hot gases through the material on each succeeding screen, said gases being directed upwardly through some and downwardly through other succeeding screens, means for selectively removing from the casing the material passing over the upper deck of each screen, means for directing the material from below the upper deck of the last screen out of the casing, and means for directing the material passing through the last screen out of the casing.

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