

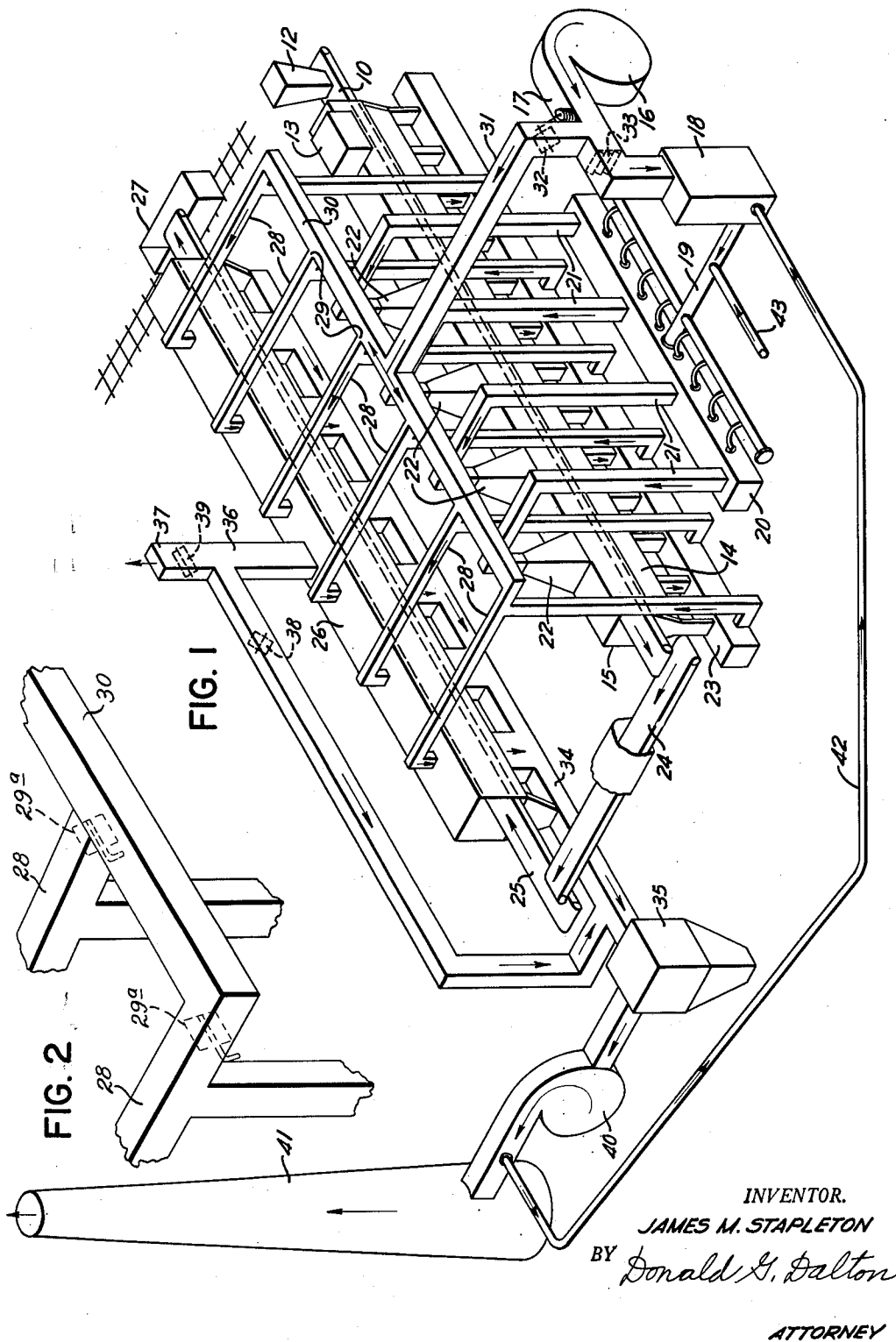
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METHOD AND APPARATUS FOR COOLING SINTER

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METHOD AND APPARATUS FOR COOLING SINTER

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This invention relates to an improved method and apparatus for cooling sintered material, particularly iron oxide sinter.

It is known that iron oxide agglomerates formed at temperatures above 2000 F. advantageously can be cooled slowly to avoid thermal shocks incident to rapid cooling, as in a water quench. A method of cooling agglomerates slowly is described and claimed in Allen et al. Patent No. 2,820,704 of common ownership. According to the patented method, agglomerates discharge directly from an agglomerating device into a refractory lined cooling shaft where they cool from their finishing temperature to about 300–600 F. over a 12 to 16 hour period. This method is especially suited for cooling nodules formed in a rotary kiln, but by itself is less suited for cooling sinter formed on a traveling grate. Nodules leave a kiln at close to their maximum temperature of 2400–2600 F., whereby they cool under controlled conditions in the shaft throughout the full range. By contrast burned sinter overlying the combustion zone on a traveling grate is subject to rapid uncontrolled cooling by contact with incoming combustion air, whereby sinter is already quite cool before any control can take place in the shaft.

An object of the present invention is to provide a method and apparatus for cooling sinter slowly and at a controlled rate throughout the full range.

A further object is to provide a method and apparatus for controlling the cooling of sinter through use of preheated combustion air in the sintering machine, in combination with slow-cooling of the sinter after it leaves the machine.

In the drawing:

FIGURE 1 is a diagrammatic perspective view of one form of apparatus constructed in accordance with my invention; and

FIGURE 2 is a diagrammatic perspective view on a larger scale illustrating a detail of the apparatus.

The drawing shows a conventional downdraft sintering machine which includes a traveling grate 10, a feeder 12, an ignition device 13, wind boxes 14 and a variable speed drive for the grate (not shown). A hood 15 covers the top of the grate. A forced draft fan 16 supplies combustion air for burning the sinter and air for controlled cooling, as hereinafter explained. In accordance with my invention, the combustion air is heated in two steps in series. In the arrangement illustrated, air from fan 16 passes through a duct 17 into a first-step heater 18 and thence through a duct 19 into a gas fired second-step heater 20. A combustible gas burns in heater 20 with a large excess of air, whereby the products of combustion remain highly oxidizing and are usable as combustion air in the sintering machine. Heated and oxidizing products of combustion from heater 20 pass through ducts 21 and heating hoods 22 into the top of hood 15. These products of combustion furnish oxygen which unites with combustible material in the sinter feed in the usual way. Sensible heat in these products of combustion maintains the burned sinter overlying the combustion zone at a high temperature, commonly a minimum of about 1200 F. while it remains in the sintering machine. Waste products of combustion from the sintering operation pass through the grate into the wind boxes 14, and thence into a waste gas duct 23 beneath the wind boxes.

In the embodiment of my invention illustrated, hot

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sinter discharges from the end of grate 10 onto a transverse covered pan conveyor 24, and thence into the entry end of a cooling apparatus which includes a pan conveyor 25, a covering hood 26 and a variable speed drive motor for the conveyor (not shown). Preferably conveyor 25 extends parallel to grate 10, but travels in the opposite direction. Cooled sinter discharges from the opposite end of this conveyor into a receiver 27. Waste gases pass from the waste gas duct 23 into a series of spaced apart overhead ducts 28 and thence into hood 26 and downwardly through the sinter on conveyor 25. Each duct 28 has a controlled air inlet 29 for introducing a regulated portion of air to the waste gases before they reach hood 26. FIGURE 2 diagrammatically shows mean 29a for controlling the proportion of air admitted to ducts 28. In this manner the temperature of gases introduced to the hood is graduated from a maximum near the entry end to a minimum near the discharge end. Thus the sinter is cooled at a controlled rate to about 300–600 F. The air inlets 29 receive air from a common manifold 30 connected to fan 16 through ducts 31 and 17. These ducts are equipped with dampers 32 and 33 respectively for apportioning the air between the sintering machine and the cooling apparatus. As an alternative to the cooling apparatus illustrated, a refractory lined shaft as shown in the Allen et al. patent could be substituted or used in conjunction with it, the sinter passing from the cooling apparatus into the refractory lined shaft.

Waste gas from the cooling apparatus passes through a duct 34 beneath conveyor 25 into a conventional dust collecting unit 35. Preferably a waste gas bypass duct 36 is connected to hood 26 and to duct 34 and has a stack 37 for limited and emergency discharge of waste gas into the atmosphere. Duct 36 and stack 37 are equipped with dampers 38 and 39 respectively for apportioning the gas flow and thus providing additional means for regulating the pressure and temperature of gases within the cooling apparatus. An induced draft fan 40 draws waste gas from the dust collecting unit 35 and directs a portion of this gas into a stack 41 and returns a portion to the first-step combustion air heater 18 through a line 42 indicated only schematically. Natural air enters this heater through duct 17, as already explained. The waste gas remains sufficiently oxidizing that a portion can be mixed advantageously with incoming air to conserve its sensible heat. Heated air from the first-step combustion air heater 18 passes through duct 19, to which gaseous fuel is introduced through a line 43, and thence to the second-step heater 20, and the action already described takes place.

From the foregoing description it is seen that my invention affords a simple apparatus and method for controlling the cooling of sinter from the temperature at which it is formed to a suitable handling temperature. Preheating the combustion air introduced to the sintering machine maintains burned sinter overlying the combustion zone at a high temperature until it discharges from the machine. Thereafter the cooling rate is closely controlled, either in an apparatus such as I have shown or an equivalent.

While I have shown and described only a single embodiment of my invention, it is apparent that modifications may arise. Therefore, I do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

I claim:

1. The combination, with a downdraft traveling grate sintering machine, of an apparatus for controlling the cooling of sinter produced by said machine, said apparatus comprising a heater operatively connected with said machine for preheating combustion air introduced thereto and thereby maintaining burned sinter at a relatively high temperature while it remains in the machine, a conveyor extending parallel to the grate of said machine

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and having an entry end adjacent the discharge end of the grate and a discharge end adjacent the entry end of the grate, means for transferring burned sinter from the discharge end of the grate to the entry end of the conveyor, a hood covering said conveyor, ducts connecting said machine and said hood for circulating waste gas from said machine through sinter carried on said conveyor, and means for introducing air to the waste gas circulated through the sinter in an increasing ratio from the entry end of said conveyor to the discharge end thereof to cool the sinter thereon slowly over an extended period.

2. In a sintering process in which a bed of iron-bearing sinter feed containing combustible material is deposited on a traveling grate, the combustible material is ignited at the upper surface of the bed, and combustion air passes downwardly through the bed, said bed thus including a layer of unburned feed adjacent the grate, a combustion zone overlying the unburned feed, and a layer of burned iron oxide sinter overlying the combustion zone, whereby the combustion air passes through the burned sinter before reaching the combustion zone, the combination therewith of a method of controlling the cooling rate of the burned sinter throughout a full range from its formation temperature of at least 2000 F. to a handling temperature of 300 to 600 F., said method comprising preheating the combustion air before it reaches the sinter bed and thereby maintaining the burned sinter at a minimum temperature of about 1200 F. while it remains on the grate, circulating a mixture of waste gas from the grate and air through the sinter after it discharges from the grate, and graduating the ratio of air to waste gas from a minimum at the beginning of the circulating step to a maximum at the end, each increment of sinter being subject to a gas-air mixture of continually increasing ratio of air to gas.

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3. In a sintering process in which a bed of iron-bearing sinter feed containing combustible material is deposited on a traveling grate, the combustible material is ignited at the upper surface of the bed, and combustion air passes downwardly through the bed, said bed thus including a layer of unburned feed adjacent the grate, a combustion zone overlying the unburned feed, and a layer of burned iron oxide sinter overlying the combustion zone, whereby the combustion air passes through the burned sinter before reaching the combustion zone, the combination therewith of a method of controlling the cooling rate of the burned sinter throughout a full range from its formation temperature of at least 2000 F. to a handling temperature of 300 to 600 F., said method comprising preheating the combustion air before it reaches the sinter bed and thereby maintaining the burned sinter at a minimum temperature of about 1200 F. while it remains on the grate, conveying the burned sinter after it discharges from the grate in a path parallel to the grate but in the reverse direction, circulating a mixture of waste gas and air through the sinter as it is conveyed, and graduating the ratio of air to waste gas from a minimum at the beginning of the circulating step to a maximum at the end, each increment of sinter being subject to a gas-air mixture of continually increasing ratio of air to gas.

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