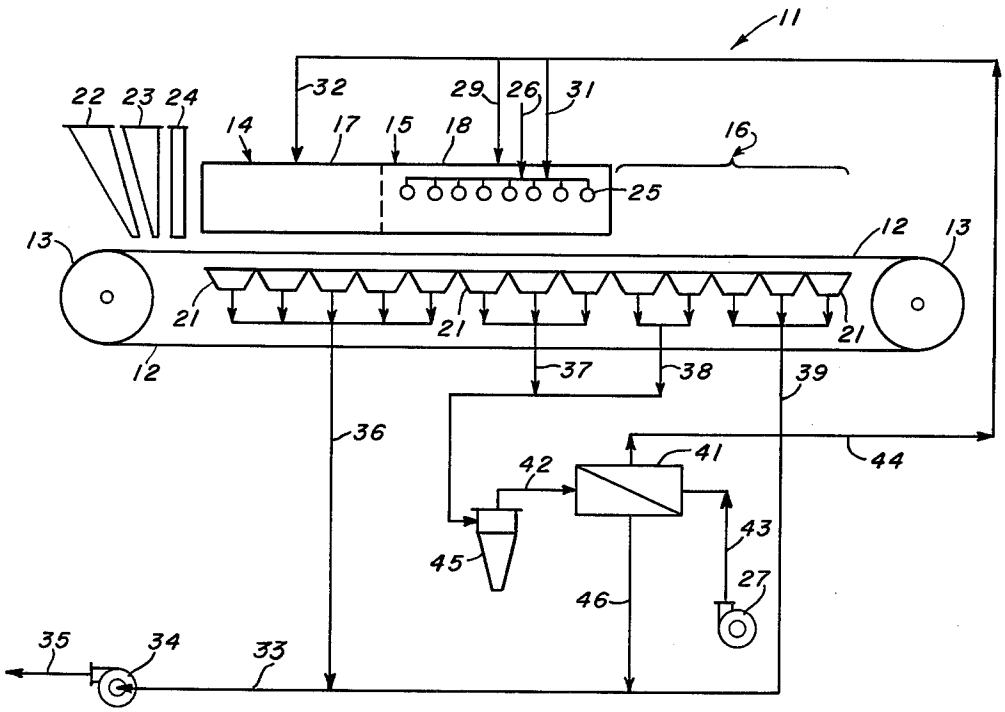
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METHOD OF AND APPARATUS FOR THE ENDOTHERMIC PROCESSING OF ORES

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METHOD OF AND APPARATUS FOR THE ENDOTHERMIC PROCESSING OF ORES

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This invention relates to a method of and apparatus for the endothermic processing of ores or minerals on a traveling grate or sintering machine, and more particularly to certain improvements in sintering apparatus and the method of operating the same.

In the operation of a sintering machine the material being processed is carried in continuous progression by pallets having their bottoms formed of grates over a series of windboxes in which subatmospheric or superatmospheric pressures are maintained to induce a flow of air or gases through the material from the top downwardly into the windboxes, or from the windboxes upwardly through the bottoms of the pallets and the materials therein. In some cases the mineral being treated is admixed with fuel and the flow of air through the bed of material sustains combustion. In other cases fuel is burned above the bed and the material is heated by the downward passage of hot gases, or even gases which are still burning, through the bed. Typically on a sintering strand the material moves first through a preheating zone, then through a firing zone, and thereafter through a cooling zone.

For the treatment of hundreds of tons of ore a day, large volumes of air and gases must be circulated through the apparatus, and one item of considerable initial cost of a sintering or heat hardening plant of this type is that of the fans for inducing such forced flow of air or gas and the motors and electrical equipment for driving the fans. The power requirements for the fans constitute a substantial item of cost in operating the equipment.

A second important factor of cost in the operation of the equipment is the fuel which is used, either in the bed of material itself or for generating hot gases for passage through the bed.

Another factor that contributes to the cost of the operation is the high temperature of the gases and the need for admixing therewith atmospheric air before such gases encounter a fan in order to protect the fan from excessive heat. The need for thus diluting the gases and increasing their volume increases the size of the fan and the power requirements therefor. Moreover, an unfavorable heat balance results from the small amount of heat which can be usefully employed when the gases are so diluted to cool them.

According to the present invention, the gases which have passed through the charge in the regions of the highest temperatures are separated from the gases that pass through the cooler regions and are forced through a recuperator or heat-exchanger where such highly heated gases yield much of their heat to a stream of air, and the air so heated is used in preheating and burning the charge, so that a substantial amount of heat which has heretofore been wasted is usefully employed and the highly heated gases are cooled in the heat-exchanger to a level where dilution with atmospheric air to protect the fans is not required. In addition the gases which have been thus cooled may be mingled with air or gases that have passed through the cooler areas of the bed, and a single fan can

be used in place of the multiple fans heretofore required. The invention thereby reduces the initial cost of an installation, conserves fuel and substantially reduces power costs for operating the fan, particularly since outside air need not be introduced into the hot gases to dilute them for protecting the fan.

The invention has for a principal object to effect a substantial economy in the initial cost and subsequent operation of a sintering or like endothermic apparatus and process.

The invention has for a further object to provide a sintering or like apparatus and method for the more effective utilization of heat and the protection of a fan which moves gases therethrough from execessive heat.

The invention has for a further object to provide an apparatus and method by which a single fan may be used to induce a flow of air and gases through the charge on a sintering machine.

A method illustrating certain features of the invention includes separating the exhaust gases from a heat-treating furnace into streams at different temperatures and transferring heat from the highest temperature exhaust gas stream to an atmospheric air stream, and utilizing the preheated air stream in endothermic treatment of material passed through the furance.

A complete understanding of the invention may be had from the following detailed description of a specific embodiment thereof when read in conjunction with the appended drawings wherein:

The figure illustrates diagrammatically the apparatus comprising a preferred emobdiment of the present invention.

In the drawing, **11** designates generally a sintering machine of a type well known in the art and wherein there is a sinter strand **12** entrained around spaced rollers **13** which translate the strand through a preheating zone **14**, a firing zone **15**, and a cooling zone **16**. A preheating zone hood **17** and firing zone hood **18** are juxtaposed over the line of travel of the strand **12**. A cooling zone hood is not required in the apparatus due to a downdraft principle being employed in the cooling of hot ore leaving the firing zone **15**. Windboxes **21**, feed hoppers **22**, **23** and **24**, fuel burners **25**, fuel line **26**, secondary air supply line **29** for the firing zone **15**, primary air supply line **31** to the burners **25**, and preheating air supply line **32** for the preheating zone **14** are arranged in general, in accordance with existing practice. Exhaust gas line **33** conducts air and gases from windboxes **21** with the exhaust fan **34**, for discharge into the flue or duct **35**.

In the present invention the windboxes **21** are connected to discharge their gases selectively through lincs **36**, **37**, **38** and **39**. That is, the exhaust gases from the windboxes in the preheating zone **14** and from a selected portion only of the windboxes of the firing zone **15** are drawn through line **36**, with the gases from the remaining windboxes **21** of the firing zone **15** being drawn downwardly through line **37** to be joined with the exhaust gases flowing through line **38** from selected windboxes of the cooling zone **21**. The temperature of the latter gases after being drawn downwardly through the cooling zone are in the range of 450° to 600° C. in the first windboxes passed by the hot ore traveling on the grate **12** from the firing zone. The remaining exhaust gases of the cooling zone are drawn through line **39**. The lines **36** and **39** duct the exhaust gases directly to the exhaust fan **34**, and are at a relatively low temperature, such as 200° to 300° C., whereby the fan **34** is capable of handling them without requiring special heat resisting characteristics in its structure.

The exhaust gases ducted through lines **37** and **38** are, in contrast with those gases discharged through lines **36** and **39**, at a relatively high temperature, preferably in the range of 400°–600° C. and before being exhausted by fan **34** are lowered to a temperature preferably just above the condensation point of the gases in order to prevent corrosion of the exhaust systems contacted subsequently by these gases.

A heat-exchanger **41** is placed in an exhaust line **42** within which empty the gases from the lines **37** and **38** at a high temperature, for example, 400°–600° C. and the heat of these gases is transferred to a stream of air induced from the atmosphere through the line **43** by a fan **27**. Preferably, the temperature of the hot exhaust gas mixture is set at not higher than 530° C. to avoid fabrication of the heat-exchanger with heat resistant materials. The warmed air current is then directed through a line **44** directly to the lines **31**, **29** and **32** for the purposes heretofore explained. A dust eliminating device **45**, such as a hot cyclone gas cleaner, is placed in the path of flow of the exhaust gases in line **42**. Consequently, the exhaust gases may be cleaned prior to passage through the heat-exchanger **41** to avoid harmful contact with the material of the exchanger, subsequent duct work, and the fan **34**. The dust collected in the device **45** is recovered for its by-product usages as is conventionally practiced.

After the hot exhaust gases in line **42** have passed through the heat-exchanger **41** to a line **46**, their temperature is low enough to be handled safely by the exhaust fan **34**, for example, in the range of 200° to 300° C. Consequently, the gases in the line **46** join with the gases of the lines **39** and **36** for simultaneous exhaust by the single fan **34**.

By the concept of the present invention the hot-working fan formerly necessary in prior art continuous sintering machines, is completely eliminated along with the need for a hood over of the cooling zone **16**. Also, the atmospheric air for the burners **25** is completely dust free whereas formerly the atmospheric air became laden with dust since it was heated by passage upwardly through the traveling grate and charge in the cooling zone. The fan **27** is no longer limited to a low pressure production of air current to avoid blowing of the charge upwardly from the grate in the cooling zone inasmuch as the present invention does not utilize this air stream as the cooling gas for the cooling zone; accordingly, a relatively high pressure of 800 mm. of water can be imparted by the fan **27** to the air stream through the heat-exchanger **41**. The air current is warmed by passage through the heat-exchanger **41**, and is then fed directly under pressure to the burners **25**, the firing zone **15**, and the preheating zone **16** by the force of fan **27**. Should it be desired, however, to provide air from the atmosphere directly to the burners **25** as primary air under high pressure, another cold air fan may be coupled directly to these burners and the required air for the preheating zone **14** and the secondary air for the firing zone **15** may be served by the cold air fan **27** which may then operate under a low pressure.

It is manifest that the process contemplated by this invention may be practiced either by supplying heat for endothermic sintering by gas or oil heating through the use of burners, or by admixing solid fuels, or admixed fuel and gas firing in which a part of the heat is supplied by combustion of admixed solid fuels and a part through hot gases from burners.

What is claimed is:

1. An ore sintering process comprising passing a layered charge of ore on a pervious grate through a preheating zone, a combustion zone, and a cooling zone while inducing a downdraft of gas through the charge in each zone; separating the exhaust gases in each of the combustion and cooling zones into low and high temperature exhaust gases; removing the preheating zone exhaust gases simultaneously with the low temperature exhaust gases from the combustion zone and the low temperature exhaust gases from the cooling zone by a single fan; transferring the heat from the high temperature exhaust gases of the combustion and cooling zones to a stream of atmospheric air and subsequently discharging these exhaust gases by the single fan; and forcing the warmed stream of atmospheric air to the combusion zone and to the preheating zone by another fan for endothermic reaction with the ore charge traveling through these zones.

2. A method as in claim **1** wherein the high temperature exhaust gases from the combustion and cooling zones are treated by eliminating the dust from these gases prior to the transferring of their heat to a stream of atmospheric air and subsequent discharge.

3. A method as in claim **1** wherein the temperature of the combined high temperature exhaust gases of the combustion zone and the high temperature exhaust gases of the cooling zone is maintained between 400° to 600° centigrade by mixing selectively portions of the exhaust gases of the combustion and cooling zones.

4. A method as in claim **3** wherein the temperature of the high temperature exhaust gases from the combustion and cooling zones is maintained above the point of condensation of the gases subsequent to the heat transfer and prior to discharge by the fan.

5. A sintering process in which an air pervious layer of material to be sintered is carried on a traveling grate progressively through a preheating zone, a firing zone and a cooling zone while inducing by an exhaust fan a downdraft of gas through the layer in each zone in such manner that the temperature of the material increases as it moves through the firing zone and decreases as it moves through the cooling zone away from the firing zone comprising combining the gases which pass through the layer in the hottest portions of the firing and cooling zones, transferring heat from these gases to a stream of air, discharging the gases subsequent to the heat transfer whereby they are cooled before they encounter the exhaust fan, discharging the gases which pass through the layer in the coolest portions of the zones through the fan, and conducting the stream of air to which heat is so transferred to the preheating and firing zones for heat-treatment of the material passing through these zones.

6. A sintering process as defined in claim **5** which includes mixing the exhaust gases from the coolest portions of the layer with the gases from the hottest portions after the latter has transferred heat to the air stream and before they encounter the fan whereby a single fan is utilized to discharge all of the gases, and utilizing the stream of air which is so heated in the preheating and firing zones.

7. A sintering process as defined in claim **5** wherein the hottest gases from said firing and cooling zones are selected to maintain the temperature of the mixed gases prior to the heating of the air between 400° and 600° C.

8. The combination with a downdraft sintering apparatus comprising a sintering strand movable over a series of wind-boxes from a loading end to a discharge end, means for suppling a charge to be sintered onto the loading end of the strand, a hood near the charging end for providing together with the windboxes thereunder a downdraft preheating zone, a second hood succeeding the first having fuel burners therein and forming with the windboxes located thereunder a downdraft firing zone, and succeeding windboxes under the strand comprising a cooling zone of

(a) means for conducting gases from the windboxes under the preheating zone and first part of the firing zone to a discharge duct,

(b) means for withdrawing gases from the remaining windboxes of the firing zone and first part of the cooling zone only as a common stream into a heat exchanger whereby only the hottest windbox gases in the series flow through the heat exchanger,

(c) means for conducting said last-named gases from the heat exchanger to the discharge duct,

(d) blower means for forcing air under pressure through said heat exchanger,

(e) duct means for conveying heated air under pressure from the heat exchanger to the hoods of the preheating and firing zone,

(f) means for conducting gases from the remaining windboxes of the cooling zone to the discharge duct, and

(g) a suction fan in said discharge duct for drawing gases therefrom and discharging them.

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