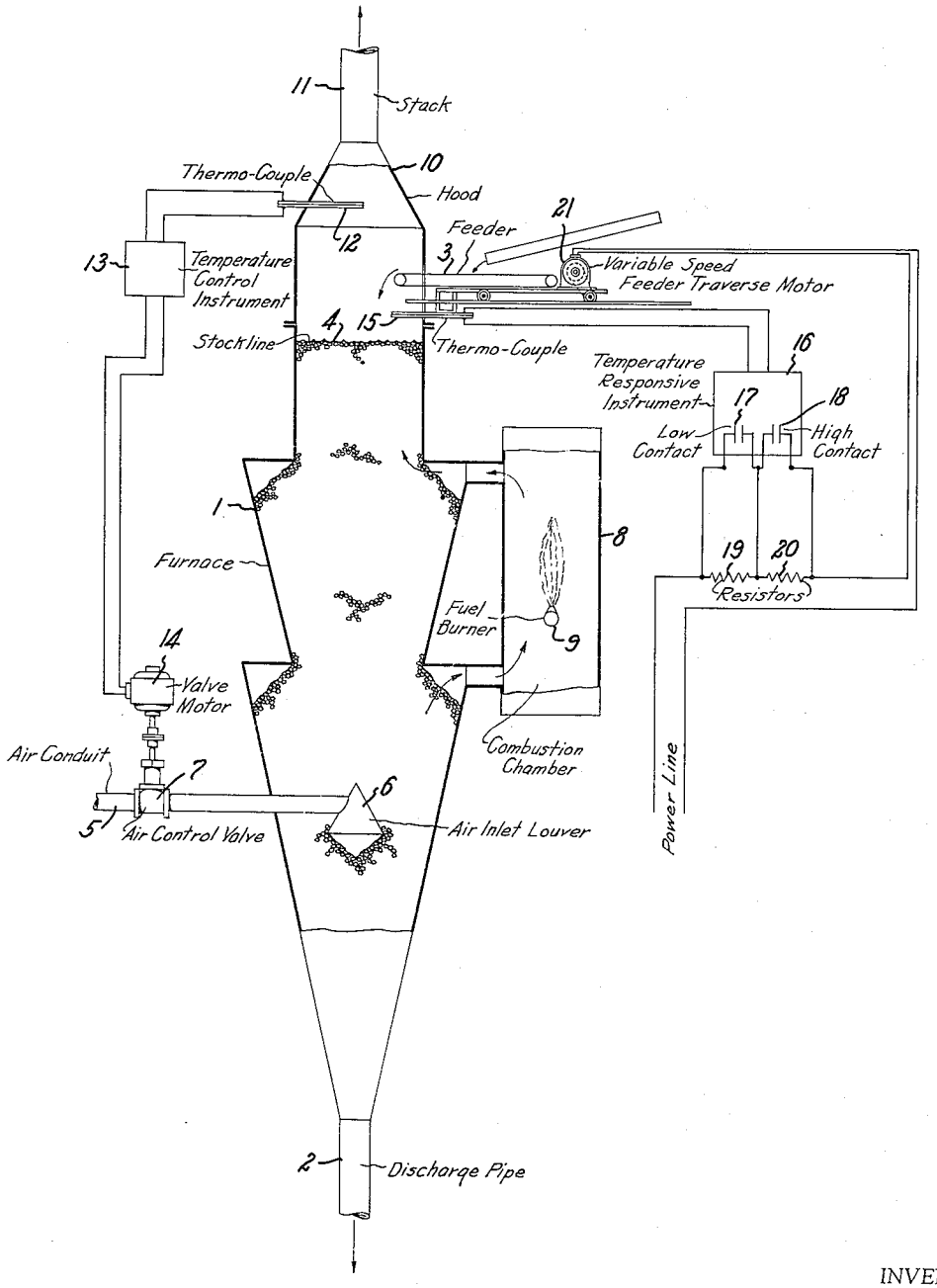
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CONTROLS FOR PELLETIZING FURNACE

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CONTROLS FOR PELLETIZING FURNACE

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This invention relates to the art of indurating pellets—or equivalent small fluent bodies—of ore fines or the like in a shaft-type induration furnace, and is concerned with a method of and apparatus for correcting irregularities in the temperature obtaining at the stockline of the charge. The invention is particularly applicable in connection with the induration of pellets which contain within themselves an exothermically oxidizable component, in which case the maximum temperature obtaining in the charge column occurs in a normally horizontal and relatively thin zone or layer—hereinafter referred to as the "heatline"—high up in the column usually only some six to eighteen inches beneath the stockline.

It heretofore had been appreciated that all of the countercurrent stream of heat-carrying gas should exit from the top of the charge column at a controlled, relatively low, temperature, and that local "hot spots" at the stockline should be avoided because the same represented areas wherein usable heat was being wasted into the exit gas and pellets were being improperly indurated. It had been thought that the heatline should be parallel with the stockline—i. e., should at all places in the cross-sectional areas of the column be at the same controlled depth beneath the stockline—and it further had been thought desirable if not absolutely necessary to maintain a level stockline in order to favor such parallel conditions. Copending application Serial No. 237,209, filed July 17, 1951, in the names of Fred D. De Vaney and Donald Beggs, describes apparatus adapted for use in maintaining a level stockline. While the "measure" consisting in maintaining a level stockline does avoid one cause of heatline irregularity, namely, the formation of shorter and longer paths for the countercurrently moving stream of gases, it has been found that maintenance of a level stockline is not, in and of itself, sufficient to prevent heatline irregularities.

In the carrying out of the above-mentioned induration process the very desirable levelness of the heatline may be adversely affected by the happening of any one or more of a number of conditions, including: irregular descent of the charge column; channeling of the heated gases forced countercurrently through the column, by reason of localized congregations of pellets providing larger—or otherwise more readily traversable—interstices than obtain in other parts of the column; non-uniformity in the amounts of exothermically oxidizable component included in the pellets; non-uniformity in rate of oxidation, and other variables. In consequence, the "heatline" instead of being a zone or plane parallel with the stockline, i. e., the top of the column, becomes non-parallel with the stockline, e. g., irregular in contour, with the result that in some areas it approaches unduly closely to or even into the stockline while in other areas it lies at a desired depth beneath the stockline or at a depth unduly removed from the stockline. Such irregularity results in loss of heat and explosive decrepitation of pellets—in those areas where the heatline is unduly close to the stockline—and/or in the caking together of pellets—in

those areas where the heatline lies too far beneath the stockline. It has been found that such undesirable conditions may obtain beneath a stockline which per se is desirably level.

According to the concept of the present invention, the problem of insuring uniform thermal treatment of the "green" pellets being fed to the stockline of the column of the induration furnace is not met by invariant levelness of the stockline, or even by invariant parallelism between stockline and heatline, but rather by locating (across the stockline) any areas of abnormally high and/or low temperature and counteracting such localized areas of abnormally high and/or low temperature by appropriate increase or decrease in the rate of addition of "green" pellets to such localized areas whereby to reduce the stockline temperature (and, hence, the exit gas temperature) at such areas, to a value within a predetermined "normal" range. In consequence, local "hot spots" in the stockline (and exit gas) are promptly eliminated, tending to produce a uniform stockline temperature and uniform heating of the green pellets.

From the apparatus standpoint the present invention comprises, in combination, a shaft-type induration furnace to the top of which "green" pellets are fed and from the bottom of which indurated pellets are withdrawn, means for introducing a heat-exchange gas into the furnace at an elevated temperature, means for maintaining a predetermined average exit gas temperature, a translatable feeding device for laying down a layer of green pellets onto the stockline of a column of pellets occupying the furnace, and means responsive to localized deviations in exit gas temperature from the average for regulating the localized rate of feeding, whereby to minimize such deviations.

The invention will now be described in greater particularity and with reference to the accompanying drawing in which the single figure is a schematic representation of an apparatus organization adapted for carrying out the concept of the present invention.

In the drawing there is indicated at 1 a shaft-type indurating furnace generally, the same being provided with a discharge pipe 2 for withdrawing pellets from the bottom of the furnace and with a translatable feeder mechanism 3 for laying down a layer of green pellets over the stockline 4 of a column of pellets occupying the furnace. Feeder mechanism 3 may be that described and claimed in U. S. Patent No. 2,538,556, de Coriolis and Campbell. A stockline control means (not shown), such as that described and claimed in my copending application Serial No. 6,743, filed February 6, 1948, now Patent No. 2,646,900, issued July 28, 1953, may be and preferably is used to maintain a normal average elevation of stockline 4 by regulating the relative average rate of withdrawal of indurated pellets to average rate of feed of green pellets, but forms no part of the present invention. Air under pressure from a blower or other suitable source (not shown) is fed through air conduit 5 into the interior of the lower part of the furnace and to air inlet louver 6; air conduit 5 is provided with a motor-operated air control valve 7. Air entering the furnace at louver 6 flows generally upwardly, a major portion by-passing the middle section of the furnace through combustion chamber 8. In this latter the air—preheated by passage through the lower section of the pellets column—is heated to a desired elevated temperature by combustion of a fuel fed thereinto by fuel burner 9. The resulting heated gases reenter the upper section of the pellets column and flow generally upwardly through the latter, exiting at stockline 4 into a hood 10 and stack 11.

In order to maintain the proper heat balance conditions in the upper or heating section of the furnace, the flow of air into the furnace is so regulated as to main-

tain a fixed predetermined average temperature of the exit gases leaving stockline 4, as described and claimed in application Serial No. 2,315, filed January 14, 1948, now Patent 2,676,095, issued April 20, 1954, in the names of Fred D. De Vaney and Donald Beggs. To this end, a thermocouple 12 in hood 10 serves to actuate air control valve 7 by means of a temperature control instrument 13 and valve motor 14.

Feeder mechanism 3 is arranged to traverse generally the entire area of the stockline by any suitable means, e. g., that described and claimed in Patent No. 2,538,556, de Coriolis and Campbell. A temperature responsive means, e. g., a thermocouple, 15 is carried by feeder 3 in its traverse, thermocouple 15 being so positioned with respect to the feeder and the stockline as to measure the temperature of the exit gas close to the stockline and at the area about to be, or being, fed by feeder 3. Thermocouple 15 actuates a conventional temperature responsive instrument 16 having a low contact 17 and a high contact 18, each of which contacts is arranged to open as the temperature increases past the setting of the contact and to close when the temperature drops below the setting of the contact.

Contacts 17 and 18 are suitably connected through electrical relays to resistors 19 and 20 in the power circuit of a variable speed motor 21 actuating the feeder traverse mechanism. When neither contact is open, the localized exit gas temperature is unduly low (signifying that the apertaining area of the heatline is unduly low in the column) and motor 21 runs at high speed. With motor 21 running at high speed, feeder mechanism 3 is caused to travel at a rate of speed in excess of its normal rate, with the result that a thinner than normal layer of green pellets is deposited at the stockline area under consideration.

Low contact 17 is set at a temperature somewhat below, preferably about 50° F. below, that of the average exit gas temperature being controlled independently from thermocouple 12. High contact 18 similarly is set to operate at a temperature say 50° F. above that of the average exit gas temperature.

In operation, when thermocouple 15 detects an area where the exit gas temperature is unduly low, say 50° F. or more below the average exit gas temperature, both contacts 17 and 18 are closed, feeder traverse motor 21 runs at high speed, the rate of travel of feeder mechanism 3 is increased above normal, and a thinner than normal layer of green pellets is deposited over the abnormally "cold" area. When thermocouple 15 detects an area where the exit gas temperature is within the average range being controlled by thermocouple 12, low contact 17 is opened, motor 21 runs at normal speed, the rate of travel of feeder mechanism 3 is normal and a layer, of normal thickness, of green pellets is deposited. When thermocouple 15 detects an area where the exit gas temperature is unduly high, say 50° F. or more above the average exit gas temperature, both contacts 17 and 18 are opened, motor 21 runs at low speed, the rate of travel of feeder mechanism 3 is decreased below normal, and a thicker than normal layer of green pellets is deposited over the abnormally "hot" area. In this fashion the cold areas, which usually (but not necessarily always) are the high areas, receive a light feed, thus encouraging the gas current to work its way up through the affected area and thus bring the localized exit gas temperature back to normal. Conversely, the hot areas (frequently the low areas) receive a heavy feed thereby tending to depress the heatline at the affected area and lowering the localized exit gas temperature. Since the feeder mechanism makes a complete traverse of the stockline every few minutes (e. g., every four minutes), the above correction for heatline irregularity is being substantially "constantly" applied.

According to the foregoing description the deposition of a localized light, normal or heavy feed layer is effected by fast, normal or slow traverse speed of the feeder mechanism over the stockline. This is the preferred mode of operation because the actual rate of feed being put onto the stockline in any given time interval need not be influenced by the speed of traverse. However, the inventive concept applies as well to other modes of feeding, such for example as a belt feeder having a fixed rate of traverse and a variable belt loading. Generally speaking, the invention is applicable with any feeding device which traverses the stockline in any fashion and is capable of feeding layers of varying thickness in response to localized departures from normal to exit gas temperature.

I claim:

1. In an apparatus for indurating small fluent bodies composed of finely divided mineral solids said apparatus including a shaft-type induration furnace adapted to be occupied by a column of such fluent bodies and to receive layers of "green" fluent bodies at the top of such column and to discharge indurated fluent bodies at the bottom thereof, means for introducing a heat-exchange gas into the furnace at an elevated temperature, means for maintaining a predetermined average exit gas temperature, and a variable-speed translatable feeding device for laying down a layer of "green" fluent bodies, in a recurring pattern, onto the stockline of a column of fluent bodies occupying the furnace, the improvement which consists in providing said feeding device with means responsive to localized deviations in exit gas temperature for regulating the localized rate of translation of said feeding device whereby to minimize such deviations.

2. An improved apparatus for indurating pellets and other small fluent bodies of finely devided mineral solids comprising, in combination, a shaft-type induration furnace to the top of which green pellets are fed and from the bottom of which indurated pellets are withdrawn, a variable-speed translatable feeding device movable over the mouth of the furnace for laying down a layer of green pellets, in a recurring pattern, onto the stockline of a column of pellets occupying the furnace, means for introducing a heat-exchange gas into the furnace at an elevated temperature and for forcing the same upwardly through a column of pellets occupying the furnace, means for maintaining a predetermined average exit gas temperature, and means carried by said translatable feeding device and responsive to localized deviations in exit gas temperature from the average exit gas temperature for regulating the localized rate of translation of said feeding device whereby to deposit a thicker than normal layer of green pellets on a localized area of such stockline above which the localized exit gas temperature exceeds the average exit gas temperature.

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