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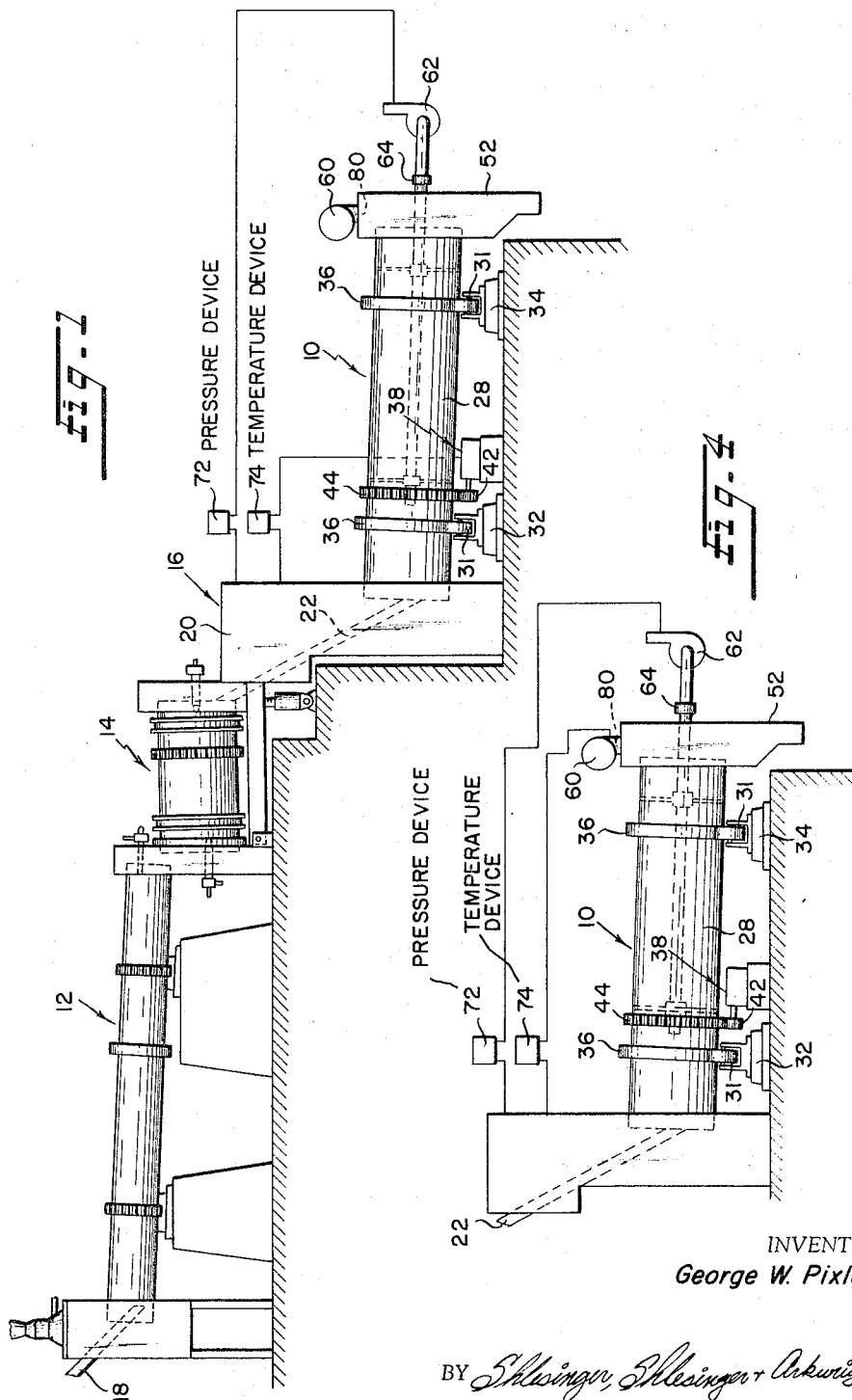
G. W. PIXLEY

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APPARATUS FOR COOLING METALLIC AND NON-METALLIC PARTICLES

Filed May 19, 1964

2 Sheets-Sheet 1



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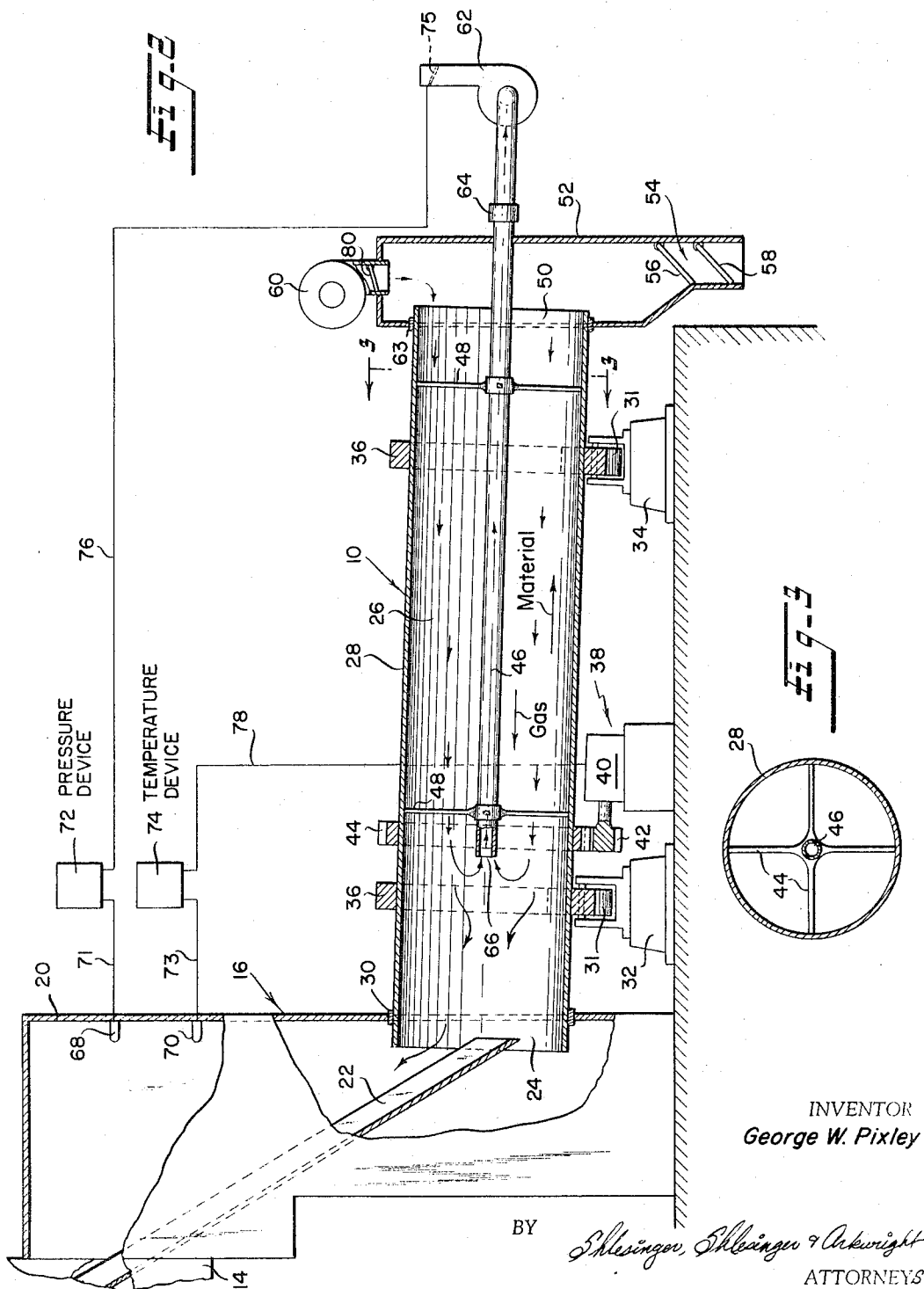
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1

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APPARATUS FOR COOLING METALLIC AND NON-METALLIC PARTICLES

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7 Claims. (Cl. 263—32)

This invention relates to the method and apparatus used in the manufacture of lightweight aggregates, cements, etc. including all metallic and non-metallic minerals, and more particularly to the method and apparatus used in cooling the aforesaid particles upon discharge from the kiln or heating chamber.

In the manufacture of the aforesaid particles the raw material particles are heated to cause expansion or "bloating." This procedure is done in various types of kilns, an example of which is illustrated in the patents to Francis V. and George W. Pixley and Harold Lopinot, U.S. Patent 3,037,040 of June 5, 1962 and 3,116,055 of December 31, 1963.

When the particles are discharged from the heating chambers, they come out at a very high temperature. Also, hot gases may be discharged with the aggregates. This invention, therefore, deals with the method and apparatus for cooling the material as it is discharged from the kiln.

It is an object of this invention to provide the method and apparatus for economically cooling the aggregate.

It is a further object of the invention to provide a controlled volume of preheated secondary combustion air to be introduced from the cooler into the kiln.

It is a further object to control the temperature of the preheated secondary combustion air.

It is another object to control the temperature of the finished material discharged from the cooling system.

Still another object is to provide a method and apparatus for regulating the quantity of cooling gas in the cooler by means of sensing the gas pressure in the kiln.

Still another object is to provide a method and apparatus for controlling the rate of movement of the material through the cooler in accordance with the temperature of the preheated secondary combustion air.

An alternative object is to control the volume of gas entering the cooling chamber in accordance with the temperature of the preheated secondary combustion air.

Another object is to provide a cooler of a design which requires less maintenance and less capital expenditure than presently known devices.

It is another object to provide a method of manufacture of lightweight aggregates wherein the aggregates are conveyed through a cooling chamber and gas is forced over the aggregates to cool same and to provide additional secondary combustion gases.

It is a further object to use the cooling gas as a preheating fluid in the kiln.

It is still another object to exhaust the low temperature cooling gas at the most advantageous point in the cooler.

General description

Briefly, the method and apparatus contemplates heating the aggregates in a kiln or other heating chamber in the conventional manner and then discharging or conveying the heated aggregates into a cooling chamber. The material is conveyed through the cooling chamber in a manner such as by rotating the cooling chamber as well as placing it on a slight incline.

Air or other gas is forced into the chamber. A portion of the air may be extracted from the cooler by means

2

of a tube extending a substantial distance into the chamber from the discharge end and attaching an exhaust pressure means to the tube. A portion of the air or gas not extracted from the chamber is allowed to pass over the hottest portion of the aggregates and flow into the kiln or heating chamber. This will provide additional preheated secondary combustion air.

The method and apparatus further contemplates the use of pressure and temperature controlling means. A temperature sensing means may be placed in a transition hood between the kiln and the cooler. This temperature control may be used to regulate the speed that the material is conveyed through the cooler or alternatively regulate the amount of gas forced into the cooling chamber.

A pressure control may be placed in the hood and used to regulate the amount of gas withdrawn from the cooling chamber so as to promote fixed volume of preheated secondary air for the kiln combustion system.

Other objects, advantages and features of the invention will appear obvious and the invention may be better understood from the accompanying drawings, detailed description and the appended claims wherein:

FIGURE 1 is a side elevation view of the cooling chamber of the instant invention attached to a conventional kiln;

FIGURE 2 is a side elevation partly in section of the transition means and cooling chamber;

FIGURE 3 is a cross sectional view taken along line 3—3 of FIGURE 2 and viewed in the direction of the arrows and

FIGURE 4 is a modification of the temperature control feature.

Detail description

As shown in FIGURE 1 of the drawing, a preferred form of the apparatus comprises a rotary cooling chamber indicated generally at 10 attached to a preheating chamber 12 and a heating chamber 14 in which the "bloating" of the particles take place. The cooling chamber 10 is connected to the heating chamber 14 by a transition means 16.

A detailed description of the preheating chamber 12 and heating unit 14 may be found in U.S. Patent 3,037,940 issued June 5, 1962 entitled Method For Forming Lightweight Aggregates and U.S. Patent 3,116,055 issued December 31, 1963, and entitled Apparatus For Forming Lightweight Aggregates.

It is sufficient to state for the instant invention that the material is fed into the preheater 12 by means of a stationary chute 18. The material flows through the preheating chamber by placing it on an incline downward toward the heating chamber 14. By a tumbling action in the kiln 14, which is clearly set forth in the above mentioned patents, the particles are discharged into the transition means 16.

The transition means as best shown in FIGURE 2 includes a hood 20 and a chute 22. The chute 22 drops material into an opening 24 of a chamber 26. The transition hood 20 forms an air tight chamber between kiln 14 and a cylindrical body 28 which forms the chamber 26. A seal indicated at 30 is constructed so that the drum or cylinder 28 will be able to rotate within the hood 20 as will be described below.

Cylinder 28 is mounted on trunnion wheels 31 which rest on foundation blocks 32 and 34 by means of riding rings 36. The foundation block 32 is made higher than 34 so that the cooling chamber 26 will be on an incline allowing the material to move from left to right as seen in FIGURE 2.

A means 38 is provided to rotate the cooling chamber. The type of rotating means illustrated includes a motor

40 connected to a gear 42 which in turn cooperates with a gear means 44 surrounding the cooling chamber.

The combination of the inclined chamber and the rotating means conveys the material through the cooling chamber.

Within the chamber 26 is placed a hollow tube 46 which is mounted by means of spiders 48 along the longitudinal axis of the chamber.

At an outlet end 50 of chamber 26 is situated a discharge chamber 52. The discharge chamber 52 is provided with an air and pressure tight double gated chamber 54 so that material may be removed without changing the pressure in chamber 52. This is done by first opening a gate 56 to allow the material to fall into the chamber 54. When gate 56 is closed a door or gate 58 may be opened to let the material deposit into a container or conveying means. Cooperating with the chamber 52 is a fan or pump 60 to force gas into the cooling chamber. The gas flows over the material as indicated by the arrows, and a portion is exhausted through tube 46 by means of an exhaust pressure means 62. The means to force gas into the chamber and the exhaust means as illustrated in the instant disclosure are a plurality of fans.

The cylinder 28 and tube 46 rotate relative to the discharge chamber 52 by means of a rotating seal type connection at 63 and a rotary seal for the tube 46 at 64.

As the cool gases flow over the material their temperature rises and are at a maximum passing into hood 22 through opening 24. Therefore, heat from the material is reclaimed and fed back into the kiln as preheated secondary air used for the combustion of the fuel in the process. Also, by cooling the product to substantially ambient temperatures, it is then possible to automatically convey the product out of discharge chamber 52 by conventional means.

The air that is allowed to enter the kiln proper will have received extra heating, not only due to having passed over the material most recently discharged from the kiln, but also because only a fraction of the total air is taken into the kiln. The location of a terminal 66 of the tube 46 is of rather significant importance. This particular location, as discussed below, together with regulation of the exhaust pressure insures that the proper amount of secondary combustion air is fed into the kiln.

It has been found that by locating the outlet 66 at a point between 15 and 40 percent of the distance between the input end 24 and the output end 50, this result is achieved. It has further been found that a point approximately 25 percent of this distance is the most advantageous location. With terminal 66 located at this point, only a fraction of the total air is taken into the kiln; therefore, the temperature of this air will always be the maximum possible available as no excess is drawn over the same path. This air flow into the kiln insures that the highest quality of preheated secondary air is available.

Located within hood 20 is a pressure sensor 68 and a temperature sensor 70. Pressure sensor 68 feeds through a line 71 to pressure controller 72; while sensor 70 feeds through line 73 to a temperature control 74. The pressure controller 72 then is used to regulate the speed of fan 62 or the opening and closing of louvres 75 in fan 62 by means of line 76. The sensors 68 and 70 may be located in the rotating members, but the installation would be more difficult.

The temperature controller is fed through line 78 and regulates the speed of motor 40.

Alternatively, as seen in FIGURE 4 the temperature may control the speed of fan 60 or the opening and closing of louvres 80 thus controlling the amount of cool gas fed into cooling chamber 26.

Operation

The hot material falls from the kiln 14 into the input opening 24 of the rotary cooler through transition hood 20 on chute 22. Since the hood 20 is substantially air tight, there will be no gas leakage between heater 14 and cooling chamber 26.

The hot particles are moved through the rotary cooler by means of the downward incline of the cooler and by the rotary action of motor means 40.

Fresh air at ambient temperature is introduced at the output end 50 of chamber 26 through the discharge hood 52 by means of blower 60. The air impinges upon the material within the cooler, drawing heat from it. At a point 66 the air, having travelled 75% of the distance through the cooling chamber is now quite hot from passing over the material, can either be withdrawn through the tube 46 out to the atmosphere, or can be allowed to traverse the remaining distance and enter the kiln 14 through the hood 20. As was explained above the air which enters the kiln will have received the extra heating due to having passed over the hottest part of the material most recently.

It has been found that by placing the end of the tube 46 at a point where the gas has traversed 75 percent of the distance of the cooler that sufficient hot air will be fed into the kiln, yet not too much air will be drawn into the hood.

The air input and exhaust from the cooler is accomplished by using blower fan 60 and exhaust fan 62, the former blowing into the cooler discharge hood 52 and the latter drawing from the tube located on the axis of rotation of the cooler. The amount of air allowed to ascend into the kiln 14 is controlled by balancing the two fans against each other, creating either a positive or negative draft condition within the cooler. The pressure limits are usually under 0.5 inch H₂O. The pressure sensing element 68 which may be in the form of a manometer or draft gauge, is placed in the firing hood of the kiln. The manometer 68 controls the input fan louvre 75 by means of pressure control system 72.

The temperature of the secondary air for the kiln is controlled by the quantity of material allowed to remain in the cooling chamber 26, i.e., the percent of loading. This is done by a temperature sensing means, for example thermocouple 70, which is placed in the transition hood 20 and by means of controller 74. The speed of rotation of motor 40, thus the speed of rotation of the cooler is regulated by this sensor. By rotating slower, less material will flow through the chamber, and thus there will be a greater temperature of secondary air.

In the alternative as seen in FIGURE 4 the temperature control 74 may be connected to the louvre of fan blower 60, or may control the speed of the fan 60 thus controlling the quantity of cool air entering into the cooling chamber. This will provide constant temperature secondary air of combustion. For greater temperatures of the secondary air less gas would be introduced into the cooling system.

As the material flows through the cooling chamber 26 it will fall into the discharge chamber 52 and by means of the sealed chamber 54 the material, which is now cool, may be discharged into conventional loading or conveying means.

While the invention has been described, it will be understood that it is capable of further modifications and this application is intended to cover any variations, uses, or adaptations of the invention following in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains, and as may be applied to the essential features hereinbefore set forth and as fall within the scope of the invention or the limits of the appended claims.

5

Having thus described my invention, what I claim is:

1. An apparatus for forming lightweight aggregates comprising:

- (a) a heating chamber,
- (b) a pressure-tight cooling chamber having input and output ends,
- (c) transition means at the input end connecting said heating chamber to said cooling chamber,
- (d) means to convey material through said cooling chamber,
- (e) means in said cooling chamber for cooling material passing therethrough and for preheating material in said heating chamber, said cooling and preheating means including means for regulating the pressure of said cooling chamber, said regulation means including means for forcing gas into said cooling chamber adjacent said output end and means for exhausting a portion of said gas from said cooling chamber after said gas has passed a substantial distance through said cooling chamber, said exhaust means including an exhaust tube and an exhaust pressure means connected to said tube, whereby a controlled pressure is maintained substantially throughout said chamber and a regulated portion of said gas is allowed to pass into said heating chamber, said cooling chamber being rotated and said tube being supported by metal spiders along the axis of rotation of said cooling chamber.

2. The apparatus of claim 1 further including a pressure responsive means in said transition means, said pressure responsive means controlling said exhaust pressure means.

3. The apparatus of claim 1 further including temperature responsive means in said transition means, means to rotate said cooling chamber, said temperature responsive

6

means controlling the speed of rotation of said cooling chamber.

4. The apparatus of claim 1 further including temperature responsive means in said transition means, said temperature responsive means controlling said means to force gas into said cooling chamber.

5. The apparatus of claim 1 wherein the end of said tube not connected to said exhaust pressure means is located at a point approximately 25% of the distance from said input end.

6. The apparatus of claim 1 further including means to rotate said cooling chamber and wherein said tube is positioned in said cooling chamber by means of a rotary seal.

7. The apparatus of claim 1 further including a substantially airtight outlet chamber at the outlet end of said cooling chamber.

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