Nov. 3, 1964 G. A. A. LESSARD 3,155,380

MULTI-UNIT KILN FOR THE PRODUCTION OF LIGHTWEIGHT AGGREGATE

Filed June 25, 1962 2 Sheets-Sheet 1

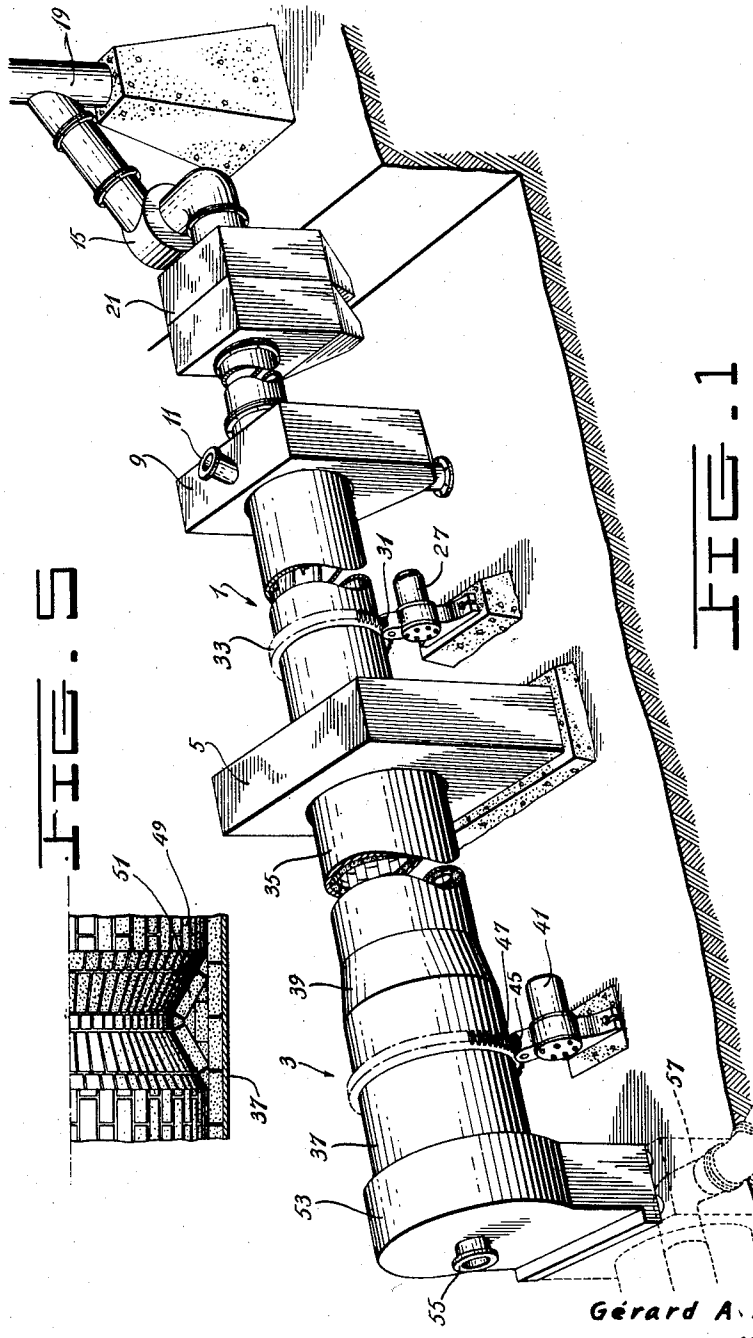


FIG. 1

FIG. 5

INVENTOR
Gérard A. A. LESSARD
BY
ATTORNEYS

Nov. 3, 1964 G. A. A. LESSARD 3,155,380

MULTI-UNIT KILN FOR THE PRODUCTION OF LIGHTWEIGHT AGGREGATE

Filed June 25, 1962 2 Sheets-Sheet 2

FIG. 2

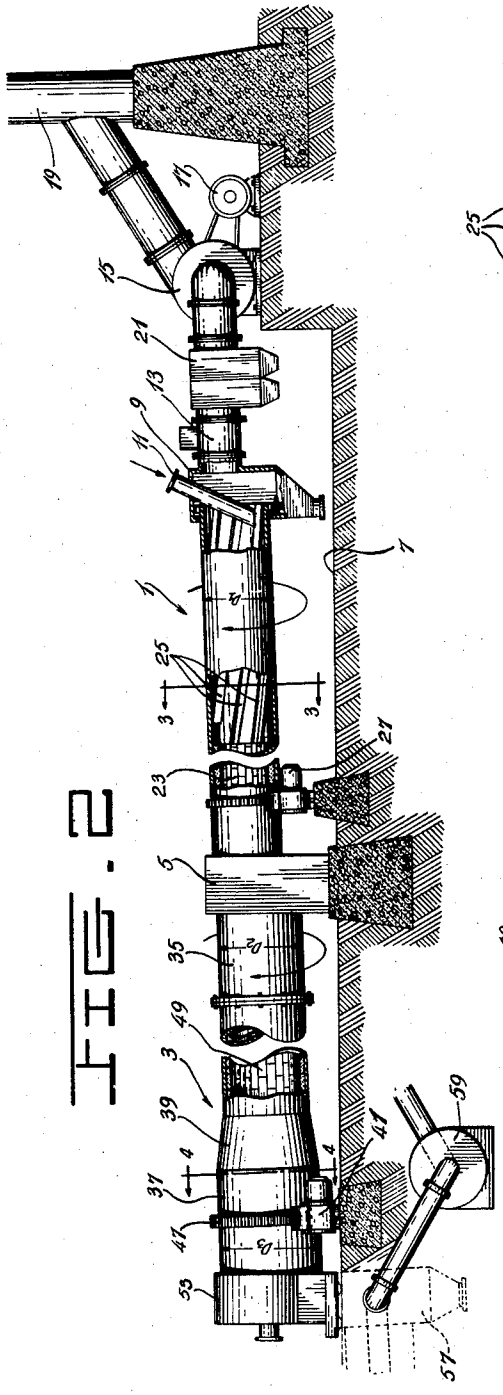


FIG. 3

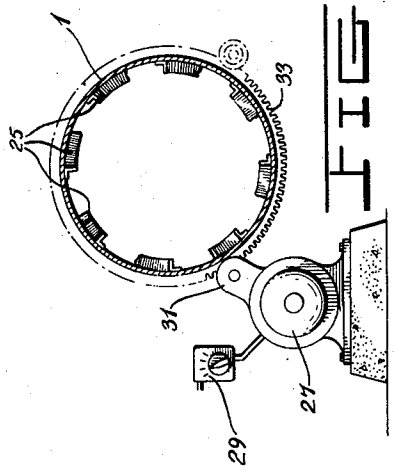
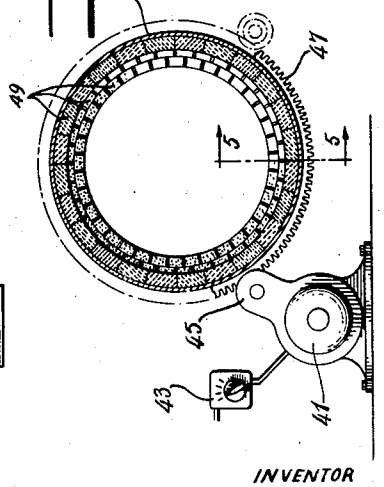


FIG. 4



INVENTOR
Gérard A. A. LESSARD
BY
ATTORNEYS

United States Patent Office

3,155,380
Patented Nov. 3, 1964

3,155,380

MULTI-UNIT KILN FOR THE PRODUCTION OF LIGHTWEIGHT AGGREGATE

Gerard Arthur Armand Lessard, 218 Bedford Ave., St. Lambert, Quebec, Canada

Filed June 25, 1962, Ser. No. 205,016
4 Claims. (Cl. 263—32)

This application relates to the production of expandable material such as lightweight aggregate and more particularly to a rotary multi-unit kiln therefor.

The equipment with which the invention is concerned is used for the processing of shale, clay or the like materials which are amenable to bloating and, particularly, to the formation of glazed or coated aggregate usable in the manufacture of concrete products and as a loose insulating material. The apparatus may also be used in the production of cement.

Lightweight aggregates are produced by the rapid firing in a rotary kiln of certain clays or shales which release gases from within while in a pyroplastic state. The natural fluxes in the material allow the expansion or bloating to take place at a temperature below that at which the material becomes sticky so that the product is discharged from the kiln in individual expanded and glazed particles or pellets. It is expected that the bulk density of the material be reduced to less than one half that of the original material.

In conventional installations, the drying or preheating and firing operations are carried out in a single rotary kiln. It has been observed that, with the conventional kiln, expansion of the contents near the discharge end of the kiln results in a back-up of the material and in a decrease in the effective slope throughout the kiln length. As throughput is a function of slope or pitch, the capacity of a conventional kiln can be greatly reduced when firing a material that expands.

Another problem which arises when using a conventional kiln is that created by the retention time of the material within the kiln which is not flexible and cannot cope with the varying temperature existing between the feed and discharge ends of the kiln. Another reason for the need of greater control is the fact that the mass or volume of material under processing varies, though unevenly, at the expansion stage as a direct result of the heat transfer from the surrounding gases to the material. Control of the retention times is also necessary due to the nature of the raw material to be processed from the stand-point of its sensitivity to heat in the course of bloating and glazing.

Generally, therefore, the object of the invention consists in providing a multi-unit kiln formed of two or more units arranged in succession so that the material moves from one unit to the next and wherein each unit has its own speed drive and its own slope which may be different from that of the other unit. Also, each unit may be of a different diameter than the others, and one particular unit may be made of zones of different diameters.

In other words, the object of the invention is to provide a multi-unit kiln wherein each unit has suitable means for the control of the retention time in the unit and for taking into account the increasing volume of the material as it moves longitudinally in the kiln, particularly, in the firing section.

This object is attained in a rotary multi-unit kiln made according to the invention which has a firing section of increasing diameter from the inlet to the outlet ends thereof. By increasing the kiln diameter as material expands, the above mentioned problems and difficulties are overcome and the effective capacity becomes that of the discharge diameter rather than somewhat less. It has also been observed that the control of material depth and the prevention of back-up tends to reduce balling and possible clinkering.

More specifically, the rotary multi-unit kiln of the invention comprises: at least one horizontally inclined preheating section and variable speed drive means to rotate the said preheating section to thus control the retention time of the material in the said preheating section to thus obtain the desired heat transfer; a horizontally inclined firing section connected in alignment with said preheating section and being of increasing diameter from the preheating section to allow for bloating of the material; variable speed drive means to rotate said firing section to control the retention time of the material in said section to thus obtain controlled discharge of the finish product to eliminate the possibility of sticking, agglomerating and clinkering and firing means firing into the larger diameter end of said firing section.

The firing means should be designed to include an induced draft fan powerful enough to draw large quantities of air through the coated material falling out at the discharge end of the firing section to solidify the vitrous coating formed on each particle or pellet.

The invention will now be more fully described in connection with the appended drawings wherein:

FIGURE 1 is a perspective view of the rotary kiln of the invention;

FIGURE 2 is a view in elevation, partly cut away to show the internal structure of the kiln;

FIGURE 3 is a cross-sectional view taken along line 3—3 of FIGURE 2;

FIGURE 4 is a cross-section view taken along line 4—4 of FIGURE 2, and

FIGURE 5 is a cross-section view, on an enlarged scale, along line 5—5 of FIGURE 4.

As aforesaid, in the preferred form of the invention, the rotary multi-unit kiln of the invention is formed of one or more preheating sections 1 and a firing section 3, in line therewith. The two sections are separated or joined by a junction box 5 of standard construction which allows the outlet of the preheating section 1 to feed into the inlet of the next preheating section or into the inlet of the firing section 3. It will be noted that all sections are horizontally inclined in relation to floor 7: the slope given to each section being determined by the desired retention time in each section.

Preheating section 1 is a horizontal housing of constant diameter D_1 having an inlet end mounted into a feed end housing 9 through which extends a feed or inlet pipe 11 for the material to be processed. Forwardly of the feed end housing is shown some equipment which is not part of the invention and which comprises a motorized damper 13 to control and regulate the induced draft caused by an induced draft fan 15 which is driven by a motor 17 and feeds into a stack 19. Between the induced draft fan 15 and the motorized damper 13 are mounted impact type dust collectors 21.

The cylindrical housing of the preheating section 1 has about 75% of its inner surface at the outlet end, as at 23, refractory lined while the remaining part of the inner surface is provided with a series of spirally arranged lifting elements 25 which may be angular members and which serve to keep the aggregate material into motion to remove as much of the very fine dust from the material as possible.

Finally and as best illustrated in FIGURE 3, the preheating section is kept into motion by a variable speed drive composed of a motor 27 equipped with a suitable speed control 29. The actual transmission may be obtained by any suitable means such as a gear 31 coupled to the motor and meshing with an arcuate toothed rack 33 mounted on the circumference of the cylindrical chamber 1.

The firing section itself comprises at least two cylindrical zones or inlet and outlet end means 35 and 37 of different diameters, D_2 and D_3 respectively, joined by a tapering zone or junction means 39. It is also preferable that the diameter D_2 of section 35 be greater than the diameter D_1 of the cylindrical housing 1, and that the discharge end of the said housing 1 opens substantially wholly within the circumferential bounds of the inlet end of section 35.

Similarly to the preheating section 1, firing section 3 is driven by a variable speed motor 41 controlled by a speed control 43 and driving the section 3 into rotation through a gear 45 and a toothed rack 47 arcuately mounted around the cylindrical zone 37. This second variable drive means is independent from the first drive means of preheating section 1. Should another preheating section be added, it would be provided with its own drive and would have an independent slope. Since this is the firing section, the inner surface thereof is completely refractory lined as best illustrated at 49 in FIGURES 2 and 5. A retarding or obstacle bridge 51 may also be provided circumferentially around the inner surface of section 3, more particularly in zone 37 and adjacent to the tapered zone 39. It may also be mounted directly at the junction of zones 37 and 39.

Finally, the firing section is mounted on an outlet chamber 53 over one face of which is fixed a burner adapter 55 of standard type. The outlet chamber 53 connects to a cooler (not shown) by means of a connector 57 while any excess air may be drawn away through a fan 59. The multi-unit kiln draws its heat solely from the burner arrangement mounted on the burner adapter 55.

The aforedescribed kiln being made of two or more sections, each of which is driven independently of the other at any desired speed, the retention time in each of the sections can therefore be completely controlled. Furthermore, the changing in diameters from the preheating to the firing sections and in the firing section itself gives the possibility of considerably increasing the amount of material to be processed in a given time.

With such features, it is possible to produce a product which consistently meets narrow specification limits.

The following particulars of a specific kiln are given in order to illustrate the various dimensions of a specific workable multi-unit kiln, assuming only one preheating section is used.

The preheating stage may be of 8' diameter by 125' long and be driven at a selective speed of 1 to 3 r.p.m. The inlet zone 35 may have a diameter of 10' and a length of 24' while the outlet zone may be 12' in diameter by 12' long and both zones connected by means of a tapered section of 6' length. The firing zone is meant to be driven at a speed varying from 6.5 to 9 r.p.m.: the normal speed being 8.5 r.p.m.

As mentioned above an extra preheating section may be provided which would have a diameter larger than section 1 to take into account the bloating of the material.

This added section would have its own speed drive so that the retention time therein may be controlled.

Similarly, the actual glazing or vitrification which, in the illustrated example takes place in the outlet zone 37 of firing section 3 may be omitted altogether by controlling the temperature, or it may be made to take place in a further short section ahead of zone 37 and before the burner. This short section would also have separate speed control for regulation of retention time.

Although a specific embodiment of the invention has just been described, it will be understood that various modifications may be made thereto without departing from the spirit of the invention the scope of which is set forth in the appended claims.

I claim:

1. A rotary kiln for the processing of materials amenable to bloating in the manufacture of lightweight aggregates, cement or the like, comprising:

(*a*) a cylindrical horizontally inclined preheating section having a material feed end and an outlet end at a lower level than said feed end;

(*b*) variable speed drive means to rotate said preheating section to thus control the retention time of the material in said section;

(*c*) a horizontally inclined firing section connected in alignment with said preheating section and having an inlet end next to the outlet end of said preheating section and a discharge end; said firing section being formed of cylindrical end means at the inlet and at the discharge ends thereof joined by a tapered junction means; the cylindrical end means at the inlet end being smaller in diameter than the cylindrical end means at the discharge end, whereby to allow for the increase in volume of material resulting from bloating thereof as said material moves from the inlet end to the discharge end of the firing section;

(*d*) variable speed drive means to rotate said firing section to thus control the retention time of the material in said section, and

(*e*) firing means firing into the larger diameter end of said firing section.

2. A rotary kiln as claimed in claim 1, wherein the inlet end of said firing section is of greater diameter than the outlet end of said preheating section with the said outlet end opening substantially wholly within the circumferential bounds of the said inlet end.

3. A rotary kiln for the processing of materials amenable to bloating in the manufacture of lightweight aggregates, cement or the like, comprising:

(*a*) a cylindrical horizontally inclined preheating section having a material feed end and an outlet end at a lower level than said feed end;

(*b*) variable speed drive means to rotate said preheating section to force said material from said inlet to said outlet end and control the retention time in said section to thus obtain the desired heat transfer;

(*c*) a horizontally inclined firing section connected in alignment with said preheating section and having an inlet end next to the outlet end of said preheating section and a discharge end;

(*d*) said firing section being formed of cylindrical end means at the inlet and discharge ends thereof joined by a tapered junction means; the diameter of the cylindrical end means at the inlet end being smaller than the diameter of the cylindrical end means at the discharge end, whereby to allow for the increase in volume of the material resulting from bloating thereof as the said material moves from the inlet end to the discharge end of the firing section;

(*e*) variable speed drive means to rotate said firing section to force said material through said section from said inlet to said outlet zones and control the retention time in said section;

(*f*) firing means for firing into the larger diameter end of said firing section.

4. A kiln as claimed in claim 3, including a circumferential obstacle bridge between the tapered junction means and the cylindrical end means at the discharge end of said firing section.

References Cited in the file of this patent

UNITED STATES PATENTS

1,453,851 McGrath ---------- May 1, 1923
1,734,417 Briggs ---------- Nov. 5, 1929
2,049,734 Fasting ---------- Aug. 4, 1936
2,939,693 Old et al. ---------- June 7, 1960
2,986,457 Jones ---------- May 30, 1961
3,037,940 Pixley et al. ---------- June 5, 1962

FOREIGN PATENTS

332,761 Great Britain ---------- July 31, 1930
864,613 Germany ---------- Jan. 26, 1953