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Beckenbach

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[54] **INCLINED FURNACE FOR CALCINATION AND SINTERING OF MATERIAL PARTICULARLY SPLINT LIMESTONE**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **432/96,** 432/14

[51] **Int. Cl.** **F27b 1/00**

[58] **Field of Search** ..... 432/15, 58, 14, 95, 96, 432/99, 100, 102, 223; 34/57 A, 57 R, 10.57 C; 23/288 S

[56] **References Cited**

UNITED STATES PATENTS

2,533,142	12/1970	Royster	432/14
2,627,399	2/1953	DeVaney	432/14
3,216,125	11/1965	Dennert	34/57 R
3,765,827	10/1973	Beckenbach	432/95

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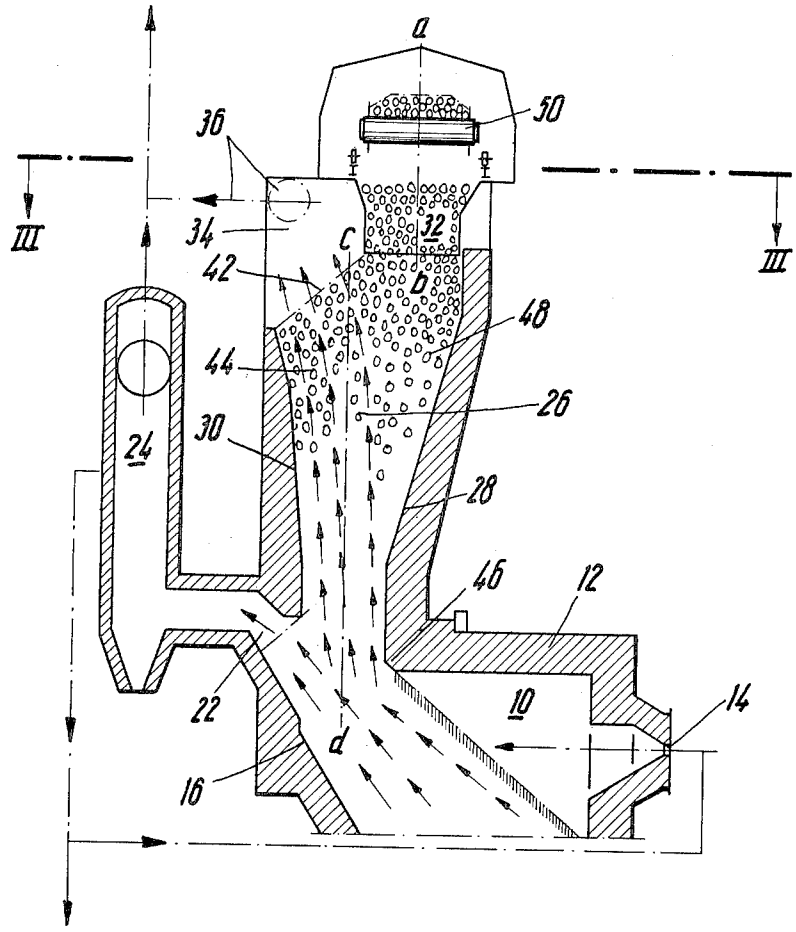
[57] **ABSTRACT**

An inclined furnace for the calcination or slaking at sintering of material, particularly split limestone, which comprises one or more superposed burner areas having preferably an arch-like ceiling, a laterally limited, inclined chute surface and burners located in a burner area wall opposite the chute surface. Feed and discharge shafts are arranged in a staggered relationship with respect to each other at the ends of the chute surface with substantially rectangular shape for the material to be treated. Draft openings are arranged beyond the upper end of the discharge surface connecting the burner area with a recuperator. An upper feed or preheating shaft has elongate walls above the discharge openings of which diverge upwardly relative to each other. The preheating shaft has a flared upper end which changes the shaft in its area facing the burner area ceiling into a presilo which is fed by an apparatus, and at its area facing the recuperator by forming an abutment surface for the material exiting from the presilo it develops into a gas collecting area communicating with a chimney.

4 Claims, 3 Drawing Figures



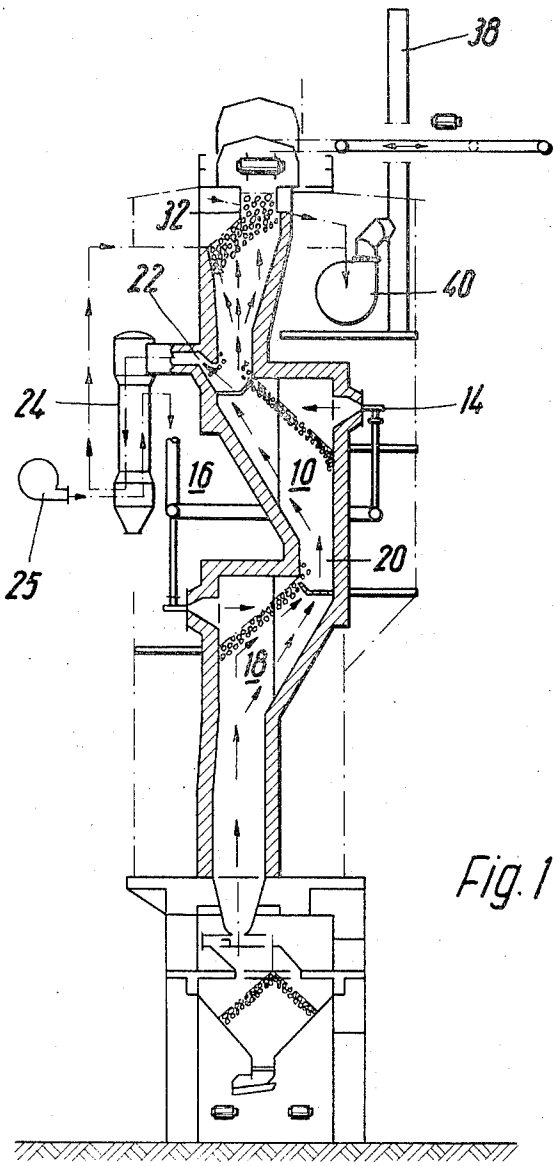


Fig. 1

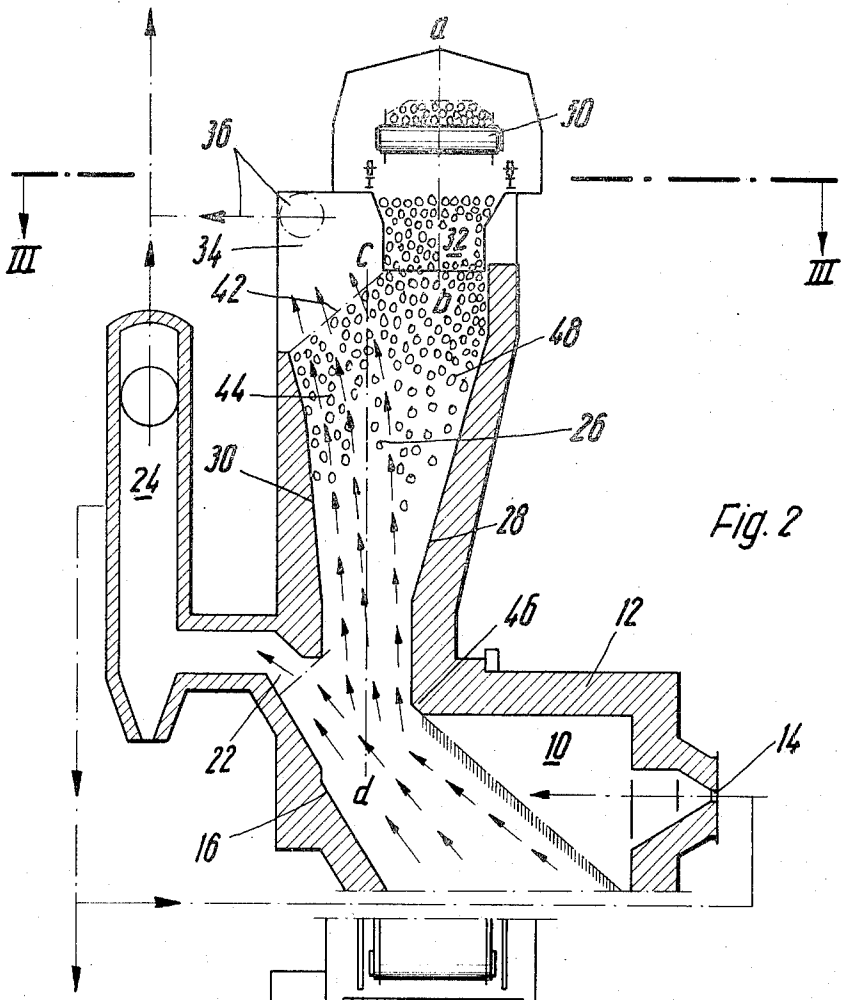


Fig. 2

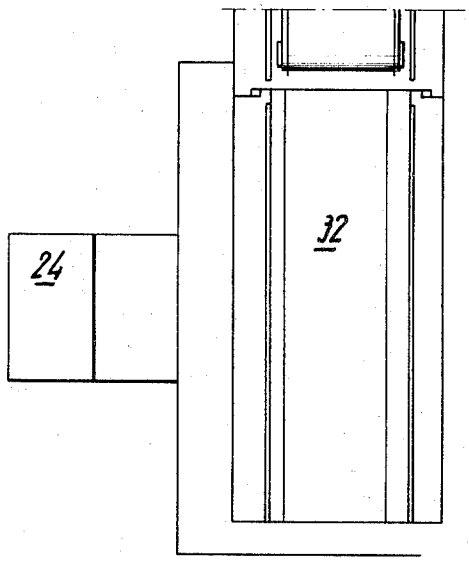


Fig. 3

INCLINED FURNACE FOR CALCINATION AND SINTERING OF MATERIAL PARTICULARLY SPLINT LIMESTONE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an inclined furnace for the calcination and sintering of material, particularly split limestone material, comprising one or more superposed burning areas preferably having an arch-like ceiling, a laterally limited inclined discharge surface at burners located in the burner area wall opposite the discharge surface, and feed and discharge shafts arranged in a staggered relationship with respect to each other at the ends of the discharge surface are substantially rectangular shape for the material to be treated, and draft openings following the upper end of the discharge surface connecting the burner area with a recuperator.

2. Description of the Prior Art

The prior art, including German Pat. application P 21 17 755.9, includes an oblique furnace in which the material is fed from a preheating shaft located above the burning area, or in case of several burning areas located above the upper burning area, to an oblique runoff surface on which the material slides while being subjected to impingement of the heating gases generated by the burners, then leaving the burning area by way of an outlet located at the lower end of the chute surface. This discharge may be in the form of a cooling shaft or lead to another burner area located below the first burner area. Part of the heating gases impinging on the layer material is thereby aspirated through the material to the chute surface and then removed from the furnace near the upper end of this surface and fed to a recuperator which is utilized for preheating the fresh air supplied to the burners.

With the presence of the recuperator it is possible to supply fresh air to the burners, on the one hand, so that for this purpose no preheated combustion air needs to be removed from the cooling zone. The combustion air contains a large amount of dust and would cause plugging the other burners and in the conduits resulting in inconvenient cleaning operations. On the other hand, the use of the recuperator effects a better gasification of the material layer as it slides down the chute surface.

However, in the inclined furnace set forth in the aforementioned German patent application, it has proven to be undesirable that the part of the heating gases penetrating the material layer and flowing along the recuperator side of the heating gases is insufficient so that an excessive amount of gas passes along the inner edge of the arched ceiling of the burner area resulting in damage of the arch near the edge thereof which is subjected to bombardment by the gases.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide an inclined furnace of the type described above wherein the part of the gases which penetrate the material layer and flow into the area located on top of the apertures of the preheating shaft is increased to provide an optimum heating of the material as it slides down the chute surface, and to avoid, as far as possible, any damage to the arched ceiling.

This object is achieved and the foregoing problems are overcome according to the invention in that at least the elongate walls of the upper feed or preheating shaft above the discharge apertures are arranged to diverge upwardly relative to each other and that the preheating shaft changes at its flared upper end in its area facing the burner area ceiling into a presilo fed by the feeding apparatus and at its area facing the recuperator, by forming an abutment surface for the material exiting from the presilo and at a point located below the presilo it changes into a gas collecting area which communicates with the chimney.

With the design of this preheating shaft, the material constantly discharged at the upper end of the shaft from the presilo, corresponding with the discharge of calcium, moves along an abutment line extending downwardly and obliquely from the silo side facing the recuperator toward the shaft wall on the recuperator side. The coarser rocks roll down along this abutment and concentrate on the side of the shaft facing away from the burner area ceiling. This assures that the feed shaft is filled over its entire height on the side facing away from the burner area ceiling, preferably with coarser rocks, which means that it is packed more loosely than on the shaft side facing the ceiling. As a result, the material layer sliding down along the chute surface has a looser packing adjacent to the chute surface so that the gases penetrating the material layer can flow immediately along the chute surface to the discharge ports. The part of the exhuast gases not aspirated through the discharge ports preferably rises in the preheating shaft along its wall on the recuperator side, caused by a looser packing in this area, and enters the chimney through the gas collection area without reaching the presilo.

This structure offers the additional advantage that the presilo is not traversed by exhaust gases, so that it is not heated in its upper filling area. This is the reason that it was impossible in the feed arrangements of inclined furnaces heretofore known, and the reason that it is now possible, to arrange a conveyor belt made of elastic material, for example rubber, and movable in the longitudinal direction of the presilo, immediately above the silo, without fear of damage to the belt by hot exhaust gases.

By feeding an inclined furnace by way of a presilo which is not traversed by exhaust gases results in a uniformity of exhaust temperature, because the rocks gradually slide down from the presilo, and no certain quantity of cold material is fed, in internals, into a feed shaft traversed by gases.

Preferably, the longitudinal central plane of the presilo is staggered with respect to the longitudinal plane of the preheating shaft in a direction toward the burner area ceiling and the elongate wall facing the burner area ceiling is inclined more than the elongate wall on the recuperator side.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the invention, its organization, construction and operation, will be best understood from the following detailed description taken in conjunction with the accompanying drawing, on which:

FIG. 1 is a partial schematic, partial sectional, illustration of an inclined furnace designed according to the present invention;

FIG. 2 is an illustration of the upper part of the furnace shown in FIG. 1 presented on an enlarged scale; and

FIG. 3 is a sectional view of the oblique furnace taken generally along the line III—III of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The oblique furnace illustrated in the drawing is provided with a burner area **10**, preferably covered on top by an arch-shaped ceiling **12** and having at the side opposite the burners **14** an oblique chute surface **16**, followed at its lower end by a transverse shaft **20** which leads to a lower burner area **18**. Discharge openings **22** are provided at the upper end of the chute surface **16**, which openings lead to a recuperator **24**. Part of the heating gases originating from the burners penetrates the layer of materials sliding down the chute surface and is directed through the discharge openings **22** into recuperator **24** where fresh air supplied to the burners by way of a blower **25** is preheated.

The present invention relates to the particular design of the preheating shaft **26** (FIG. 2) leading to the upper burner area **12** and the feeding of material to the shaft **26**, as well as the conducting of material within this shaft.

A contrast to the conventional parallel-wall preheating shafts customarily employed for inclined furnaces in the prior art, the substantially rectangular preheating shaft **26** is so designed that it flares upwardly by a considerable degree, whereby at least both of its elongate side walls **28** and **30** upwardly diverge relative to each other. In the preferred embodiment illustrated in the drawing, both of these side walls are inclined upwardly and outwardly, whereby the wall **28** originating from the furnace ceiling **12** is inclined more than its opposite wall **30**, which extends in an upward direction from the discharge openings **22** leading to the recuperator **24**.

The preceding shaft **26** changes at its flared upper end on the side located above the furnace ceiling **12** into a presilo by way of which the material to be burned is supplied. As illustrated in FIG. **2**, the central longitudinal plane *a–b* of presilo **32** is staggered to the right in relation to the longitudinal center plane *c–d* which extends through the lower discharge area of the shaft **26** and bisects the furnace ceiling **12**.

The shaft **26** is opened on the side of the recuperator side of its flared upper end and terminates into a gas collection area located at a point below the presilo. The gas collection area **34** is connected by way of a conduit **36** (FIG. **2**) with the chimney **38** and/or an exhaust fan **40** connected to the gas collection area (see FIG. **1**), the latter also being connected to the exhaust gas portion of the recuperator. Because of this arrangement, the material discharging from the presilo **32** at the side of the shaft open toward the gas collection area **34** flows along a slope at **42** between the presilo and the wall **30**. As seen in Fig. **2**, during the sloping process, the larger rocks located in the area of the presilo facing the recuperator slope downwardly upon leaving the silo toward the wall **30** on the recuperator side of the feed shaft **26**. Therefore, a looser packed layer **44** of relatively coarse rocks is created approximate this shaft wall, so that the exhaust gases not passing through the recuperator preferably flow along this wall to the gas collection area, in fact over the shortest route, as can be seen from FIG. **2**. With this conduction of gases, no exhaust gases discharge to the exterior by way of a presilo **32**; and it is also avoided that the edge **46** of the arched ceiling **12** facing away from the burners **14** will be excessively bombarded with exhaust gases and therefore endangered. Because the larger rocks are impinged more intensively in the preheating shaft by the heating gases than the smaller rocks passing particularly at the other shaft side and located as indicated by the reference character **48** and optimum uniform preheating of the material is achieved in the preheating shaft.

Moreover, by the arrangement of the looser layer containing larger rocks on the recuperator side of the preheating shaft **26**, it is assured that preferably larger rocks adhere at the chute surface **16**. Therefore, the heating gases aspirated through the material layers sliding down on the chute surface can flow more easily along the chute surface **16** upwardly toward the discharge apertures **22**, resulting in a uniform heating of the downwardly sliding layer of material.

In the embodiment of the preheating shaft according to the invention, a uniform temperature of exhaust gases results against a feed without presilo in that the rocks gradually slide down from the presilo, while no certain quantity of cold material is directly fed, at intervals, into the preheating shaft.

While the material to be fed is so arranged in the presilo as it is fed by the conveyor system, for example a conveyor belt **50**, and has in addition to larger rocks, also smaller fragments fed from the beginning along with the larger rocks, produced in the presilo by friction or percussion, during the downward sliding of the material from the presilo. As previously mentioned, the larger rocks located toward the abutment **42** will slide downwardly. Therefore, near the short wall on the recuperator side, these larger rocks form a loosely packed layer, while the smaller granular parts preferably remain below the presilo, that is in proximity to the wall **28** on the ceiling side of the apparatus.

Another advantage of the design of a preheating shaft according to the present invention results from the fact that, due to feeding the shaft from a presilo not traversed by exhaust gases, it is possible to utilize, in lieu of a conveying system made from heat-resisting material, a conveyor belt **50** made of elastic material, for example rubber, which is movably arranged in a spaced-saving manner immediately adjacent an above presilo, with respect to the longitudinal direction of presilo.

Although I have described my invention by reference to a particular illustrative embodiment thereof, many changes and modifications of the invention may become apparent to those skilled in the art without departing from the spirit and scope of the invention. I therefore intend to include within the patent warranted hereon all such changes and modifications as may reasonably and properly be included within the scope of my contribution to the art.

I claim:

1. A furnace for calcining and sintering material, particularly split-limestone material, comprising a firing chamber defined by a slopping hearth having upper and lower ends, a dome-like roof, lateral walls and a wall opposite said hearth; at least one burner located in said chamber defined by a sloping hearth having upper and fice means adjacent said upper end of said hearth; a recuperator connected to said firing chamber through said orifice means; vertical inlet and outlet shafts for

material to be treated located at said ends of said hearth and laterally staggered relative to each other, each said shaft being defined by a pair of opposed long walls and a pair of opposed short walls, at least said long walls of said inlet shaft diverging upwardly above said orifice means, and said long and short walls of said inlet shaft defining an inlet shaft top opening having opposed lateral portions; a pre-silo arranged to discharge material into one of said lateral portions of said inlet shaft opening; a gas collection chamber arranged in the other of said lateral portions of said inlet shaft opening, said other lateral portion of said inlet shaft opening being on that side of the inlet shaft nearest said recuperator, and said inlet shaft forming a sloping surface at a level below said pre-silo for material issuing from said pre-silo; and a chimney communicating with said gas collection chamber.

2. A furnace according to claim **1,** wherein the longitudinal central plane of said pre-silo is staggered relative to the longitudinal central plane of said inlet shaft in the direction toward the firing chamber roof.

3. A furnace according to claim **1,** wherein both of said long walls of said inlet shaft diverge outwardly, with the wall farthest from the recuperator sloping more than the wall on the recuperator side.

4. A furnace according to claim **1,** including a feed belt of elastic material located immediately above said pre-silo and movable in the longitudinal direction thereof.

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