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Triebel et al.

[11] **3,775,042**

[45] **Nov. 27, 1973**

[54] **ROTARY KILN WITH A PLURALITY OF COOLING PIPES**

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[30] **Foreign Application Priority Data**

Mar. 10, 1971 Germany ..... P 21 11 403.4

[52] **U.S. Cl.** **432/80,** 432/117, 432/115

[51] **Int. Cl.** **F28d 11/08,** F25b 29/00, F27b 7/00

[58] **Field of Search** 263/32; 34/134, 135; 165/88; 432/80, 26, 115, 83, 106, 117, 103, 105

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Assistant Examiner—Henry C. Yuen
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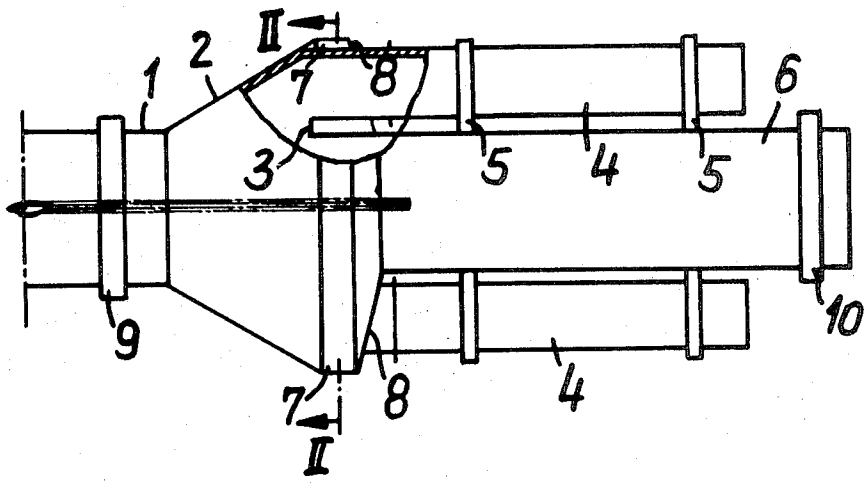
[57] **ABSTRACT**

A rotary kiln construction, in which the kiln has one end connected to a funnel-shaped member the wider end of which is provided with a closure wall having a plurality of annularly arranged bores in which one end of a plurality of cooling pipes is mounted, the cooling pipes extending from the funnel-shaped member either in a direction away from the rotary kiln on in a direction toward the rotary kiln and around the same.

8 Claims, 9 Drawing Figures



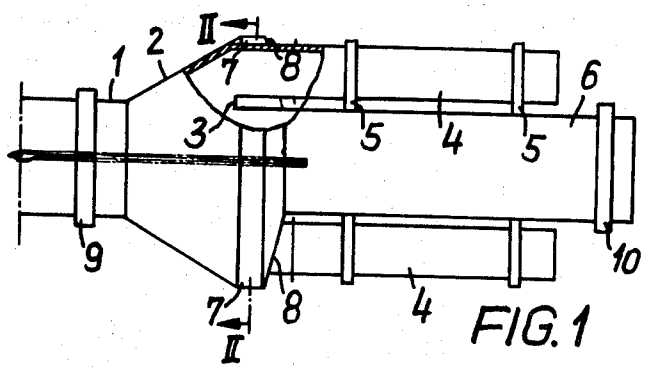


FIG. 1

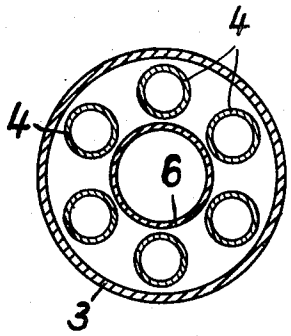


FIG. 2

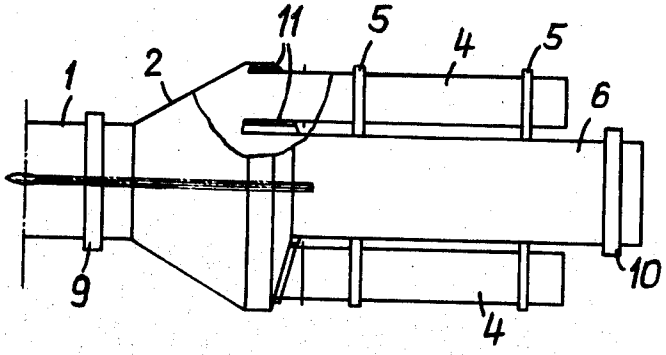


FIG. 3

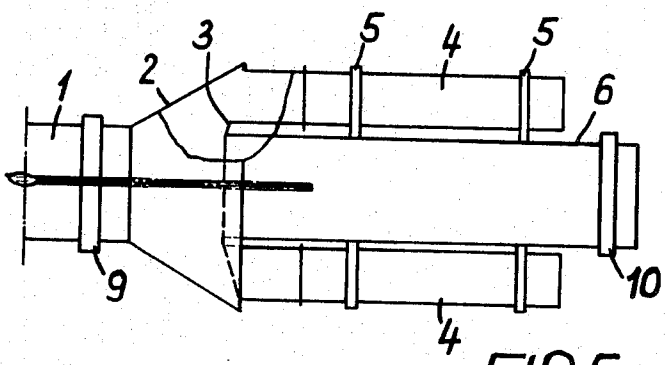


FIG. 4

FIG. 5

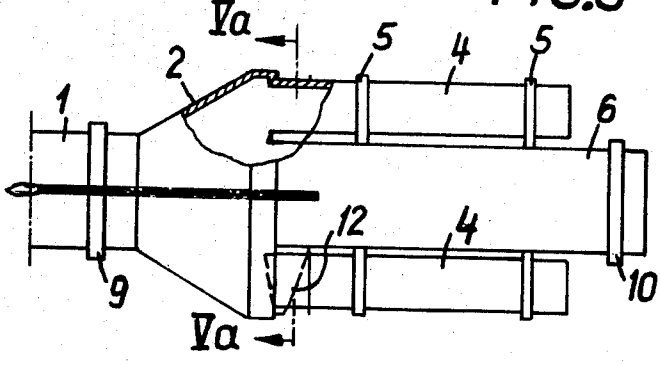
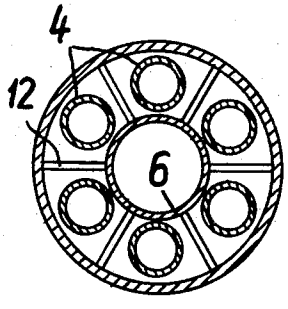


FIG. 5a



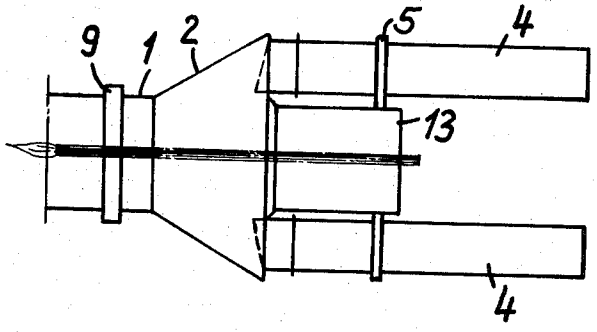


FIG. 6

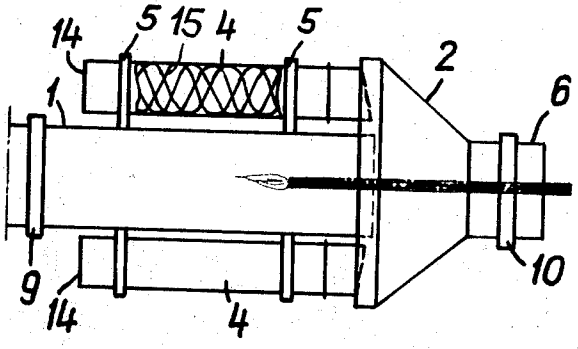


FIG. 7

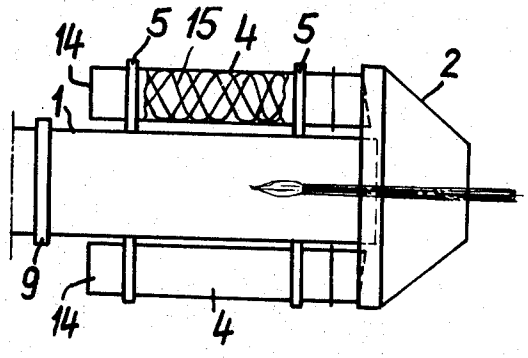


FIG. 8

ROTARY KILN WITH A PLURALITY OF COOLING PIPES

The present invention relates to a rotary kiln with a plurality of cooling pipes which are arranged around the outlet end of the kin and the axes of which are substantially parallel to the axis of the rotary kiln. Customarily the cooling pipes are uniformly distributed over the circumference of the kiln and extend either upwardly from their inlets toward the inlet of the rotary kiln or downwardly away from the inlet end. The hot material, such as cement clinker, calcined alumina, or the like, which leaves the rotary kiln subsequently passes through rotary cooling pipes which are slightly inclined similar to the rotary kiln and rotate therewith, if desired with the aid of transporting elements, and conveys its heat to the cooling air which is passed in counter current flow to the hot material through the cooling pipes, and in the rotary kiln serves as secondary combustion air.

With heretofore known rotary kilns of this type, the cooling pipes are connected to the cylindrical mantle of the rotary kiln by means of special substantially radially extending tubular connecting members. These connecting members also at the same time serve for transporting the material to be fired from the rotary kiln into the cooling pipes and for transferring the air preheated in the cooling pipes to the rotary kiln. Experience has shown that such an arrangement has the following disadvantages.

The high thermal and mechanical stresses of the connecting members between the cooling pipes and the mantle of the rotary kiln call for considerable structural expenses and require the employment of high grade special material. To this is to be added the difficulty that with the structural design involved, occurring heat expansions have to be taken into consideration, which could be realized by using a loose connection, but on the other hand also the high static loads and the required impermeability for gas and dust has to be considered, which would call for a fixed connection. In addition thereto, the mantle of the rotary kiln forming a supporting element is considerably weakened by the numerous passages.

Moreover, the heretofore known constructions also have a number of disadvantages with regard to the method itself. Such drawbacks are a high wear of the mechanically and thermally considerably stressed connecting members. Furthermore the operation of the kiln may be affected by clinker dust which is introduced into the kiln by the air passing through the narrow connecting members. A flow resistance is caused by the sharp bends and abrupt cross-sectional changes in the kiln. Also difficulties and stoppage of the kiln may be caused by too large sizes of the material to be fired which cannot pass through the connecting members.

Structural improvements of individual structural elements as effected hereofore have been only partially successful in eliminating the above mentioned drawbacks.

It is, therefore, an object of the present invention to create a novel connection from the rotary kiln into the cooling pipes in order to eliminate the above outlined drawbacks.

This object and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 shows the outlet end of a rotary kiln with the battery of cooling pipes in top view and partially also in longitudinal section.

FIG. 2 is a section taken along the line II—II of FIG. 1.

FIGS. 3 to 8 respectively illustrate various arrangements of cooling pipe batteries, again in top view and partially in longitudinal section.

The rotary kiln according to the present invention is characterized primarily in that the outlet end of the rotary kiln has a conically outwardly flaring portion with a closure wall to which the cooling pipes are directly connected without connecting members.

This design overcomes the above listed drawbacks inherent to the heretofore known "satellite coolers." The complicated and quickly wearing connecting members become superfluous and have been replaced by a closed truncated cone-shaped member which is easy to manufacture. The truncated cone-shaped member will assure a dust and air tight connection of the cooling pipes to the rotary kiln while simultaneously permitting a free heat expansion. Moreover, there will no longer exist the necessity to provide openings through the mantle of the kiln. The mantle of the kiln is not weakened at this area but is rather reinforced. With this arrangement, the hot material is conveyed to the individual cooling pipes in conformity with its customary movement in the rotary kiln so that the wear is reduced to the degree customary in rotary kiln installations while special wear resistant parts are no longer necessary. The large cross sections of the passages and the favorable guiding of the flow also overcome the above referred to drawbacks of the heretofore known satellite coolers, such as high air speed, high flow resistance, distribution of the dust, and blocking of the passages by too large pieces of the material to be fired.

Referring now to the drawings in detail, the cylindrical rotary pipe has its outlet end provided with a widened portion 2 which has the shape of a truncated cone. Firmly connected to the closure wall 3 of the truncated cone are six cooling pipes 4 which are arranged around the outlet end of rotary pipe 1 and which by means of two holding members 5 permitting heat expansions are held by a supporting pipe 6 which forms the end of the rotary kiln.

According to the arrangement of FIGS. 1 and 2, the widened portion 2 is through a short cylindrical intermediate member 7 and a further cone 8 through which the cooling pipes 4 extend connected to the supporting pipe 6. The rotary kiln is furthermore provided with two race rings 9 and 10.

As will be evident from FIG. 4, the closure wall 3 of the truncated cone 2 is likewise designed as truncated cone whereby the material to be fired will be prevented from falling back during the rotation of the cooling pipes 4 in the truncated cone 2.

According to FIG. 5, the closure wall 3 is reinforced by means of radial ribs 12 which are arranged between the cooling pipes 4 and which rest against the supporting pipe 6.

FIG. 6 shows an arrangement in which the supporting pipe 13 is shortened to such an extent that the cooling pipes 4 are connected thereto only by means of a single holding member 5 while the race ring 10 is eliminated so that the entire load of the outlet end of the rotary

kiln with the cooling pipe battery is absorbed by the bearing means (not shown) in which the race ring **9** is journalled.

FIGS. **7** and **8** illustrate an arrangement according to which the cooling pipes **4** are arranged around the firing zone of the rotary pipe **1** in such a way that their discharge ends **14** extend in the direction toward the inlet end of the rotary pipe **1**. The transport of the cooling medium through the cooling pipes which in this instance slightly ascend in the direction in which the cooling medium passes through the kiln is made possible in a manner known per se by conveying spirals on the inner walls of the cooling pipes. According to FIG. **7**, a supporting pipe **6** with an end race ring **10** is provided which latter is eliminated in the embodiment shown in FIG. **8**.

It is, of course, to be understood that the present invention is, by no means, limited to the particular showing in the drawings, but also comprises any modifications within the scope of the appended claims.

What we claim is:

1. A rotary kiln construction comprising a rotary kiln with an outlet end portion,which includes: a funnel-shaped member connected to said outlet end portion and having its interior via its open end of smaller diameter in communication with the interior of said kiln, said funnel-shaped member having its greater diameter end provided with a bottom wall, and a plurality of cooling pipes having their longitudinal extension approximately in the same direction as said kiln and communicating through said bottom wall with the interior of said funnel-shaped member.

2. A rotary kiln construction according to claim **1**, in which the narrower end of said funnel-shaped member is connected to the outlet end portion of said rotary kiln, and in which the wider end of said funnel-shaped member is provided with a closure wall having a plurality of annularly arranged bores therethrough respectively receiving one end of said cooling pipes, said outlet end portion of said kiln and said one end of said cooling pipes being air tight connected to said funnel-shaped member.

3. A rotary kiln construction according to claim **1**, in which said bottom wall has a substantially central bore receiving the outer end section of said outlet end portion of said kiln and also having a plurality of additional bores corresponding in number to the number of said cooling pipes and arranged around said central bore while respectively receiving one end of said cooling pipes, the outer end section of said outlet end portion of said kiln and those end portions of said cooling pipes which are adjacent said funnel-shaped member being gas-tight connected to said bottom wall.

4. A rotary kiln construction comprising a rotary kiln with an outlet end portion, which includes: a funnel-shaped member connected to said outlet end portion and having its interior in communication with the interior of said kiln, said funnel-shaped member having its greater diameter end provided with a bottom wall, a plurality of cooling pipes having their longitudinal extension approximately in the same direction as said kiln and communicating through said bottom wall with the interior of said funnel-shaped member, the narrower end of said funnel-shaped member being connected to said rotary kiln, and a conical member connected to the wider end of said funnel-shaped member and also including a substantially cylindrical supporting member substantially axially aligned with said rotary kiln and connected to said conical member, said supporting member forming an extension of said rotary kiln.

5. A rotary kiln construction according to claim **4**, which includes race ring means respectively mounted on said rotary kiln near said funnel-shaped member and on said extension.

6. A rotary kiln construction according to claim **4**, which includes reinforcing pipe means interconnecting said funnel-shaped member and said conical member.

7. A rotary kiln construction according to claim **4**, which includes reinforcing ribs radially extending with regard to and resting upon said supporting member and reinforcing said bottom wall.

8. A rotary kiln construction comprising a rotary kiln with an outlet end portion which includes: a funnel-shaped member connected to said outlet end portion and having its interior in communication with the interior of said kiln, said funnel-shaped member having its greater diameter end provided with a bottom wall, and a plurality of cooling pipes having their longitudinal extension approximately in the same direction as said kiln and communicating through said bottom wall with the interior of said funnel-shaped member, the bottom wall of said funnel-shaped member being conical.

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